

University of Mumbai



No. UG/ 93 of 2021

CIRCULAR:-

Attention of the Principals of the Affiliated Colleges, Directors of the recognized Institutions in Science & Technology Faculty.

They are hereby informed that the recommendations made by the All Board of Studies in Engineering under the Faculty of Science & Technology and subsequently passed by the Board of Deans at its online meeting held on 11th February, 2021 vide item No. 6.2 (R) have been accepted by the Academic Council at its meeting held on 23rd February, 2021 vide item No.6.11 and that in accordance therewith, regarding the syllabus for Second year of B.E Degree Course (REV – 2019 'C' Scheme) for **Direct Second Year (Sem – III)** admitted students in all Engineering branches mentioned below only for the current academic year 2020-21. (The same is available on the University's website www.mu.ac.in).

1. Civil Engineering
2. Bio-medical Engineering
3. Production Engineering
4. Computer Engineering
5. Mechanical Engineering
6. Automobile Engineering
7. Printing & Packing Engineering
8. Mechatronics Engineering
9. Information Technology
10. Electrical Engineering
11. Electronics Engineering
12. Electronics & Telecommunication Engineering
13. Instrumentation Engineering
14. Chemical Engineering
15. Electronics and Computer Science,

MUMBAI – 400 032

18th March, 2021


(Dr. B.N. Gaikwad)
I/c REGISTRAR

2/-

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To

The Principals of the Affiliated Colleges, and Directors of the recognized Institutions in Science & Technology Faculty. (Circular No. UG/334 of 2017-18 dated 9th January, 2018.)

A.C.6.11/23/2/2021

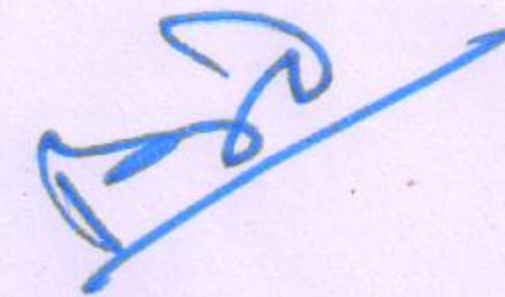
No. UG/93 -A of 2021

MUMBAI-400 032

15th March, 2021

Copy forwarded with Compliments for information to:-

- 1) The Dean, Faculty of Science & Technology,
- 2) The Chairman, All Board of Studies in Engineering,
- 3) The Director, Board of Examinations and Evaluation,
- 4) The Director, Board of Students Development,
- 5) The Co-ordinator, University Computerization Centre,


(Dr. B.N. Gaikwad)
I/c REGISTRAR

Copy to :-

- 1. The Deputy Registrar, Academic Authorities Meetings and Services (AAMS),**
- 2. The Deputy Registrar, College Affiliations & Development Department (CAD),**
- 3. The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Department (AEM),**
- 4. The Deputy Registrar, Research Administration & Promotion Cell (RAPC),**
- 5. The Deputy Registrar, Executive Authorities Section (EA),**
- 6. The Deputy Registrar, PRO, Fort, (Publication Section),**
- 7. The Deputy Registrar, (Special Cell),**
- 8. The Deputy Registrar, Fort/ Vidyanagari Administration Department (FAD) (VAD), Record Section,**
- 9. The Director, Institute of Distance and Open Learning (IDOL Admin), Vidyanagari,**

They are requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to in the above circular and that on separate Action Taken Report will be sent in this connection.

- 1. P.A to Hon'ble Vice-Chancellor,**
- 2. P.A Pro-Vice-Chancellor,**
- 3. P.A to Registrar,**
- 4. All Deans of all Faculties,**
- 5. P.A to Finance & Account Officers, (F.& A.O),**
- 6. P.A to Director, Board of Examinations and Evaluation,**
- 7. P.A to Director, Innovation, Incubation and Linkages,**
- 8. P.A to Director, Board of Lifelong Learning and Extension (BLLE),**
- 9. The Director, Dept. of Information and Communication Technology (DICT) (CCF & UCC), Vidyanagari,**
- 10. The Director of Board of Student Development,**
- 11. The Director, Department of Students Welfare (DSD),**
- 12. All Deputy Registrar, Examination House,**
- 13. The Deputy Registrars, Finance & Accounts Section,**
- 14. The Assistant Registrar, Administrative sub-Campus Thane,**
- 15. The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan,**
- 16. The Assistant Registrar, Ratnagiri sub-centre, Ratnagiri,**
- 17. The Assistant Registrar, Constituent Colleges Unit,**
- 18. BUCTU,**
- 19. The Receptionist,**
- 20. The Telephone Operator,**
- 21. The Secretary MUASA**

for information.

UNIVERSITY OF MUMBAI



Bachelor of Engineering

in

Civil Engineering

**Direct Second Year (Sem. III) Admitted Students for the
current Academic Year 2020-21(Only)**

(REV- 2019 'C' Scheme) from Academic Year 2019 – 20

**Under
FACULTY OF
SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2019–2020)

Program Structure for Second Year Engineering
Semester III & IV
UNIVERSITY OF MUMBAI
(With Effect from 2020-2021)
Semester - III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			Total
		Theory	Pract	Tut	Theory	Pract.	Tut.	
CEC301	Engineering Mathematics-III	3	-	1	3	-	1	4
CEC302	Mechanics of Solids	4			4			4
CEC303	Engineering Geology	3			3			3
CEC304	Architecture planning and Design of Building	2	-	-	2	-	-	2
CEC305	Fluid Mechanics- I	3	-	-	3	-	-	3
CEL301	Mechanics of Solids	-	2	-	-	1	-	1
CEL302	Engineering Geology	-	2	-	-	1	-	1
CEL303	Architectural Planning & Design of Buildings	-	2	-	-	1	-	1
CEL304	Fluid Mechanics- I	-	2	-	-	1	-	1
CEL305	Skill Based Lab Course-I		3		-	1.5		1.5
CEM301	Mini Project – 1 A	-	3 ^s	-	-	1.5	-	1.5
Total		15	14	1	15	7	1	23

Examination Scheme									
Course Code	Course Name	Internal Assessment			End Sem Exam	Exam Duration (Hrs.)-	Term Work	Prac. /Oral	Total
		Test I	Test II	Avg					
CEC301	Engineering Mathematics-III	20	20	20	80	3	25	-	125
CEC302	Mechanics of Solids	20	20	20	80	3	-	-	100
CEC303	Engineering Geology	20	20	20	80	3	-	-	100
CEC304	Architectural Planning & Design of Buildings	20	20	20	80	3	-	-	100
CEC305	Fluid Mechanics- I	20	20	20	80	3	-	-	100
CEL301	Mechanics of Solids	-	-	-	-	-	25	25	50
CEL302	Engineering Geology	-	-	-	-	-	25	25	50
CEL303	Architectural Planning & Design of Buildings	-	-	-	-	-	25	25	50
CEL304	Fluid Mechanics- I	-	-	-	-	-	25	25	50
CEL305	Skill Based Lab Course-I	-	-	-	-	-	50	-	50
CEM301	Mini Project – 1 A	-	-	-	-	-	25	25	50
	Total			100	400	-	200	125	825

CEC301 Engineering Mathematics-III

Course Code	Course Name	Credits
CEC 301	Engineering Mathematics-III	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	-	01	03	-	01	04

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem. Exam	Duration of End Sem. Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	03 hrs	25	-	-	125

Pre-requisite: Engineering Mathematics-I,
Engineering Mathematics-II,

Course Objectives:

1. To familiarize with the Laplace Transform, Inverse Laplace Transform of various functions, its applications.
2. To acquaint with the concept of Fourier Series, its complex form and enhance the problem solving skills.
3. To familiarize with the concept of complex variables, C-R equations with applications.
4. To study the application of the knowledge of matrices and numerical methods in complex engineering problems.

Course Outcomes: Learner will be able to....

1. Apply the concept of Laplace transform to solve the real integrals in engineering problems.
2. Apply the concept of inverse Laplace transform of various functions in engineering problems.
3. Expand the periodic function by using Fourier series for real life problems and complex engineering problems.
4. Find orthogonal trajectories and analytic function by using basic concepts of complex variable theory.
5. Apply Matrix algebra to solve the engineering problems.
6. Solve Partial differential equations by applying numerical solution and analytical methods for one dimensional heat and wave equations.

Module	Detailed Contents	Hrs.
01	Module: Laplace Transform 1.1 Definition of Laplace transform, Condition of Existence of Laplace transform, 1.2 Laplace Transform (L) of Standard Functions like e^{at} , $\sin(at)$, $\cos(at)$, $\sinh(at)$, $\cosh(at)$ and t^n , where $n \geq 0$. 1.3 Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by t , Division by t , Laplace Transform of derivatives and integrals (Properties without proof). 1.4 Evaluation of integrals by using Laplace Transformation. Self-learning topics: Heaviside's Unit Step function, Laplace Transform. of Periodic functions, Dirac Delta Function.	07 Hrs.
02	Module: Inverse Laplace Transform 2.1 Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivative 2.2 Partial fractions method & first shift property to find inverse Laplace transform. 2.3 Inverse Laplace transform using Convolution theorem (without proof) Self-learning Topics: Applications to solve initial and boundary value problems involving ordinary differential equations.	06 Hrs.
03	Module: Fourier Series: 3.1 Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof) 3.2 Fourier series of periodic function with period 2π and $2l$, 3.3 Fourier series of even and odd functions 3.4 Half range Sine and Cosine Series. Self-learning Topics: Complex form of Fourier Series, orthogonal and orthonormal set of functions, Fourier Transform.	07Hrs.
04	Module: Complex Variables: 4.1 Function $f(z)$ of complex variable, limit, continuity and differentiability of $f(z)$, Analytic function, necessary and sufficient conditions for $f(z)$ to be analytic (without proof), 4.2 Cauchy-Riemann equations in cartesian coordinates (without proof) 4.3 Milne-Thomson method to determine analytic function $f(z)$ when real part (u) or Imaginary part (v) or its combination (u+v or u-v) is given. 4.4 Harmonic function, Harmonic conjugate and orthogonal trajectories Self-learning Topics: Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations	07Hrs.

05	Module: Matrices: 5.1 Characteristic equation, Eigen values and Eigen vectors, Properties of Eigen values and Eigen vectors. (No theorems/ proof) 5.2 Cayley-Hamilton theorem (without proof): Application to find the inverse of the given square matrix and to determine the given higher degree polynomial matrix. 5.3 Functions of square matrix 5.4 Similarity of matrices, Diagonalization of matrices Self-learning Topics: Verification of Cayley Hamilton theorem, Minimal polynomial and Derogatory matrix & Quadratic Forms (Congruent transformation & Orthogonal Reduction)	06 Hrs.
06	Module: Numerical methods for PDE 6.1 Introduction of Partial Differential equations, method of separation of variables, Vibrations of string, Analytical method for one dimensional heat and wave equations. (only problems) 6.2 Crank Nicholson method 6.3 Bender Schmidt method Self-learning Topics: Analytical methods of solving two and three dimensional problems.	06 Hrs.
	Total	39

Term Work:

General Instructions:

- 1 Batch wise tutorials are to be conducted. The number of student's per batch should be as per University pattern for practicals.
- 2 Students must be encouraged to write at least 6 class tutorials on entire syllabus.
- 3 A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Engineering Mathematics. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1	Attendance (Theory and Tutorial)	05 marks
2	Class Tutorials on entire syllabus	10 marks
3	Mini project	10 marks

Assessment:

Internal Assessment for 20 marks: Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

End Semester Examination: Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

- 1 Question paper will comprise of total six questions, each carrying 20 marks
- 2 Question 1 will be compulsory and should cover maximum contents of the curriculum
- 3 Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
- 4 Only Four questions need to be solved.

References:

- 1 Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication
- 2 Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited,
- 3 Advanced Engineering Mathematics, R. K. Jain and S.R.K. Iyengar, Narosa publication
- 4 Advanced Engineering Mathematics, H.K. Das, S. Chand Publication
- 5 Higher Engineering Mathematics B.V. Ramana, McGraw Hill Education
- 6 Complex Variables and Applications, Brown and Churchill, McGraw-Hill Education,
- 7 Text book of Matrices, Shanti Narayan and P K Mittal, S. Chand Publication
- 8 Laplace transforms, Murray R. Spiegel, Schaum's Outline Series

CEC302 - Mechanics of Solids

Semester-III								
Course Code			Course Name			Credits		
CEC302			Mechanics of Solids			4		
Contact Hours				Credits Assigned				
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total		
4	--		4	--	--	4		
Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem. Exam	Duration of End Sem Exam				
Test-I	Test-II	Average			TW	PR	OR	
20	20	20	80	3 Hours	--	--	--	

Rationale

Civil Engineering structures are made using various engineering materials such as steel, concrete, timber, other metals or their composites. They are subjected to force systems resulting into axial forces, bending moments, shear forces, torsion and their combinations. Different materials respond differently to these by getting deformed and having induced stresses. Determination of stress, and strain experienced by structural elements when subjected to diverse loads is prerequisite for an economical and safe design.

In this course, learners will understand the internal response behavior of material under different force systems. The knowledge of 'Mechanics of Structures' will be foundation of essential theoretical background for the courses like Structural Analysis and Structural Design.

Objectives

- 1) To compute the stresses developed and deformations of thin cylindrical shell and spherical shell subjected to internal pressure.

- 2) To learn to represent graphically the distribution of axial force, shear force and bending moment for statically determinate portal frames.
- 3) To study the circular shafts under the action of twisting moment.
- 4) To determine the principal planes and stresses.
- 6) To compute strain energy in elastic members.
- 6) To learn the general theorems.

Detailed Syllabus			
Module		Course Modules/Contents	Hours
1	Module Name-Stresses and strains in Thin Cylindrical and Spherical Shells		(03)
	1.1	Thin cylindrical shell subjected to internal pressure; determination of hoop stress, longitudinal stress, shear stress and volumetric strain.	2
	1.2	Thin spherical shell subjected to internal pressure; determination of hoop stress, shear stress and volumetric strain.	1
2	Module Name- Axial Force, Shear Force and Bending Moment Diagrams for Portal Frames		(06)
	2.1	Concept of Axial Force, Shear Force and Bending Moment.	02
	2.2	A.F., S.F. and B.M Diagrams for statically determinate 3-member simple Portal Frames without internal hinges.	04
3	Module Name- Torsion in Circular Shafts		(05)
	3.1	Torsion in solid and hollow circular shafts; shafts with varying cross sections.	3
	3.2	Shafts transmitting and receiving power at different points. Stresses in Shafts while transmitting power.	2
4	Module Name- Principal Planes and Stresses, Strain Energy		(08)
	4.1	General equation for transformation of stress, Principal planes and principal stresses, maximum Shear stress, stress determination by analytical and Graphical method (using Mohr's circle).	06
	4.2	Strain energy due to axial force and impact loads in columns, due to bending in beams, due to torsion of shaft.	02
5	Module Name- General Theorems		(03)
	5.1	General theorems: Betti's and Maxwell's reciprocal theorems, principle of superposition.	02
	5.2	Principle of virtual work, Castigliano's theorem.	01
Total Hours			25

Contribution to Outcome

On completion of this course, the learners will be able to:

- 1) Evaluate stresses and strains in thin cylindrical and spherical shells subjected to internal pressure.
- 2) Draw variation of axial force, shear force and bending moment diagram for statically

determinate portal frames.

- 3) Predict the angle of twist and shear stress developed due to torsion of circular shaft and compute power transmitted by the shaft.
- 4) Locate principal planes in members and calculate principal stresses using analytical and graphical method.
- 5) Calculate strain energy stored in the members due to elastic deformation.
- 6) Explain the general theorems.

Internal Assessment (20 Marks):

One **Compulsory Class Test**, based on approximately 40% of contents and another on 40% from the remaining content shall be conducted. Average of the two will be considered as IA Marks.

End Semester Examination (80 Marks):

Weightage of each module in end semester examination will be proportional to the number of respective hours mentioned in the curriculum.

- 1) Question paper will comprise of total **six questions, each carrying 20 marks.**
- 2) **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum.**
- 3) **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
- 4) **Totally Four questions** need to be **solved.**

Recommended Books:

1. Strength of Materials: *S. Ramamrutham*, Dhanpatrai Publishers.
2. Strength of Materials: *R.K. Rajput*, S. Chand Publications.
3. Mechanics of Materials: Vol-I: *S.B. Junnarkar and H.J. Shah*, Charotar Publications.
4. Strength of Materials: *Subramanian*, Oxford University Press
5. Strength of Materials: *S.S. Rattan*, Tata Mc-Graw Hill, New Delhi
6. Strength of Materials (Mechanics of Materials): *R.S. Lehri and A.S. Lehri*, S.K. Kataria Publishers, New Delhi
7. Strength of Materials: *Dr. V.L. Shah*, Structures Publications, Pune

Reference Books:

8. Mechanics of Materials: *James, M. and Barry J.*; Cengage Learning.
9. Mechanics of Materials: *Andrew Pytel and Jaan Kiusalaas*, Cengage Learning.
10. Mechanics of Materials: *Timoshenko and Gere*, Tata McGraw Hill, New Delhi.
11. Mechanics of Materials: *James M. Gere*, Books/Cole.
12. Strength of Materials: *G.H. Ryder*, Mc-Millan.
13. Mechanics of Materials: *E.P. Popov*, Prentice Hall India (PHI) Pvt. Ltd.
14. Mechanics of Materials: *Pytel and Singer*, Mc-Graw Hill, New Delhi.
15. Strength of Materials: *William A. Nash and Nillanjan Mallick*, Mc-Graw Hill Book Co. (Schaum's Outline Series)

CEC303 - Engineering Geology

Course Code	Course Name	Credits
CEC303	Engineering Geology	4

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
3	2	-	3	1	-	4

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	3 Hours	25	-	25	50

Rationale

Engineering geology is an applied geology discipline that involves the collection, analysis, and interpretation of geological data and information required for the safe development of civil works. The objective of this course is to focus on the core activities of engineering geologists – site characterization, geologic hazard identification and mitigation. Through lectures, labs, and case study examination student will learn to couple geologic expertise with the engineering properties of rock in the characterization of geologic sites for civil work projects. Understanding of the foundation rocks and structures present in them is of utmost importance for the safety and stability of Civil engineering structures. The study also helps in the assessment of groundwater, oil and gas and mineral resource evaluation.

Objectives

1. To acquire basic knowledge of Geology and to understand its significance in various civil engineering projects.
2. To study minerals and rocks in order to understand their fundamental characteristics and engineering properties.
3. To study structural geology for characterization of site, analysis and report geologic data using standards in engineering practice.
4. To understand advantages and disadvantages caused due to geological conditions and assessment of site for the construction of civil structures.
5. To study the suitability of rock mass for the construction of tunnels and assessment of rock as source of ground water.
6. To study the control of geology over the natural hazards and their preventive measures.

Module		Course Modules / Contents	Periods
1		Introduction & Physical Geology	3
	1.1	Branches of geology useful to civil engineering, Importance of geological studies in various civil engineering Projects.	
	1.2	Internal structure of the Earth and use of seismic waves in understanding the interior of the earth. Theory of Plate Tectonics.	
	1.3	Weathering and its types, engineering consideration of weathering	
2		Mineralogy and Petrology	5
	2.1	Identification of minerals with the help of physical properties, rock forming minerals, study of common ore minerals.	
	2.2	Igneous Petrology - Mode of formation, Texture (Equigranular, Porphyritic, Poikilitic, Intergrowth), Structure (Flow structure, vesicular and amygdaloidal structure) Classification (depth wise and classification based on silica percentage), Engineering aspect of Granite and Basalt.	
	2.3	Sedimentary Petrology - Mode of formation, Textures, Structures (lamination, bedding, current bedding), classification, and engineering consideration of sedimentary rocks.	
	2.4	Metamorphic Petrology - Mode of formation, agents and types of metamorphism, classification (Foliated and non-foliated) and engineering consideration of metamorphic rocks.	
3		Structural Geology and Stratigraphy	5
	3.1	Dip and Strike. Outcrop and width of outcrop. Inliers and Outliers. Fold: Terminology, Classification on the basis of position of axial plane and engineering consideration of folds. Fault: Terminology, Classification on the basis of movement of faulted block and Engineering consideration of faults. Joints & Unconformity: Types and geological importance.	
	3.2	Determination of thickness of the strata with the help of given data.	
	3.3	General principles of Stratigraphy.	
4		Geological Investigation, study of dam and reservoir site:	3
	4.1	Required geological consideration for selecting dam and reservoir site. Favorable & unfavorable conditions in different types of rocks in presence of various structural features, precautions to be taken to counteract unsuitable conditions.	
	4.2	Rock Quality Designation and its importance to achieve safety and economy of the projects like dams and tunnels.	
5		Tunnel Investigation and Ground Water Control	3
	5.1	Importance of geological considerations while choosing tunnel sites and alignments of the tunnel, safe and unsafe geological and structural conditions.	
	5.3	Sources, zones, water table, unconfined, confined and Perched water tables. Factors controlling water bearing capacity of rocks, Cone of Depression and its use in Civil engineering.	

6	Geological Disasters and Control Measures		2
	6.1	Landslides-Types, causes and preventive measures for landslides.	
	6.2	Volcano- Central type and fissure type, products of volcano.	
	6.3	Earthquake- Causes, Terminology, Earthquake waves, and Preventive measures for structures constructed in Earthquake prone area.	

Contribution to Outcome

On completion of this course, the students will be able to:

- Explain the concepts of Geology and its application for safe, stable and economic design of any civil engineering structure.
- Interpret the lithological characters of the rock specimen and distinguish them on the basis of studied parameters.
- Describe the structural elements of the rocks and implement the knowledge for collection and analysis of the geological data.
- Interpret the geological conditions for the dam site and calculate RQD for the assessment of rock masses.
- Analyze the given data and assess tunneling and groundwater conditions.
- Interpret the causes of geological hazards and implement the knowledge for their prevention.

Internal Assessment (20 Marks):

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination (80 Marks):

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks.**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

Recommended Books:

1. Text book of Engineering Geology: N. Chenna, Kesavulu, Mc-Millan.
2. Text book of Engineering and General Geology, 8th edition (2010): Parbin Singh, S K Kataria & Sons.
3. Text book of Engineering Geology: P. K. Mukerjee, Asia.
4. Text book of Engineering Geology: Dr. R. B. Gupta, Pune Vidyarthi Griha Prakashan, Pune.

5. Principles of Engineering Geology: K. M. Banger.

Reference Books:

1. A Principles of Physical Geology: Arthur Homes, Thomas Nelson Publications, London.
2. Structural Geology, 3rd edition (2010): Marland P. Billings, PHI Learning Pvt. Ltd. New Delhi
3. Earth Revealed, Physical Geology: David McGeeary and Charles C. Plummer
4. Principles of Geomorphology: William D. Thornbury, John Wiley Publications, New York.
5. Geology for Civil Engineering: A. C. McLean, C.D. Gribble, George Allen & Unwin London.
6. Engineering Geology: A Parthasarathy, V. Panchapakesan, R Nagarajan, Wiley India 2013.

CEC304 - Architectural Planning & Design of Buildings

Course Code	Course Name	Credits
CEC304	Architectural Planning & Design of Buildings	02

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
02	-	-	02	-	-	02

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Ave						
20	20	20	80	3 Hours	-	-		100

Rationale

Drawing is the language of Civil Engineers to communicate. Drawing is one of the most essential documents as far as civil engineering is concerned. It provides guidance and instructions to architects, engineers and workmen at field, on how to construct structures according to the figures and dimensions shown in the drawing. Approved drawings are also essential for the estimation of cost and materials; as well as a very important contract document.

Objectives

- 1) To remember and recall the intricate details of building design and drawing.
- 2) To gain an understanding of the basic concepts of building design and drawing.
- 3) To learn how to apply professional ethics and act responsibly pertaining to the norms of building design and drawing practices, rules, regulation and byelaws, Building codes

- 4) To identify, analyze, research literature and solve complex building design and drawing problems.
- 5) To have new solutions for complex building design and drawing problems.
- 6) To effectively communicate ideas, related to building design and drawing, both orally as well as in written format like reports & drawings.

Course Outcomes

At the end of the course learners will be able to:

1. Students will be able to design and draw plans, elevations and sections of public buildings
2. Students will be able to draw foundation plans and roof plans
3. Students will be able to draw perspective drawings
4. Students will be able to explain town planning
5. Students will be able to explain green buildings
6. Students will be able to summarize an overview of CAD

Modules	Sub-Modules/Contents	Periods
1.	Principles and Codes of Practice for Planning and Designing of Buildings	5
1.1.	Study of National Building Code of India 2016: a) Classification of Buildings b) Development Control Rules (for Public Buildings)	
1.2.	Principles of Planning of Public Buildings (School or Hospital)	
1.3.	Planning and Designing of Public Buildings (School or Hospital)	
1.4.	Sun Path Diagram, Wind Rose Diagram and Sun Shading Devices	
1.5.	Principles of Architectural Planning	
2.	Components of Buildings	2
2.1.	Types of Foundations and Foundation Plan	
2.2.	Types of Roofs and Roof Plan (for flat roof only)	2
3.	Perspective Drawings	
3.1.	Introduction to Perspective Drawings	2
3.2.	Two Point Perspective Drawing	
4.	Town Planning	2
4.1.	Objectives and Principles of Town Planning	
4.2.	Master plan, Redevelopment of Buildings, Slum Rehabilitation	1
5.	Green Buildings	
5.1.	Introduction and Overview	1
5.2.	Green Building Rating System – LEED, TERI, GRIHA, IGBC (any one)	
6.	Computer Aided Drawing	3
6.1	Introduction and Overview of any one professional CAD software	
6.2	Study and demonstration of any one of the professional CAD software's	

Theory Examination:

- 1) Only 4 questions (out of 6) need to be attempted.
- 2) Question no. 1 will be compulsory and based on the drawing work of any one building, may be residential or public building.. Some questions from the remaining may be on Theory portion.

- 3) 4. Any 3 out of the remaining 5 questions need to be attempted.
- 4) In question paper, weightage of each module maybe approximately proportional to the number of lecture hours assigned to it in the syllabus.

Internal Assessment:

There will be **Two** class tests (to be referred to as an ‘**Internal Assessment**’) to be conducted in the semester. The first internal assessment (IA-I) will be conducted in the mid of the semester based on the 50% of the syllabus. It will be of 20 marks. Similarly, the second internal assessment (IA-II) will be conducted at the end of the semester and it will be based on next 50% of the syllabus. It will be of 20 marks. Lastly, the average of the marks scored by the students in both the Internal Assessment will be considered. Duration of both the IA examination will be of one hour duration, respectively. Civil Engineering Drawing (including Architectural aspect) by *M. Chakraborti* (Monojit Chakraborti Publications, Kolkata)

Recommended Books

- 1) Planning and Designing Buildings by Y. S. Sane (Modern Publication House, Pune)
- 2) Building Drawing and Detailing by B.T.S. Prabhu, K.V. Paul and C. V. Vijayan (SPADES Publication, Calicut)
- 3) Building Planning by Gurucharan Singh (Standard Publishers & Distributors, New Delhi)

References:

- 1) IS 962: 1989 – Code of Practice for Architectural and Building Drawings.
- 2) National Building Code of India – 2005 (NBC 2005)
- 3) Development Control Regulations for Mumbai Metropolitan Region for 2016 – 2036 (<https://mmrda.maharashtra.gov.in>)
- 4) Development Control Regulations for Navi Mumbai Municipal Corporation – 1994 (<https://www.nmmc.gov.in/development-control-regulations>)
- 5) Development Plan and Control Regulation KDMC, <https://mmrda.maharashtra.gov.in>

Reference Codes:

- 1) National Building Code of India, 2005
- 2) IS 779-1978 Specification for Water Meter
- 3) IS 909-1975 Specification for Fire Hydrant
- 4) IS 1172-1983 Code of Basic Requirement for Water Supply, Drainage & Sanitation
- 5) IS 1742-1983 Code of Practice for Building Drainage

CEC305 - Fluid Mechanics- I

Course Code		Course Name				Credits
CEC305		Fluid Mechanics - I				03
Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
3	-	-	03	-	-	03

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	03 Hours	-	-	-	100
Rationale								

The concept of fluid mechanics in civil engineering is essential to understand the processes and science of fluids. The course deals with the basic concepts and principles in hydrostatics, hydrokinematics and hydrodynamics with their applications in fluid flow problems.

Objectives

The students will be able to learn:

1. The properties & types of fluids, units and dimensions
2. Principle of buoyancy and stability of floating body
3. Kinematic and Dynamic behavior through various laws of fluids like continuity, Euler's, Bernoulli's equations.
4. Importance of fluid flow and various velocity measuring and discharge measuring devices.
5. The basic difference between in-compressible and compressible flow, Propagation of pressure waves and stagnation points.

Detailed Syllabus

Module		Course Modules / Contents	Periods
1		Properties of Fluids -	02
	1.1	Types of fluids, and introduction to real life applications.	
2		Buoyancy and flotation:	04
	2.1	Archimedes principle, Meta-Centre, metacentric height, Stability of floating and submerged bodies, determination of metacentric height, Experimental and analytical methods, metacentric height for floating bodies containing liquid.	
3		Fluid Kinematics	06
	3.1	Types of fluid flow, description of flow pattern, Lagrangian methods, Eulerian method, continuity equation, velocity and	

		acceleration of fluid particles. Stream line, Equipotential line, flow net and its uses.	
4	Fluid Dynamics		06
	4.1	Forces acting on fluid in motion, Navier Stokes Equation, Euler's Equation of motion, Integration of Euler's equations of motion, Bernoulli's Theorem (Numerical Only), Practical applications of Bernoulli's Equation to Venturimeter, Orifice meter, pitot tube.	
5	Compressible flow		04
	5.1	Basic equation of flow (elementary study), velocity of sound or pressure wave in a fluid, Mach number, propagation of pressure waves, area-velocity relationship, Stagnation properties.	

Contribution to Outcome

Upon completion of the course, students shall have ability to:

- 1) Describe various properties of fluids and types of flow
- 2) Determine the pressure difference in pipe flows, application of Continuity equation and Bernoulli's theorem to determine velocity and discharge
- 3) Apply hydrostatic and dynamic solutions for fluid flow applications
- 4) Analyse the stability of floating bodies
- 5) Apply the working concepts of various devices to measure the flow through pipes and channels
- 6) Explain the compressible flow, propagation of pressure waves and stagnation properties

Internal Assessment (20 Marks):

Consisting Two Compulsory Class Tests:

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination (80 Marks):

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

- 1) Question paper will comprise of total **six questions, each carrying 20 marks.**
- 2) **Question 1** will be compulsory and should **cover maximum contents of the curriculum**
- 3) **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
- 4) Only **Four questions need to be solved.**

Recommended Books:

- 1) Hydraulics and Fluid mechanics: Dr. P.M. Modi and Dr. S.M. Seth, Standard Book House, Delhi
- 2) Theory and Application of Fluid Mechanics: K. Subramanian, Tata McGraw hill publishing company, New Delhi.

- 3) Fluid Mechanics: Dr. A.K Jain, Khanna Publishers.
- 4) Fluid Mechanics and Hydraulics: Dr. S.K. Ukarande, Ane's Books Pvt.Ltd. (Revised Edition 2012), ISBN 97893 8116 2538
- 5) Fluid Mechanics and fluid pressure engineering: Dr. D.S. Kumar, F.K. Kataria and sons
- 6) Fluid Mechanics: R.K. Bansal Laxmi Publications (P) Ltd.

Reference Books:

- 1) Fluid Mechanics: Frank M. White, Tata McGraw Hill International Edition.
- 2) Fluid Mechanics: Streeter White Bedford, Tata McGraw International Edition.
- 3) Fluid Mechanics with Engineering Applications: R.L. Daugherty, J.B. Franzini, E.J. Fennimore, Tata McGraw Hill, New Delhi.
- 4) Hydraulics: James F. Cruise, Vijay P. Singh and Mohsen M. Sherif, CENGAGE Learning India (Pvt.) Ltd.
- 5) Introduction to Fluid Mechanics: Edward J. Shaughnessy, Jr, Ira M. Katz, James P. Schaffer. Oxford Higher Education.

Civil Engineering Semester – III -LAB

CEL301 - Mechanics of Solids

Semester- III		
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Course Code	Course Name	Credits
CEL301	Mechanics of Solids- LAB	01

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	02	-	-	01	-	01

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
-	-	-	-	-	25	-	25	50

Objectives

- 1) To learn stress - strain behavior and physical properties of materials and to compute the stresses developed and deformation of elastic members.
- 2) To study circular shafts under the action of twisting moment.
- 3) To study the bending stresses induced in the specimen.
- 4) To learn about the compressive strength of an engineering material.

Outcomes

Learner will be able to...

- 1) Evaluate stress - strain behavior of materials and assess the structural behavior by the virtue of stresses developed and deformation of elastic members.
- 2) Analyze the material response under the action of flexure (bending).
- 3) Predict the angle of twist and shear stress developed due to torsion.
- 4) Evaluate the compressive strength of a specimen.

Term Work: Term work comprises of Laboratory work and assignments.

Laboratory Work: CEL301

Mechanics of Solids (Practical Performance)		
Experiment No.	Name of the Experiment	Duration (Hours)
1	Tension test on circular Mild Steel rod	02
2	Compression test on timer block	02
3	Pure bending test on timber beam.	02
4	Torsion test on circular mild steel specimen	02

Assignments:

At least 1 assignment from each module as per the course instructor's guidelines is to be written. It is to be assessed during the laboratory hours. In order to avoid Copying/ repetition, course instructor may give different assignments to different groups.

Mechanics of Solids		
Assignment No.	Name of the Assignment	Duration (Hours)
1	Stresses and strains in Thin Cylindrical and Spherical Shells	02
2	Axial Force, Shear Force and Bending Moment Diagrams for Portal Frames	02
3	Torsion in Circular Shafts	02
4	Principal Planes and Stresses, Strain Energy	02
5	General Theorems	

Important Websites:

- 1) [http://www.iitk.ac.in/mseold/mse_new/facilities/laboratories/Material Testing Lab / MSE313A.pdf](http://www.iitk.ac.in/mseold/mse_new/facilities/laboratories/Material_Testing_Lab/MSE313A.pdf)
- 2) [https://home.iitm.ac.in/kramesh/Strength of Materials Laboratory Manual.pdf](https://home.iitm.ac.in/kramesh/Strength%20of%20Materials%20Laboratory%20Manual.pdf)
- 3) https://www.researchgate.net/publication/338139499_Me_8381-Strength_Of_Materials_Lab_Manual

Assessment:

- **Term Work**

Including both the Laboratory Work and Assignments, distribution of marks for Term Work shall be as follows:

Laboratory work: 15 Marks

Assignments: 10 Marks

The sum will be multiplied by a factor of attendance between 0.5 (for poor attendance) to 1 (very good attendance).

- **End Semester Oral Examination**

Oral examination will be based on the entire syllabus.

CEL302 - Engineering Geology

Course Code	Course Name	Credits
CEL302	Engineering Geology Lab. Practice	1

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	2	-	-	1	-	1

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
-	-	-	-		25	-	25	50

Objectives

Objectives:

- To acquire basic knowledge of Geological Lab practices and apply it for the safe development of Civil Engineering works.
- To examine the mineral and identify their physical properties.
- To examine the rock sample and understand their fundamental properties for their evaluation as construction and foundation material.
- To Study the drilling data and calculate RQD for assessment of rock masses for Civil Engineering purposes.

Outcomes: Learner will be able to...

- Identify various rock forming minerals on the basis of physical properties.
- Explain the characteristics of Igneous, Sedimentary and Metamorphic rocks and assess their suitability as construction material and foundation rock.

- Interpret the rock characteristics and comment on their suitability as water bearing horizons.
- Calculate RQD and evaluate the rock masses for Civil Engineering Works.

A) List of Experiments

Module	Detailed Contents	Lab Sessions /Hr
1	Study of Physical Properties of Minerals: Identification of common Rock forming minerals on the basis of physical Properties- Silica Group: Quartz and its varieties; Cryptocrystalline silica: Jasper and Agate; Feldspar Group: Orthoclase, Plagioclase; Carbonate Group: calcite;	2
2	Amphibole Group: Asbestos, Actinolite and Hornblende; Pyroxene Group: Augite; Mica Group: Muscovite, Biotite and Talc; Element Group: Graphite. Identification of Metallic minerals: Galena, Pyrite, Hematite, Magnetite.	2
3	Identification of rocks: Igneous Rocks- Granite and its varieties, Basalt and its varieties	2
4	Sedimentary Rocks- Conglomerate, Breccia, Sandstone, Shales, Limestones, Laterites.	2
5	Metamorphic Rocks- Schist, Gneiss, Slate, Marbles and Quartzite.	2
6	Calculation of RQD from the given data and assessment of rock quality.	2

B) Assessment:

● Term Work

Including Laboratory Work and Assignments both, Distribution of marks for Term Work shall be as follows:

Laboratory work-	:	10 Marks
Assignments-	:	10 Marks
Attendance	:	05 Marks

● End Semester Oral Examination

Pair of Internal and External Examiner should conduct Oral examination.

CEL303 - Architectural Planning & Design of Buildings

Course Code	Course Name	Credits
CEL 303	Architectural Planning & Design of Buildings	01

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	02	-	-	01	-	01

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
-	-	-	-	-	25	-	25	50

@ For the course ‘Architectural Planning & Design of Buildings, the oral examination shall be conducted in conjunction with the sketching examination.

Rationale

Drawing is the language of Civil Engineers to communicate. Drawing is one of the most essential documents as far as civil engineering is concerned. It provides guidance and instructions to architects, engineers and workmen at field, on how to construct structures according to the figures and dimensions shown in the drawing. Approved drawings are also essential for the estimation of cost and materials; as well as a very important contract document.

Course Outcomes for Practicals

1. Students will be able to design and draw plans, elevations and sections of public buildings
2. Students will be able to draw foundation plans and roof plans
3. Students will be able to draw perspective drawings

Sr. No.	Practical	Periods
1	i) Developed plans, ii) elevation and iii) section (passing through staircase and one sanitary unit) of (G+1) Public Buildings - RCC Framed Structure	3
2	i) Foundation Plan and ii) Roof Plan of (G+1) Public Buildings - RCC Framed Structure	1
3	Two – Point Perspective	2

Practical Examination (Oral and Sketching)

Practical examination will consist of sketching and oral examination based on the entire syllabus.

Term Work:

Drawings:

- 1) Ground floor plan, first floor plan, elevation, section passing through at least one sanitary unit & staircase, Site plan, Foundation Plan and details of one FOOTING, Roof Plan, schedule of opening and construction notes of a **public building** to be constructed as a (G+1) R.C.C. framed structure (**only Manual Drawing**)
- 2) **Foundation Plan and Roof Plan** of Sheet 1
- 3) **Two-Point Perspective Drawing**

Assignment: Short notes on theory topics of syllabus (green building, town planning etc.)

Distribution of Term-work Marks:

The marks of term-work shall be judiciously awarded depending upon the quality of the term work. The final certification acceptance of term-work warrants the satisfactorily the appropriate completion of the required quality & quantity of work for the minimum passing marks to be obtained by the students. Broadly, the split of the marks for term work shall be as given below. However, there can be further bifurcation in the marks under any of the heads to account for any sub-head therein.

	Particulars	Marks
1	Drawing Sheet (Manual)	15 Marks
2	Assignments	5 Marks
3	Attendance	5 Marks
	Total	25 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to. 75% 80%: 03 Marks; 81% 90%: 04 Marks 91% onwards: 05 Marks (**Consider**

Practical attendance)

Recommended Books:

- Building Drawing with an Integrated Approach to Built Environment by *M. G. Shah, C. M. Kale, S.Y. Patki*(Tata McGraw-Hill Education)
- Civil Engineering Drawing (including Architectural aspect) by *M. Chakraborti* (MonojitChakraborti Publications, Kolkata)
- Planning and Designing Buildings by *Y. S. Sane* (Modern Publication House, Pune)
- Building Drawing and Detailing by *B.T.S. Prabhu, K.V. Paul and C. V. Vijayan* (SPADES Publication, Calicut)
- Building Planning by *Gurucharan Singh* (Standard Publishers & Distributors, New Delhi)

References:

- IS 962: 1989 – Code of Practice for Architectural and Building Drawings.
- National Building Code of India – 2005 (NBC 2005)
- Development Control Regulations for Mumbai Metropolitan Region for 2016 – 2036 (<https://mmrda.maharashtra.gov.in>)
- Development Control Regulations for Navi Mumbai Municipal Corporation – 1994 (<https://www.nmmc.gov.in/development-control-regulations>)
- Development Plan and Control Regulation KDMC, <https://mmrda.maharashtra.gov.in>

Reference Codes:

- National Building Code of India, 2016
- IS 779-1978 Specification for water meter
- IS 909-1975 Specification for fire hydrant
- IS 1172-1983 Code of basic requirement for water supply, drainage & sanitation
- IS 1742-1983 code of practice for building drainage

CEL304 - Fluid Mechanics- I

Semester- III						
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Course Code	Course Name	Credits
CEL304	Fluid Mechanics – I (Lab)	01

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	02	-	-	01	-	01

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
-	-	-	-	-	25	-	25	50

Course Objectives:

The students will be able to learn:

1. The basic fluid mechanics concepts
2. Measuring pressure, velocity and discharge of fluid flow through pipes and channels

Course Outcomes:

At the end of the course, learner will be able to:

1. Calculate the metacentric height
2. Verify the Bernoulli's theorem
3. Determine the discharge coefficients
4. Measure fluid flow using various devices
5. Determine the hydraulic coefficients of an orifice

Module	Detailed Contents	Lab Sessions/ Hr
1	Determination of the Metacentric height of a floating body	2
2	Determination of coefficient of discharge of Venturimeter.	2
3	Determination of coefficient of discharge of Orifice meter.	2
4	Determination of coefficient of discharge of Notches (Rectangular and Triangular notch).	2
5	To determine the value of coefficient of contraction, coefficient of velocity and coefficient of discharge for the given orifice	2

Assessment:

Term Work

Including Laboratory Work and Assignments both, Distribution of marks for Term Work shall be as follows:

Laboratory work	:	15 Marks
Assignments	:	05 Marks
Attendance	:	05 Marks

End Semester Oral Examination

Oral examination will be based on entire syllabus.

Reference Books:

- Fluid Mechanics and Hydraulic Machines: R. K. Rajput, S. Chand and Company
- Hydraulics and Fluid mechanics: Dr.P.M. Modi and Dr. S.M. Seth, Standard Book House, Delhi
- Hydraulics Fluid Mechanics and Fluid Machines: S. Ramamrutham, DhanpatRai Publishing Company (P) Ltd-New Delhi
- Theory and Application of Fluid Mechanics: K. Subramanian, Tata McGraw hill publishing company, New Delhi.
- Fluid Mechanics and Hydraulics: Dr. S.K. Ukarande, Ane's Books Pvt. Ltd. (Revised Edition 2012), ISBN 97893 8116 2538
- Fluid Mechanics and fluid pressure engineering: Dr. D.S. Kumar, F.K. Kataria and sons
- Fluid Mechanics: R.K. Bansal Laxmi Publications (P) Ltd.

NOTE –

1: For Detailed Course Schemes, Course Objectives, Internal & External Assessment process, End Semester Examination, Recommended & reference Books please refer MU syllabus of Second year (C-Scheme / R-19) Civil Engineering.

2: Theory and Practical Examination will be strictly based on above compressed syllabus.

UNIVERSITY OF MUMBAI



Bachelor of Engineering

in

Electrical Engineering

**Direct Second Year (Sem. III) Admitted Students for the
current Academic Year 2020-21(Only)**

(REV- 2019 'C' Scheme) from Academic Year 2019 – 20

**Under
FACULTY OF
SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2019–2020)

Program Structure for Second Year Engineering
UNIVERSITY OF MUMBAI
(With Effect from 2020-2021)
Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
EEC301	Engineering Mathematics-III	3	--	1	3	--	1	4
EEC302	Electrical Circuit Analysis	3		--	3		--	3
EEC303	Fundamentals of Electrical Machines & Measurements	4	--	--	4	--	--	4
EEC304	Electrical Power System I	3	--	--	3	--	--	3
EEC305	Analog Electronics	3	--	--	3	--	--	3
EEL301	Electrical Machines & Measurements Lab	--	2	--	--	1	--	1
EEL302	Electronics Lab-I	--	2	--	--	1	--	1
EEL303	Simulation Lab-I	--	2	--	--	1	--	1
EEL304	SBL-I: Applied Electrical Engineering Lab	--	4	--	--	2	--	2
EEM301	Mini Project – 1A	--	4 ^{\$}	--	--	2	--	2
Total		16	14	1	16	07	1	24

Examination Scheme

Course Code	Course Name	Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test I	Test II	Avg					
EEC301	Engineering Mathematics-III	20	20	20	80	3	25	--	125
EEC302	Electrical Circuit Analysis	20	20	20	80	3	--	--	100
EEC303	Fundamentals of Electrical Machines & Measurements	20	20	20	80	3	--	--	100
EEC304	Electrical Power System-I	20	20	20	80	3	--	--	100
EEC305	Analog Electronics	20	20	20	80	3	--	--	100
EEL301	Electrical Machines & Measurements Lab	--	--	--	--	--	25	25	50
EEL302	Electronics Lab-I	--	--	--	--	--	25	25	50
EEL303	Simulation Lab-I	--	--	--	--	--	25	25	50
EEL304	SBL-I: Applied Electrical Engineering Lab	--	--	--	--	--	50	--	50
EEM301	Mini Project – 1A	--	--	--	--	--	25	25	50
Total		--	--	100	400	--	175	100	775

\$ indicates work load of Learner (Not Faculty), for Mini Project

Semester-III								
Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract.	Tut.	Total
EEC301	Engineering Mathematics-III	03	-	01	03	-	01	04

Examination Scheme								
Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem. Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs	25	-	-	125

Pre-requisite: Engineering Mathematics-I, Engineering Mathematics-II, Scalar and Vector Product: Scalar and vector product of three and four vectors.

Course Objectives	The course is aimed: 1. To familiarize with the Laplace Transform, Inverse Laplace Transform of various functions, and its applications. 2. To acquaint with the concept of Fourier Series, its complex form and enhance the problem solving skills 3. To familiarize the concept of complex variables, C-R equations, harmonic functions, its conjugate and mapping in complex plane. 4. To understand the basics of Linear Algebra and its applications 5. To use concepts of vector calculus to analyze and model engineering problems.
Course Outcomes	On successful completion of course learner/student will be able to: 1. Apply the concept of Laplace transform to solve the real integrals in engineering problems. 2. Apply the concept of inverse Laplace transform of various functions in engineering problems. 3. Expand the periodic function by using Fourier series for real life problems and complex engineering problems. 4. Find orthogonal trajectories and analytic function by using basic concepts of complex variables. 5. Illustrate the use of matrix algebra to solve the engineering problems. 6. Apply the concepts of vector calculus in real life problems.

Module	Detailed Contents	Hours
1.	Module: Laplace Transform 1.1 Definition of Laplace transform, Condition of Existence of Laplace transform. 1.2 Laplace Transform (L) of Standard Functions like e^{at}, $\sin(at)$, $\cos(at)$, $\sinh(at)$, $\cosh(at)$ and $t^n, n \geq 0$. 1.3 Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by t, Division by t, Laplace Transform of derivatives and integrals (Properties without proof). 1.4 Evaluation of integrals by using Laplace Transformation. Self-learning Topics: Heaviside's Unit Step function, Laplace Transform of Periodic functions, Dirac Delta Function.	07

2.	Module: Inverse Laplace Transform 2.1 Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivatives. 2.2 Partial fractions method to find inverse Laplace transform. 2.3 Inverse Laplace transform using Convolution theorem (without proof). Self-learning Topics: Applications to solve initial and boundary value problems involving ordinary differential equations.	06
3.	Module: Fourier Series: 3.1 Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof). 3.2 Fourier series of periodic function with period 2π and $2l$. 3.3 Fourier series of even and odd functions. 3.4 Half range Sine and Cosine Series. Self-learning Topics: Complex form of Fourier Series, Orthogonal and orthonormal set of functions. Fourier Transform.	07
4.	Module: Complex Variables: 4.1 Function $f(z)$ of complex variable, limit, continuity and differentiability of $f(z)$ Analytic function, necessary and sufficient conditions for $f(z)$ to be analytic (without proof). 4.2 Cauchy-Riemann equations in cartesian coordinates (without proof). 4.3 Milne-Thomson method to determine analytic function $f(z)$ when real part (u) or Imaginary part (v) or its combination ($u+v$ or $u-v$) is given. 4.4 Harmonic function, Harmonic conjugate and orthogonal trajectories Self-learning Topics: Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations.	07
5.	Module: Linear Algebra: Matrix Theory 5.1 Characteristic equation, Eigen values and Eigen vectors, Example based on properties of Eigen values and Eigen vectors. (Without Proof). 5.2 Cayley-Hamilton theorem (Without proof), Examples based on verification of Cayley- Hamilton theorem and compute inverse of Matrix. 5.3 Similarity of matrices, Diagonalization of matrices. Functions of square matrix Self-learning Topics: Application of Matrix Theory in machine learning and google page rank algorithms, derogatory and non-derogatory matrices.	06
6.	Module: Vector Differentiation and Integral 6.1 Vector differentiation: Basics of Gradient, Divergence and Curl (Without Proof) 6.2 Properties of vector field: Solenoidal and irrotational (conservative) vector fields 6.3 Vector integral: Line Integral, Green's theorem in a plane (Without Proof), Stokes' theorem (Without Proof) only evaluation. Self-learning Topics: Gauss' divergence Theorem and applications of Vector calculus.	06

Term Work:

General Instructions:

1. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
2. A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in

Engineering Mathematics. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1.	Attendance (Theory and Tutorial)	05 marks
2.	Class Tutorials on entire syllabus	10 marks
3.	Mini project	10 marks

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first class test (Internal Assessment-I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment-II) when additional 40% (approx.) syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

References Books:

1. Advanced engineering mathematics, H.K. Das, S. Chand, Publications
2. Higher Engineering Mathematics, B. V. Ramana, Tata Mc-Graw Hill Publication
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication
4. Advanced Engineering Mathematics, Wylie and Barret, Tata Mc-Graw Hill.
5. Theory and Problems of Fourier Analysis with applications to BVP, Murray Spiegel, Schaum's Outline Series
6. Vector Analysis Murry R. Spiegel, Schaum's outline series, Mc-Graw Hill Publication
7. Beginning Linear Algebra, Seymour Lipschutz, Schaum's outline series, Mc-Graw Hill Publication
8. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication

Semester-III								
Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract.	Tut.	Total
EEEC302	Electrical Circuit Analysis	03			03			03

Examination Scheme								
Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem. Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs	-	-	-	100

Course Objectives	The course is aimed: 1. To impart the knowledge of various fundamental electrical theorems for analysis of electrical circuits from application point of view. 2. To inculcate the problem solving and analysis skills in students.
Course Outcomes	Upon successful completion of this course, the learner will be able to 1. Apply network theorems for the analysis of electrical circuits. 2. Obtain the transient and steady-state response of electrical circuits. 3. Develop and analyse transfer function model of system using two port network parameters. 4. Analyse time domain behaviour from pole zero plot. 5. Analyse electrical network using graph theory. 6. Analyse the effect of switching conditions on electrical networks using differential equations and Laplace Theorem.

Module	Detailed Contents	Hours
1.	First and Second Order Circuits: Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.	06
2.	Electrical Circuit Analysis Using Laplace Transforms: The Laplace transform and its application in electrical circuit analysis, transient and steady state response to step, ramp and impulse signals.	06
3.	Two port parameters: Open circuit, short circuit, transmission and hybrid Parameters, relationships between parameter sets, reciprocity and symmetry conditions; Self-learning Topics: Parallel connection of two port networks, cascade connection of two-port networks.	04
4.	Network Functions- Poles and Zeros: Network functions for one port and two port networks, Driving point and transfer functions, poles and zeros of network functions, restrictions on Pole and zero locations for driving point functions and Transfer functions, time domain behavior from pole - zero plot. Self-learning Topics: Ladder network, General network.	04

Additional Self- learning Topics: Electrical Circuit Analysis-With DC Dependent Sources: Mesh analysis, Super mesh analysis, Nodal analysis, Super node analysis, Source transformation and Source shifting. Superposition theorem, Thevenin's theorems and Norton's theorem and Maximum power transfer theorem; **Graph Theory and Network Topology:** Introduction, Graph of network, Tree, Co-tree, Loop incidence matrix, Cut set matrix, Tie set matrix and Loop current matrix, Number of possible tree of a graph, Analysis of network equilibrium equation.

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first class test (Internal Assessment-TEST-I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment Test-II) when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Books Recommended:

Text Books:

1. W H Hayt, S M Durbin, J E Kemmerly, *Engineering Circuit Analysis*, Tata McGraw-Hill Education, 2013.
2. M. E. Van Valkenburg, *Network Analysis*, 3rd Edition, PHI Learning.
3. D. Roy Choudhury, *Networks and System*, 2nd Edition, New Age International.
4. M. E. Van Valkenburg, *Linear Circuits*, Prentice Hall.
5. C. K. Alexander and M. N. O. Sadiku, *Electric Circuits*, McGraw Hill Education, 2004.
6. K. V. V. Murthy and M. S. Kamath, *Basic Circuit Analysis*, Jaico Publishers, 1999

Reference Books:

1. F. F. Kuo, *Network Analysis and Synthesis*, John Wiley and sons.
2. N Balabanian and T.A. Bickart, *Linear Network Theory: Analysis, Properties, Design and Synthesis*, Matrix Publishers.
3. C. L. Wadhwa, *Network Analysis and Synthesis*, New Age International.
4. B. Somanathan Nair, *Network Analysis and Synthesis*, Elsevier Publications.

NPTEL/ Swayam Course:

1. **Course: Basic Electric Circuits By Prof. Ankush Sharma (IIT Kanpur);**
https://swayam.gov.in/nd1_noc19_ee36/preview
2. **Course: Basic Electrical Circuits by Prof. Nagendra Krishnapura (IIT Madras)**
<https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-ee64/>

Semester-III								
Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract.	Tut.	Total
EEEC303	Fundamentals of Electrical Machines & Measurements	04	-	-	04	-	-	04

Examination Scheme								
Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem. Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs	-	-	-	100

Course Objectives	The course is aimed: 1. To study the concepts of magnetism and energy conversion. 2. To familiarize with the operational characteristics of DC machines and their applications. 3. To learn the working principles of various analog and digital instruments & devices used for measurement of the various electrical and electronic parameters.
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1. Illustrate the principle of energy conversion in single and double excited machines. 2. Understand and analyze the significance of the DC machines performance parameters. 3. Implement various starting methods and speed control methods for DC machines applications 4. Evaluate the working of various sensors, transducers and analog / digital instruments used in electrical and electronic measurements. 5. Analyze the use and performance of bridges used in electrical and electronic measurements. 6. Illustrate the need for extension of range of meters and calibration in instruments.

Module	Detailed Contents	Hours
1	Electromechanical Energy Conversion: Principle, Energy stored in magnetic field, Field and co energy, Force and torque equations, Torque in singly and doubly excited systems, Magnetic field in rotating machines, Rotating MMF wave Leakage flux and magnetic saturation. Self-learning Topics: MMF in distributed windings Winding inductance	06
2	DC Machines: Review of construction and components of DC machine; Characteristics of DC generators and motors (speed – torque and performance); Braking methods, Losses and efficiency, Swinburne's, Hopkinson's and Retardation tests;	05
3	Potentiometers, Bridges and Transducers: Potentiometers: Basic potentiometer circuit; Bridges: Wheatstone, Kelvin's double bridge, Maxwell's bridge, Schering Bridge, Q meter. Transducers: Classification of transducers, Hall effect, Optical and digital transducers.	05

	Basic requirements of signal conditioning circuits. Amplifier, Filter, and linearization circuit. Self-learning Topics: Hay's bridge, Anderson's bridge, velocity, force and torque measurement.	
4	Digital Measurements: Advantages of digital meters over analog meters, Resolution & sensitivity of digital meters, Working principles of digital Voltmeter and Ammeter, Working principles and features of Digital Tachometer and Digital Megger Self-learning Topics: Multi-meter; Digital Storage Oscilloscope; Introduction to MEMS (micro-electromechanical systems) technology and their applications in electrical and automotive domain.	06

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first class test (Internal Assessment-I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment-II) when additional 40% (approx.) syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Books Recommended:

Text Books:

1. Bimbhra P. S., *Electric Machinery*, Khanna Publisher,
2. Bimbhra P. S., *Generalized Machine Theory*, Khanna Publisher,
3. S. K. Pillai, *A first course on Electrical Drives*, New Age Publication
4. V. K. Mehta, *Principles of Electrical Machines*, S Chand Publications
5. AK Sawhney, *Electrical & Electronic Measurements and Instrumentation*, Dhanpat Rai & Sons
6. Helfric and Cooper, *Modern Electronic Instrumentation and Measurement Techniques*, PHI
7. H.S.Kalsi, *Electronic Instrumentation*, Third Edition, Tata McGraw Hill
8. Ramon Pallaá S-Areny and J. G. Webster, *Sensors And Signal Conditioning*, Second Edition, John Wiley & Sons, Inc.

Reference Books:

1. M. G. Say and E. O. Taylor, *Direct current machines*, Pitman publication
2. Ashfaq Husain, *Electric Machines*, Dhanpat Rai and Co. Publications
3. Alan.S.Moris, *Principle of Measurement & Instrumentation*, Prentice Hall of India
4. RS Sirohi & Radhakrisnan, *Electrical Measurement & Instrumentation*, New Age International
5. M. V. Deshpande, *Electric Machines*, PHI
6. Vedam Subramanyam, *Electrical Drive-concept and applications*, TMH Publication
7. Sabrie Soloman, *Sensors Handbook*, Second Edition, McGraw Hill

NPTEL/ Swayam Course:

Course: Electrical Machines – I By Prof. Tapas Kumar Bhattacharya (IIT Kharagpur)
https://swayam.gov.in/nd1_noc20_ee60/preview

Semester-III								
Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract.	Tut.	Total
EEEC304	Electrical Power System-I	03	-	-	03	-	-	03

Examination Scheme								
Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem. Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs	-	-	-	100

Course Objectives	The course is aimed: 1. To learn basics of electrical power systems and its different components. 2. To acquaint knowledge of transmission / distribution line and its parameters. 3. To learn representation and performance evaluation of power systems. 4. To understand electric cable and earthing
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1. Understand the power system and its components. 2. Categorize the ac transmission / distribution lines and understand the insulators. 3. Evaluate the parameters of different types of ac transmission / distribution lines. 4. Draw the PU reactance diagram of a power system for analysis. 5. Analyse the performance of transmission lines. 6. Study the performance parameters of electric cable and earthing.

Module	Detailed Contents	Hours
1	Transmission / Distribution Systems and Line Parameters: Definition of inductance, internal and external flux linkage of single conductor, inductance of single phase two wire line, inductance of three phase three wire line with symmetrical and unsymmetrical spacing, concept of GMR and GMD, inductance of three phase double circuit line, inductance of bundled conductor lines, Capacitance of transmission line, capacitance of single phase line, capacitance of three phase line with symmetrical and unsymmetrical spacing, effect of earth on transmission line capacitance (single phase only) Self-learning Topics: Basic structure of power system: generation, transmission and distribution; Types of AC Transmission / Distribution Lines: single phase two wire, three phase three wire (symmetrical and unsymmetrical spacing), three phase double circuit, three phase four wire, concept of composite and bundle conductor.	10
2	Representation of Power System Components: Per Unit (PU) system, advantage of PU system, PU impedance diagram, representation of load (Numerical).	02
3	Performance of Transmission Line: Ferranti effect, evaluation and estimation of generalized circuit constant (ABCD) for short and medium lines. Self-learning Topics: surge impedance loading, tuned power line.	03

4	Electric Cable and Earthing: Electric Cable: Classification and construction of cable, insulation resistance of cable, capacitance of single core and three core cable, grading of cable, inter-sheath grading, capacitance grading Earthing: Earthing definition, step and touch potentials; neutral grounding and its methods.	05
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Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first class test (Internal Assessment-I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment-II) when additional 40% (approx.) syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Books Recommended:

Text Books:

1. Fredrick T Morse, *Power Plant Engineering*, East-West Press Pvt Ltd
2. Mahesh Verma, *Power Plant Engineering*, Metrolitan Book Co Pvt Ltd
3. RK Rajput, *A Text Book of Power System engineering*, Laxmi Publication
4. George W Sutton-(Editor), *Direct Energy Conversion*, Lathur University, Electronic Series Vol-3 McGraw Hill
5. D. P. Kothari, I. J. Nagrath, *Power System Engineering*, 3 Edition, Mc Graw Hill
6. B.R. Gupta, *Power System Analysis And Design*, S.Chand
7. J B. Gupta, *A Course in Power System*, S. K. Kataria & Sons
8. Mehta V.K., *Principles of Power System*, S Chand

Reference Books:-

1. Stevenson and Grainger, *Modern Power System Analysis*, 1 Edition, TMH publication
2. W. D. Stevenson, *Elements of Power System*, 4 Edition TMH

NPTEL/ Swayam Course:

Course: Power System Analysis, By Prof. Debapriya Das (IIT Kharagpur)

https://swayam.gov.in/nd1_noc19_ee62/preview

Semester-III								
Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract.	Tut.	Total
EEEC305	Analog Electronics	03	-	-	03			03

Examination Scheme								
Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem. Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs	-	-	-	100

Course Objectives	The course is aimed: 1. To understand the characteristics of diode, transistors and FETs. 2. To understand design of different biasing circuits of BJT and MOSFET. 3. To understand the functioning of Op-Amplifier and design of Op- amp based circuits. 4. To understand the functioning of linear voltage regulators and IC 555.
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1. Analyze the performance of various rectifiers and filter circuits. 2. Illustrate the use DC and AC parameters of BJT in analysis of amplifier circuits. 3. Apply the knowledge of MOSFET's DC/ AC parameters in analysis of amplifier and switching applications of MOSFET. 4. Understand the functioning of OP-AMP and design OP-AMP based circuits. 5. Illustrate the practical design aspect of regulated power supply circuits using linear regulators. 6. Understand applications of commonly used special semiconductor devices.

Module	Detailed Contents	Hours
1	Bipolar Junction Transistor: BJT as an amplifier <i>DC Circuit Analysis:</i> Types of biasing circuits, load line, thermal runaway. <i>AC Circuit Analysis:</i> Small signal analysis of CE configurations with different biasing network using H-parameter model; Amplification derivation of expression for voltage gain, current gain, input impedance and output impedance of CE amplifiers. Self-learning Topics: BJT's hybrid-pi model and r_e Model; Study of frequency response of BJT amplifier.	05
2	Field Effect Transistor: Types of FETs, basics of construction and working principle; MOSFET structure and I-V characteristics. MOSFET as an amplifier <i>DC Circuit Analysis:</i> Types of biasing circuits of MOSFET and region of operation. Self-learning Topics: Small signal model of MOSFET CS amplifier, derivation of expressions for voltage gain and output impedance of MOSFET CS amplifier.	04

3	Operational Amplifiers: Differential amplifier, direct coupled multi-stage amplifier, Block diagram of Op-amp, ideal op-amp, non-idealities in an op-amp, Frequency response; Idealized analysis and design of Inverting and Non-inverting amplifier. Design of different Op-amp circuits- adder, integrator and differentiator. Self-learning Topics: Comparator (ZCD, window comparator); Instrumentation amplifier (using 3 Op-amp); First order Low Pass Filter using op-amp; Oscillator (Wein bridge), Square-wave generator;	05
4	Linear Voltage Regulators and Timer: Design of voltage supply using IC-7805 and LM317 (Numerical). IC-555- Functional block diagram, study of Mono-stable and Astable Multivibrator using IC555.	03
5	Special Purpose Semiconductor Devices: Applications of rectifier diode and zener diode as clippers; Principle of operation and applications of Schottky diode; Basics of Opto-isolator.	03

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first class test (Internal Assessment-I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment-II) when additional 40% (approx.) syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Books Recommended:

Text Books:-

1. Neamen D.A., *Electronic Circuit Analysis and Design*, McGraw Hill International.
2. Robert Boylestad and Louis Nashelsky, *Electronic Devices and Circuits*, PHI
3. Ramakant A. Gayakwad, *Op-Amps and Linear Integrated Circuits*, PHI, 2000
4. Millman and Halkias, *Electronic Devices and Circuits*, Tata McGraw-Hill.
5. A. S. Sedra and K. C. Smith, *Micro-electronic Circuits*, Oxford University Press, 1998.

Reference Books:-

1. David Bell, *Electronic Devices and Circuits*, Oxford University Press
2. Thomas Floyd, *Electronic Devices*, PHI
3. S. Salivahanan and N. Suresh Kumar, "*Electronic Devices and Circuits*, TMH
4. P. Horowitz and W. Hill, *The Art of Electronics*, Cambridge University Press, 3rd Edition

NPTEL/ Swayam Course:

1. Course: Analog Electronic Circuits By Prof. Pradip Mandal (IIT Kharagpur)
https://swayam.gov.in/nd1_noc20_ee45/preview
2. Course: Analog Electronic Circuit By Prof. Shouribrata Chatterjee (IIT Madras)
<https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-ee89/>

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract.	Tut.	Total
EEL301	Electrical Machines and Measurements Lab	-	02	-	-	01	-	01

Examination Scheme								
Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem. Exam	Term Work	Pract./ Oral	Oral	
Test-I	Test-II	Average						
-	-	-	-	-	25	-	25	50

Course Objectives	To impart the knowledge on the following : 1. Practical understanding of DC machines and their applications. 2. Working principles of various sensors, transducers and instruments used for measurement of the various physical parameters.
Course Outcomes	Upon successful completion of this course, the learner will be able to 1. Illustrate and analyze the performance of DC machines. 2. Demonstrate different speed control methods of DC motors. 3. Illustrate and analyze the working of various sensors, transducers and instruments used for measurement of the various physical parameters. 4. Demonstrate the use of bridges for measurements of passive electrical components. 5. Understand and analyse the working signal processing circuits used in measurements and instruments

Syllabus: Same as **EEEC303: Fundamentals of Electrical Machines and Measurements**

Suggested List of Laboratory Experiments: Minimum Two from 1 – 9 and Two from 10 – 16, in all minimum Four experiments need to be performed.

1. Open circuit and load characteristics of DC shunt generator.
2. Load characteristics of DC compound generator with differential and cumulative connections.
3. Load test on DC shunt motor.
4. Load test on DC compound motor.
5. Load test on DC series motor.
6. Speed control of DC shunt motor.
7. Retardation test of DC motor.
8. Swinburne's test on DC motor.
9. Hopkinson's test on DC motor.
10. Measurement of the medium resistance using Wheatstone bridge.
11. Measurement of the low resistance using Kelvin's double bridge.
12. Measurement of inductance using Maxwell's bridge.
13. Measurement of capacitance using Schering's bridge.
14. Measurement of R/L/C using a bridge technique as well as LCR meter.
15. Current Measurement using Shunt, CT, and Hall Sensor.
16. Measurement of temperature using RTD/ Thermistor
17. Measurement of Pressure using Pressure transducer.
18. Study of Signal Processing circuits used for sensors/ transducers.
19. Range Extension of meters used in electrical and electronic measurements.

Any other experiments based on syllabus which will help students to understand topic/concept.

Note:

Students and teachers are encouraged to use the virtual labs whose links are as given below The remote-access to Labs in various disciplines of Science and Engineering is available. Students can conduct online experiments which would help them in learning basic and advanced concepts through remote experimentation.

Virtual Lab Website Reference

1. <http://vlab.co.in/broad-area-electrical-engineering>
2. <http://vlab.co.in/broad-area-electronics-and-communications>

Term work:

Term work shall consist of minimum 08 experiments. The distribution of marks for term work shall be as follows:

Laboratory Performance	: 10 marks
Journal	: 10 marks
Attendance	: 05 marks

The final certification and acceptance of term work ensures the minimum passing in the term Work.

Oral Examination:

Oral examination will be based on entire syllabus of **EEEC303: Fundamentals of Electrical Machines & Measurements**

Semester-III								
Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract.	Tut.	Total
EEL302	Electronics Lab-I	-	02	-	-	01	-	01

Examination Scheme								
Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem. Exam	Term Work	Pract./ Oral	Oral	
Test-I	Test-II	Average						
-	-	-	-	-	25	25	-	50

Course Objectives	The course is aimed: 1. To understand the basic concept of various electronic devices, circuits and their application. 2. To develop ability among students to design and implement electronic circuits.
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1. Identify the different types of semiconductor devices and demonstrate their applications in electronic circuits. 2. Analyse the performance of different types of rectifier with and without filter. 3. Determine the dc and ac parameters of various semiconductor devices. 4. Illustrate the frequency response of BJT/ MOSFET amplifier. 5. Understand the practical use of Op-amps in signal processing and waveform generators.

Syllabus: Same as that of Course EEC305 Analog Electronics

Suggested List of Laboratory Experiments: Minimum Four experiments need to be performed.

1. Use of diode as clipper.
2. BJT biasing network and stability analysis
3. BJT Input and Output Characteristics for CE configuration
4. Frequency response of BJT CE amplifier
5. Study of MOSFET characteristics and calculation of parameters
6. Frequency response of MOSFET CS amplifier
7. Study of differential BJT amplifier
8. Design of OP-AMP based Inverting amplifier and Non-inverting Amplifier
9. Study of OP-AMP as Adder and Subtractor
10. Design of adjustable Voltage regulator based on IC 78XX
11. Design of adjustable Voltage regulator based on LM317
12. Study of V-I characteristics of Schottky diode.
13. Study of opto-isolators

Any other experiment based on syllabus which will help students to understand topic/concept.

Note:

Students and teachers are encouraged to use the virtual labs whose links are as given below The remote-access to Labs in various disciplines of Science and Engineering is available. Students can conduct experiments which would help them in learning basic and advanced concepts through remote experimentation.

Virtual Lab Website Reference

1. <http://vlab.co.in/broad-area-electrical-engineering>
2. <http://vlab.co.in/broad-area-electronics-and-communications>

Term work:

Term work shall consist of minimum 08 experiments. The distribution of marks for term work shall be as follows:

Laboratory Performance	: 10 marks
Journal	: 10 marks
Attendance	: 05 marks

The final certification and acceptance of term work ensures the minimum passing in the term Work.

Practical & Oral Examination:

Practical exam will be based on all the experiments carried out & Oral examination will be based on entire syllabus of **EEEC305 Analog Electronics**.

The distribution of marks for practical/ oral examination shall be as follows:

- Practical Exam : 15 marks
- Oral Exam : 10 marks

Semester-III								
Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract.	Tut.	Total
EEL303	Simulation Lab-I	-	02	-	-	01	-	01

Examination Scheme								
Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem. Exam	Term Work	Pract./ Oral	Oral	
Test-I	Test-II	Average						
-	-	-	-	-	25	-	25	50

Course Objectives	The course is aimed: 1. To understand basic block sets of different simulation platform used in electrical /electronic circuit design. 2. To understand use and coding in different software tools used in electrical/ electronic circuit design
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1. Develop the skill to use the software packages to model and program electrical and electronics systems 2. Model different electrical and electronic systems and analyze the results 3. Articulate importance of software packages used for simulation in laboratory experimentation /research/industry by analyzing the simulation results. 4. Simulate electric machines/circuits for performance analysis.

Suggested Software Tools to be Used for Simulation Lab-I:

1. Students should be encouraged to use open source softwares such as **SCILAB**, **LTSPICE**, Texas Instrument's '**Webbench**', **Ngspice**, **Solve Elec** etc. for carrying out the lab simulation listed below.
2. Use of Professional Licensed versions of softwares like **MATLAB**, **Proteus**, **LabVIEW**, **NI Multisim**, **PSpice**, **PowerSim**, **TINA** etc. is also allowed.
3. Use of 'Python' platform for simulating components/ circuit behaviour.

Suggested List of Laboratory Experiment: Minimum Four experiments need to be performed from various subjects domain

1. Introduction to basic block sets of simulation platform.
2. Algorithm on matrix operations
3. Simulation of transmission line model
4. Algorithms to determine transmission line performance and parameters
5. Simulation of differential equations
6. Simulation to verify different network theorems with dependent and independent sources
7. Algorithm for generation of standard test signals
8. Simulation / Algorithms to draw the response of electrical network for standard test signals.
9. Simulation / Algorithms to draw the pole zero plot of electrical networks
10. Simulation of DC motor performance characteristics
11. Simulation of various measurement bridges I Maxwell's bridge, Hay's bridge etc.
12. Design of OP-AMP based Inverting amplifier and Non-inverting Amplifier
13. Study of OP-AMP as Adder and Subtractor

Any other simulations / algorithms based on third semester syllabus, which will help students to understand topic / concept.

Note:

Students and teachers are also encouraged to use the virtual labs whose links are as given below. The remote-access to Labs in various disciplines of Science and Engineering is available. Students can conduct experiments which would help them in learning basic and advanced concepts through remote experimentation.

Virtual Lab Website Reference:

1. <http://vlab.co.in/broad-area-electrical-engineering>
2. <http://vlab.co.in/broad-area-electronics-and-communications>

Term work:

Term work consists of minimum 08 simulation / algorithms from various subject domains. The distribution of the term work shall be as follows:

Simulation / Algorithm	: 20 marks
Attendance	: 05 marks

The final certification and acceptance of term-work ensures the minimum passing in the term-work.

Oral Examination:

Oral examination will be based on all the laboratory experiments carried out in **Simulation Lab-I**

Semester-III								
Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract.	Tut.	Total
EEL304	Skill Based Lab (SBL-I) Applied Electrical Engineering Lab	-	04	-	-	02	-	02

Examination Scheme								
Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem. Exam	Term Work	Pract./ Oral	Oral	
Test-I	Test-II	Average						
-	-	-	-	-	50	-	-	50

Course Objectives	The course is aimed: 1. To provide hands on experience to use laboratory instruments for testing and measurement. 2. To develop the ability to repair and maintain electrical equipment/ appliances 3. To impart the knowledge of electrical installation on institute campus. 4. To impart the knowledge of Electrical fire and shock hazards safety.
Course Outcomes	Upon successful completion of this course, the learner will be able to 1. Demonstrate the effective use of various electrical and electronic measuring lab equipments. 2. Identify various electrical LV/HV substation, supply equipments and their network connection 3. Identify and use different low voltage protective switchgears along with residential / industrial wiring practices. 4. Illustrate the understanding of Repair and maintenance of common electrical appliances. 5. Handle Electrical fire and shock hazards safety challenges in real practice.

Module	Detailed Contents	Hours
1	Use of Lab Equipments: <i>Standard Lab Equipments:</i> Multi-meter, Power Supply, Function Generator, Tachometer, thermometer, clamp-on meter, DSO etc. (Study two the equipments) <i>Special Measuring Equipments:</i> True RMS multi-meter, Lux meter, Megger, LCRQ meter, Power Meter, Thermal Analyser, Anemometer, Humidity Meter, Earthing Resistance meter, Insulation Resistance meter etc. (Study at least one such equipments) Lab Activities: Students should be trained to use these classes of lab equipments with good expertise achieved. Students should clearly understand and differentiate the situations in which use of each of these equipments is best suitable.	04
2	Electrical LV/HV Substation and Supply Equipments: Electrical LV/HV Substation: RMU, Transformer, HV switchgear and panels, LV switchgears and panels, HT metering, LT metering APFC panel, Backup DG sets, UPS, Changeover switchgears, Feeder Pillar, Solar PV Installation. Single line diagram (SLD), Supply Utility service: Electricity bills and details. Students should study the actual electrical supply system on institute campus, prepare SLD for the network and detailed report on actual ratings of the complete system.	06

3	Residential/ Industrial Wiring and switch-gears Wiring materials, selection of wire, conductor sizing, Cables and cable management Estimation and costing of residential wiring (Simple numerical on wiring of single room); Fire retardant wires. Different switching and protection devices (MCBs/ Fuses/Relays), selection and sizing connection of energy meter and distribution board, wiring standards (IS-732, section 4). (Students should be given demonstration of real life devices and DBs in use). Students should perform following experiments (Any Two) 1. Identify different types of cables/wires, switches and their uses. 2. Identify different types of fuses & fuse carriers, MCB and ELCB, MCCB with ratings and usage. 5. Wiring of simple light circuit for controlling light/fan point (PVC conduit wiring and wiring accessories) 6. Wiring of fluorescent lamps and light sockets (6 A). 7. Wiring of Power circuit for controlling power device (16A socket) 8. Design of Staircase wiring / Go-down wiring / Tunnel wiring 9. Demonstration and measurement of power/energy consumption and repair maintenance of electric iron/mixer grinder/ washing machine/refrigerator/ air conditioner/water heater/geyser/single phase pump/exhaust fan.	06
4	Repair and Maintenance of House-hold Appliances and Machines: Testing, fault finding, Dismantling, assembling and testing after repairs of house hold appliances like standard fan and regulator, BLDC fan, heater, geyser, mixer, washing machine, microwave oven, LED lamps/tubes, Induction Cooker, Air cooler etc. (Minimum one such appliances must be studied) Troubleshooting of 1 ph and 3ph transformers and motors (Any one)	04
5	Electrical Fire Prevention and Safety in Buildings: Guidelines and charts for electrical fire prevention, role of electrical switchgear and protection devices, Earth leakage and Earth Resistance measurements, Preventive maintenance, Thermal analysis of electrical installations, Electrical Fire mitigation ; Electrical Shock safety, symptoms and emergency first aid; Self Study: Indian Electricity Act and National Electrical Code (Training of Electrical Fire Prevention and Safety must be provided to all the students)	04

Term Work:

Term work shall consist of minimum requirement as given in the syllabus. The distribution of marks for term work shall be as follows:

Laboratory Performance	: 30 marks
Journal	: 10 marks
Attendance	: 10 marks

The final certification and acceptance of term work ensures the minimum passing in the term work.

Books Recommended:

1. J. B. Gupta, *Electrical Installation Estimating & Costing*, S. K. Kataria & Sons, 2009
2. Raina Bhattacharya, *Electrical Design Estimating And Costing*, New Age International,
3. K B. Bhatia, *Electrical Appliances and Devices*, Khanna Publications
4. K B. Bhatia, *Fundamentals of Maintenance of Electrical Equipments*, Khanna Publications
5. BIS SP 30:National Electrical Code
6. Electricity Act 2003

Semester-III								
Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract.	Tut.	Total
EEM301	Mini Project – 1A	-	04^{\$}	-	-	02	-	02

\$ indicates work load of Learner (Not Faculty)

Examination Scheme								
Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem. Exam	Term Work	Pract./ Oral	Oral	
Test-I	Test-II	Average						
-	-	-	-	-	25	-	25	50

Course Objectives	The course is aimed: 1. To acquaint with the process of identifying the needs and converting it into the problem. 2. To familiarize the process of solving the problem in a group. 3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems. 4. To inculcate the process of self-learning and research.
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1. Identify problems based on societal /research needs. 2. Apply Knowledge and skill to solve societal problems in a group. 3. Develop interpersonal skills to work as member of a group or leader. 4. Draw the proper inferences from available results through theoretical/ experimental/simulations. 5. Analyse the impact of solutions in societal and environmental context for sustainable development. 6. Use standard norms of engineering practices 7. Excel in written and oral communication. 8. Demonstrate capabilities of self-learning in a group, which leads to life long learning. 9. Demonstrate project management principles during project work.

General Guidelines for Mini Project 1A/ 1B	
	• Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity. • Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties. • Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project. • A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments. • Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning. • Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor. • Students shall convert the best solution into working model using various components of their domain areas and demonstrate. • The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.

- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project-1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Mini Project 1A/1B–General Guidelines for Execution

Design and Fabrication

- Initial fabrication of the project by students can be done using standard devices/material/software tools to verify the circuit functionalities Initial project fabrication and testing is expected to be done by soldering/assembling on general purpose PCB/ Bakelite boards or suitable platforms required for the electrical/electronic/digital components. Avoid the use of breadboards.
- If essential, use of a simulation/ emulation software tools to test and verify the performance of the circuit should be encouraged.
- Students should prepare the proper drawings (electrical/ mechanical), schematics/ layouts of the project.
- For final implementation of the circuit, preparation of PCB (if any required) using suitable CAD tools and fabricating the same in the lab is expected.

Devices/ Components/ Systems to be Used:

Students are encouraged to use passive components like resistors, capacitors, inductors etc. If any specialize inductor is not readily available, the fabrication of the same in the lab should be encouraged. Other components like: Transistors, diodes, voltage regulators, logic gates, Op-amps, general purpose microcontroller, DC motors/ AC motors, sensors, actuators, relays etc. (Students may add more components as per the requirement of project).

Testing and analysis of the Project

Students should test the circuit using suitable laboratory equipments like power supply, multi-meter, CRO, DSO etc. In case of any debugging requirement, students should record the problems faced during the testing and solutions sought after for the fault in the circuit.

All the testing results must be well documented in the final project report verifying the functionalities of the propose project.

Use of Reference Material/Literature :

Students are advised to refer Application Notes, research publications & data sheets of various electrical/electronic/digital devices from Texas Instruments, Microchips, International Rectifiers, ST Microelectronics, Philips, NXP and many other manufacturers.

Self-learning and Skill Set Development

Students should be encouraged to develop/ improve their understanding and skill sets by attending various online/offline expert lectures / video lectures/ courses/ webinars/ workshops etc. to facilitate the smooth execution of mini project

1. Understanding passive components viz. resistors, capacitors and inductors from practical point of view: types/ varieties, device packages, applications and cost.
2. Understanding semiconductor components viz. diodes, BJT and JFET/MOSFETs from practical point of view: types/ varieties, device packages, applications and cost.
3. Design principles of simple electrical / electronic circuits with some examples.
4. Selection of switches and circuit protection components.
5. Selection and sizing of wires and conductors.
6. Soldering Practice.

7. Heat-sinking and Enclosure design concepts
8. Overall workmanship while working on the project fabrication.
9. Use of different software tools for design and development of circuits
10. Use of standard as well as advanced laboratory equipments needed for testing of such projects

Suggested Application Domains for Mini Projects:

List of key application domains from where students are encouraged to derive Mini Projects topics:

1. Home/Office automation
2. Renewable Energy
3. Energy Conservation
4. Energy Storage
5. Battery Charging and Protection
6. Fire Safety
7. Electrical System Protection
8. Lighting Control
9. Wireless Power Transfer
10. Electrical Components Testing
11. Electrical Parameters Measurement
12. Non-conventional Electricity Generation
13. Laboratory Equipments
14. E-Mobility
15. Video Surveillance Systems
16. Robotics for Hazardous applications
17. Waste Management System 2.
18. Smart City Solutions
19. Smart Classrooms and learning Solutions
20. Smart Agriculture solutions etc.
21. Health/ Biomedical

Students can identify the mini project topics either from above suggested domains or **any other relevant engineering domains**.

Guidelines for Assessment of Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;
 - Marks awarded by guide/supervisor based on log book : 10
 - Marks awarded by review committee : 10
 - Quality of Project report : 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year Mini Project:

- In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.
 - First shall be for finalization of problem

- Second shall be on finalization of proposed solution of problem.
- In second semester expected work shall be procurement of components /systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
 - First review is based on readiness of building working prototype to be conducted.
 - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year Mini Project:

- In this case in one semester students' group shall complete project in all aspects including,
 - Identification of need/problem
 - Proposed final solution
 - Procurement of components/systems
 - Building prototype and testing
- Two reviews will be conducted for continuous assessment,
 - First shall be for finalization of problem and proposed solution
 - Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project.

Mini Project shall be assessed based on following criteria;

1. Quality of survey/ need identification
 2. Clarity of Problem definition based on need.
 3. Innovativeness in solutions
 4. Feasibility of proposed problem solutions and selection of best solution
 5. Cost effectiveness
 6. Societal impact
 7. Innovativeness
 8. Cost effectiveness and Societal impact
 9. Full functioning of working model as per stated requirements
 10. Effective use of skill sets
 11. Effective use of standard engineering norms
 12. Contribution of an individual's as member or leader
 13. Clarity in written and oral communication
- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
 - In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organizations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Oral Examination:

Mini Project shall be assessed based on following points;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact

4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication

Reference Books:

1. P. Horowitz and W. Hill, "The Art of Electronics", 3rd Edition, Cambridge University Press, 2015
2. R. S. Khandpur, "Printed Circuit Board", McGraw-Hill Education; 1st edition, 2005.
3. Simon Monk, "Hacking Electronic: Learning Arduino and Raspberry Pi", McGraw-Hill Education TAB; 2 edition (September 28, 2017).

Suggested Software Tools:

1. LTspice: <https://www.analog.com/en/design-center/design-tools-and-calculators/ltspice-simulator.html#>
2. Eagle : <https://www.autodesk.in/products/eagle/overview>
3. OrCAD: <https://www.orcad.com/>
4. Multisim : <https://www.multisim.com/>
5. Webbench: <http://www.ti.com/design-resources/design-tools-simulation/webench-power-designer.html>
6. Tinkercad : <https://www.tinkercad.com/>
7. Raspbian OS: <https://www.raspberrypi.org/downloads>
8. Arduino IDE: <https://www.arduino.cc/en/main/software>

Online Repository:

1. <https://www.electronicsforu.com>
2. <https://circuitdigest.com>
3. <https://www.electronicshub.org>
4. Github

UNIVERSITY OF MUMBAI



Bachelor of Engineering

in

Electronics Engineering

**Direct Second Year (Sem. III) Admitted Students for the
current Academic Year 2020-21(Only)**

(REV- 2019 'C' Scheme) from Academic Year 2019 – 20

**Under
FACULTY OF
SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2019–2020)

Program Structure for Second Year Electronics Engineering

UNIVERSITY OF MUMBAI
(With Effect from 2020-2021)

SEMESTER III

Course Code	CourseName	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical And Oral	Tutorial	Total
ELC301	Engineering Mathematics-III	3	--	1	3	--	1	4
ELC302	Electronics Devices and Circuits -I	3		--	3		--	3
ELC303	Digital Logic Circuits	3	--	--	3	--	--	3
ELC304	Electrical Networks Analysis and Synthesis	3	--	1	3	--	1	4
ELC305	Electronic Instruments and Measurements	3	--	--	3	--	--	3
ELL301	Electronics Devices and circuits -I Lab	--	2	--	--	1	--	1
ELL302	Digital Logic Circuits Lab	--	2	--	--	1	--	1
ELL303	Electronic Instruments and Measurements Lab	--	2	--	--	1	--	1
ELL304	Skill base Lab OOPM (Java)	--	4	--	--	2	--	2
ELM301	MiniProject– 1A	--	4 ^{\$}	--	--	2	--	2
Total		15	14	2	15	07	2	24

\$ indicates workload of Learner(NotFaculty), for Mini Project

Course Code	Course Name	Examination Scheme							
		Theory					Term	Practical	Total
		Internal Assessment			End Sem . Exam	Exam. Duration (inHrs)			
		Test 1	Test 2	Avg .					
ELC301	Engineering Mathematics-III	20	20	20	80	3	25	--	125
ELC302	Electronics Devices and circuits -I	20	20	20	80	3	--	--	100
ELC303	Digital Logic Circuits	20	20	20	80	3	--	--	100
ELC304	Electrical Networks Analysis and Synthesis	20	20	20	80	3	25	--	125
ELC305	Electronic Instruments and Measurement	20	20	20	80	3	--	--	100
ELL301	Electronics Devices and circuits -I Lab	--	--	--	--	--	25	25	50
ELL302	Digital Logic Circuits Lab	--	--	--	--	--	25	25	50
ELL303	Electronic Instruments and Measurements Lab	--	--	--	--	--	25	25	50
ELL304	Skill base Lab - OOPM (Java)	--	--	--	--	--	50	--	50
ELM301	MiniProject-1 A	--	--	--	--	--	25	25	50
Total		--	--	100	400	--	200	100	800

Note:

1. Students group and load of faculty per week.

Mini Project 1 and 2:

Students can form groups with minimum 2 (Two) and not more than 4 (Four)

Faculty Load: 1 hour per week per four groups

Major Project 1 and 2:

Students can form groups with minimum 2 (Two) and not more than 4 (Four)

Faculty Load: In Semester VII – $\frac{1}{2}$ hour per week per project group

In Semester VIII – 1 hour per week per project group

2. Out of 4 hours/week allotted for the mini-projects 1-A and 1-B, an expert lecture of at least one hour per week from industry/institute or a field visit to nearby domain specific industry should be arranged.
3. Mini-projects 2-A and 2-B should be based on DLOs.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tutorial	Theory	TW/Pract.	Tutorial	Total
ELC301	Engineering Mathematics-III	03	-	01	03	-	01	04

Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract.	Oral	Total
		Internal Assessment			End Sem Exam				
		Test 1	Test 2	Avg of Test 1 & 2					
ELC301	Engineering Mathematics-III	20	20	20	80	25	-	-	125

Pre-requisite:

Engineering Mathematics-I, Engineering Mathematics-II, Scalar and Vector Product: Scalar and vector product of three and four vectors,

Course Objectives: The course is aimed

- 1.To familiarize with the Laplace Transform, Inverse Laplace Transform of various functions, and its applications.
- 2.To acquaint with the concept of Fourier Series, its complex form and enhance the problem solving skills
- 3.To familiarize the concept of complex variables, C-R equations, harmonic functions, its conjugate and mapping in complex plane.
- 4.To understand the basics of Linear Algebra and its applications
- 5.To use concepts of vector calculus to analyze and model engineering problems.

Course Outcomes: On successful completion of course learner will be able to;

- 1.Apply the concept of Laplace transform to solve the real integrals in engineering problems.
- 2.Apply the concept of inverse Laplace transform of various functions in engineering problems.
- 3.Expand the periodic function by using Fourier series for real life problems and complex engineering problems.
- 4.Find orthogonal trajectories and analytic function by using basic concepts of complex variables.
- 5.Illustrate the use of matrix algebra to solve the engineering problems.
- 6.Apply the concepts of vector calculus in real life problems.

Module No	Contents	Hrs.
01	Module 1: Laplace Transform 1.1 Definition of Laplace transform, Condition of Existence of Laplace transform. 1.2 Laplace Transform (L) of Standard Functions like e^{at}, $\sin(at)$, $\cos(at)$, $\sinh(at)$, $\cosh(at)$ and t^n, $n \geq 0$. 1.3 Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by t, Division by t, Laplace Transform of derivatives and integrals (Properties without proof). 1.4 Evaluation of integrals by using Laplace Transformation. Self-learning Topics: Heaviside's Unit Step function, Laplace Transform of Periodic functions, Dirac Delta Function.	7
02	Module 2: Inverse Laplace Transform 2.1. Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivatives. 2.2 Partial fractions method to find inverse Laplace transform. 2.3 Inverse Laplace transform using Convolution theorem (without proof). Self-learning Topics: Applications to solve initial and boundary value problems involving ordinary differential equations.	6
03	Module 3: Fourier Series 3.1 Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof). 3.2 Fourier series of periodic function with period 2π and $2l$. 3.3 Fourier series of even and odd functions. 3.4 Half range Sine and Cosine Series. Self-learning Topics: Complex form of Fourier Series, Orthogonal and orthonormal set of functions. Fourier Transform.	7
04	Module 4: Complex Variables 4.1 Function $f(z)$ of complex variable, limit, continuity and differentiability of $f(z)$ Analytic function, necessary and sufficient conditions for $f(z)$ to be analytic (without proof). 4.2 Cauchy-Riemann equations in cartesian coordinates (without proof). 4.3 Milne-Thomson method to determine analytic function $f(z)$ when real part (u) or Imaginary part (v) or its combination ($u+v$ or $u-v$) is given. 4.4 Harmonic function, Harmonic conjugate and orthogonal trajectories	7

	Self-learning Topics: Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations.	
05	Module 5: Linear Algebra: Matrix Theory 5.1 Characteristic equation, Eigen values and Eigen vectors, Example based on properties of Eigen values and Eigen vectors.(Without Proof). 5.2 Cayley-Hamilton theorem (Without proof), Examples based on verification of Cayley-Hamilton theorem and compute inverse of Matrix. 5.3 Similarity of matrices, Diagonalization of matrices. Functions of square matrix Self-learning Topics: Application of Matrix Theory in machine learning and google page rank algorithms, derogatory and non-derogatory matrices.	6
06	Module 6: Vector Differentiation and Integral 6.1 Vector differentiation: Basics of Gradient, Divergence and Curl (Without Proof). 6.2 Properties of vector field: Solenoidal and irrotational (conservative) vector fields. 6.3 Vector integral: Line Integral, Green's theorem in a plane (Without Proof), Stokes' theorem (Without Proof) only evaluation. Self-learning Topics: Gauss' divergence Theorem and applications of Vector calculus.	6
Total		39

Term Work:

General Instructions:

1. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
2. A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Engineering Mathematics. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1.	Attendance (Theory and Tutorial)	05 marks
2.	Class Tutorials on entire syllabus	10 marks
3.	Mini project	10 marks

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first-class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment II) when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

References:

1. Advanced Engineering Mathematics, H.K. Das, S. Chand, Publications
2. Higher Engineering Mathematics, B. V. Ramana, Tata Mc-Graw Hill Publication
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication
4. Advanced Engineering Mathematics, Wylie and Barret, Tata Mc-Graw Hill.
5. Theory and Problems of Fourier Analysis with applications to BVP, Murray Spiegel, Schaum's Outline Series
6. Vector Analysis Murry R. Spiegel, Schaum's outline series, Mc-Graw Hill Publication
7. Beginning Linear Algebra, Seymour Lipschutz, Schaum's outline series, Mc-Graw Hill Publication
8. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	TW/Practical and Oral	Tutorial	Total
ELC302	Electronic Devices & Circuits-I	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours	-	-	-
		Test 1	Test 2	Avg of Test 1 and Test 2		-	-	-	-
ELC 302	Electronic Devices & Circuits-I	20	20	20	80	03	-	-	100

Course Objectives:

1. To deliver the knowledge about physics of basic semiconductor devices and circuits.
2. To enhance comprehension capabilities of students through understanding of electronic devices and circuits
3. To introduce and motivate students to the use of advanced microelectronic devices
4. To analyze and design electronic circuits using semiconductor devices.

Course Outcomes:

After successful completion of the course students will be able to:

1. Students will be able to explain working of semiconductor devices.
2. Students will be able to analyze characteristics of semiconductor devices.
3. Students will be able to perform DC and AC analysis of Electronics circuits.
4. Students will be able to compare various biasing circuits as well as various configurations of BJT and MOSFETs.
5. Students will be able to select best circuit for the given specifications/application.
6. Students will be able to design electronics circuits for given specifications.

Module No.	Unit No,	Contents	Hrs
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1.	PN Junction Diode		2
	1.1	Fermi level concepts, Basic Diode Structure, Energy Band Diagrams, drift and diffusion current, junction capacitance.	
2.	Bipolar Junction Transistor		6
	2.1	DC Circuit Analysis: biasing circuits, bias stability and Compensation, analysis and design of biasing circuits	
	2.2	AC Analysis of BJT Amplifiers: AC load line, small signal models: h-parameter model, re model, Hybrid-pi model. AC equivalent circuits and analysis to obtain voltage gain, current gain, input impedance, output impedance of CE, CB and CC amplifiers using Hybrid-pi model only.	
3.	Field Effect Devices		8
	3.1	MOSFET: Construction, operation and characteristics of D-MOSFET and E-MOSFET	
	3.2	DC Circuit Analysis: DC load line and region of operation, Common-MOSFETs configurations, Analysis and Design of Biasing Circuits	
	3.3	AC Analysis: AC load line, Small-Signal model of MOSFET and its equivalent Circuit, Small-Signal Analysis MOSFET Amplifiers (Common-Source, Source Follower, Common Gate)	
4	Design of Electronic Circuits		4
	4.1	Design of single stage CE amplifier	
	4.2	Design of single stage CS MOSFET amplifier	
	4.2	Design of full wave rectifier with LC and pi filter.	
Total:			20

Text Books:

1. Donald A. Neamen, "Electronic Circuit Analysis and Design", TATA McGraw Hill, 2nd Edition
2. Adel S. Sedra, Kenneth C. Smith and Arun N Chandorkar, "Microelectronic Circuits Theory and Applications", International Version, OXFORD International Students Edition, Fifth Edition.

Reference Books:

1. Boylestad, "Electronic Devices and Circuit Theory", Pearson
2. David A. Bell, "Electronic Devices and Circuits", Oxford, Fifth Edition.
3. Muhammad H. Rashid, "Microelectronics Circuits Analysis and Design", Cengage
4. S. Salivahanan, N. Suresh Kumar, "Electronic Devices and Circuits", Tata McGraw Hill
5. Millman and Halkies, "Integrated Electronics", TATA McGraw Hill.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and oral	Tutorial	Theory	Practical and oral	Tutorial	Total
ELC303	Digital Logic Circuits	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours		--	--
		Test 1	Test 2	Avg of Test 1 and Test 2	--	--	--	--	--
ELC303	Digital Logic Circuits	20	20	20	80	03	--	--	100

Course Pre-requisite:

Basic Electrical & Electronics Engineering

Course Objectives:

1. To understand various number system & codes and to introduce the students to various logic gates, SOP, POS form and their minimization techniques.
2. To teach the working of combinational circuits, their applications and implementation of combinational logic circuits using MSI chips.
3. To teach the elements of sequential logic design, analysis and design of sequential circuits.
4. To understand various counters and shift registers and its design using MSI chips.
5. To explain and describe various logic families and Programmable Logic Devices.
6. To train students in writing program with Verilog hardware description languages.

Course Outcome:

After successful completion of the course students will be able to;

1. Perform code conversion and able to apply Boolean algebra for the implementation and minimization of logic functions.
2. Analyse, design and implement Combinational logic circuits.
3. Analyse, design and implement Sequential logic circuits.
4. Design and implement various counter using flip flops and MSI chips.
5. Understand TTL & CMOS logic families, PLDs, CPLD and FPGA.
6. Understand basics of Verilog Hardware Description Language and its programming with combinational and

sequential logic circuits.			
Module No.	Unit No,	Contents	Hrs

1.	Fundamentals of Digital Design		2
	1.1	Review of Number System, Weighted code, Parity Code: Hamming Code	
2.	Combinational Circuits using basic gates as well as MSI devices		2
	2.1	Arithmetic Ripple carry adder, Carry Look ahead adder,	
	2.2	MSI devices: IC7483, IC74151, IC74138, IC7485.	
3.	Sequential Logic Design		6
	3.1	Sequential Logic Design: Mealy and Moore Machines, Clocked synchronous state machine analysis, State reduction techniques (inspection, partition and implication chart method) and state assignment, sequence detector, Clocked synchronous state machine design	
	3.2	Sequential logic design practices: MSI counters (7490, 7492, 7493, 74163, 74169) and applications, MSI Shift registers (74194) and their applications.	
4.	Logic Families and Programmable Logic Devices		4
	4.1	CMOS Logic :- CMOS inverter, CMOS NAND and CMOS NOR, Interfacing CMOS to TTL and TTL to CMOS.	
	4.2	Introduction to CPLD and FPGA architectures, Numerical based on PLA and PAL.	
5.	Introduction to Verilog HDL		6
	5.1	Basics: Introduction to Hardware Description Language and its core features, synthesis in digital design, logic value system, data types, constants, parameters, wires and registers. Verilog Constructs: Continuous & procedural assignment statements, logical, arithmetic, relational, shift operator, always, if, case, loop statements, Gate level modelling, Module instantiation statements.	
	5.2	Modelling Examples: Combinational logic eg. Arithmetic circuits, Multiplexer, Demultiplexer, decoder, Sequential logic eg. flip flop, counters.	
	Total		20

Text Books:

1. R. P. Jain, Modern Digital Electronics, Tata McGraw Hill Education, Third Edition 2003.

2. Morris Mano, Digital Design, Pearson Education, Asia 2002.
3. J. Bhaskar, A Verilog HDL Primer, Third Edition, Star Galaxy Publishing, 2018.

Reference Books:

1. Digital Logic Applications and Design – John M. Yarbrough, Thomson Publications, 2006
2. John F. Wakerly, Digital Design Principles and Practices, Pearson Education, Fourth Edition, 2008.
3. Stephen Brown and Zvonko Vranesic, Fundamentals of digital logic design with Verilog design, McGraw Hill, 3rd Edition.
4. Digital Circuits and Logic Design – Samuel C. Lee, PHI
5. William I. Fletcher, “An Engineering Approach to Digital Design”, Prentice Hall of India.
6. Parag K Lala, “Digital System design using PLD”, BS Publications, 2003.
7. Charles H. Roth Jr., “Fundamentals of Logic design”, Thomson Learning, 2004.

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first-class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment II) when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.

Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical and oral	Tutorial	Total
ELC304	Electrical Network Analysis & Synthesis	03	--	01	03	--	01	04

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg of Test 1 and Test 2					
ELC304	Electrical Network Analysis & Synthesis	20	20	20	80	03	25	--	125

Course Pre-requisite:

1. Basic Electrical Engineering
2. Engineering Mathematics I and II

Course Objectives:

1. To learn electrical networks and its analysis in time and frequency domain.
2. To understand synthesis of electrical networks.
3. To understand various types of filters.

Course Outcomes:

After successful completion of the course students will be able to;

1. Explain basic electrical circuits with nodal and mesh analysis and apply network theorems.
2. Apply Laplace Transform for steady state and transient analysis.
3. Determine different network functions and solve complex circuits using network parameters.
4. Realize electrical networks for given network functions using synthesis concepts.
5. Design various types of filters.

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Module No.	Unit No,	Contents	Hrs
1.		Analysis of Circuits	2
	1.1	Analysis of coupled circuits: Solution using loop analysis.	
2.		Time and Frequency Domain Analysis of Electrical Networks	6
	2.1	Time Domain Analysis of Electrical Networks: Forced and natural response, Initial and final conditions in network elements, Solution of first and second order differential equations for series and parallel R-L, R-C, R-L-C circuits, Transient and steady state response.	
	2.2	Frequency Domain Analysis of Electrical Networks: S-domain representation, Concept of complex frequency, Applications of Laplace Transform in solving electrical networks.	
3.		Two Port Networks	4
	3.1	Two Port Parameters: Transmission and Hybrid parameters, relationships among parameters, reciprocity and symmetry conditions	
4		Synthesis of Electrical Networks	6
	4.1	Realizability Concept: Hurwitz polynomial, Concept of positive real function, testing for necessary and sufficient conditions for positive real functions.	
	4.2	Synthesis of RC, RL, LC circuits: Concepts of synthesis of RC, RL, LC driving point functions, Foster and Cauer forms.	
5		Introduction to Filters	2
	5-1	Basic Filters and Design and analysis of Constant K filters	
		Total:	20

Text Books:

1. Network Analysis, M. E. Van Valkenburg/T.S. Rathore, Pearson Education, 3rd Edition (2019).
2. Engineering Circuit Analysis, William H. Hayt, Jack Kemmerly, Jamie Phillips, Steven Durbin McGraw Hill, 9th Edition (2018).
3. Networks and Systems, Ashfaq Husain, Khanna Book Publishing Co. (P) Ltd.; 2nd Edition (2019).
4. Circuits and Networks: Analysis and Synthesis, A. Sudhakar and S.P. Shyamamohan McGraw Hill Education (India) Private Limited; 5th edition (2015).

Reference Books:

1. Circuit Theory Analysis and Synthesis, A. Chakrabarti, Dhanpat Rai & Co., Seventh - Revised edition (2018)
2. Mahmood Nahvi and Joseph A. Edminister, "Schaum's Outline of Electrical Circuits", McGraw-Hill Education, 7th Edition (2017).
3. Problems and Solutions of Electrical Circuit Analysis, R.K. Mehta & A.K. Mal, CBS Publishers and Distributors Pvt Ltd (2015).
4. Networks and systems, D. Roy Choudhary, New Age International Publishers, 2nd Edition (2013).

Term Work:

This shall consist of at least 10 tutorials based on the entire syllabus. Each tutorial shall have a minimum of four numerical problems solved and duly graded.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub- questions of 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical and Oral	Tutorial	Total
ELC305	Electronic Instruments and Measurements	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg of Test 1 and Test 2					
ELC305	Electronic Instruments and Measurements	20	20	20	80	03		--	100

Course Pre-requisite:

1. FEC105-Basic Electrical Engineering
2. FEC101-Engineering Mathematics-I
3. FEC201-Engineering Mathematics-II

Course Objectives:

1. To develop understanding of fundamental principles of electronic measurements.
2. To disseminate basic methods for measurements of electrical quantities.
3. To impart knowledge of analog and digital instrumentation.

Course Outcomes:

After successful completion of the course students will be able to:

1. Recall and define instrument characteristics as well as interpret errors in measurements.
2. Understand and Measure various variables or value of unknown element.
3. Illustrate digital instruments like digital voltmeter, signal generator, wave analyzer.
4. Explain various components of oscilloscopes.
5. Choose appropriate transducer for measurement of distance, temperature and pressure.

Module No.	Unit No,	Contents	Hrs
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6. Develop a calibration scheme for given instrument.

1.	Fundamental Principles of Measurement		3
	1.1	Instrument characteristics: Static (accuracy, precision, linearity, drift, sensitivity, resolution, hysteresis, dead band). Dynamic (Speed of response, fidelity, lag and dynamic error)	
	1.2	Instrument characteristics: Static (accuracy, precision, linearity, drift, sensitivity, resolution, hysteresis, dead band). Dynamic (Speed of response, fidelity, lag and dynamic error)	
2.	Measurement of Resistance, Inductance and Capacitance		7
	2.1	The concept of measurement with bridge, measurement of low, medium and high resistances using Wheatstone bridge, Kelvin double bridge and mega-ohm bridge (Megger). Numerical problems (computation of sensitivity, resolution, range, errors)	
	2.2	Measurement of Inductance, Capacitance and Frequency: Maxwell bridge, Anderson bridge, Hay's bridge, Schering bridge, Wien's bridge. LCR-Q meter. Numerical problems (computation of sensitivity, resolution, range, errors)	
3.	Electronic Instruments		7
	3.1	3.1 Digital DC Voltmeters (DVM): Ramp, dual slope, integrating, successive approximation. AC Voltmeters: Rectifier, average responding, peak responding, true RMS meter. Digital multimeter (DMM), Digital phase meter.	
	3.2	3.2 Signal Generators: Low frequency signal generator, function generator, pulse generator, sweep frequency generator.	
	3.3	3.3 Wave analyzer: Basic wave analyzer, frequency selective and heterodyne. Harmonic distortion analyzer, spectrum analyzer.	
4	Instrument Calibration		3
	4.1	Principles and characteristics of calibration. Need of calibration	
	4.2	Calibration of potentiometer. Use of potentiometer for calibration of voltmeter. DMM as standard instrument for calibration.	
Total:			20

Text Books:

1. David Bell, "Electronic Instrumentation and Measurements", Oxford Publishing, 2nd edition, 2003.

2. A. D. Helfrick, W. D. Cooper, “Modern Electronics Instrumentation and Measurement Techniques”, NJ.: Prentice Hall, 2002.
3. H. S. Kalsi, “Electronic Instrumentation”, Tata McGraw Hill, 2nd edition, 2004.

Reference Books:

1. C. S. Rangan, G. R. Sarma, V. S. V. Mani, “Instrumentation: Devices and Systems”, Tata McGraw Hill, 2nd edition, 2004.
2. A. K. Sawhney, “Electrical and Electronic Instruments and Measurements”, Dhanpat Rai & Sons, Delhi, 2015.
3. D. Prenskey, “Electronic Instrumentation”, Prentice Hall Publication.
4. S. K. Singh, “Industrial Instrumentation and Control”, Tata McGraw Hill, 3rd Edition, 2017.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the module

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELL301	Electronic Devices & Circuits-I Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical And Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg of Test 1 and Test 2					
ELL301	Electronic Devices & Circuits-I Lab	--	--	--	--	--	25	25	50

Term Work:

At least 06 experiments covering entire syllabus of ELC302 (Electronic Devices and Circuits I) should be set to have well predefined inference and conclusion. The experiments should be student centric and attempt should be made to make experiments more meaningful, interesting. Simulation experiments are also encouraged. Experiments must be graded from time to time. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. The grading and term work assessment should be done based on this scheme. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus.

Suggested List of Experiments

Sr. No.	Experiment Title
1	To study passive(R,L,C) and active (BJT,MOSFET) components.
2	To study equipment (CRO, Function Generator, Power supply).
3	To perform characteristics of PN junction diode.
4	To perform Clippers and Clampers.

5	To perform analysis and design Fixed bias, voltage divider bias for CE amplifier.
6	To perform CE amplifier as voltage amplifier (Calculate A_v , A_i , R_i , R_o).
7	To perform CS MOSFET amplifier as voltage amplifier and measurement of its performance parameters.
8	To perform Full wave/Bridge rectifier with LC/pi filter.
9	To perform Zener as a shunt voltage regulator.
10	To design Full wave/Bridge rectifier with LC/pi filter.
11	To design single stage CE Amplifier.
12	To design single stage CS Amplifier.

Suggested Simulation Experiments:

Sr. No.	Experiment Title
1	SPICE/NGSPICE simulation of and implementation for junction analysis
2	SPICE/NGSPICE simulation of and implementation for BJT characteristics
3	SPICE/NGSPICE simulation of and implementation for JFET characteristics
4	SPICE/NGSPICE simulation of for MOSFET characteristics
5	SPICE/NGSPICE simulation of Full wave/Bridge rectifier with LC/pi filters.
6	SPICE/NGSPICE simulation of CE amplifier
7	SPICE/NGSPICE simulation of CS MOSFET amplifier.

(Expected percentage of H/w and software experiments should be 60% & 40% respectively)

Note:

Suggested List of Experiments is indicative. However, flexibilities lies with individual course instructor to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that, the fundamentals can be explored to the students with greater clarity, ease and motivate to think differently.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELL302	Digital Logic Circuits Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical & Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg of Test 1 and Test 2					
ELL302	Digital Logic Circuits Lab	--	--	--	--	--	25	25	50

Term Work:

At least 06 experiments covering entire syllabus of ELC 303 (Digital Logic Circuits) should be set to have well predefined inference and conclusion. The experiments should be student centric and attempt should be made to make experiments more meaningful, interesting. Simulation experiments are also encouraged. Experiment must be graded from time to time. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. The grading and term work assessment should be done based on this scheme. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus.

Course Objective:-

1. To learn the functionality of basic logic gates.
2. To Construct combinational circuits and verify their functionalities.
3. To learn the functionality of flip flops and their conversion.
4. To Design and implement synchronous and asynchronous counters, Shift registers using MSI.
5. To simulate various combinational and sequential circuits and analyze the results using Verilog HDL.

Suggested List of Experiments:

Sr. No.	Hardware Experiment Title
1	To verify different logic gates and implement basic gates using universal gates
2	To implement Boolean function in SOP and POS form
3	To implement half adder, full adder, half Subtractor, full Subtractor

4	To implement BCD adder using binary adder IC 7483
5	To implement logic equations using Multiplexer IC 74151
6	To verify truth table of SR,JK,T and D flip flops
7	To perform Flip flop conversion JK to D, JK to T and D to T flip flop
8	To implement MOD N counter using IC 7490/7492/7493
9	To implement Synchronous counter using IC 74163/74169 OR To implement universal shift register using IC 74194

Simulation/Software Experiments

Sr. No.	Software Experiment Title
1	To design and simulate Full adder/full subtractor using Verilog HDL
2	To design and simulate Multiplexer/Demultiplexer using Verilog HDL
3	To design and simulate decoder 74138 using Verilog HDL
4	To simulate basic flip flops using Verilog HDL
5	To design and simulate 4 bit counter / up-down counter using Verilog HDL
6	To design and simulate Shift register using Verilog HDL

(Additional suggested experiments (optional) Implementation of any of above using FPGA/CPLD)

Note:

Suggested List of Experiments is indicative. However, flexibility lies with individual course instructor to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that, the fundamentals can be explored to the students with greater clarity, ease and motivate to think differently.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical and Oral	Tutorial	Total
ELL303	Electronic Instruments and Measurements Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical/Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg of Test 1 and Test 2					
ELL303	Electronic Instruments and Measurements Lab	--	--	--	--	--	25	25	50

Course Outcomes:

After successful completion of the course students will be able to:

1. Demonstrate the instrument characteristics as well as interpret errors in measurements.
2. Measure various variables or value (R, L and C) of unknown element.
3. Illustrate digital instruments like digital voltmeter, signal generator, wave analyzer.
4. Explain various functions of oscilloscopes.
5. Choose appropriate transducer for measurement of distance, temperature and pressure.
6. Develop a calibration scheme for given instrument.

Term Work:

At least 06 experiments covering entire syllabus of ELC303 (**Electronic Instruments and Measurements**) should be set to have well predefined inference and conclusion. The experiments should be student centric and attempt should be made to make experiments more meaningful, interesting. Simulation experiments are also encouraged. Experiment must be graded from time to time. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. The grading and term work assessment should be done based on this scheme. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus.

Suggested List of Experiments:

Sr. No.	Hardware Experiment Title
1	Study of DSO for measurements of voltage, frequency and phase.
2	Measurement of resistance using wheat-stone /kelvin bridge.
3	Measurement of inductance and Q-factor using Hay's bridge.
4	Measurement of capacitance using Schering bridge.
5	Measurement of frequency using Wien bridge.
6	Study characteristics and use of LVDT.
7	Measurement of temperature using RTD/Thermister.
8	Measurement of displacement using strain gauge.
9	Calibration of potentiometer.
10	Calibration of voltmeter using potentiometer/DMM.

Simulation/Software Experiments

Sr. No.	Software Experiment Title
1	Simulation of the zeroth, first order and second order Instrument to understand its dynamic characteristics.
2	Simulation of measurement of rms , average with error indication
3	Simulation of the Working of multichannel oscilloscope and demonstrate the different modes
4	Simulation of measurement of various physical parameters such as Temperature, distance or pressure.
5	Simulation of DAS
6	Simulation of the calibration method and its performance evaluation

Preferably open source software should be used for implementation.

Note:

Suggested List of Experiments is indicative. However, flexibilities lies with individual course instructor to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that, the fundamentals can be explored to the students with greater clarity, ease and motivate to think differently.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical and Oral	Tutorial	Total
ELL304	Skill based Lab OOPM (Java)	--	02* + 02	--	--	02	--	02
* Theory class to be conducted for full class								

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical And Oral	Total
		Internal assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg. Of Test 1 and Test 2					
ELL304	Skill based Lab OOPM (Java)	--	--	--	--	--	50	--	50

Course Pre-requisites:

- Fundamentals of C-Programming

Course Objectives:

- To understand Object Oriented Programming basics and its features.
- To understand and apply Object Oriented Programming (OOP) principles using Java
- Able to implement Methods, Constructors, Arrays, Multithreading and Applet in java
- Able to use a programming language to resolve problems.

Course Outcomes:

After successful completion of the course student will be able to;

- Understand fundamental features of an object-oriented language: object classes and interfaces, exceptions and libraries of object collections.
- Understand Java Programming.
- To develop a program that efficiently implements the features and packaging concept of java in laboratory.
- To implement Exception Handling and Applets using Java.

Module No.	Unit No,	Contents	Hrs
1.	Introduction to Java		6
	1.1	Programming paradigms- Introduction to programming paradigms, Introduction to four main Programming paradigms like procedural, object oriented, functional, and logic & rule based. Difference between C++ and Java.	
	1.2	Java History, Java Features, Java Virtual Machine, Data Types and Size (Signed vs. Unsigned, User Defined vs. Primitive Data Types, Explicit Pointer type), Programming Language JDK Environment and Tools.	
2.	Inheritance, Polymorphism, Encapsulation using Java		10
	2.1	Classes and Methods: class fundamentals, declaring objects, assigning object reference variables, adding methods to a class, returning a value, constructors, this keyword, garbage collection, finalize() method, overloading methods, argument passing, object as parameter, returning objects, access control, static, final, nested and inner classes, command line arguments, variable-length Arguments. String: String Class and Methods in Java	
	2.2	Inheritances: Member access and inheritance, super class references, Using super, multilevel hierarchy, constructor call sequence, method overriding, dynamic method dispatch, abstract classes, Object class. Packages and Interfaces: defining a package, finding packages and CLASSPATH, access protection, importing packages, interfaces (defining, implementation, nesting, applying), variables in interfaces, extending interfaces, instance of operator.	
3.	Exception Handling and Applets in Java		8
	3.1	Exception Handling: fundamental, exception types, uncaught exceptions, try, catch, throw, throws, finally, multiple catch clauses, nested try statements, built-in exceptions, custom exceptions (creating your own exception subclasses). Managing I/O: Streams, Byte Streams and Character Streams, Predefined Streams, Reading console Input, Writing Console Output, and Print Writer class. Threading: Introduction, thread life cycle, Thread States: new, runnable, Running, Blocked and terminated, Thread naming, thread join method, Daemon thread.	
	3.2	Applet: Applet Fundamental, Applet Architecture, Applet Life Cycle, Applet Skeleton, Requesting Repainting, status window, HTML Applet tag, passing parameters to Applets, Applet and Application Program.	
Total:			24

Textbooks:

1. D. T. Editorial Services, “Java 8 Programming Black Book”, Dreamtech Press, Edition, 2015.
2. Yashwant Kanitkar, “Let Us Java”, BPB Publications, 4th Edition, 2019.

Reference Books:

1. Herbert Schildt, “The Complete Reference”, Tata McGraw-Hill Publishing Company Limited, 10th Edition, 2017.
2. Harvey M. Deitel, Paul J. Deitel, Java: How to Program, 8th Edition, PHI, 2009.
3. Grady Booch, James Rumbaugh, Ivar Jacobson, “The Unified Modeling Languageser Guide”, Pearson Education.
4. Sachin Malhotra, Saurabh Chaudhary “Programming in Java”, Oxford University Press, 2010

Software Tools:

1. Raptor-Flowchart Simulation: <http://raptor.martincarlisle.com/>
2. Eclipse: <https://eclipse.org/>
3. Netbeans: <https://netbeans.org/downloads/>
4. CodeBlock: <http://www.codeblocks.org/>
5. J-Edit/J-Editor/Blue J

Online Repository:

1. Google Drive
2. GitHub
3. Code Guru

Suggested list of Experiments:

Sr. No.	Write JAVA Program to
1	Display addition of number
2	Accept marks from user, if Marks greater than 40, declare the student as “Pass” else “Fail”
3	Accept 3 numbers from user. Compare them and declare the largest number (Using if-else statement).
4	Display sum of first 10 even numbers using do-while loop.
5	Display Multiplication table of 15 using while loop.
6	Display basic calculator using Switch Statement.
7	Display the sum of elements of arrays.
8	Accept and display the string entered and execute at least 5 different string functions on it.
9	Read and display the numbers as command line Arguments and display the addition of them
10	Define a class, describe its constructor, overload the Constructors and instantiate its object.

11	Illustrate method of overloading
12	Demonstrate Parameterized Constructor
13	Implement Multiple Inheritance using interface
14	Create thread by implementing 'Runnable' interface or creating 'Thread Class'.
15	Demonstrate Hello World Applet Example

Note:

Suggested List of Experiments is indicative. However, flexibility lies with individual course instructor to design and introduce new, innovative and challenging experiments, from within the curriculum, so that, the fundamentals can be explored to the students with greater clarity, ease and motivate to think differently.

Term Work:

At least **10** experiments covering entire syllabus should be set to have well predefined inference and conclusion. Teacher should refer the suggested experiments and can design additional experiment to maintain better understanding and quality.

The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the overall performance of the student with every experiments and are graded from time to time.

The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus. Students are encouraged to share their experiments codes on online repository. Practical exam slip should cover all 16 experiments for examination.

Course code	Course Name	Credits
ELM 301	Mini Project -1A	02

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical/ Oral	Total
		Internal Assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ELM 301	Mini Project- 1A	--	--	--	--	--	25	25	50

Objectives

- 1.To acquaint with the process of identifying the needs and converting it into the problem.
- 2.To familiarize the process of solving the problem in a group.
- 3.To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
- 4.To inculcate the process of self-learning and research.

Outcomes:

Learner will be able to...

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as member of a group or leader.
4. Draw the proper inferences from available results through theoretical/ experimental/simulations.
5. Analyse the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to life long learning.
9. Demonstrate project management principles during project work.

Guidelines for Mini Project-1A (Especially for DSE Admitted Students in A.Y. 2020-21 only)

- Students from among the **DSE admitted students** shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- **As a special case for DSE Admitted Students in AY 2020-21 only, a single project of appropriate level and quality need to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1A in semester III and Mini Project 1B in semester IV.**
- **Since the two semesters i.e. sem-III and IV would be progressing simultaneously for these students as a special case, Mini Project-1A shall cover only the detailed survey, Problem definition and report writing for the same for the chosen project which shall constitute the term work of Mini Project-1A.**
- **The detailed implementation, presentation and final report writing shall be covered in Mini Project 1B which shall also constitute the term work of Mini Project 1B in sem-IV.**
- The report to be compiled in standard format of University of Mumbai.

Guidelines for Assessment of Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;
 - Marks awarded by guide/supervisor based on log book: 10
 - Marks awarded by review committee : 10
 - Quality of Project report : 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

Assessment criteria of Mini Project:

Mini Project shall be assessed based on following criteria;

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness
6. Societal impact
7. Innovativeness
8. Cost effectiveness and Societal impact
9. Effective use of skill sets
10. Effective use of standard engineering norms
11. Contribution of an individual's as member or leader
12. Clarity in written and oral communication

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation of the detailed survey carried out, Problem identification and proposal of the best solution being showcased to a panel of Internal and External Examiners preferably from industry or research organisations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on the following points;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets

- 6. Effective use of standard engineering norms
- 7. Contribution of an individual's as member or leader
- 8. Clarity in written and oral communication

UNIVERSITY OF MUMBAI



Bachelor of Engineering

in

Electronics and Telecommunication Engineering

**Direct Second Year (Sem. III) Admitted Students for the
current Academic Year 2020-21(Only)**

(REV- 2019 'C' Scheme) from Academic Year 2019 – 20

**Under
FACULTY OF
SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2019–2020)

**Program Structure for Second Year Engineering Semester
III & IV
UNIVERSITY OF MUMBAI
(With Effect from 2020-2021)
Semester III**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC301	Engineering Mathematics-III	3	--	1*	3	--	1	4
ECC302	Electronic Devices & Circuits	3	--	--	3	--	--	3
ECC303	Digital System Design	3	--	--	3	--	--	3
ECC304	Network Theory	3	--	1	3	--	1	4
ECC305	Electronic Instrumentation & Control Systems	3	--	--	3	--	--	3
ECL301	Electronic Devices & Circuits Lab	--	2	--	--	1	--	1
ECL302	Digital System Design Lab	--	2	--	--	1	--	1
ECL303	Electronic Instrumentation & Control Systems Lab	--	2	--	--	1	--	1
ECL304	Skill Lab: C++ and Java Programming	--	4	--	--	2	--	2
ECM301	Mini Project 1A	--	4 ^{\$}	--	--	2	--	2
Total		15	14	2	15	07	2	24

* Should be conducted batch wise.

\$ Indicates work load of a learner (Not Faculty) for Mini Project 1A. Faculty Load: 1 hour per week per four groups.

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. & oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg.					
ECC301	Engineering Mathematics-III	20	20	20	80	3	25	--	125
ECC302	Electronic Devices & Circuits	20	20	20	80	3	--	--	100
ECC303	Digital System Design	20	20	20	80	3	--	--	100
ECC304	Network Theory	20	20	20	80	3	25	--	125
ECC305	Electronic Instrumentation & Control Systems	20	20	20	80	3	--	--	100
ECL301	Electronic Devices & Circuits Lab	--	--	--	--	--	25	25	50
ECL302	Digital System Design Lab	--	--	--	--	--	25	--	25
ECL303	Electronic Instrumentation & Control Systems Lab	--	--	--	--	--	25	--	25
ECL304	Skill Lab: C++ and Java Programming	--	--	--	--	--	25	25	50
ECM301	Mini Project 1A	--	--	--	--	--	25	25	50
Total		--	--	100	400	--	175	75	750

ECC301 Engineering Mathematics-III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
ECC301	Engineering Mathematics-III	03	-	01*	03	-	01	04

Course Code	Course Name	Examination Scheme								
		Theory					Exam Duration (in Hrs.)	Term Work	Pract & Oral	Total
		Internal Assessment			End Sem Exam					
		Test1	Test2	Avg of Test 1 & 2						
ECC301	Engineering Mathematics-III	20	20	20	80	03	25	-	125	

* Should be conducted batch wise.

Pre-requisite:

1. FEC101-Engineering Mathematics-I
2. FEC201-Engineering Mathematics-II
3. Scalar and Vector Product: Scalar and vector product of three and four vectors

Course Objectives: The course is aimed

1. To learn the Laplace Transform, Inverse Laplace Transform of various functions and its applications.
2. To understand the concept of Fourier Series, its complex form and enhance the problem solving skill.
3. To understand the concept of complex variables, C-R equations, harmonic functions and its conjugate and mapping in complex plane.
4. To understand the basics of Linear Algebra.
5. To use concepts of vector calculus to analyze and model engineering problems.

Course Outcomes: After successful completion of course student will be able to:

1. Understand the concept of Laplace transform and its application to solve the real integrals in engineering problems.
2. Understand the concept of inverse Laplace transform of various functions and its applications in engineering problems.
3. Expand the periodic function by using Fourier series for real life problems and complex engineering problems.
4. Understand complex variable theory, application of harmonic conjugate to get orthogonal trajectories and analytic function.
5. Use matrix algebra to solve the engineering problems.
6. Apply the concepts of vector calculus in real life problems.

Module	Detailed Contents	Hrs.
01	Module: Laplace Transform Definition of Laplace transform, Condition of Existence of Laplace transform. Laplace Transform (L) of Standard Functions like e^{at}, $\sin(at)$, $\cos(at)$, $\sinh(at)$, $\cosh(at)$ and $t^n, n \geq 0$. Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by t, Division by t, Laplace Transform of derivatives and integrals (Properties without proof). Evaluation of integrals by using Laplace Transformation. Self-learning Topics: Heaviside's Unit Step function, Laplace Transform of Periodic functions, Dirac Delta Function.	7
02	Module: Inverse Laplace Transform 2.1 Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivatives. 2.2 Partial fractions method to find inverse Laplace transform. 2.3 Inverse Laplace transform using Convolution theorem (without proof). Self-learning Topics: Applications to solve initial and boundary value problems involving ordinary differential equations.	6
03	Module: Fourier Series: 3.1 Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof). 3.2 Fourier series of periodic function with period 2π and $2l$. 3.3 Fourier series of even and odd functions. 3.4 Half range Sine and Cosine Series. Self-learning Topics: Complex form of Fourier Series, Orthogonal and orthonormal set of functions. Fourier Transform.	7
04	Module: Complex Variables: 4.1 Function $f(z)$ of complex variable, limit, continuity and differentiability of $f(z)$ Analytic function, necessary and sufficient conditions for $f(z)$ to be analytic (without proof). 4.2 Cauchy-Riemann equations in cartesian coordinates (without proof). 4.3 Milne-Thomson method to determine analytic function $f(z)$ when real part (u) or Imaginary part (v) or its combination ($u+v$ or $u-v$) is given. 4.4 Harmonic function, Harmonic conjugate and orthogonal trajectories Self-learning Topics: Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations.	7
05	Module: Linear Algebra: Matrix Theory 5.1 Characteristic equation, Eigen values and Eigen vectors, Example based on properties of Eigen values and Eigen vectors. (Without Proof). 5.2 Cayley-Hamilton theorem (Without proof), Examples based on verification of Cayley-Hamilton theorem and compute inverse of Matrix. 5.3 Similarity of matrices, Diagonalization of matrices. Functions of square matrix Self-learning Topics: Application of Matrix Theory in machine learning and google page rank algorithms, derogatory and non-derogatory matrices.	6
06	Module: Vector Differentiation and Integral 6.1 Vector differentiation: Basics of Gradient, Divergence and Curl (Without Proof). 6.2 Properties of vector field: Solenoidal and irrotational (conservative) vector	6

fields. 6.3 Vector integral: Line Integral, Green's theorem in a plane (Without Proof), Stokes' theorem (Without Proof) only evaluation. Self-learning Topics: Gauss' divergence Theorem and applications of Vector calculus.	
Total	39

References:

1. Advanced engineering mathematics, H.K. Das, S . Chand, Publications
2. Higher Engineering Mathematics, B. V. Ramana, Tata Mc-Graw Hill Publication
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication
4. Advanced Engineering Mathematics, Wylie and Barret, Tata Mc-Graw Hill.
5. Theory and Problems of Fourier Analysis with applications to BVP, Murray Spiegel, Schaum's Outline Series
6. Vector Analysis Murry R. Spiegel, Schaum's outline series, Mc-Graw Hill Publication
7. Beginning Linear Algebra, Seymour Lipschutz, Schaum's outline series, Mc-Graw Hill Publication
8. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication

Term Work:

General Instructions:

1. Batch wise tutorials are to be conducted. The number of students per batch should be as per University pattern for practicals.
2. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
3. A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Engineering mathematics. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1. Attendance (Theory and Tutorial)	05 marks
2. Class Tutorials on entire syllabus	10 marks
3. Mini project	10 marks

Internal Assessment Test (20-Marks):

Assessment consists of two class tests of 20 marks each. The first-class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment II) will be based on remaining contents (approximately 40% syllabus but excluding contents covered in Test I). Duration of each test shall be one hour.

End Semester Theory Examination (80-Marks):

Weightage to each of the modules in end-semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Question No: 01 will be compulsory and based on entire syllabus wherein 4 to 5 sub- questions will be asked.
3. Remaining questions will be mixed in nature and randomly selected from all the modules.
4. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
5. Total 04 questions need to be solved.

ECC302 - Electronic Devices & Circuits

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC302	Electronic Devices & Circuits	3	-	--	3	--	--	3

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. Of Test 1 and Test 2					
ECC302	Electronic Devices & Circuits	20	20	20	80	--	--	--	100

Course pre-requisite:

FEC:102 - Engineering Physics-I
FEC:201 - Engineering Physics-II
FEC:105 - Basic Electrical Engineering

Course Objectives:

1. To explain functionality different electronic devices.
2. To perform DC and AC analysis of small signal amplifier circuits.
3. To analyze frequency response of small signal amplifiers.
4. To compare small signal and large signal amplifiers.
5. To explain working of differential amplifiers and it's applications in Operational Amplifiers

Course Outcome:

After successful completion of the course student will be able to :-

1. Know functionality and applications of various electronic devices.
2. Explain working of various electronics devices with the help of V-I characteristics.
3. Derive expressions for performance parameters of BJT and MOSFET circuits.
 4. Evaluate performance of Electronic circuits (BJT and MOSFET based).
5. Select appropriate circuit for given application.
6. Design electronic circuit (BJT, MOSFET based) circuits for given specifications.

Module No.	Unit No.	Topics	Hrs.
1.0		Small Signal Amplifiers	06
	1.1	Concept of AC load line and Amplification, Small signal analysis (Z_i , Z_o , A_v and A_i) of CE amplifier using hybrid pi model.	
	1.2	Small signal analysis (Z_i , Z_o , A_v) of CS (for E-MOSFET) amplifiers.	
	1.3	Introduction to multistage amplifiers. (Concept, advantages & disadvantages)	
2.0		Frequency response of Small signal Amplifiers:	08
	2.1	Effects of coupling, bypass capacitors and parasitic capacitors on frequency response of single stage amplifier, Miller effect and Miller capacitance.	
	2.2	High and low frequency analysis of CE amplifier.	
	2.3	High and low frequency analysis of CS(E-MOSFET) amplifier.	
3.0		Power Amplifiers and Differential Amplifiers	06
	3.1	Classification of Power Amplifiers, analysis of Class A transformer coupled power amplifier	
	3.2	E-MOSFET Differential Amplifier, DC transfer characteristics, operation with common mode signal and differential mode signal	
	3.3	Differential and common mode gain, CMRR, differential and common mode Input impedance	
		Total	20

Text books:

1. D. A. Neamen, "Electronic Circuit Analysis and Design," Tata McGraw Hill, 2nd Edition.
2. A. S. Sedra, K. C. Smith, and A. N. Chandorkar, "Microelectronic Circuits Theory and Applications," International Version, OXFORD International Students, 6th Edition
3. Franco, Sergio. Design with operational amplifiers and analog integrated circuits. Vol. 1988. New York: McGraw-Hill, 2002.

References:

1. Boylestad and Nashelesky, "Electronic Devices and Circuits Theory," Pearson Education, 11th Edition.
2. A. K. Maini, "Electronic Devices and Circuits," Wiley.
3. T. L. Floyd, "Electronic Devices," Prentice Hall, 9th Edition, 2012.
4. S. Salivahanan, N. Suresh Kumar, "Electronic Devices and Circuits," Tata Mc-Graw Hill, 3rd Edition
5. Bell, David A. Electronic devices and circuits. Prentice-Hall of India, 1999.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

ECC303 - Digital System Design

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC303	Digital System Design	02	--	--	02	--	--	02

Course Code	Course Name	Examination Scheme							
		Theory Marks				Exam Duration (Hrs.)	Term Work	Practical and Oral	Total
		Internal Assessment			End Sem. Exam.				
		Test1	Test2	Avg.					
ECC303	Digital System Design	20	20	20	80	03	--	--	100

Course Pre-requisite:

FEC105 – Basic Electrical Engineering

Course Objectives:

1. To understand number system representations and their inter-conversions used in digital electronic circuits.
2. To analyze digital logic processes and to implement logical operations using various combinational logic circuits.
3. To analyze, design and implement logical operations using various sequential logic circuits.
4. To study the characteristics of memory and their classification.
5. To learn basic concepts in VHDL and implement combinational and sequential circuits using VHDL.

Course Outcomes:

After successful completion of the course student will be able to:

1. Understand types of digital logic, digital circuits and logic families.
2. Analyze, design and implement combinational logic circuits.
3. Analyze, design and implement sequential logic circuits.
4. Develop a digital logic and apply it to solve real life problems.
5. Classify different types of memories and PLDs.
6. Simulate and implement basic combinational and sequential circuits using VHDL/Verilog.

	Unit No.	Topics	Hrs.
1.0		Number system & Logic Gates	06
	1.1	Review of Binary, Octal and Hexadecimal Number Systems, their inter-conversion, Binary code, Gray code and BCD code, Binary Arithmetic, Addition, Subtraction using 1's and 2's	04
	1.2	Digital logic gates, Universal gates, Realization using NAND and NOR gates, Boolean Algebra, De Morgan's Theorem	02
2.0		Combinational & Sequential Logic Circuits	11
	2.1	SOP and POS representation, K-Map up to four variables and Quine-McClusky method for minimization of logic expressions	04
	2.2	Arithmetic Circuits: Half adder, Full adder, Half Subtractor, Full Subtractor, Carry Look ahead adder and BCD adder, Magnitude Comparator	04
	2.3	Flip flops: RS, JK, Master slave flip flops; T & D flip flops with, Conversion of flip flops, Registers: SISO, SIPO, PISO, PIPO.	03
3.0		Different Types of Memories and Programmable Logic Devices, Introduction to VHDL	03
	3.1	Introduction: Programmable Logic Devices (PLD), Programmable Logic Array (PLA), Programmable Array Logic (PAL)	01
	3.2	Basics of VHDL/Verilog Programming, Design and implementation of adder, subtractor, multiplexer and flip flop using VHDL/Verilog	02
		Total	20

Suggested list of experiments:

1. Simplification of Boolean functions.
2. Design AND, OR, NOT, EXOR, EXNOR gates using Universal gates: NAND and NOR.
3. Implement Half adder, Full adder, Half subtractor and Full subtractor circuits.
4. Verify truth table of different types of flip flops.
5. Flip flop conversions JK to D, JK to T and D to TFF.
6. Design asynchronous/synchronous MOD N counter using IC7490.
7. Write VHDL/Verilog simulation code for different logic gates.

Term Work:

At least 05 experiments covering the entire syllabus must be given “**Batch Wise**”. Teacher should refer the suggested list of experiments and can design additional experiments to acquire practical design skills. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative

Text Books:

1. John F. Warkerly, “Digital Design Principles and Practices”, Pearson Education, Fifth Edition (2018).
2. Morris Mano, Michael D. Ciletti, “Digital Design”, Pearson Education, Fifth Edition (2013).
3. R. P. Jain, “Modern Digital Electronics”, Tata McGraw Hill Education, Forth Edition (2010).
4. A. Anand Kumar, “Fundamentals of Digital Circuits”, PHI, Fourth Edition (2016).
5. Volnei A. Pedroni, “Digital Electronics and Design with VHDL” Morgan Kaufmann Publisher, First Edition (2008).
6. Stephen Brown & Zvonko Vranesic, “Fundamentals of Digital Logic with Verilog Design”, Third Edition, MGH (2014).

Reference Books:

1. Thomas L. Floyd, “Digital Fundamentals”, Pearson Prentice Hall, Eleventh Global Edition (2015).
2. Mandal, “Digital Electronics Principles and Applications”, McGraw Hill Education, First Edition (2010).
3. Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss “Digital Systems Principles and Applications”, Ninth Edition, PHI (2009).
4. Donald P. Leach / Albert Paul Malvino/Gautam Saha, “Digital Principles and Applications”, The McGraw Hill, Eight Edition (2015).
5. Stephen Brown & Zvonko Vranesic, “Fundamentals of Digital Logic Design with VHDL”, Second Edition, TMH (2009).
6. J. Bhasker, “A Verilog HDL Primer”, Star Galaxy Press, Third Edition (1997).

NPTEL / Swayam Course:

1. Course: Digital Circuits By Prof. Santanu Chattopadhyay (IIT Kharagpur);

Internal Assessment (20-Marks):

Internal Assessment (IA) consists of two class tests of 20 marks each. IA-1 is to be conducted on approximately 40% of the syllabus completed and IA-2 will be based on remaining contents (approximately 40% syllabus but excluding contents covered in IA-1). Duration of each test shall be one hour. Average of the two tests will be considered as IA marks.

End Semester Examination (80-Marks):

Weightage to each of the modules in end-semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of **total 06** questions, each carrying **20 marks**.
2. **Question No: 01** will be **compulsory** and based on entire syllabus wherein 4 to 5 sub-questions will be asked.
3. Remaining questions will be mixed in nature and randomly selected from all the modules.
4. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
5. **Total 04 questions** need to be solved.

ECC304 - Network Theory

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC 305	Network Theory	03	--	01	03	--	01	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Exam. Duration (in Hrs)	Term Work	Practical And Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. Of Test 1 and Test 2					
ECC 305	Network Theory	20	20	20	80	03	25	--	125

Course Pre-requisite:

- ☐ Basic Electrical Engineering
- ☐ Solution to Differential Equations and Laplace Transform

Course Objectives:

1. To analyze the Circuits in time and frequency domain
2. To study network Topology, network Functions, two port network
3. To synthesize passive network by various methods

Course Outcome:

After successful completion of the course student will be able to

1. Apply their knowledge in analyzing Circuits by using network theorems.
2. Apply the time and frequency method of analysis.
3. Evaluate circuit using graph theory.
4. Find the various parameters of two port network.
5. Apply network topology for analyzing the circuit.
6. Synthesize the network using passive elements.

Module No.	Unit No.	Topics	Hrs.
1.0		Electrical circuit analysis and Graph Theory	09
	1.1	Analysis of DC Circuits: Analysis of Circuits with dependent sources using generalized loop and node analysis, super mesh and super node analysis technique Circuit Theorems: Superposition, Thevenin's, Norton's, Maximum Power Transfer (No numerical with AC source in ESE).	
	1.2	Graph Theory: Linear Oriented Graphs, graph terminologies Matrix representation of a graph: Incidence matrix, Circuit matrix, Cut-set matrix, reduced Incident matrix, Tieset matrix, f-cutset matrix. Relationship between sub matrices A, B & Q KVL & KCL using matrix (No numerical) .	
2.0		Time & Frequency domain analysis and Network Function	8
	2.1	Time domain analysis of R-L and R-C Circuits: Forced and natural response, initial and final values Solution using first order differential using step signals. Time and frequency domain analysis of R-L-C Circuits: Forced and natural response, effect of damping factor (no numerical)	
	2.2	Network functions for the one port and two port networks, Driving point and transfer functions, Poles and Zeros of Network functions, necessary condition for driving point functions, necessary condition for transfer functions	
3.0		Two port Networks	03
	3.1	Parameters: Open Circuits, short Circuit and Transmission parameters, conditions for reciprocity and symmetry	
	3.2	Interconnections of Two-Port networks T & π representation (Numerical on it are NOT expected in ESE).	
		Total	20

Textbooks :

1. Franklin F Kuo, "Network Analysis and Synthesis", Wiley Toppan, 2nd.ed. ,1966.
2. M E Van Valkenburg, "Network Analysis", Prentice-Hall of India Pvt Ltd, New Delhi, 26th Indian Reprint, 2000.

Reference Books:

1. A. Chakrabarti, "Circuit Theory", Dhanpat Rai & Co., Delhi, 6th Edition.
2. A. Sudhakar, Shyam Mohan S. Palli "Circuits and Networks", Tata McGraw-Hill education.
3. Smarajit Ghosh "Network Theory Analysis & Synthesis", PHI learning.
4. K.S. Suresh Kumar, "Electric Circuit Analysis" Pearson, 2013.
5. D. Roy Choudhury, "Networks and Systems" , New Age International, 1998.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks.

End Semester Examination:

1. Question paper will comprise of **06** questions, each carrying 20 marks.
2. The students need to solve total **04** questions.
- 3: Question **No.1** will be **compulsory** and based on entire syllabus.
- 4: Remaining question (Q.2 to Q.6) will be selected from all the modules.

Term Work:

At least **05 assignments** covering entire syllabus must be given during the “**Class Wise Tutorial**”. The assignments should be students’ centric and an attempt should be made to make assignments more meaningful, interesting and innovative.

Term work assessment must be based on the overall performance of the student with every assignment graded from time to time. The grades will be converted to marks as per “**Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

ECC305 - Electronic Instrumentation & Control Systems

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ECC305	Electronic Instrumentation & Control System	03	--	-----	03	--	---	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ECC305	Electronic Instrumentation & Control System	20	20	20	80	--	--	--	100

Prerequisites: Basics of Electronics and Electrical Engineering.

Course Objectives:

- 1.To provide basic knowledge about the various sensors and transducers
2. To provide fundamental concepts of control system such as mathematical modeling, time response and Frequency response.
3. To develop concepts of stability and its assessment criteria.

Course Outcomes: Students will be able to:

1. Identify various sensors, Transducers and their brief performance specification.
2. Understand principle of working of various transducer used to measure Temperature, Displacement, level and their application in industry
3. Determine and use models of physical systems in forms suitable for use in the analysis and design of control systems.

4. Evaluate the transfer functions for a given Control system.
5. Understand the analysis of system in time domain and frequency domain.
6. Predict stability of given system using appropriate criteria.

Module No.	Section No.	Topics	Hrs.
1.		Principle of Measurement, Testing and Measuring instruments	05
	1.1	Introduction to Basic instruments: Components of generalized measurement system, Concept of accuracy, precision, linearity, sensitivity, resolution, hysteresis, calibration.	
	1.2	Measurement of Resistance : Kelvin's double bridge, Wheatstone bridge and Mega ohm bridge Measurement of Inductance: Maxwell bridge and Hey bridge Measurement of Capacitance: Schering bridge	
2.		Stability Analysis in Time Domain	05
	2.1	Root locus Analysis: Root locus concept, general rules for constructing root-locus, Root locus analysis of control system	
3		Stability Analysis in frequency domain	10
	3.1	Introduction: Frequency domain specification, Relationship between time and frequency domain specification of system, stability margins	
	3.2	Bode Plot: Magnitude and phase plot, Method of plotting Bode plot, Stability margins and analysis using bode plot. Frequency response analysis of RC, RL, RLC circuits	
	3.3	Nyquist Criterion: Concept of Polar plot and Nyquist plot, Nyquist stability criterion, gain and phase margin	
		Total	20

Textbooks :

1. A.K. Sawhney, "Electrical & Electronic Measurement & Instrumentation" – DRS . India
2. B.C Nakra, K.K. Cahudhary, Instrumentation Measurement and Analysis, Tata Mc Graw Hill.
3. W.D. Cooper, "Electronic Instrumentation And Measuring Techniques" – PHI
4. Nagrath, M.Gopal, "Control System Engineering", Tata McGraw Hill.

5. Rangan C. S., Sarma G. R. and Mani V. S. V., "Instrumentation Devices And Systems", Tata McGraw-Hill, 2nd Ed., 2004.
6. K.Ogata, "Modern Control Engineering, Pearson Education", IIIrd edition.

Reference Books:

1. Helfrick&Copper, "Modern Electronic Instrumentation & Measuring Techniques" – PHI
2. M.M.S. Anand, "Electronic Instruments and instrumentation Technology".
3. Gopal M., "Control Systems Principles and Design", Tata McGraw Hill Publishing Co. Ltd. New Delhi, 1998.
4. Benjamin C.Kuo, "Automatic Control Systems, Pearson education", VIIth edition
5. Doebelin E.D., Measurement system, Tata Mc Graw Hill., 4th ed, 2003.Madan Gopal, "Control Systems Principles and Design", Tata McGraw hill, 7th edition,1997.
6. Normon, "Control System Engineering", John Wiley & sons, 3rd edition.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
- 3: Question No.1 will be compulsory and based on entire syllabus.
- 4: Remaining question (Q.2 to Q.6) will be selected from all the modules.

Term Work:

Term work assessment must be based on the overall performance of the student with every assignment graded from time to time. The grades will be converted to marks as per "**Credit and Grading System**" manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

ECL303 – Electronic Instrumentation & Control Systems Lab

Subject Code	Subject Name	Teaching Scheme (Hrs.)	Credits Assigned					
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL305	Electronic Measurement and Control system Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. Of Test 1 and Test 2					
ECL305	Electronic Measurement and Control system Laboratory	--	--	--	--	25	-	--	25

Course Pre-requisites: Basics of Electrical and Electronics Engineering
Signals and Systems

Course Objectives:

- Introduction to Electronics instruments for measurement of different physical and electrical parameter.
- To simulate and analyze different parameters of control system.
- To discuss stability of control system using various criteria.

Course outcomes: After successful completion of the course student will be able to

1. Explain the principle of working of various transducers and their application in industry.
2. Measure the physical and electrical parameters of various transducers and sensors.
3. Understand the concept of first order and second order systems with their frequency response.
4. Solve problems and calculate the time response specification of control system.

Laboratory plan

Maximum of 5 practicals

List of Experiments

1. Designing DC bridge for Resistance Measurement (Quarter, Half and Full bridge)
2. Designing AC bridge Circuit for capacitance measurement.
3. To inspect the relative stability of systems Root-Locus using Simulation Software.
4. To determine the frequency specification from Polar plot of system.
5. To inspect the stability of system by Nyquist plot using Simulation software.
6. To inspect the stability of system by Bode plot using Simulation software.

Term Work:

At least 05 Experiments covering entire syllabus must be given during the “**Laboratory session batch wise**”.

Computation/simulation-based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative.

ECL304 - Skill Lab: C++ and Java Programming

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECL304	Skill Lab: C++ and Java Programming	--	04	--	--	02	--	02

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical And Oral	Total
		Internal assessment			End Sem. Exam			
		Test 1	Test 2	Avg. Of Test 1 and Test 2				
ECL304	Skill Lab: C++ and Java Programming	--	--	--	--	25	25	50

Note: Before performing practical ‘Necessary Theory’ will be taught by concern faculty

Course Pre-requisites:

1. FEL204 - C-Programming

Course Objectives:

1. Describe the principles of Object Oriented Programming (OOP).
2. To understand object-oriented concepts such as data abstraction, encapsulation, inheritance and polymorphism.
3. Utilize the object-oriented paradigm in program design.
4. To lay a foundation for advanced programming.
5. Develop programming insight using OOP constructs.

Course Outcomes:

After successful completion of the course student will be able to:

1. Describe the basic principles of OOP.
2. Design and apply OOP principles for effective programming.
3. Develop programming applications using OOP language.
4. Implement different programming applications using packaging.
5. Analyze the strength of OOP.
6. Percept the Utility and applicability of OOP.

Module No.	Unit No.	Topics	Hrs.
1.0		C++ Control Structures	05
	1.1	Branching - If statement, If-else Statement, Decision. Looping – while, do-while, for loop Nested control structure - Switch statement, Continue statement, Break statement.	
	1.2	Array - Concepts, Declaration, Definition, Accessing array element, One-dimensional and Multidimensional array.	
2.0		Object-Oriented Programming using C++	10
	2.1	Operator Overloading - concept of overloading, operator overloading, Overloading Unary Operators, Overloading Binary Operators, Data Conversion, Type casting (implicit and explicit), Pitfalls of Operator Overloading and Conversion, Keywords explicit and mutable. Function - Function prototype, accessing function and utility function, Constructors and destructors, Copy Constructor, Objects and Memory requirements, Static Class members, data abstraction and information hiding, inline function. Constructor - Definition, Types of Constructor, Constructor Overloading, Destructor.	
	2.2	Inheritance - Introduction, Types of Inheritance, Inheritance, Public and Private Inheritance, Multiple Inheritance, Ambiguity in Multiple Inheritance, Visibility Modes Public, Private, Protected and Friend, Aggregation, Classes Within Classes. Deriving a class from Base Class, Constructor and destructor in Derived Class, Overriding Member Functions, Class Hierarchies, Polymorphism - concept, relationship among objects in inheritance hierarchy, Runtime & Compile Time Polymorphism, abstract classes, Virtual Base Class.	
3.0		Java : Introduction, Inheritance, Polymorphism & Encapsulation	09
	3.1	Programming paradigms- Introduction to programming paradigms, Introduction to four main Programming paradigms like procedural, object oriented, functional, and logic & rule based. Difference between C++ and Java.	
	3.2	Classes and Methods : class fundamentals, declaring objects, assigning object reference variables, adding methods to a class, returning a value, constructors, this keyword, garbage collection, finalize() method, overloading methods, argument passing, object as parameter, returning objects, access control, static, final, nested and inner classes, command line arguments, variable-length Arguments. String : String Class and Methods in Java.	
	3.3	Inheritances : Member access and inheritance, super class references, Using super, multilevel hierarchy, constructor call sequence, method overriding, dynamic method dispatch, abstract classes, Object class. Packages and Interfaces : defining a package, finding packages and CLASSPATH, access protection, importing packages, interfaces (defining, implementation, nesting, applying), variables in interfaces, extending interfaces, instance of operator.	
		Total	24

Suggested list of Experiments:

Note: Before performing practical necessary Theory will be taught by concern faculty

Sr.No	Write C++ Program to
1	Add Two Numbers
2	Print Number Entered by User
3	Swap Two Numbers
4	Check Whether Number is Even or Odd
5	Find Largest Number Among Three Numbers
6	Create a simple class and object.
7	Create an object of a class and access class attributes
8	Create class methods
9	Create a class to read and add two distance
10	Create a class for student to get and print details of a student.
11	Demonstrate example of friend function with class
12	Implement inheritance.

Sr. No.	Write JAVA Program to
1	Display addition of number
2	Accept marks from user, if Marks greater than 40, declare the student as "Pass" else "Fail"
3	Accept 3 numbers from user. Compare them and declare the largest number (Using if-else statement).
4	Display sum of first 10 even numbers using do-while loop.
5	Display Multiplication table of 15 using while loop.
6	Display basic calculator using Switch Statement.
7	Display the sum of elements of arrays.
8	Accept and display the string entered and execute at least 5 different string functions on it.
9	Read and display the numbers as command line Arguments and display the addition of them
10	Define a class, describe its constructor, overload the Constructors and instantiate its object.
11	Illustrate method of overloading
12	Demonstrate Parameterized Constructor
13	Implement Multiple Inheritance using interface
14	Create thread by implementing 'Runnable' interface or creating 'Thread' Class.
15	Demonstrate Hello World Applet Example

Textbooks:

1. Bjarne Stroustrup, "The C++ Programming language", Third edition, Pearson Education.
2. Yashwant Kanitkar, "Let Us Java", 2nd Edition, BPB Publications.
3. D.T. Editorial Services, "Java 8 Programming Black Book", Dreamtech Press, Edition: 2015
4. Deitel, "C++ How to Program", 4th Edition, Pearson Education.

Reference Books:

1. Herbert Schidt, "The Complete Reference", Tata McGraw-Hill Publishing Company Limited, Ninth Edition.
2. Java: How to Program, 8/e, Dietal, PHI.
3. Grady Booch, James Rumbaugh, Ivar Jacobson, "The Unified Modeling Languageser Guide", Pearson Education.
4. Sachin Malhotra, Saurabh Chaudhary "Programming in Java", Oxford University Press, 2010.

Skill-Enhancement:

1. The students should be trained to code in Eclipse (an industry accepted software tool). Also, for a given problem statement, there is need to include external library files (other than JDK files). Moreover, the students need to be trained on Maven (a build tool).
2. Real-life mini-problem statements from software companies (coming in for placement) to be delegated to groups of 3-4 students each and each group to work on the solution for 8-12 hours (last 2 lab sessions).

Software Tools:

1. Raptor-Flowchart Simulation:<http://raptor.martincarlisle.com/>
2. Eclipse: <https://eclipse.org/>
3. Netbeans:<https://netbeans.org/downloads/>
4. CodeBlock:<http://www.codeblocks.org/>
5. J-Edit/J-Editor/Blue J

Online Repository:

1. Google Drive
2. GitHub

Term Work:

At least **08** experiments (**04 experiments** each on **C++** and **JAVA**) covering entire syllabus should be set to have well predefined inference and conclusion. Teacher should refer the suggested experiments and can design additional experiment to maintain better understanding and quality.

The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative.

Term work assessment must be based on the overall performance of the student with every Experiments are graded from time to time.

The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus. Students are encouraged to share their experiments codes on online repository. Practical exam should cover all **08** experiments for examination.

ECM301 - Mini Project 1A

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECM301	Mini Project 1A	--	04 ^{\$}	--	--	2	--	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical And Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. Of Test1 and Test2				
ECM301	Mini Project 1A	--	--	--	--	25	25	50

\$ Indicates work load of a learner (Not Faculty) for Mini Project 1A. Faculty Load: 1 hour per week per four groups.

Objectives

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Outcome: At the end of the course learners will be able to...

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as member of a group or leader.
4. Draw the proper inferences from available results through theoretical/ experimental/simulations.
5. Analyse the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to life long learning.
9. Demonstrate project management principles during project work.

Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Mini Project: Term

Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;
 - Marks awarded by guide/supervisor based on log book : 10
 - Marks awarded by review committee 10
 - Quality of Project report 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

UNIVERSITY OF MUMBAI



Bachelor of Engineering

in

Instrumentation Engineering

**Direct Second Year (Sem. III) Admitted Students for the
current Academic Year 2020-21(Only)**

(REV- 2019 'C' Scheme) from Academic Year 2019 – 20

**Under
FACULTY OF
SCIENCE & TECHNOLOGY**

As per AICTE guidelines with effect from the academic year 2019–2020)

Program Structure for Second Year Instrumentation Engineering

Scheme for Semester- III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
ISC301	Engineering Mathematics-III	3	--	1	3	--	1	4	
ISC302	Transducers-I	4		--	4		--	4	
ISC303	Analog Electronics	3	--	--	3	--	--	3	
ISC304	Digital Electronics	3	--	--	3	--	--	3	
ISC305	Electrical Networks and Measurements	4	--	--	4	--	--	4	
ISL301	Transducers-I - Lab	--	2	--	--	1	--	1	
ISL302	Analog Electronics - Lab	--	2	--	--	1	--	1	
ISL303	Digital Electronics - Lab	--	2	--	--	1	--	1	
ISL304	Object Oriented Programming Lab	--	3 [#]	--	--	1.5	--	1.5	
ISM301	Mini Project – 1 A	--	3 ^{\$}	--	--	1.5	--	1.5	
Total		17	12	1	17	06	1	24	
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	PR & OR	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test2	Avg.					
ISC301	Engineering Mathematics-III	20	20	20	80	3	25	--	125
ISC302	Transducers-I	20	20	20	80	3	--	--	100
ISC303	Analog Electronics	20	20	20	80	3	--	--	100
ISC304	Digital Electronics	20	20	20	80	3	--	--	100
ISC305	Electrical Networks and Measurements	20	20	20	80	3	--	--	100
ISL301	Transducers-I - Lab	--	--	--	--	--	25	25	50
ISL302	Analog Electronics - Lab	--	--	--	--	--	25	25	50
ISL303	Digital Electronics - Lab	--	--	--	--	--	25	25	50
ISL304	Object Oriented Programming Lab	--	--	--	--	--	25	25	50
ISM301	Mini Project – 1 A	--	--	--	--	--	25	25	50
	Total	--	--	100	400	--	150	125	775

Subject code	Subject Name	Teaching scheme			Credit assigned			
ISC301	Engineering Mathematics-III	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		3	--	1	3	--	1	4

Subject code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISC301	Engineering Mathematics-III	20	20	20	80	25	-	-	125

Subject Code	Subject Name	Credits
ISC301	Engineering Mathematics-III	4
Course Objectives	The course is aimed 1. To familiarize with the Laplace Transform, Inverse Laplace Transform of various functions, and its applications. 2. To acquaint with the concept of Fourier Series, its complex form and enhance the problem solving skills 3. To familiarize the concept of complex variables, C-R equations, harmonic functions, its conjugate and mapping in complex plane. 4. To understand the basics of Linear Algebra and its applications 5. To use concepts of vector calculus to analyze and model engineering problems.	
Course Outcomes	On successful completion of course learner/student will be able to: 1. Apply the concept of Laplace transform to solve the real integrals in engineering problems. 2. Apply the concept of inverse Laplace transform of various functions in engineering problems. 3. Expand the periodic function by using Fourier series for real life problems and complex engineering problems. 4. Find orthogonal trajectories and analytic function by using basic concepts of complex variables. 5. Illustrate the use of matrix algebra to solve the engineering problems. 6. Apply the concepts of vector calculus in real life problems.	

Pre-requisite: Engineering Mathematics-I, Engineering Mathematics-II, Scalar and Vector Product: Scalar and vector product of three and four vectors.

Module	Detailed Contents	Hrs.
01	Module: Laplace Transform 1.1 Definition of Laplace transform, Condition of Existence of Laplace transform. 1.2 Laplace Transform (L) of Standard Functions like e^{at}, $\sin(at)$, $\cos(at)$, $\sinh(at)$, $\cosh(at)$ and $t^n, n \geq 0$. 1.3 Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by t, Division by t, Laplace Transform of derivatives and integrals (Properties without proof). 1.4 Evaluation of integrals by using Laplace Transformation. Self-learning Topics: Heaviside's Unit Step function, Laplace Transform of Periodic functions, Dirac Delta Function.	CO-1 7
02	Module: Inverse Laplace Transform 2.1 Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivatives. 2.2 Partial fractions method to find inverse Laplace transform. 2.3 Inverse Laplace transform using Convolution theorem (without proof). Self-learning Topics: Applications to solve initial and boundary value problems involving ordinary differential equations.	CO-2 6
03	Module: Fourier Series: 3.1 Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof). 3.2 Fourier series of periodic function with period 2π and $2l$. 3.3 Fourier series of even and odd functions. 3.4 Half range Sine and Cosine Series. Self-learning Topics: Complex form of Fourier Series, Orthogonal and orthonormal set of functions. Fourier Transform.	CO-3 7
04	Module: Complex Variables: 4.1 Function $f(z)$ of complex variable, limit, continuity and differentiability of $f(z)$ Analytic function, necessary and sufficient conditions for $f(z)$ to be analytic (without proof). 4.2 Cauchy-Riemann equations in cartesian coordinates (without proof). 4.3 Milne-Thomson method to determine analytic function $f(z)$ when real part (u) or Imaginary part (v) or its combination ($u+v$ or $u-v$) is given. 4.4 Harmonic function, Harmonic conjugate and orthogonal trajectories Self-learning Topics: Conformal mapping, linear, bilinear mapping, cross ratio,	CO-4 7

	fixed points and standard transformations.	
05	Module: Linear Algebra: Matrix Theory 5.1 Characteristic equation, Eigen values and Eigen vectors, Example based on properties of Eigen values and Eigen vectors. (Without Proof). 5.2 Cayley-Hamilton theorem (Without proof), Examples based on verification of Cayley- Hamilton theorem and compute inverse of Matrix. 5.3 Similarity of matrices, Diagonalization of matrices. Functions of square matrix Self-learning Topics: Application of Matrix Theory in machine learning and google page rank algorithms, derogatory and non-derogatory matrices.	CO-5 6
06	Module: Vector Differentiation and Integral 6.1 Vector differentiation: Basics of Gradient, Divergence and Curl (Without Proof). 6.2 Properties of vector field: Solenoidal and irrotational (conservative) vector fields. 6.3 Vector integral: Line Integral, Green's theorem in a plane (Without Proof), Stokes' theorem (Without Proof) only evaluation. Self-learning Topics: Gauss' divergence Theorem and applications of Vector calculus.	CO-6 6

Term Work:

General Instructions:

1. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
2. A group of 4 - 6 students should be assigned a self-learning topic. Students should prepare a presentation/ problem solving of 10-15 minutes. This should be considered as mini project in Engineering mathematics. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1.	Attendance (Theory and Tutorial)	05 marks
2.	Class Tutorials on entire syllabus	10 marks
3.	Mini project	10 marks

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first-class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment II) when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

References:-

1. Advanced engineering mathematics, H.K. Das, S. Chand, Publications
2. Higher Engineering Mathematics, B. V. Ramana, Tata Mc-Graw Hill Publication
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication
4. Advanced Engineering Mathematics, Wylie and Barret, Tata Mc-Graw Hill.
5. Theory and Problems of Fourier Analysis with applications to BVP, Murray Spiegel, Schaum's Outline Series
6. Vector Analysis Murry R. Spiegel, Schaum's outline series, Mc-Graw Hill Publication
7. Beginning Linear Algebra, Seymour Lipschutz, Schaum's outline series, Mc-Graw Hill Publication
8. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication

Subject code	Subject Name	Teaching scheme			Credit assigned				
ISC302	Transducers –I	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
		4	-	-	4	-	-	4	
Subject code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISC302	Transducers –I	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISC302	Transducers-I	4
Course objectives	1.To introduce the students for the purpose of explaining the measurement systems, errors of measurement. 2.To understand the sensors and transducers concept, operation and its applications in the various industry. 3.To familiarize the student with the Identification, classification, construction, working principle and application of various transducers used for Displacement, level, temperature, speed and vibration measurement.	
Course Outcomes	The students will be able to: 1.Explain the measurement systems, sources errors of measurement 2.List various standards used for selection of transducers/sensors. 3.To describe, draw, classify and produced sketches, drawings to explain working principles of various displacement sensors and transducers. 4.Interpret the characteristics of different temperature transducers/sensors also discuss working principle of transducers used for temperature measurement. 5. To create, design, formulate, generate and deliver the solutions for given applications using best applicable level sensors and transducer 6. To analyze the problem using basic principles for development of speed and vibration measurement project for Automobiles, Environmental, agriculture, biomedical, Petrochemical or other process industries.	

Details of Syllabus:

Module	Contents	Hours	CO mapping
1.	Instrumentation System Introduction, block diagram, functional elements of measurement system, static and dynamic characteristics of transducer, measurement and calibration systems.	2	CO1
2.	Sensor and Transducer: Definition, working principle, classification (active, passive, primary, secondary, mechanical, electrical, analog, digital), selection criteria.	2	CO2
3.	Displacement transducers: Resistive type transducers: potentiometer (linear and logarithmic), piezo-resistive effect. Inductive type transducers: LVDT, RVDT (transferfunction, linearity, sensitivity, source, frequency dependence, phase null, and signal conditioning). Capacitive type transducers: Linear and rotary (with change in distance between plates, change in dielectric constant and change in overlapping area).	6	CO3
4.	Temperature transducers: Resistance temperature detector (RTD): Principle, types, Configurations, construction and working of RTD, Material for RTD, Signal Measurement techniques for RTD, Comparative Response curves for RTD, 2 wire, 3 wire and 4 wire RTD Element, Lead wire Compensation in RTD, self-heating effect, Specifications, advantages, disadvantages and applications of RTD and sums. Thermistors: Principle, types (NTC and PTC), characteristics, Construction and working of Thermistor, Materials, specifications of Thermistor, applications and sums. Thermocouples: Principle, thermoelectric effect, Seebeck effect, Peltier effect, laws of thermocouple, types of thermocouple with characteristic curve, thermocouple table, Sensitivity, constructional features of Thermocouples. Thermocouple specifications, cold junction Compensation method and sums. Pyrometers: Principle, Construction and working of Radiation and optical pyrometers and its applications. Comparative study for Temperature Transducers.	7	CO4
5.	Level Transducers: working principle, types, materials, design criterion: float, displacers, bubbler, and DP- cell, ultrasonic, capacitive types.	4	CO5
6.	Speed and Vibration Measurement: electromagnetic transducers (moving coil, moving magnet), AC and DC tachometers: Hall Effect proximity pickup, photoelectric, LVDT.	3	CO6

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be a compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books:

1. B.C Nakra, K.K. Chaudhary, Instrumentation, Measurement and Analysis, Tata McGraw-Hill Education, 01-Oct-2003 - Electronic instruments - 632 page.
2. Patranabis D, Sensors and Transducers, Prentice Hall India Learning Private Limited; 2 edition (2003) - 344 pages.
3. A. K. Sawhney, Puneet Sawhney, A course in Electrical and Electronic Measurement and Instrumentation, Dhanpat Rai and Co. Rai, 1996 -
4. Rangan, Mani, Sharma. Instrumentation systems and Devices, 2nd Ed., Tata McGraw Hill.
5. D.V.S. Murthi, "Instrumentation and Measurement Principles", PHI, New Delhi, Second ed. 2003.

Reference Books:

1. Doebelin E.D., Measurement system, Tata McGraw Hill., 4th ed, 2003.
2. Bela G. Liptak, Instrument Engineers' Handbook, Fourth Edition, Volume One: Process Measurement and Analysis, June 27, 2003.
3. Neubert Hermann K. P., Instrument Transducer, 2nd ed., Oxford University Press, New Delhi, 2003.
4. Johnson Curtis D., Process Control Instrumentation Technology, 8th Ed., 2005
5. S.P. Sukhatme, Heat Transfer, 3rd edition, University Press.
6. B.E. Jones, Instrument Technology.
7. Chortle Keith R., Fundamentals of Test, Measurement Instrument Instrumentation, ISA Publication.
8. Alan S Morris, Measurement and Instrumentation Principles; 3rd Edition

Subject code	Subject Name	Teaching scheme			Credit assigned				
ISL301	Transducers –I Lab Practice	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
		-	02	-	-	1	-	1	
Subject code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISL301	Transducers –I Lab Practice	-	-	-	-	25	25	-	50

Subject Code	Subject Name	Credits
ISL301	Transducer –I Lab Practice	1
Course objective	1. To make students understand the Identification, construction, working principle of various transducers used for Displacement measurement, Temperature measurement, Level measurement and miscellaneous measurement 2. To experimentally verify the principle and characteristics of various transducers	
Course Outcome	The students will be able to 1. Demonstrate various measurement techniques and measuring instruments. 2. Classify sensors, Transducers, and their brief Performance specifications 3. Plot and validate the performance characteristics of displacement transducers 4. Validate the characteristics of various temperature transducers. 5. Describe the construction and operation of various level transducers 6. To demonstrate the performance characteristics of miscellaneous transducers.	

Syllabus: Same as that of Subject ISC302 Transducers - I.

List of Laboratory Experiments:

Sr. No.	Detailed Contents	CO mapping
1.	Demonstrate the basic measurements techniques and Measuring Instruments.	CO1
2.	Displacement measurement using Potentiometer.	CO3
3.	To determine characteristics of RTD	CO4
4.	To determine characteristics of various Thermocouples.	CO4
5.	To determine characteristics of Thermistors.	CO4
6.	To study Temperature Measurement with and without Thermo-well.	CO4
7.	Liquid Level Measurement using DP Cell.	CO5
8.	To evaluate performance characteristics capacitive level sensor.	CO5
9.	Liquid Level Measurement using Tubular Level Gauge and ultra-sonic sensor	CO5
10.	To determine the LVDT characteristics.	CO3

Any other experiments based on syllabus which will help students to understand topic/concept.

Term Work:

Term work shall consist of minimum **five experiments**.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments):	10 Marks
Laboratory work (programs / journal):	10 Marks
Attendance (Practical):	5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of Laboratory work and minimum passing in the term work.

Practical/Oral Examination:

Practical/Oral examination will be based on entire syllabus.

Subject code	Subject Name	Teaching scheme			Credit assigned			
ISC303	Analog Electronics	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		3	-	-	3	-	-	3

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISC303	Analog Electronics	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISC303	Analog Electronics	3
Course Objectives	1. To familiarize the student with basic electronic devices and circuits. 2. To provide understanding of applications of diodes, bipolar and MOSFET, DC biasing circuits, AC analysis and low and high Frequency response, 3. To introduce the students the basic construction of differential amplifier and its types. Different types of power amplifiers.	
Course Outcomes	Students will be able to: 1. Explain working of Diode and DC analysis of Transistor. 2. Analyze, simulate, and design amplifiers using BJT biasing techniques, frequency response. 3. Analyze circuits using FET characteristics and DC analysis. 4. Analyze circuits using MOSFET characteristics and analysis, Frequency response. 5. Differential amplifier configuration using transistor and frequency response. 6. Types of power amplifiers and power supply.	

Module	Contents	Hrs.	CO mapping
Pre-requisite Introduction of PN junction,			
1.	Bipolar Junction Transistor: Bipolar Junction Transistor, Device structure and physical operation, characteristics, the BJT as an amplifier and a switch, DC Analysis of BJT Circuits (Potential Divider Circuit only), Biasing BJT Amplifier Circuits,	05	CO1
2.	BJT AC Analysis: Amplification in AC domain, BJT transistor modelling, The r_e Transistor model, Single stage BJT amplifiers CE configuration (with and without feedback), Small Signal equivalent circuit, frequency response of a CE amplifier,	03	CO2
3.	Field effect Transistors: Introduction to JFET, Types, Construction, Operation, Static Characteristics, Pinch off voltage, FET Configurations (CS). Biasing of FET.	03	CO3
4.	MOS Field effect Transistors: Introduction to MOSFET as basic element in VLSI, Device structure and physical operation, current – voltage characteristics, the MOSFET as an amplifier and a switch, DC Analysis of MOSFET Circuits, Biasing MOSFET (No Numericals)	03	CO4
5.	Differential and Multistage Amplifiers: Preview, the Differential Amplifier, Basic BJT Differential Pair (SIBO, SIUO, DIBO, DIUO), Capacitive coupled and Direct coupled multistage amplifier.	02	CO5
6.	Power Amplifier: Definition and amplifier types, Series fed class A amplifier, Class B amplifier operation and circuits, Voltage regulation, Basic linear series and shunt Regulators, Power supply design using 78xx series, 79xx series and adjustable voltage IC regulators 317. Switched Mode Power Supply (SMPS) block Diagram.	04	CO6

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on Minimum 02 Modules) and the other is either a class test or assignment on live problems or Course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books:

1. Robert L. Boylestad, Louis Nashelsky, "*Electronic Devices and Circuit Theory*", PHI publishers, 2004
2. Thomas L. Floyd, "Electronic Devices", Pearson 2015.
3. Adel S. Sedra, Kenneth C. Smith & Arun N. Chandorkar, "*Microelectronic Circuits, Theory and Applications*", OUP, 2013
4. D. A. Neamen, "*Micro Electronic Circuit Analysis and Design*", McGraw-Hill, New Delhi, 2010.

Reference Books:

1. J. Millman and C. C. Halkias, "*Integrated Electronics: Analog and Digital Circuits and Systems*", Tata McGraw-Hill Publishing Company, 1988.
2. D. A. Bell, "*Electronic Devices and Circuits*", OUP, India, 2010.
3. T. F. Boghart, J. S. Beasley and G. Rico, "*Electronic Devices and Circuits*", Pearson Education, 2004.

Subject code	Subject Name	Teaching scheme			Credit assigned			
ISL302	Analog Electronics Lab practice	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		--	2	--	--	1	--	1

Subject Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISL302	Analog Electronics Lab practice	--	--	--	--	25	25		50

Subject Code	Subject Name	Credits
ISL302	Analog Electronics	1
Course Objectives	1. To familiarize the student with basic electronic devices and circuits. 2. To provide understanding of applications of diodes, bipolar and MOSFET, DC biasing circuits, AC analysis and low and high Frequency response, 3. To introduce the students the basic construction of differential amplifier and its types. Different types of power amplifiers.	
Course Outcomes	Students will be able to: 1. Explain working of Diode and DC analysis of Transistor. 2. Analyze, simulate, and design amplifiers using BJT biasing techniques, frequency response. 3. Analyze circuits using FET characteristics and DC analysis.. 4. Analyze circuits using MOSFET characteristics and analysis, Frequency response. 5. Differential amplifier configuration using transistor and frequency response. 6. Types of power amplifiers and power supply.	

Syllabus: Same as that of Subject ISC303 Analog Electronics.

List of Experiments:

Sr. No	Contents	CO mapping
1.	Verify the input -output characteristics of BJT in CE configuration.	CO1
2.	Implementation of a biasing circuit for BJT and estimate the parameters.	CO1
3.	Plot and validate the frequency response of BJT amplifier.	CO1
4.	Analyse the JFET circuit and validate its transfer characteristics.	CO2
5.	Plot and validate the frequency response of FET amplifier.	CO3
6.	Analyse the MOSFET circuit and validate its transfer characteristics.	CO3
7.	Simulate the multistage amplifier and analyse its frequency response with the help of simulation software.	CO4
8.	Simulate the differential amplifier and analyse its frequency response with the help of simulation software.	CO4
9.	Simulate the class A power amplifier and analyse with the help of simulation software.	CO5
10.	Design of fixed voltage regulator using adjustable regulator IC.	CO5

Any other experiment based on syllabus which will help students to understand topic/concept.

Practical and Oral Examination:

Practical and Oral examination will be based on entire syllabus of ISC303 Analog Electronics.

Term Work:

Term work shall consist of minimum 04 experiments and any one practical should be verified with software.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments) : 10 Marks

Laboratory work (programs / journal) : 10 Marks

Attendance : 05 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Subject code	Subject Name	Teaching scheme			Credit assigned			
ISC304	Digital Electronics	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		3	-	-	3	-	-	3

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISC304	Digital Electronics	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISC304	Digital Electronics	3
Course Objectives	1. To provide an understanding of the principles of digital electronics and use of number systems. 2. To give knowledge about combinational circuits, 3. To describe working and design methods of sequential circuits. 4. To familiarize with the basics of asynchronous sequential circuits and design techniques. 5. To provide understanding of memory devices and state machines. 6. To make the students understand basic logic families and their applications.	
Course Outcomes	Students will be able to: 1. Represent numerical values in various number systems and perform number conversions between different number systems. 2. Explain operation of logic gates using IEEE/ANSI standard symbols. Analyze and design, digital combinational circuits. 3. Analyze and design, sequential logic circuits. 4. Analyze and design, asynchronous sequential logic circuits. 5. Explain nomenclature and technology in memory devices. 6. Analyze logic families and their application to design the digital system.	

Module	Contents	Hours
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Pre-requisite		
Knowledge of number systems and Boolean logic.		
1.	Binary number system: Binary Arithmetic, Binary codes, Gray code, Error detecting code. Reduction methods: De-Morgan's Theorem, Sum of Products (SOP), Product of Sums (POS), Karnaugh map Minimization, Don't care conditions.	03
2.	Design of combinational logic circuits: Adders, Subtractors, Parity checker, Multiplexer, De multiplexer (up to 16:1 and 1:16), Encoder and Decoder. Implementation of combinational logic circuits using Multiplexer and Demultiplexer.	06
3.	Sequential logic circuits : Flip flops- SR, D and Master slave JK, T, Asynchronous & Synchronous counters, shift registers.	03
4.	Asynchronous sequential circuits: Circuit Design – primitive state / flow table, Minimization of primitive state table, Excitation table,	02
5.	Logic families: Basics of digital integrated circuits, basic operational characteristics and parameters. TTL, tri-state gate ECL, CMOS, comparison of logic families (TTL/ECL/CMOS).	03
6.	Memory and programmable logic devices: PROM / EPROM / EEPROM / EAPROM Programmable Logic Devices –Programmable Logic Array (PLA), Programmable Array Logic (PAL),	03

Internal Assessment: Internal Assessment consists of two tests out of which, one should be compulsory class test (on Minimum 02 Modules) and the other is either a class test or assignment on live problems or Course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books

1. M. Morris Mano, *"Digital Design"*, Prentice Hall of India, 2003.
2. John .M Yarbrough, *"Digital Logic Applications and Design"*, Thomson-Vikas publishing house, 2002.
3. Barry B. Brey, *"The Intel Microprocessors"*, Pearson/Prentice Hall, 2006.

4. B. Ram, "*Fundamentals of Microprocessors and Microcontrollers*", Dhanpat Rai Publications, 2004.

References Books:

1. Charles H. Roth., "*Fundamentals of Logic Design*", Thomson Publication Company, 2003.
2. Donald P. Leach and Albert Paul Malvino, "*Digital Principles and Applications*", Tata McGraw Hill Publishing Company Limited, 2003.
3. R.P.Jain, "*Modern Digital Electronics*", Tata McGraw–Hill publishing company limited, 2003.
4. Thomas L. Floyd, "*Digital Fundamentals*", Pearson Education, 2003.

Subject code	Subject Name	Teaching scheme			Credit assigned			
ISL303	Digital Electronics Lab practice	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		--	2	--	--	1	--	1

Subject Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISL303	Digital Electronics Lab practice	--	--	--	--	25	25		50

Subject Code	Subject Name	Credits
ISL303	Digital Electronics	1
Course Objectives	1. To provide an understanding of the principles of digital electronics and use of number systems. 2. To give knowledge about combinational circuits, 3. To describe working and design methods of sequential circuits. 4. To familiarize with the basics of asynchronous sequential circuits and design techniques. 5. To provide understanding of memory devices and state machines. 6. To make the students understand basic logic families and their applications.	
Course Outcomes	Students will be able to: 1. Represent numerical values in various number systems and perform number conversions between different number systems. 2. Explain operation of logic gates using IEEE/ANSI standard symbols. Analyze and design, digital combinational circuits. 3. Analyze and design, sequential logic circuits. 4. Analyze and design, asynchronous sequential logic circuits. 5. Explain nomenclature and technology in memory devices. 6. Analyze logic families and their application to design the digital system.	

Syllabus: Same as that of Subject ISC304Digital Electronics.

List of Experiments:

Sr. No	Detailed Contents	CO Mapping
1	Implement conversion of Gray/Binary code.	CO1
2	Truth table verification and implementation of all gates using Universal gates.	CO2
3	Implementation of half/ full adder/ Subtractor.	CO2
4	Realise full adder using Multiplexer.	CO3
5	Realise full Subtractor using Multiplexer.	CO3
6	Implementation of various flip-flops.	CO3
7	Implement BCD to seven segments display.	CO4
8	Design and implement universal shift register.	CO4

Any other experiment based on syllabus which will help students to understand topic/concept.

Practical and Oral Examination:

Practical and Oral examination will be based on entire syllabus of ISC304Digital Electronics.

Term Work:

Term work shall consist of minimum 04 experiments and any ONE experiment should be verify using any software.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments) : 10 Marks

Laboratory work (programs / journal): 10 Marks

Attendance : 05 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Subject code	Subject Name	Teaching scheme			Credit assigned			
ISC305	Electrical Networks and Measurement	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		2	-	-	2	-	-	3

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISC305	Electrical Networks and Measurement	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISC305	Electrical Networks and Measurement	3
Course Objectives	1. To introduce the concept of circuit elements lumped circuits, circuit laws and reduction. 2. To introduce the concept of circuit elements and analyze DC and AC circuits using various theorems. 3. To analyze the transient response of series and parallel A.C. circuits. 4. To analyze two port model of circuit and evaluate its parameters. 5. To synthesize the circuits using different techniques. 6. To demonstrate basic analog and digital Instruments. 7. To identify the various techniques for measurement of R-L-C.	
Course Outcomes	On successful completion of course learner/student will be able to: 1. Analyze AC and DC circuits using different theorems. 2. Evaluate transient and steady-state the parameters of passive electrical networks. 3. Analyze network using poles and zeros and determine their parameters like Z, Y, and ABCD. 4. Synthesize the networks using canonical forms. 5. Demonstrate construction and working principle and applications of analog and digital instruments. 6. Formulate electrical bridges and evaluate electrical parameter like R, L, C.	

Details of Syllabus:

Prerequisite: Knowledge of Matrix algebra, Root-locus, Bode-plot and Nyquist stability criterion.

Module	Contents	Hrs.	CO mapping
1	Network Theorems Analysis of networks with dependent sources: mesh analysis, nodal analysis, superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem.	08	CO1
2	Transient Analysis Initial Conditions in Elements, Solution of a First order and Second order differential equations.	03	CO2
3	Network Functions and Two-Port parameters Network functions for one port and two port networks, driving point and transfer functions, poles and zeros of network functions Open circuit, Short circuit, parameters of two port network.	04	CO3
4	Fundamentals of Network Synthesis. Causality and stability, Hurwitz polynomials, positive real functions. Properties of R-L-C Circuits.	03	CO4
5	Analog & Digital Meters D'Arsonval galvanometers, PMMC and PMMI instruments. Construction and working principle of: ammeters, voltmeters, ohmmeters, energy meter, digital multimeter.	03	CO5
6	Measurement of R, L, C Measurement of medium, low and high resistance, Megger AC bridges, measurement of self and mutual inductances (Maxwell). Measurement of capacitance (Schering Bridge). Derivations	03	CO6

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on Minimum 02 Modules) and the other is either a class test or assignment on live problems or Course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books:

1. Kuo Franklin F., "*Network analysis and synthesis*", Wiley International, 1962.
2. Van Valkenburg M.E., "*Network analysis*", Eastern Economy Edition, 1983.
3. A. K. Sawhney, Puneet Sawhney, "*A course in Electrical and Electronic Measurement and Instrumentation*", Dhanpat Rai and Co. Rai, 1996.

Reference Books:

1. Hayt William, Kemmerly Jr. Jack E., "*Engineering circuit Analysis*", Tata McGraw Hill, 2002.
2. Edminister Joseph A., Nahvi Mohmood, "*Electric Circuits*", Tata McGraw Hill, 1999.
3. Shyammoan Sudhakar, "*Circuits and Networks Analysis and Synthesis*", Tata McGraw Hill, 2000.
4. Ravish Singh, — *Electrical Networks Analysis and Synthesis*, Mc-Graw Hill

Sub Code	Subject Name	Examination scheme							
		Internal Assessment			End Sem Exam	Term work	Pract. and Oral	Oral	Total
ISL304	Object Oriented Programming and Methodology	-	-	-	-	25	-	25	50

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
ISL304	Object Oriented Programming and Methodology	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		-	3	-	-	2	-	2

#1 out of four hours two hours theory shall be taught to entire class and two hours practical in batches

Details of Syllabus:

Prerequisite: Structured Programming Approach

Module	Contents	Hrs	CO Mapping
1	Introduction to Object Oriented Programming OO Concepts: Object, Class, Encapsulation, Abstraction, Inheritance, Polymorphism. Features of Java, JVM Basic Constructs/Notions: Constants, variables and data types, Operators and Expressions, Revision of Branching and looping	01	CO1
2	Classes, Object and Packages Class, Object, Method. Constructor, Static members and methods Passing and returning Objects	02	CO2

	Method Overloading, Packages in Java		
3	Array, String and Vector Arrays, Strings, String Buffer	01	CO3
4	Inheritance and Interface Types of Inheritance, super keyword, Method Overriding	01	CO4
5	Exception Handling and Multithreading Error vs Exception, try, catch, finally, throw, throws	01	CO5
6	GUI programming in JAVA Event Handling: Event classes and event listener Introduction to AWT: Working with windows, Using AWT controls- push Buttons, Label, Text Fields, Text Area, Checkbox and Radio Buttons.	01	CO6

Text books:

1. Herbert Schildt, 'JAVA: The Complete Reference', Ninth Edition, Oracle Press.
2. Sachin Malhotra and Saurabh Chaudhary, "Programming in Java", Oxford University Press, 2010

Reference Books:

1. Ivor Horton, 'Beginning JAVA', Wiley India.
2. Dietal and Dietal, 'Java: How to Program', 8/e, PHI
3. 'JAVA Programming', Black Book, Dreamtech Press.

List of Laboratory Experiments/ Assignments:

Sr. No.	Detailed Contents
1.	Program on various ways to accept data through keyboard and unsigned right shift operator.

2.	Program on branching, looping, labelled break and labelled continue.
3.	Program to create class with members and methods, accept and display details for single object.
4.	Program on constructor and constructor overloading
5.	Program on method overloading
6.	Program on passing object as argument and returning object
7.	Program on 1D array
8.	Program on String
9.	Program on single and multilevel inheritance (Use super keyword)
11	Program to demonstrate try, catch, throw, throws and finally.
12	Program to create GUI application without event handling using AWT controls
13	Mini Project based on content of the syllabus. (Group of 2-3 students)

Term Work:

Students will submit term work in the form of journal that will include:

1. At least 11 programs and mini project
2. ONE assignments/MCQ covering whole syllabus
3. Class test based on the above syllabus.

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

The distribution of marks for term work shall be as follows:

Total: 50 Marks (Total Marks) : 20 marks (Experiments),

10 marks (Mini Project),

05 marks (Assignments),

10 marks (Class Test),

05 marks (Attendance)

Practical and oral examination will be based on the suggested experiment list and the entire syllabus.

UNIVERSITY OF MUMBAI



Bachelor of Engineering

in

Chemical Engineering

**Direct Second Year (Sem. III) Admitted Students for the
current Academic Year 2020-21(Only)**

(REV- 2019 'C' Scheme) from Academic Year 2019 – 20

**Under
FACULTY OF
SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2019–2020)

University of Mumbai
Program Structure for B.E. Chemical Engineering (Revised 2020-2021)
Semester III

Course code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			Total
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	
CHC301	Engineering Mathematics-III	3	-	1	3	-	1	4
CHC302	Industrial and Engineering Chemistry I	3	-	-	3	-	-	3
CHC303	Fluid Flow Operations	3	-	-	3	-	-	3
CHC304	Chemical Engineering Thermodynamics I	3	-	-	3	-	-	3
CHC305	Process Calculations	3	-	-	3	-	-	3
CHL301	Industrial and Engineering Chemistry I Lab	-	3	-	-	1.5	-	1.5
CHL302	Fluid Flow Operation Lab	-	3	-	-	1.5	-	1.5
CHL303	Basic Chemical Engineering Lab	-	3	-	-	1.5	-	1.5
CHL304	Skilled Based Lab: Chemical Technology Lab	-	2*2	-	-	2	-	2
CHM301	Mini Project 1A	-	3#	-	-	1.5	-	1.5
	Total	15	16	1	15	8	1	24

Course code	Course Name	Examination Scheme								
		Theory					Term Work	Pract/ Oral	Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in hrs)				
		Test 1	Test 2	Avg						
CHC301	Engineering Mathematics-III	20	20	20	80	3	25	-	-	125
CHC302	Industrial and Engineering Chemistry I	20	20	20	80	3	-	-	-	100
CHC303	Fluid Flow Operations	20	20	20	80	3	-	-	-	100
CHC304	Chemical Engineering Thermodynamics I	20	20	20	80	3	-	-	-	100
CHC305	Process Calculations	20	20	20	80	3	-	-	-	100
CHL301	Industrial and Engineering Chemistry I Lab	-	-	-	-	3	25	25	-	50
CHL302	Fluid Flow Operation Lab	-	-	-	-	3	25	25	-	50
CHL303	Basic Chemical Engineering Lab	-	-	-	-	-	25	-	25	50
CHL304	Skilled Based Lab: Chemical Technology Lab	-	-	-	-	-	25	-	25	50
CHM301	Mini Project 1A	-	-	-	-	-	25	-	25	50
	Total	-	-	100	400	-	150	50	75	775

*Indicates Theory class to be conducted for full class

indicates work load of Learner (Not Faculty), for Mini Project;
 faculty load : 1 hour per week per four groups, for Mini Project

Semester III

Course Code	Course Name	Credits
CHC301	Engineering Mathematics III	04

Course Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	-	01	03	-	01	04

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	03 Hours	25	-	-	125

Prerequisites

Engineering Mathematics-I, Engineering Mathematics-II,

Course Objectives

- 1.To familiarize with the Laplace Transform, Inverse Laplace Transform of various functions, its applications.
- 2.To acquaint with the concept of Fourier Series, its complex form and enhance the problem solving skills.
- 3.To familiarize with the concept of complex variables, C-R equations with applications.
- 4.To study the application of the knowledge of matrices and numerical methods in complex engineering problems.

Detailed Syllabus

Module No.	Course Contents	No. of Hours.
01	Module: Laplace Transform 1.1 Definition of Laplace transform, Condition of Existence of Laplace transform, 1.2 Laplace Transform (L) of Standard Functions like e^{at}, $\sin(at)$, $\cos(at)$, $\sinh(at)$, $\cosh(at)$ and t^n, where $n \geq 0$. 1.3 Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by t, Division by t, Laplace Transform of derivatives and integrals (Properties without proof). 1.4 Evaluation of integrals by using Laplace Transformation. Self-learning topics: Heaviside's Unit Step function, Laplace Transform. of Periodic functions, Dirac Delta Function.	07

02	Module: Inverse Laplace Transform 2.1 Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivative. 2.2 Partial fractions method & first shift property to find inverse Laplace transform. 2.3 Inverse Laplace transform using Convolution theorem (without proof) Self-learning Topics: Applications to solve initial and boundary value problems involving ordinary differential equations.	06
03	Module: Fourier Series: 3.1 Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof) 3.2 Fourier series of periodic function with period 2π and $2l$, 3.3 Fourier series of even and odd functions 3.4 Half range Sine and Cosine Series. Self-learning Topics: Complex form of Fourier Series, orthogonal and orthonormal set of functions, Fourier Transform.	07
04	Module: Complex Variables: 4.1 Function $f(z)$ of complex variable, limit, continuity and differentiability of $f(z)$, Analytic function, necessary and sufficient conditions for $f(z)$ to be analytic (without proof), 4.2 Cauchy-Riemann equations in cartesian coordinates (without proof) 4.3 Milne-Thomson method to determine analytic function $f(z)$ when real part (u) or Imaginary part (v) or its combination (u+v or u-v) is given. 4.4 Harmonic function, Harmonic conjugate and orthogonal trajectories Self-learning Topics: Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations	07
05	Module: Matrices: 5.1 Characteristic equation, Eigen values and Eigen vectors, Properties of Eigen values and Eigen vectors. (No theorems/ proof) 5.2 Cayley-Hamilton theorem (without proof): Application to find the inverse of the given square matrix and to determine the given higher degree polynomial matrix. 5.3 Functions of square matrix 5.4 Similarity of matrices, Diagonalization of matrices Self-learning Topics: Verification of Cayley Hamilton theorem, Minimal polynomial and Derogatory matrix & Quadratic Forms (Congruent transformation & Orthogonal Reduction)	06
06	Module: Numerical methods for PDE 6.1 Introduction of Partial Differential equations, method of separation of variables, Vibrations of string, Analytical method for one dimensional heat and wave equations. (only problems) 6.2 Crank Nicholson method	06

	6.3 Bender Schmidt method Self-learning Topics: Analytical methods of solving two and three dimensional problems.	
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Course Outcomes

On successful completion of course learner/student will:

1. Apply the concept of Laplace transform to solve the real integrals in engineering problems.
2. Apply the concept of inverse Laplace transform of various functions in engineering problems.
3. Expand the periodic function by using Fourier series for real life problems and complex engineering problems.
4. Find orthogonal trajectories and analytic function by using basic concepts of complex variable theory.
5. Apply Matrix algebra to solve the engineering problems.
6. Solve Partial differential equations by applying numerical solution and analytical methods for one dimensional heat and wave equations

Term Work

General Instructions:

1. Batch wise tutorials are to be conducted. The number of student's per batch should be as per University pattern for practical's.
2. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
3. A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Engineering Mathematics. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1.	Attendance (Theory and Tutorial)	05 marks
2.	Class Tutorials on entire syllabus	10 marks
3.	Mini project	10 marks

Assessment

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment II) when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.

Semester III

Course Code	Course Name	Credits
CHC302	Industrial and Engineering Chemistry – I	03

Course Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	-	-	03	-	-	03

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	03 Hours	-	-	-	100

Prerequisites

1. Basic knowledge of Vander-Waal's forces, various bonds, octet rule, resonance theory, and hybridization.
2. Knowledge of periodic table, properties of transition metals, non-metals, oxidation state, variable valency, basic functional groups etc.
3. XII class chemistry

Course Objectives

1. To study nomenclature, shapes, stability of coordination compounds and its applications.
2. To understand structures of different bio-molecules and stereochemistry of organic molecules.
3. To study structure and bonding of organometallic compounds and its industrial applications.
4. To study applications of electrochemistry conductometrically and potentiometrically and solvent extraction technique.
5. To study the effect of temperature on stability of reactive intermediate and their reaction mechanism.
6. To understand importance of dyes, fertilizers and their effects.

Detailed Syllabus

Module No.	Course Content	No of Hours
01	Applications of Electrochemistry-	04

	Conductance, specific conductance, equivalent conductance, molar conductance. Effect of dilution and temperature on conductance. Transport number, moving boundary method and numerical. Conductometry: Principle and types of titrations - Acid-base and precipitation	
02	Co-ordination chemistry & Organometallic compounds Definitions: Co-ordination number/ligancy, Complex ion, Co-ordination/dative bond. Nomenclature and isomerism (only geometrical and structural) in co-ordination compounds w.r.t co-ordination number 4 and 6. Effective Atomic Number (EAN) and numericals. Crystal field theory (CFT), Application of CFT to octahedral complexes and its drawbacks. Measurement of CFSE (10Dq) and numericals. Applications of coordination compounds. Organometallic compounds: Definition, metal clusters. Chemistry of Fe-carbonyls $[\text{Fe}(\text{CO})_5]$ and $[\text{Fe}_2(\text{CO})_9]$ w.r.t preparation, properties, structure and bonding.	08
03	Reaction pathways. Difference between Transition state & intermediate. Equilibrium (Thermodynamically) and Rate (Kinetically) controlled reactions-explain w.r.t. sulphonation of naphthalene, Nitration of Chlorobenzene, Friedel-Craft's reaction.	03
04	Ion Exchange and solvent extraction techniques Ion exchange resins, cation and anion exchangers. Desalination by ion exchange and separation of lanthanides. Liquid-Liquid solvent extraction, Nernst distribution law, distribution ratio. Batch, continuous and counter current extraction. Numerical based on solvent extraction.	05
	TOTAL	20

❖ One guest lecture from industry expert.

Course Outcomes

On completion of the course the **students will:**

1. Understand the different theories of chemical bonding, organometallic chemistry and reactive intermediate.
2. Apply knowledge of dyes, fertilizers, analytical techniques of separation, identification and quality of fertilizers.
3. Describe the reaction mechanisms, states of molecules, various types of dyes and reaction pathway in biological process.
4. Justify stability of coordination compounds, kinetics and energy of reactions and importance of organometallic compounds in biological process.
5. Express role of biomolecules, elemental constituents in fertilizers, and exchangers in industries.
6. Apply concepts of electrochemistry and its applications quantitatively.

Assessment

Consisting **Two Compulsory Class Tests**. First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I).

1. Weightage of each module in end semester examination will be proportional to number of respective lectures.
2. Question paper will comprise of total **six questions, each carrying 20 marks**
3. **Question 1** will be compulsory and should cover **maximum contents of the curriculum.**
4. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module3)
5. Only **Four questions need to be solved.**

- 1.Engineering Chemistry- Jain& Jain Dhanpat Rai & Co. (P) Ltd
- 2.Engineering Chemistry- Satyaprakash& Manisha Agrawal, Khanna Book Publishing
- 3.Organic reaction Mechanisms- V.K. Ahluwalia , Rakesh Parashar, Narosa Publication
4. Industrial Chemistry – B K Sharma, Goel Publishing House

1. Principles of Physical Chemistry- B. R. Puri, L. R. Sharma, M.S. Pathania.
2. Principles of Inorganic Chemistry- Puri, Sharma, Kalia ,Milestone Publishers
3. Advanced Inorganic Chemistry – J. D. Lee
4. Organic Chemistry - I L Finar volume I and II.
5. Organic Chemistry – J. Clayden, Greeves, Warren, Wothers. Oxford university press
6. Principles Of Bioinorganic Chemistry- S.J. Lippard & J.M. Berg
7. Stereochemistry: Conformation and Mechanism by Kalsi, P.S, New Age International. Delhi
8. Stereochemistry of carbon compounds- Ernest Eliel, Tata McGraw Hill.
9. A textbook of Physical Chemistry - Glasston Samuel, Macmillan India Ltd. (1991)
10. Technology of Textile Processing Vol. 2: Chemistry of Dyes and Principles of Dyeing- Prof. V. A. Shena

Semester III

Course Code	Course Name	Credits
CHC303	Fluid Flow Operations	03

Course Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	-	-	03	-	-	03

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	03 Hours	--	--	--	100

Prerequisites

Students are assumed to have adequate background in physics, units and dimensions and thermodynamics

Course Objectives

1. Students should be able to understand the scope of the subject in chemical industry and pressure drop- flow rate relationship.
2. They should be able to understand the boundary layer conditions and types of flow.
3. They should be able to understand the Bernoulli's equation and its applications in transportation of fluids.
4. They should be able understand the relationship between pressure drop and flow rates in conduits for incompressible fluids.
5. They should be able understand the types of velocities and stagnation properties for compressible flow and viscosity using Stokes law.
6. They should be able understand the purpose and need of power requirement in agitation and selection and importance of pumps and valves.

Detailed Syllabus

Module no.	Course Contents	No. of Hours
1	Fluid and its properties, Newton's law of viscosity, Kinematic viscosity, Rheological behavior of fluid, Reynold's experiment and Reynold's number, Laminar and turbulent flow in boundary layer, Boundary layer formation in straight tube, Transition length for laminar and turbulent flow. Boundary layer formation in straight tube, Transition length for laminar and turbulent flow.	03
2	Bernoulli's equation, Euler's equation, Modified Bernoulli's equation.	03

	Practical Application of Bernoulli's Equation (Venturimeter & Orificemeter)	
3	Derivation of Hagen – Poiseuille equation, Friction factor, Darcy-Weisbach equation, Moody diagram, Equivalent diameter for circular and non-circular ducts. Major and minor losses	04
4	Flow of Compressible Fluids: Mach number, Sonic, Supersonic and Subsonic flow, Continuity equation and Bernoulli's equation Flow past immersed bodies: Drag Forces, Coefficient of Drag, One dimensional motion of particle through fluid, Terminal Settling Velocity, Stoke's law, Stagnation Point.	04
5	Classification of pumps, Centrifugal Pump- Construction & working, Characteristics of pumps (curves), Cavitation, NPSH, NPSHA, NPSHR, Priming. Power Consumption in Agitation: Purpose of Agitation, Types of Impellers, Prevention of Swirling, Power Curves, Power Number	04
	TOTAL	18

Course Outcomes

On completion of the course the students will:

1. Acquire basic concepts and pressure measurement methods.
2. Learn kinematics of flow, rheological behavior of fluid and boundary layer conditions.
3. Learn Bernoulli's equation and apply it in practical applications of various problems in Chemical Engineering.
4. Learn flow equations and evaluate the losses in incompressible flow.
5. Learn the behavior of compressible fluids and Stokes Law and also able to apply these concepts for estimation of stagnation properties.
6. Gain the knowledge of various pumps, choice of pumps, valves and agitators and would be able to calculate power requirement for pumps as well as for agitators.

Assessment

Internal Assessment (20 Marks):

Consisting **Two Compulsory Class Tests**.
First test based on approximately 40% of contents and second test based on remaining contents (approximately) 40% but excluding contents covered in Test 1).

End Semester Examination (80 marks):

1. Weightage of each module in end semester examination will be proportional to number of respective lectures.
2. Question paper will comprise of total **six questions, each carrying 20 marks**.
3. **Question 1** will be compulsory and should cover **maximum contents of the Curriculum**.
4. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from Module 3 then part (b) will be from any module other than module 3).
5. Only **Four Questions need to be solved**.

Recommended Books

1. Warren L. McCabe, Julian C. Smith, Peter Harriott, Unit Operations of Chemical Engineering, McGraw Hill International Edition.
2. Coulson J. M., Richardson J. F., Backhurst J. R. and J. H. Harker, Chemical Engineering, Vol. 1 and 2.
3. Dr. R. K. Bansal, Fluid Mechanics and Hydraulic Machines, Laxmi Publications Pvt. Ltd.

Reference Books

1. Cengel, Y. A. (2006). Fluid mechanics: fundamentals and applications. New Delhi, India: Tata McGraw-Hill Publishing.
 2. Darby, R. (2001). Chemical Engineering Fluid Mechanics (2nd ed., rev.). New York: Marcel Dekker.
 3. Douglas, J. F. (2001). Fluid mechanics (5th ed.). New Delhi, India: Pearson Education
 4. Batchelor, G. K. (1999). Introduction to Fluid Dynamics. New Delhi, India: Cambridge University Press.
 5. Rajput, R. K. (1998). A Textbook of Fluid Mechanics. New Delhi, India: S Chand and co
 6. Mohanty, A. K. (2009). Fluid Mechanics (2nd ed.). New Delhi, India: PHI Learning.
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Semester III

Course Code	Course Name	Credits
CHC304	Chemical Engineering Thermodynamics I	03

Course Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	-	-	03	-	-	03

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs	--	--	--	100

Prerequisites

1. Basic thermodynamic properties, laws and equations.
2. Engineering Mathematics : Differential and Integral Calculus, Linear Algebraic Equations.
3. Engineering Physics and Engineering Chemistry.

Course Objectives

1. To apply the first law of thermodynamics to chemical engineering systems.
2. To apply the second law of thermodynamics to chemical engineering systems.
3. To predict the P-V-T behavior of ideal gases and real gases.
4. To explain various thermodynamic concepts such as Entropy, Exergy and Fugacity.
5. To perform calculations involving the applications of the laws of thermodynamics to flow processes.
6. To demonstrate the use of thermodynamic charts and diagrams.

Detailed Syllabus

Module No	Course Contents	No. of Hours
1	Review of First Law of Thermodynamics for flow and nonflow processes.	04
2	Concepts of heat engine, heat pump and refrigerator, Carnot Cycle and Carnot Principle	04
3	Concept of Exergy, Applications of Exergy	02

4	Equations of state for non-ideal gases: van der Waals equation of state.Redlich-Kwong equation of state.	03
5	Maxwell's Equations,Enthalpy and Entropy departure functions (van der Waals and Redlich-Kwong EOS), Fugacity and fugacity coefficient (van der Waals and Redlich-Kwong EOS)	06
	TOTAL	19

Course Outcomes

On completion of the course the students will:

1. Apply the First Law of Thermodynamics to flow and non-flow Chemical Engineering processes.
2. Compute the thermal efficiencies of various engines and machines using Second Law of Thermodynamic and Entropy concepts.
3. Apply the concept of Exergy to engineering applications and utilize the laws of thermodynamics to analyze flow processes.
4. Compute the properties of real fluids using different equations of state.
5. Compute property changes of non-ideal gas systems using departure functions.
6. Use thermodynamic charts and diagrams for estimation of various thermodynamic properties.

Assessment

Internal Assessment (20 Marks):

Consisting **Two Compulsory Class Tests**. First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I).

End Semester Examination (80 marks):

1. Weightage of each module in end semester examination will be proportional to number of respective lectures.
2. Question paper will comprise of total **six questions, each carrying 20 marks**.
3. **Question 1** will be compulsory and should cover **maximum contents of the curriculum**.
4. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
5. Only **Four questions need to be solved**.

Recommended Books

1. J.M. Smith, H.C. Van Ness, M.M. Abbot, M.T. Swihart, Introduction to Chemical Engineering Thermodynamics, 8th Edition, McGraw-Hill Education, 2017.
2. K.V. Narayanan, A Textbook of Chemical Engineering Thermodynamics, 2nd Edition, Prentice Hall of India Pvt. Ltd., 2013.
3. Y.V.C. Rao, Chemical Engineering Thermodynamics, Universities Press, 1997.

Reference Books

1. M.J. Moran, H.N. Shapiro, D.D. Boettner, M.B. Bailey, Fundamentals of Engineering Thermodynamics, 9th Edition, Wiley, 2018.
2. Gopinath Halder, Introduction to Chemical Engineering Thermodynamics, 2nd Edition, Prentice Hall of India Pvt. Ltd., 2014.

3. M.D. Koretsky, Engineering and Chemical Thermodynamics, John Wiley and Sons, 2009.
4. J. Richard Elliot and Carl T. Lira, Introductory Chemical Engineering Thermodynamics, 2nd Edition, Prentice Hall, 2012.

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Semester III

Course Code	Course Name	Credits
CHC305	Process Calculations	03

Course Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	-	-	03	-	-	03

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	03 hours	--	--	--	100

Prerequisites

1. Linear algebra
2. Differential equations

Objectives

- 1 Familiarize various systems of units and conversion.
- 2 Learn about material balance of various unit operations for both steady and unsteady state operations.
- 3 Understand the material balance of various unit processes.
- 4 To have the knowledge of recycle, bypass and purge operations.
- 5 Understand the energy balance calculations over various processes with and without chemical reactions.
- 6 Development of the material balance and energy load of a binary distillation column.

Detailed Syllabus

Module No.	Course Contents	No. of Hours
1	Introduction: Basic Chemical Calculations. Density, specific volume, specific gravity, concentration & composition of mixtures and solutions. Ideal Gas law, Dalton's law, Amagat's law and Raoult's law.	02

2	Material Balance without Chemical Reactions: Solving material balance problems for various unit operations (Absorption, Distillation, Extraction and Crystallization)	03
3	Material Balance with Chemical Reactions: Concept of limiting and excess reactants, conversion and yield, selectivity and degree of completion of reaction.	04
4	Recycle, Bypass and Purge Operations: Material Balance calculations for both with and without chemical reactions.	02
5	Energy Balance: Heat capacity, sensible heat, latent heat, calculation of enthalpy changes. General energy balance equation. Energy balances for process involving chemical reaction including adiabatic reactions.	04
6	Combined Material and Energy Balance: Material and energy balance for binary distillation.	01
	TOTAL	16

Course Outcome

On completion of the course the students will:

- 1 Identify the various systems of units and conversion and apply principles of basic chemical calculations.
- 2 Apply the material balance for various unit operations for both steady and unsteady state operations.
- 3 Compute the material balance of various unit processes.
- 4 Evaluate recycle, bypass and purge operations and its streams.
- 5 Perform energy balance calculations over various processes with and without chemical reactions.
- 6 Assess the material balance and energy load of a binary distillation column.

Assessment

Internal Assessment (20 Marks):

Consisting **Two Compulsory Class Tests**. First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I).

End Semester Examination (80 marks):

1. Weightage of each module in end semester examination will be proportional to number of respective lecture.
2. Question paper will comprise of total **six questions, each carrying 20 marks**.
3. **Question 1** will be compulsory and should cover **maximum contents of the curriculum**.
4. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
5. Only **Four questions need to be solved**.

Recommended Books

1. Narayan, K. V. and Lakshmi Kutty, B. "Stoichiometry and Process Calculations", 1st edition, Prentice Hall of India Pvt. Ltd., New Delhi (2006)
2. Bhatt, B. I. and Thakore, S. B., "Stoichiometry", 5th edition, Tata McGraw Hill Education Private Limited, New Delhi

3. Ch. Durga Prasad Rao and D. V. S. Murthy, "Process Calculations for Chemical Engineers", McMillan India Ltd. (2010)
4. O. A. Hougen, K. M. Watson, and R. A. Ragatz., "Chemical process principles-part 1, Material and Energy Balances". Second Edition. John Wiley & Sons, Inc., New York (1954).

Reference Books

1. Himmelblau, D. M. and Riggs, J. B., "Basic Principles and Calculations in Chemical Engineering, 7th edition, Prentice Hall of India Pvt. Ltd., New Delhi (2009)

Semester III

Course Code	Course Name	Credits
CHL301	Industrial and Engineering Chemistry Lab-I	1.5

Course Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	03	-	-	1.5	-	1.5

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR/OR	OR	
Test-I	Test-II	Average						
-	-	-	-	-	25	25	--	50

Prerequisites

1. Basic knowledge of quantitative terms, Mole fractions, Normality, Molarity etc.
2. Basic identification of salts, acids, bases, indicators etc.
3. Basic introduction of lab safety and handling of glass wares.

Lab Objectives

1. To enable students to prepare the standard solutions, carry out volumetric analysis to check their accuracy and present the outcome of the experiment in statistical format to calculate standard deviation.
2. To provide students an insight of titrimetry to determine contents of solution quantitatively.
3. To enable students to apply knowledge of instrumental analysis to carry out acid-base titrations without indicators, to calculate solubility product etc.
4. To make students learn the estimation of organic compound from given solution quantitatively.
5. To make students understand the concept and importance of gravimetric analysis in determination of amount of element in given solution.
6. To enable students carry out synthesis of chemicals by laboratory methods

Lab Outcomes

On completion of the course the **students will:**

1. Prepare standard solutions, check their accuracy and present results in statistical format to calculate standard deviation.
2. Perform titrations and determine contents of solution quantitatively.
3. Apply knowledge of instrumental analysis like Conductometry and Potentiometry.
4. Learn methods of estimation of organic compounds quantitatively.
5. Carry out gravimetric analysis systematically with proper understanding.
6. Carry out synthesis of chemicals in laboratory.

List of Experiments (Minimum Five)

Experiment no.	Details of Experiment	Lab Hours
1	Volumetric analysis: Preparation of standard solutions and to find normality, strength and deviation factor.	3
2	Titrimetric analysis: Analysis of talcum powder for Mg content by EDTA method	3
3	Potentiometric Titrations Titration of strong acid and strong base potentiometrically.	3
4	Organic estimations Estimation of phenol /Aniline	3
5	Gravimetric estimation of Nickel as Ni D.M.G.	3
6	Preparation. Preparation of Methyl Salicylate	3
7	Nitration of Aromatic compounds: Nitration of Nitrobenzene/Acetanilide	3

Assessment

Term Work (25 marks):

Distribution of marks will be as follows:

Laboratory work: 15 marks

Assignments: 05

Attendance: 05

End Semester Practical Examination/orals (25 marks):

Practical Examination will be on experiments performed in the laboratory

Reference Books

1. Vogel's Quantitative Chemical Analysis-David J. Barnes J. Mendham, R.C. Denney, M.J.K Thomas Pearson Education; 6 edition
2. Laboratory Manual Engg. Chemistry- Anupma Rajput, Dhanpat Rai & Co.
3. Vogel's Textbook of Practical organic chemistry.

Semester III

Course Code	Course Name	Credits
CHL302	Fluid Flow Operations Lab	1.5

Course Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	03	-	-	1.5	-	1.5

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR/OR	OR	
Test-I	Test-II	Average						
-	-	-	-	-	25	25	-	50

Prerequisites

1. Knowledge of physical sciences and units and dimensions.
2. Knowledge of properties of fluids, law of conservation of mass and law of momentum.
3. Knowledge of flow and pressure measurement devices.
4. Knowledge of different flow patterns and pumps.

Lab Objectives

Students should be able to:

1. Understand the basic properties and concepts of the fluid behavior in chemical industry.
2. Understand various flow patterns and boundary layer conditions.
3. Understand applications of flow and pressure measuring devices.
4. Understand various pipe fittings, valves and its applications.
5. Understand working and operations of various pumps.
6. Understand Working and application of agitated vessel and use of different impellers in process industries.

Lab Outcome

On completion of the course the students will:

1. Determine viscosity by stokes law.
2. Distinguish different flow patterns and calculations involving Reynolds number.
3. Find coefficient of discharge for various flow measuring devices.

4. Evaluate minor losses and frictional losses for various pipe fittings and network.
5. Calculate power required and efficiency for various pumps.
6. Find power requirement for various impellers in agitated vessel.

List of Experiments (Minimum Four)

Experiment No.	Details of Experiment	Lab Hours
1	To determine the coefficient of discharge for Orifice meter.	3
2	To determine minor losses in pipes.	3
3	To find out Reynolds number for the fluid flow using Reynolds's apparatus	3
4	To study the characteristics of centrifugal pumps.	3
5	To verify Bernoulli's theorem.	3
6	To determine the coefficient of discharge for horizontal Venturi meter.	3

Assessment

Term Work (25 marks):

Distribution of marks will be as follows:

Laboratory work: 15 marks

Assignments: 05

Attendance: 05

End Semester Practical Examination/Orals (25 marks):

Practical Examination will be based on experiments performed in the laboratory.

Reference Books

1. Warren L. McCabe, Julian C. Smith, Peter Harriott, Unit Operations of Chemical Engineering, McGraw Hill International Edition.
2. Coulson J. M., Richardson J. F., Backhurst J. R. and J. H. Harker, Chemical Engineering, Vol. 1 and 2.
3. Batchelor, G. K. (1999). Introduction to fluid dynamics. New Delhi, India: Cambridge University Press.
4. Darby, R. (2001). Chemical engineering fluid mechanics (2nd ed., rev.). New York: Marcel Dekker.

Semester III

Course Code	Course Name	Credits
CHL303	Basic Chemical Engineering Lab	1.5

Course Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	03	-	-	1.5	-	1.5

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR/OR	OR	
Test-I	Test-II	Average						
-	-	-	-	-	25		25	50

Prerequisites

1. Knowledge of Inorganic, Organic and Physical Chemistry
2. Knowledge of Physics and
3. Knowledge of Mathematics

Lab Objectives

1. To understand basic chemical engineering concepts such as vapor pressure, surface tension, heat of reaction, solubility, colligative properties etc.
2. To apply knowledge of chemistry to do experimental set up and carry out experiment
3. To understand different errors, sampling methods and sample size in laboratory experiments.
4. To collect data after experiments
5. To study applications of experimental methods in practical situations
6. To become aware of industrially important reactions and operations

Lab Outcomes

On completion of the course the students will:

1. Apply basic principles of chemistry and chemical engineering to solve and analyze complex industrial problems

2. Apply mathematical skills to perform calculations on data obtained and use required formulas to do the same
3. Evaluate sampling methods, required sampling size and reduce measurement errors for accurate experimental design
4. Evaluate experimental data by different data analysis methods on PC using MS Excel for investigating complex problems
5. Analyze and interpret the results obtained from experiments
6. Design new laboratory experiments to study industrial problems which will benefit society and environment by following strict ethical standards

List of Experiments (minimum four)

Experiment no.	Details of Experiment	Lab Hours
1	Heat of reaction and Hess's law of heat summation	3
2	Measurement of Dew Point Temperature	3
3	Demonstration of vapor pressure	3
4	Freezing point depression	3
5	Boiling point elevation	3
6	Limiting reactant and excess reactant for chemical reaction	3

Assessment

Term Work (25 marks):

Distribution of marks will be as follows:

Laboratory work: 20 marks

Attendance: 05

End Semester orals (25 marks):

Orals will be on experiments performed in the laboratory

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Semester III

Course Code	Course Name	Credits
CHL304	Skilled based lab: Chemical Technology Lab	02

Course Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
02	02	-	01	01	-	02

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR/OR	OR	
Test-I	Test-II	Average						
-	-	-	-	-	25	-	25	50

Prerequisites

1. Knowledge of Inorganic Chemistry.
2. Knowledge of Organic Chemistry.
3. Knowledge of Physical Chemistry.
4. Knowledge of Physics and Mathematics.

Course Objectives

1. To provide students an insight of different chemical processes and their engineering problems.
2. To enable the students to understand the development of a process from its chemistry.
3. To equip students to draw and illustrate process flow diagrams.
4. To develop laboratory procedures for the preparation of industrially important chemicals and products.
5. To enable students to be skilled in the practical aspects of synthesis of chemicals.
6. To present the outcomes of laboratory experiments in the form of reports.

Course Outcomes

On completion of the course the students will:

1. Describe various manufacturing processes used in the chemical process industries.

2. Explain industrial processing and overall performance of any chemical process including the major engineering problems encountered in the process.
3. Draw and illustrate the process flow diagram for a given process.
4. Outline laboratory procedures for the preparation of industrially important chemicals and products.
5. Plan and perform synthesis of important chemicals in the laboratory.
6. Demonstrate the ability to present scientific and technical information resulting from laboratory experimentation and draw conclusions from the results of the experiments.

Detailed Syllabus (theory 02 hours per week)

Module No.	Course Contents	No. of Hours
1	Introduction : Concept and brief description of the Unit Operations and Unit Processes used in Chemical Industries Overview of Industrially Important Products in the Chemical Process Industries: Soaps and Detergents	02
2	Natural Product Industries and Biodiesel Processing: Manufacture of ethanol by fermentation of molasses Biodiesel production by base-catalysed transesterification process	02
3	Manufacture of Acids: Sulphuric Acid (DCDA Process), Nitric Acid Manufacture of Fertilizers: Urea	03
4	Chloro-Alkali Industries: Manufacture of Caustic Soda Manufacture of Soda Ash (Solvay Process)	03
5	Basic Building Blocks of Petrochemical Industry: Introduction to Petroleum Refining Catalytic Cracking by Fluidized Catalytic Cracking Unit (FCCU)	02
6	Synthesis of Important Heavy Organic Chemicals and Intermediates: Manufacture of Cumene from benzene and propylene Manufacture of Phenol from cumene by peroxidation-hydrolysis process Synthesis of Polymers: Manufacture of Polyethylene: LDPE and HDPE Manufacture of Nylon 66	02
	TOTAL	14

List of Experiments (minimum six)

Experiment no.	Details of Experiment	Lab Hours
1	Preparation of Soap	2
2	Preparation of Alum from Aluminum	2
3	Preparation of Aspirin	2
4	Preparation of Methyl Orange	2

Semester III

Course Code	Course Name	Credits
CHM301	Mini Project 1A	1.5

Course Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	03	-	-	1.5	-	1.5

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR/OR	OR	
Test-I	Test-II	Average						
-	-	-	-	-	25	-	25	50

Objectives

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Outcome: Learner will...

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as member of a group or leader.
4. Draw the proper inferences from available results through theoretical/ experimental/simulations.
5. Analyse the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to life long learning.
9. Demonstrate project management principles during project work.

Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.

- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;

o Marks awarded by guide/supervisor based on log book	: 10
o Marks awarded by review committee	: 10
o Quality of Project report	: 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.
 - First shall be for finalisation of problem
 - Second shall be on finalisation of proposed solution of problem.

- In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
- First review is based on readiness of building working prototype to be conducted.
- Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
 - o Identification of need/problem
 - o Proposed final solution
 - o Procurement of components/systems
 - o Building prototype and testing
- Two reviews will be conducted for continuous assessment,
 - First shall be for finalisation of problem and proposed solution
 - Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project.

Mini Project shall be assessed based on following criteria;

1. Quality of survey/ need identification
 2. Clarity of Problem definition based on need.
 3. Innovativeness in solutions
 4. Feasibility of proposed problem solutions and selection of best solution
 5. Cost effectiveness
 6. Societal impact
 7. Innovativeness
 8. Cost effectiveness and Societal impact
 9. Full functioning of working model as per stated requirements
 10. Effective use of skill sets
 11. Effective use of standard engineering norms
 12. Contribution of an individual's as member or leader
 13. Clarity in written and oral communication
- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
 - In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organisations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on following points;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication

UNIVERSITY OF MUMBAI



Bachelor of Engineering

in

Electronics and Computer Science

**Direct Second Year (Sem. III) Admitted Students for the
current Academic Year 2020-21(Only)**

(REV- 2019 'C' Scheme) from Academic Year 2019 – 20

**Under
FACULTY OF
SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2019–2020)

Preamble

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this, the Faculty of Science and Technology (in particular Engineering), of University of Mumbai, has taken a lead in incorporating the philosophy of outcome-based education in the process of curriculum development.

Faculty resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes, understand the depth and approach of the course to be taught, which will enhance learner's learning process. Choice based Credit and grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. Credit assignment for courses is based on 15 weeks teaching learning process. However, content of courses is to be taught in 12-13 weeks and the remaining 2-3 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

There was a concern that the earlier revised curriculum was more focused on providing information and knowledge across various domains of the said program, which led to heavily loading students in terms of direct contact hours. In this regard, faculty of science and technology resolved that to minimize the burden of contact hours, total credits of the entire program will be of 170, wherein focus is not only on providing knowledge but also on building skills, attitude and self-learning. There-fore in the present curriculum, skill-based laboratories and mini projects are made mandatory across all disciplines of engineering in second and third year of programs, which will definitely facilitate self-learning of students. The overall credits and approach of the curriculum proposed in the present revision is in line with the AICTE model curriculum.

The present curriculum will be implemented for Second Year of Engineering from the academic year 2020-21. Subsequently this will be carried forward for Third Year and Final Year Engineering in the academic years 2021-22, 2022-23, respectively.

Dr. S. K. Ukarande

Associate Dean

Faculty of Science and Technology

Member, Academic Council, RRC in Engineering

University of Mumbai

Incorporation and implementation of Online Contents from NPTEL/ Swayam Platform

The curriculum revision is mainly focused on knowledge component, skill based activities and project based activities. Self learning opportunities are provided to learners. In the revision process this time, in particular Revised syllabus of 'C' scheme, wherever possible, additional resource links of platforms such as NPTEL, Swayam are appropriately provided. In earlier revisions of the curriculum in the years 2012 and 2016, in Revised scheme 'A' and 'B' respectively, efforts were made to use online contents as additional learning materials to enhance learning of students.

In the current revision based on the recommendation of AICTE model curriculum, overall credits are reduced to 171, to provide opportunity of self-learning to learner. Learners are now getting sufficient time for self-learning either through online courses or additional projects for enhancing their knowledge and skill sets.

The Principals/ HOD's/ Faculties of all the institutes are required to motivate and encourage learners to use additional online resources available on platforms such as NPTEL/ Swayam. Learners can be advised to take up online courses and on successful completion, they are required to submit certification for the same. This will definitely help learners to facilitate their enhanced learning based on their interest.

Dr. S. K. Ukarande

Associate Dean

Faculty of Science and Technology

Member, Academic Council, RRC in Engineering

University of Mumbai

Program Structure for Second Year Electronics and Computer Science

UNIVERSITY OF MUMBAI

(With Effect from 2020-2021)

Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC 301	Engineering Maths III	3	-	1	3	-	1	4
ECC 302	Electronic Devices	3	-	-	3	-	-	3
ECC 303	Digital Electronics	3	-	-	3	-	-	3
ECC 304	Data Structures and Algorithms	3	-	-	3	-	-	3
ECC 305	Database Management Systems	3	-	-	3	-	-	3
ECL301	Electronic Devices Lab	-	2	-	-	1	-	1
ECL302	Digital Electronics Lab	-	2	-	-	1	-	1
ECL303	Data Structures and Algorithms Lab	-	2	-	-	1	-	1
ECL304	Database Management Systems lab	-	2	-	-	1	-	1
ECL305	Skill-based Lab course: OOPM (C++ and Java)	-	4	-	-	2	-	2
ECM301	Mini-project -1 A	-	4\$	-	-	2	-	2
	Total	15	16	1	15	08	1	24

\$ indicates workload of learner (Not faculty), for mini-project

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Practical/ Oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg .					
ECC 301	Engineering Maths III	20	20	20	80	03	25	-	125
ECC 302	Electronic Devices	20	20	20	80	03	-	-	100
ECC 303	Digital Electronics	20	20	20	80	03	-	-	100
ECC 304	Data Structures and Algorithms	20	20	20	80	03	-	-	100
ECC 305	Database Management Systems	20	20	20	80	03	-	-	100
ECL 301	Electronic Devices Lab	-	-	-	-	-	25	25	50
ECL 302	Digital Electronics Lab	-	-	-	-	-	25	25	50
ECL 303	Data Structures and Algorithms Lab	-	-	--	-	-	25	25	50
ECL 304	Database Management systems lab	-	-	-	-	-	25	25	50
ECL 305	Skill-based Lab course: OOPM (C++ and Java)	-	-	-	-	-	50	-	50
ECM 301	Mini Project - 1A						25	25	25
	Total	-	-	100	400	-	200	125	825

Note:

1. Students group and load of faculty per week.

Mini Project 1 and 2:

Students can form groups with minimum 3 (Three) and not more than 4(Four).

Faculty Load:1 hour per week per four groups

Major Project 1 and2:

Students can form groups with minimum 2 (Two) and not more than 4 (Four)

Faculty Load: In Semester VII– ½ hour per week per project group

In Semester VIII – 1 hour per week per project group

2. Out of 4 hours/week allotted for the mini-projects 1-A and 1-B, an expert lecture of at least one hour per week from industry/institute or a field visit to nearby domain specific industry should be arranged.
3. Mini-projects 2-A and 2-B should be based on DLOs.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC 301	Engineering Maths III	03	--	01	03	--	01	04

Course Code	Course Name	Examination Scheme								
		Theory Marks					Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours				
		Test 1	Test 2	Avg. of Test 1 and Test 2						
ECC 301	Engineering Maths III	20	20	20	80	03	25	--	--	125

Pre-requisite:

Engineering Mathematics-I, Engineering Mathematics-II, Scalar and Vector Product: Scalar and vector product of three and four vectors

Course Objectives:

The course is aimed

1. To learn the Laplace Transform, Inverse Laplace Transform of various functions and its applications.
2. To understand the concept of Fourier Series, its complex form and enhance the problem-solving skills.
3. To understand the concept of complex variables, C-R equations, harmonic functions and its conjugate and mapping in complex plane.
4. To understand the basics of Linear Algebra.
5. To use concepts of vector calculus to analyze and model engineering problems.

Course Outcomes:

After successful completion of the course students will be able to:

1. Understand the concept of Laplace transform and its application to solve the real integrals in engineering problems.
2. Understand the concept of inverse Laplace transform of various functions and its applications in engineering problems.
3. Expand the periodic function by using Fourier series for real life problems and complex engineering problems.
4. Understand complex variable theory, application of harmonic conjugate to get orthogonal trajectories and analytic function.
5. Use matrix algebra to solve the engineering problems.
6. Apply the concepts of vector calculus in real life problems.

Module No.	Unit No.	Contents	Hrs.
1		Laplace Transform	06
	1.1	Definition of Laplace transform, Condition of Existence of Laplace transform.	
	1.2	Laplace Transform (L) of Standard Functions like e^{at} , $\sin(at)$, $\cos(at)$, $\sinh(at)$, $\cosh(at)$ and $t^n, n \geq 0$	
	1.3	Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by t , Division by t , Laplace Transform of derivatives and integrals (Properties without proof).	
	1.4	Evaluation of integrals by using Laplace Transformation.	
	Self-learning Topics: Heaviside's Unit Step function, Laplace Transform of Periodic functions, Dirac Delta Function.		
2		Inverse Laplace Transform	06
	2.1	Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivatives.	
	2.2	Partial fractions method to find inverse Laplace transform.	
	2.3	Inverse Laplace transform using Convolution theorem (without proof).	
	Self-learning Topics: Applications to solve initial and boundary value problems involving ordinary differential equations.		
3		Fourier Series	06
	3.1	Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof).	
	3.2	Fourier series of periodic function with period 2π and $2l$.	
	3.3	Fourier series of even and odd functions.	
	3.4	Half range Sine and Cosine Series.	
	Self-learning Topics: Complex form of Fourier Series, Orthogonal and Orthonormal set of functions. Fourier Transform.		
4		Complex Variables	06
	4.1	Function $f(z)$ of complex variable, limit, continuity and differentiability of $f(z)$ Analytic function, necessary and sufficient conditions for $f(z)$ to be analytic (without proof).	
	4.2	Cauchy-Riemann equations in Cartesian coordinates (without proof).	

	4.3	Milne-Thomson method to determine analytic function $f(z)$ when real part (u) or Imaginary part (v) or its combination (u+v or u-v) is given.	
	4.4	Harmonic function, Harmonic conjugate and orthogonal trajectories	
	Self-learning Topics: Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations		
5		Linear Algebra: Matrix Theory	06
	5.1	Characteristic equation, Eigen values and Eigen vectors, Example based on properties of Eigen values and Eigen vectors. (Without Proof).	
	5.2	Cayley-Hamilton theorem (Without proof), Examples based on verification of Cayley- Hamilton theorem and compute inverse of Matrix.	
	5.3	Similarity of matrices, Diagonalization of matrices. Functions of square matrix	
	Self-learning Topics: Application of Matrix Theory in machine learning and google page rank algorithms, derogatory and non-derogatory matrices.		
6		Vector Differentiation and Integral	06
	6.1	Vector differentiation: Basics of Gradient, Divergence and Curl (Without Proof).	
	6.2	Properties of vector field: Solenoidal and irrotational (conservative) vector fields.	
	6.3	Vector integral: Line Integral, Green's theorem in a plane (Without Proof), Stokes' theorem (Without Proof) only evaluation.	
	Self-learning Topics: Gauss' divergence Theorem and applications of Vector calculus		
Total			36

References:

1. H. K. Das, Advanced Engineering Mathematics, S. Chand Publications, 22nd edition, 2018.
2. B. V. Ramana, Higher Engineering Mathematics, Tata Mc-Graw Hill Publication. 1st edition, 2006.
3. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Narosa Publication, 1st edition, 2006.
4. Wylie and Barret, Advanced Engineering Mathematics, Tata Mc-Graw Hill, 6th edition, 2003.
5. Murray Spiegel, Schaum's Outline of Fourier Analysis with Applications to Boundary Value Problems (Schaum's Outline Series).
6. Murray Spiegel, Schaum's Outline of Vector Analysis (Schaum's Outline Series), Mc-Graw Hill Publication.
7. Seymour Lipschutz, Schaum's Outline of Beginning Linear Algebra (Schaum's Outline Series), Mc-Graw Hill Publication.
8. Dr. B. S. Grewal, Higher Engineering Mathematics, Khanna Publication, 43rd edition, 2010.

Term Work:

General Instructions:

1. Batch wise tutorials are to be conducted. The number of students per batch should be as per University pattern for practicals.
2. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
3. A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Engineering mathematics. This project should be graded for 10 marks depending on the performance of the students.
4. The distribution of Term Work marks will be as follows –

1.	Attendance (Theory and Tutorial)	05 marks
2.	Class Tutorials on entire syllabus	10 marks
3.	Mini project	10 marks

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks.

End Semester Examination:

1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on the entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC 302	Electronic Devices	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme								
		Theory Marks					Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours				
		Test 1	Test 2	Avg. of Test 1 and Test 2						
ECC 302	Electronic Devices	20	20	20	80	03	--	--	--	100

Course Objectives:

1. To deliver the knowledge of basic semiconductor devices.
2. To enhance comprehension capabilities of students through understanding of electronic devices.
3. To introduce and motivate students to the use of advanced nano-electronic devices
4. To analyse amplifiers using BJT and FET based devices.

Course Outcomes:

After successful completion of the course students will be able to:

1. Explain the working of semiconductor devices.
2. Interpret the characteristics of semiconductor devices.
3. Analyse Electronics circuits using BJT and FET (DC & AC analysis)
4. Compare various biasing circuits & configurations of BJT and MOSFETs.
5. Select best circuit for the given specifications/application.
6. Describe the working of advanced nano-electronic devices

Module No.	Unit No.	Contents	Hrs.
1		P-N Junction Diode & Applications	06
	1.1	Theoretical description of basic structure & construction, symbol, operation under zero bias, forward bias & reverse bias, avalanche breakdown, V-I characteristics & temperature effects (no mathematical analysis or numerical examples)	
	1.2	Application of P-N junction diode as clippers & clampers (different types of configurations with input-output waveforms & transfer characteristics; theoretical description & analysis of each circuit; numerical examples)	
2		Special Semiconductor Devices	04
	2.1	Zener diode as the voltage regulator (theoretical description only which includes construction of circuit diagram, operation / working for varying DC input voltage & varying load resistance, concept of line regulation & load regulation – no numerical examples)	
	2.2	Construction, structure, symbol, operating principle, working & V-I characteristics of special semiconductor devices such as Varactor diode, Schottky diode, Photo diode, Light emitting diode (LED) & Solar cells	
3		Bipolar Junction Transistor (BJT)	03
	3.1	BJT construction & structure, symbol, operation, voltages & currents, V-I characteristics of common emitter (CE), common base (CB) & common collector (CC) configuration, Early effect & concept of leakage current	
4		Field Effect Devices (FET)	03
	4.1	JFET: Construction, symbol, operation, V-I & transfer characteristics MOSFET: Construction, operation, symbol, V-I & transfer characteristics of the D-MOSFET & E-MOSFET (theoretical description only for JFET & MOSFET)	
5		Rectifiers & Filters	04
	5.1	Rectifiers: Working & mathematical analysis of full – wave centre tapped rectifier & bridge type rectifier (mathematical analysis include expressions for the DC / average & RMS output voltage, DC / average & RMS output current & ripple factor; numerical examples included)	
	5.2	Filters: Capacitor (C), Inductor (L), Inductor – Capacitor (LC), C-L-C (π) with circuit diagram, waveforms, working / operation & expression for ripple factor (theoretical description only – no analysis or numerical examples to be included)	
		Total	20

Text Books:

1. Donald A. Neamen, “Electronic Circuit Analysis and Design”, TATA McGraw Hill, 2nd Edition
2. Adel S. Sedra, Kenneth C. Smith and Arun N Chandorkar, “Microelectronic Circuits Theory and Applications”, International Version, OXFORD International Students Edition, Fifth Edition.
3. James Morris & Krzysztof Iniewski, Nano-electronic Device Applications Handbook by CRC Press

Reference Books:

1. Boylestead, " Electronic Devices and Circuit Theory", Pearson Education
2. David A. Bell, “Electronic Devices and Circuits”, Oxford, Fifth Edition.
3. Muhammad H. Rashid, “Microelectronics Circuits Analysis and Design”, Cengage
4. S. Salivahanan, N. Suresh Kumar, “Electronic Devices and Circuits”, Tata McGraw Hill.
5. Millman and Halkies, “Integrated Electronics”, Tata McGraw Hill.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks.

End Semester Examination:

1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on the entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and oral	Tutorial	Theory	Practical and oral	Tutorial	Total
ECC 303	Digital Electronics	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ECC 303	Digital Electronics	20	20	20	80	03	--	--	100

Course Pre-requisites:

Basic Electrical & Electronics Engineering

Course Objectives:

1. To understand various number systems & codes and to introduce students to various logic gates, SOP, POS form and their minimization techniques.
2. To teach the working of combinational circuits, their applications and implementation of combinational logic circuits using MSI chips.
3. To teach the elements of sequential logic design, analysis and design of sequential circuits.
4. To understand various counters and shift registers and its design using MSI chips.
5. To explain and describe various logic families and Programmable Logic Devices.
6. To train students in writing programs with Verilog hardware description languages.

Course Outcomes:
After successful completion of the course students will be able to

1. Perform code conversion and able to apply Boolean algebra for the implementation and minimisation of logic functions.
2. Analyse, design and implement Combinational logic circuits.
3. Analyse, design and implement Sequential logic circuits.
4. Design and implement various counter using flip flops and MSI chips.
5. Understand TTL & CMOS logic families, PLDs, CPLD and FPGA.
6. Understand basics of Verilog Hardware Description Language and its programming with combinational and sequential logic circuits.

Module No.	Unit No	Contents	Hrs.
1		Fundamentals of Digital Design	02
	1.1	Number Systems and Codes: Review of Number System, Weighted code, Parity Code: Hamming Code	
		Combinational Circuits using basic gates as well as MSI devices	02
2	2.1	Arithmetic Circuits: Ripple carry adder, Carry Look ahead adder	
	2.2	MSI devices: IC 7483, IC 74151, IC 74138, IC 7485.	
		Sequential Logic Design	07
3	3.1	Sequential Logic Design: Mealy and Moore Machines, Clocked synchronous state machine analysis, State reduction techniques (inspection, partition and implication chart method) and state assignment, sequence detector, Clocked synchronous state machine design.	
	3.2	Sequential logic design practices: MSI counters (7490, 7492, 7493, 74163, 74169) and applications, MSI Shift registers (74194) and their applications.	
		Logic Families and Programmable Logic Devices	04
4	4.1	CMOS Logic: CMOS inverter, CMOS NAND and CMOS NOR, Interfacing CMOS to TTL and TTL to CMOS.	
	4.2	Programmable Logic Devices: Concepts of PAL and PLA. Simple logic implementation using PAL and PLA, Introduction to CPLD and FPGA architectures, Numericals based on PLA and PAL	
		Introduction to Verilog HDL	05
5	5.1	Basics: Introduction to Hardware Description Language and its core features, synthesis in digital design, logic value system, data types, constants, parameters, wires and registers. Verilog Constructs: Continuous & procedural assignment statements, logical, arithmetic, relational, shift operator, always, if, case, loop statements, Gate level modelling, Module instantiation statements.	
	5.2	Modelling Examples: Combinational logic eg. Arithmetic circuits, Multiplexer, Demultiplexer, decoder, Sequential logic eg. flip flop, counters.	
		Total	20

Text Books:

1. R. P. Jain, Modern Digital Electronics, Tata McGraw Hill Education, Third Edition 2003.
2. Morris Mano, Digital Design, Pearson Education, Asia 2002.
3. J. Bhaskar, A Verilog HDL Primer, Third Edition, Star Galaxy Publishing, 2018.

Reference Books:

1. Digital Logic Applications and Design – John M. Yarbrough, Thomson Publications, 2006
2. John F. Warkerly, Digital Design Principles and Practices, Pearson Education, Fourth Edition, 2008.
3. Stephen Brown and Zvonko Vranesic, Fundamentals of digital logic design with Verilog design, McGraw Hill, 3rd Edition.
4. Digital Circuits and Logic Design – Samuel C. Lee, PHI
5. William I. Fletcher, “An Engineering Approach to Digital Design”, Prentice Hall of India.
6. Parag K Lala, “Digital System design using PLD”, BS Publications, 2003.
7. Charles H. Roth Jr., “Fundamentals of Logic design”, Thomson Learning, 2004.

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first-class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and the second class test (Internal Assessment II) when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on the entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC 304	Data Structures and Algorithms	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ECC 304	Data Structures and Algorithms	20	20	20	80	03	--	-- --	100

Course Prerequisite:
C Programming

Course Objectives:

1. To understand and demonstrate basic data structures (such as Arrays, linked list, stack, queue, binary tree, graph).
2. To implement various operations on data structures.
3. To study different sorting and searching techniques.
4. To choose efficient data structures and apply them to solve real world problems.

Course Outcomes:

After successful completion of the course students will be able to

1. Implement various linear data structures.
2. Implement various non-linear data structures.
3. Select appropriate sorting and searching techniques for a given problem and use it.
4. Develop solutions for real world problems by selecting appropriate data structure and algorithms.
5. Analyse the complexity of the given algorithms.

Module No.	Unit No.	Contents	Hrs.
1		Introduction to Data Structures	02
		Introduction to Data Structures, Types of Data Structures – Linear and Nonlinear, Operations on Data Structures, Concept of array, Static arrays vs Dynamic Arrays, structures.	
2		Stack and Queues	04
		Introduction, Basic Stack Operations, Representation of a Stack using Array, Applications of Stack – Infix to Postfix Conversion and Postfix Evaluation. Queue, Operations on Queue	
3		Linked List	04
		Introduction, Representation of Linked List, Linked List v/s Array, Types of Linked List - Singly Linked List (SLL), Operations on Singly Linked List: Insertion, Deletion, Print SLL. Implementation of Stack and Queue using Singly Linked List.	
4		Trees	04
		Introduction, Tree Terminologies, Binary Tree, Representation of Binary Trees, Binary Tree Traversals, Binary Search Tree Operations on Binary Search Tree,	
5		Graphs	03
		Introduction, Graph Terminologies, Representation of graph (Adjacency matrix and adjacency list), Graph Traversals – Depth First Search (DFS) and Breadth First Search (BFS)	
6		Introduction to Sorting and Searching	03
		Introduction to Searching: Linear search, Binary search, Sorting: Internal VS. External Sorting, Sorting Techniques: Bubble, Insertion, selection, Quick Sort, Merge Sort	
		Total	20

Text Books:

1. Data Structures Using C, Aaron M Tenenbaum, Yedidyah Langsam, Moshe J Augenstein, Pearson Education
2. Introduction to Data Structure and its Applications Jean-Paul Tremblay, P. G.Sorenson
3. Data Structures using C, Reema Thareja, Oxford
4. C and Data structures, Prof. P.S.Deshpande, Prof. O.G.Kakde, Dreamtech Press.
5. Data Structures: A Pseudocode Approach with C, Richard F. Gilbert & Behrouz A. Forouzan, Second Edition, CENGAGE Learning

Reference Books:

1. Data Structure Using C, Balagurusamy.
2. Data Structures using C and C++, Rajesh K Shukla, Wiley - India
3. ALGORITHMS Design and Analysis, Bhasin, OXFORD.
4. Data Structures Using C, ISRD Group, Second Edition, Tata McGraw-Hill.
5. Computer Algorithms by Ellis Horowitz and Sartaj Sahni, Universities Press.
6. Data Structures, Adapted by: GAV PAI, Schaum's Outlines.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered as the final IA marks.

End Semester Examination:

1. Question paper will consist of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on the entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC 305	Database Management Systems	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ECC 305	Database Management Systems	20	20	20	80	03	--	--	100

Course Objectives:

1. Develop entity relationship data model and its mapping to relational model
2. Learn relational algebra and formulate SQL queries
3. Apply normalization techniques to normalize the database
4. Understand concepts of transaction, concurrency control and recovery techniques

Course Outcomes:

After successful completion of the course students will be able to:

1. Recognize the need of database management system
2. Design ER and EER diagram for real life applications
3. Construct relational model and write relational algebra queries.
4. Formulate SQL queries
5. Apply the concept of normalization to relational database design.
6. Describe the concepts of transaction, concurrency and recovery.

Module No.	Unit No.	Contents	Hrs.
1		Introduction to Database Concepts	03
	1.1	Introduction, Characteristics of databases	
	1.2	File systems v/s Database systems	
	1.3	Data abstraction and Data Independence	
	1.4	DBMS system architecture	
	1.5	Database Administrator	
2		Entity–Relationship Data Model	03
	2.1	The Entity-Relationship (ER) Model	
	2.2	Entity types: Weak and strong entity sets, Entity sets, Types of Attributes, Keys	
	2.3	Relationship constraints: Cardinality and Participation	
3		Relational Model and Relational Algebra	03
	3.1	Relational schema and concept of keys	
	3.2	Relational Algebra – operators, Relational Algebra Queries.	
4		Structured Query Language (SQL)	05
	4.1	Overview of SQL	
	4.2	Data Definition Commands	
	4.3	Integrity constraints: Key constraints, Domain Constraints, Referential integrity, Check constraints	
	4.4	Data Manipulation commands, Data Control commands	
	4.5	Set and string operations, aggregate function - group by, having	
5		Relational–Database Design	03
	5.1	Concept of normalization	
	5.2	Function Dependencies	
	5.3	First Normal Form, 2NF, 3NF	
6		Transactions Management and Concurrency and Recovery	03
	6.1	Transaction Concept, Transaction states	

	6.2	ACID properties	
	6.3	Transaction Control Commands	
	6.4	Serializability: Conflict and View	
		Total	20

Text Books:

1. Korth, Silberchatz, Sudarshan, Database System Concepts, 6th Edition, McGraw Hill
2. Elmasri and Navathe, Fundamentals of Database Systems, 5th Edition, Pearson education
3. Raghu Ramkrishnan and Johannes Gehrke, Database Management Systems, TMH

Reference Books:

1. Peter Rob and Carlos Coronel, Database Systems Design, Implementation and Management, Thomson Learning, 5th Edition.
2. Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g, Black Book, Dreamtech Press.
3. G. K. Gupta, Database Management Systems, McGraw Hill., 2012

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on the entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Total
ECL 301	Electronic Devices Lab	--	02	--	--	01	01

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical & Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ECL 301	Electronic Devices Lab	--	--	--	--	--	25	25	50

Laboratory Objectives:

1. To deliver a hands-on approach for studying electronic devices
2. To comprehend characteristics of electronic devices; thereby understanding their behaviour
3. To analyse & calculate inherent parameters of electronic devices through experimental approach
4. To introduce modern software simulation tools for modelling & simulation of electronic devices

Laboratory Outcomes:

After successful completion of the laboratory students will be able to

1. Explain the working of semiconductor devices.
2. Interpret the characteristics of semiconductor devices.
3. Analyse electronics circuits using BJT and FET (DC & AC analysis)
4. Simulate basic circuits using electronic devices through software simulation

Term Work:

At least 6 experiments covering entire syllabus of ECC 302 (Electronic Devices) should be set to have well predefined inference and conclusion. **This must include 60% Hardware and 40% Simulation experiments.** The experiments should be student centric and attempt should be made to make the experiments meaningful and interesting. Experiments must be graded from time to time. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. The grading and term work assessment should be done based on this scheme. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus.

Suggested List of Experiments is given below. 70% of the experiments performed should be from this list. For the rest 30%, the course instructor has the option to set innovative experiments, from within the curriculum.

List of Hardware Experiments

Sr. No.	Experiment Name
1	To study passive (R, L, C) and active (BJT, MOSFET) components.
2	To study equipment (CRO, Function Generator, Power supply).
3	To perform characteristics of PN junction diode.
4	To perform Clippers and Clampers.
5	To perform Full wave/Bridge rectifier with LC/pi filter.
6	To perform Zener as a shunt voltage regulator.
7	To simulate VI characteristics of MEMRISTOR using nanohub.org

List of Simulation Experiments

Sr. No.	Experiment Name
1	SPICE simulation of and implementation for junction analysis
2	SPICE simulation of and implementation for BJT characteristics
3	SPICE simulation of and implementation for JFET characteristics
4	SPICE simulation of for MOSFET characteristics
5	SPICE simulation of Full wave/Bridge rectifier with LC/pi filter.

Course Code	Course Name	Teaching Scheme			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Total
ECL 302	Digital Electronics Lab	--	02	--	--	01	01

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical & Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ECL 302	Digital Electronics Lab	-	-	-	-	-	25	25	50

Laboratory Objectives:

1. To learn the functionality of basic logic gates.
2. To construct combinational circuits and verify their functionalities.
3. To learn the functionality of flip flops and their conversion.
4. To design and implement synchronous and asynchronous counters, Shift registers using MSI
5. To simulate various combinational and sequential circuits and analyze the results using Verilog HDL.

Term Work:

At least 6 experiments covering the entire syllabus of ECC 303 (Digital Logic Circuits) should be set to have well predefined inference and conclusion. The experiments should be student centric and attempt should be made to make experiments meaningful and interesting. Simulation experiments are also encouraged. Experiment must be graded from time to time. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. The grading and term work assessment should be done based on this scheme. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus.

Suggested List of Experiments is given below. 70% of the experiments performed should be from this list. For the rest 30%, the course instructor has the option to set innovative experiments, from within the curriculum.

List of Hardware Experiments

Sr. No.	Experiment Title
1	To verify different logic gates and implement basic gates using universal gates
2	To implement Boolean function in SOP and POS form
3	To implement half adder, full adder, half Subtractor, full Subtractor
4	To implement BCD adder using binary adder IC 7483
5	To implement logic equations using Multiplexer IC 74151
6	To verify truth table of SR, JK, T and D flip flops
7	To perform Flip flop conversion JK to D, JK to T and D to T flip flop
8	To implement MOD N counter using IC 7490/7492/7493
9	To implement Synchronous counter using IC 74163/74169 OR To implement universal shift register using IC 74194

List of Simulation/Software Experiments

Sr. No.	Experiment Title
1	To design and simulate Full adder/full subtractor using Verilog HDL
2	To design and simulate Multiplexer/Demultiplexer using Verilog HDL
3	To design and simulate decoder 74138 using Verilog HDL
4	To simulate basic flip flops using Verilog HDL
5	To design and simulate 4 bit counter / up-down counter using Verilog HDL
6	To design and simulate Shift register using Verilog HDL

Additional/ Suggested experiments (optional) - Implementation of any of above using FPGA/CPLD

Course Code	Course Name	Teaching Scheme			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Total
ECL 303	Data Structures and Algorithms Lab	--	02	--	--	01	01

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical & Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ECL 303	Data Structures and Algorithms Lab	--	--	--	--	--	25	25	50

Prerequisite:

C Programming Language

Laboratory Outcomes:

1. Students will be able to implement linear data structures & will be able to handle operations like insertion, deletion, searching and traversing on them.
2. Students will be able to implement nonlinear data structures & will be able to handle operations like insertion, deletion, searching and traversing on them.
3. Students will be able to choose appropriate data structure and apply it in various problem domains.
4. Students will be able to select appropriate searching techniques for given problems.

Term Work:

At least 6 experiments and 2 assignments covering entire syllabus of **Data Structures and Algorithms (ECC 304)** should be set to have well predefined inference and conclusion. The experiments should be student centric and attempt should be made to make experiments meaningful and interesting. Experiment must be graded from time to time. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. The grading and term work assessment should be done based on this scheme. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus.

Total 25 Marks = (Experiments-15 mark + Attendance -5 mark + Assignments-05 mark)

Suggested List of Experiments

(*) marked experiments are compulsory.

Sr. No	Experiment Name
1	*Implement Stack ADT using array
2	*Convert an Infix expression to Postfix expression using stack ADT
3	*Implement Linear Queue ADT using array
4	*Implement Singly Linked List ADT
5	*Implement Binary Search Tree ADT using Linked List
6	*Implement searching algorithms -Linear search, Binary search
7	*Implement sorting algorithms (any 2)- bubble, selection, insertion, merge,quick

Useful Links:

1. www.leetcode.com
2. www.hackerrank.com
3. www.cs.usfca.edu/~galles/visualization/Algorithms.html
4. www.codechef.com

Course Code	Course Name	Teaching Scheme			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Total
ECL 304	Database Management Systems lab	--	02	--	--	01	01

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ECL 304	Database Management Systems lab	--	--	--	--	--	25	25	50

Laboratory Outcomes:

At the end of the course the student should be able to

1. Design ER /EER diagram and convert to relational model for the realworld application.
2. Apply DDL, DML, DCL and TCL commands.
3. Write simple and complex queries
4. Use PL/SQL Constructs.
5. Demonstrate the concept of concurrent transactions execution and frontend-backend connectivity

Term Work:

At least 6 experiments covering the entire syllabus of Database Management Systems (ECC 305) should be set to have well predefined inference and conclusion. The experiments should be student centric and attempt should be made to make the experiments meaningful and interesting. Experiments must be graded from time to time. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. The grading and term work assessment should be done based on this scheme. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus.

Suggested List of Experiments is given below. 70% of the experiments performed should be from this list. For the rest 30%, the course instructor has the option to set innovative experiments, from within the curriculum.

Sr. No.	Experiment Name
1	Identify the case study and detailed statement of problem. Design an Entity-Relationship (ER)
2	Create a database using Data Definition Language (DDL) and apply integrity constraints for the specified System
3	Apply DML Commands for the specified system
4	Perform Simple queries, string manipulation operations and aggregate functions.
5	Implement various Join operations.
6	Perform Nested and Complex queries
7	Perform DCL and TCL commands
8	Demonstrate Database connectivity

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECL 305	Skill-based Lab OOPM	--	02* + 02	--	--	02	--	02
* Theory class to be conducted for full class								

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical And Oral	Total
		Internal assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ECL 305	Skill-based Lab OOPM	--	--	--	--	--	50	--	50

Course Pre-requisites:

- Fundamentals of C-Programming
- Control Structures
- Arrays and String

Course Objectives:

1. To understand Object Oriented Programming basics and its features.
2. To understand and apply Object Oriented Programming (OOP) principles
3. Able to implement Methods, Constructors, Arrays, Multithreading and Applet in java
4. Able to use a programming language to resolve problems.

Course Outcomes:

After successful completion of the course student will be able to

1. Use different control structures.
2. Understand fundamental features of an object-oriented language: object classes and interfaces, exceptions and libraries of object collections.
3. Understand Java Programming.
4. To develop a program that efficiently implements the features and packaging concept of java in laboratory.
5. To implement Exception Handling and Applets using Java.

Module No	Unit No.	Contents	Hrs.
1		Introduction to Java	06
	1.1	Programming paradigms- Introduction to programming paradigms, Introduction to four main Programming paradigms like procedural, object oriented, functional, and logic & rule based. Difference between C++ and Java.	
	1.2	Java History, Java Features, Java Virtual Machine, Data Types and Size (Signed vs. Unsigned, User Defined vs. Primitive Data Types, Explicit Pointer type), Programming Language JDK Environment and Tools.	
2		Inheritance, Polymorphism, Encapsulation using Java	12
	2.1	Classes and Methods: class fundamentals, declaring objects, assigning object reference variables, adding methods to a class, returning a value, constructors, this keyword, garbage collection, finalize () method, overloading methods, argument passing, object as parameter, returning objects, access control, static, final, nested and inner classes, command line arguments, variable-length Arguments. String: String Class and Methods in Java.	
	2.2	Inheritances: Member access and inheritance, super class references, Using super, multilevel hierarchy, constructor call sequence, method overriding, dynamic method dispatch, abstract classes, Object class. Packages and Interfaces: defining a package, finding packages and CLASSPATH, access protection, importing packages, interfaces (defining, implementation, nesting, applying), variables in interfaces, extending interfaces, instance of operator.	
3		Exception Handling and Applets in Java	06
	3.1	Exception Handling: fundamental, exception types, uncaught exceptions, try, catch, throw, throws, finally, multiple catch clauses, nested try statements, built-in exceptions, custom exceptions (creating your own exception subclasses).	
	3.2	Applet: Applet Fundamental, Applet Architecture, Applet Life Cycle, Applet Skeleton, Requesting Repainting, status window, HTML Applet tag, passing parameters to Applets, Applet and Application Program.	
		Total	24

Textbooks:

1. Bjarne Stroustrup, “The C++ Programming language”, Third edition, Pearson Education, 2000.
2. Deitel, “C++ How to Program”, 4th Edition, Pearson Education, 2005.
3. D. T. Editorial Services, “Java 8 Programming Black Book”, Dreamtech Press, Edition, 2015.
4. Yashwant Kanitkar, “Let Us Java”, BPB Publications, 4nd Edition, 2019.

Reference Books:

1. Herbert Schidt, “The Complete Reference”, Tata McGraw-Hill Publishing Company Limited, 10th Edition, 2017.
2. Harvey M. Deitel, Paul J. Deitel, Java: How to Program, 8th Edition, PHI, 2009.
3. Grady Booch, James Rumbaugh, Ivar Jacobson, “The Unified Modeling Languageser Guide”, Pearson Education.
4. Sachin Malhotra, Saurabh Chaudhary “Programming in Java”, Oxford University Press, 2010

Software Tools:

1. Raptor-Flowchart Simulation:<http://raptor.martincarlisle.com/>
2. Eclipse: <https://eclipse.org/>
3. Netbeans:<https://netbeans.org/downloads/>
4. CodeBlock:<http://www.codeblocks.org/>
5. J-Edit/J-Editor/Blue J

Online Repository:

1. Google Drive
2. GitHub
3. Code Guru

Suggested list of Experiments

Sr. No.	JAVA Programs
1	Display addition of number
2	Accept marks from user, if Marks greater than 40, declare the student as “Pass” else “Fail”
3	Accept 3 numbers from user. Compare them and declare the largest number (Using if-else statement).
4	Display sum of first 10 even numbers using do-while loop.
5	Display Multiplication table of 15 using while loop.
6	Display basic calculator using Switch Statement.
7	Display the sum of elements of arrays.
8	Accept and display the string entered and execute at least 5 different string functions on it.
9	Read and display the numbers as command line Arguments and display the addition of them
10	Define a class, describe its constructor, overload the Constructors and instantiate its object.
11	Illustrate method of overloading
12	Demonstrate Parameterized Constructor

13	Implement Multiple Inheritance using interface
14	Create thread by implementing 'Runnable' interface or creating 'Thread Class.
15	Demonstrate Hello World Applet Example

Term Work:

At least 8 experiments covering entire syllabus should be set to have well predefined inference and conclusion. Teacher should refer the suggested experiments and can design additional experiment to maintain better understanding and quality.

The experiments should be students centric and attempt should be made to make experiments meaningful, interesting and innovative. Term work assessment must be based on the overall performance of the student, with experiments graded from time to time.

The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on the entire syllabus. Students are encouraged to share their experiment codes on online repository. Practical exam slip should cover all 16 experiments for examination.

Course code	Course Name	Credits
ECM 301	Mini Project 1 A	02

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical/ Oral	Total
		Internal Assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ECM 301	Mini Project- 1A	--	--	--	--	--	25	25	50

Objectives

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Outcomes:

Learner will be able to...

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as member of a group or leader.
4. Draw the proper inferences from available results through theoretical/ experimental/simulations.
5. Analyse the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to life-long learning.
9. Demonstrate project management principles during project work.

Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.

- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.
- **Students must take up a project spanning Semester 3 and Semester 4. It is expected that in Semester 3, Literature Survey and Problem formulation is completed and a concise report of the same is submitted. In Semester 4, Implementation of the project followed by report is expected.**

Guidelines for Assessment of Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;
 - Marks awarded by guide/supervisor based on log book : 10
 - Marks awarded by review committee : 10
 - Quality of Project report : 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.
 - First shall be for finalisation of problem
 - Second shall be on finalisation of proposed solution of problem.
- In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
 - First review is based on readiness of building working prototype to be conducted.
 - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
 - Identification of need/problem
 - Proposed final solution
 - Procurement of components/systems
 - Building prototype and testing
- Two reviews will be conducted for continuous assessment,
 - First shall be for finalisation of problem and proposed solution
 - Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project.

Mini Project shall be assessed based on following criteria;

1. Quality of survey/ need identification
 2. Clarity of Problem definition based on need.
 3. Innovativeness in solutions
 4. Feasibility of proposed problem solutions and selection of best solution
 5. Cost effectiveness
 6. Societal impact
 7. Innovativeness
 8. Cost effectiveness and Societal impact
 9. Full functioning of working model as per stated requirements
 10. Effective use of skill sets
 11. Effective use of standard engineering norms
 12. Contribution of an individual's as member or leader
 13. Clarity in written and oral communication
- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
 - In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organisations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on following points;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication

UNIVERSITY OF MUMBAI



Bachelor of Engineering

in

Bio-medical Engineering

**Direct Second Year (Sem. III) Admitted Students for the
current Academic Year 2020-21(Only)**

(REV- 2019 'C' Scheme) from Academic Year 2019 – 20

**Under
FACULTY OF
SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2019–2020)

Program Structure for Second Year Engineering
Semester III & IV
UNIVERSITY OF MUMBAI
(With Effect from 2020-2021)

Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
BMC301	Engineering Mathematics - III	3	--	1	3	--	1	4	
BMC302	Human Anatomy and Physiology for Engineers	3		--	3		--	3	
BMC303	Medical Sensors	3	--	--	3	--	--	3	
BMC304	Electronic Circuits Analysis and Design	4	--	--	4	--	--	4	
BMC305	Digital Electronics	3	--	--	3	--	--	3	
BML301	Human Anatomy and Physiology for Engineers Lab	--	2	--	--	1	--	1	
BML302	Medical Sensors Lab	--	2	--	--	1	--	1	
BML303	Electronic Circuits Analysis and Design Lab	--	2	--	--	1	--	1	
BML304	Electronics Lab (SBL)	--	4	--	--	2	--	2	
BMM301	Mini Project – 1 A	--	4 ^{\$}	--	--	2	--	2	
Total		16	14	1	16	07	1	24	
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg.					
BMC301	Engineering Mathematics - III	20	20	20	80	3	25	--	125
BMC302	Human Anatomy and Physiology for Engineers	20	20	20	80	3	--	--	100
BMC303	Medical Sensors	20	20	20	80	3	--	--	100
BMC304	Electronic Circuits Analysis and Design	20	20	20	80	3	--	--	100
BMC305	Digital Electronics	20	20	20	80	3	--	--	100
BML301	Human Anatomy and Physiology for Engineers Lab	--	--	--	--	--	25	--	25
BML302	Medical Sensors Lab	--	--	--	--	--	25	25	50
BML303	Electronic Circuits Analysis and Design Lab	--	--	--	--	--	25	25	50
BML304	Electronics Lab (SBL)	--	--	--	--	--	25	25	50
BMM301	Mini Project – 1 A	--	--	--	--	--	25	--	25
Total		--	--	100	400	--	150	75	725

\$ indicates work load of Learner (Not Faculty), for Mini Project - 1 A.

Faculty Load :1 hour per week per 4 mini project groups.

Semester – III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
BMC301	Engineering Mathematics-III	03	-	01	03	-	01	04

Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Avg of Test 1 & 2					
BMC301	Engineering Mathematics-III	20	20	20	80	25	-	-	125

Pre-requisite: Engineering Mathematics-I, Engineering Mathematics-II, Scalar and Vector Product: Scalar and Vector product of three and four vectors.

Course Code	Course Name	Credits
BMC301	Engineering Mathematics - III	04
Course Objectives	- To familiarize with the Laplace Transform, Inverse Laplace Transform of various functions, and its applications. - To acquaint with the concept of Fourier Series, its complex form and enhance the problem solving skills - To familiarize the concept of complex variables, C-R equations, harmonic functions, its conjugate and mapping in complex plane. - To understand the basics of Linear Algebra and its applications - To use concepts of vector calculus to analyze and model engineering problems.	
Course Outcomes	On successful completion of course learner will be able to: - Apply the concept of Laplace transform to solve the real integrals in engineering problems. - Apply the concept of inverse Laplace transform of various functions in engineering problems. - Expand the periodic function by using Fourier series for real life problems and complex engineering problems. - Find orthogonal trajectories and analytic function by using basic concepts of complex variables. - Illustrate the use of matrix algebra to solve the engineering problems. - Apply the concepts of vector calculus in real life problems.	

Module	Detailed Contents	Hrs.
1.	Module: Laplace Transform 1.1 Definition of Laplace transform, Condition of Existence of Laplace Transform. 1.2 Laplace Transform (L) of standard functions like e^{at}, $\sin(at)$, $\cos(at)$, $\sinh(at)$, $\cosh(at)$ and t^n, $n \geq 0$. 1.3 Properties of Laplace Transform: Linearity, First Shifting Theorem, Second Shifting Theorem, Change of Scale Property, Multiplication by t, Division by t, Laplace Transform of derivatives and integrals (Properties without proof). 1.4 Evaluation of integrals by using Laplace Transformation. Self-learning Topics: Heaviside's Unit Step function, Laplace Transform of Periodic functions, Dirac Delta Function.	07
2.	Module: Inverse Laplace Transform 2.1 Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace Transform using derivatives. 2.2 Partial fractions method to find inverse Laplace Transform. 2.3 Inverse Laplace Transform using Convolution theorem (without proof). Self-learning Topics: Applications to solve initial and boundary value problems involving ordinary differential equations.	06
3.	Module: Fourier Series: 3.1 Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof). 3.2 Fourier series of periodic function with period 2π and $2l$. 3.3 Fourier series of even and odd functions. 3.4 Half range Sine and Cosine Series. Self-learning Topics: Complex form of Fourier Series, Orthogonal and orthonormal set of functions. Fourier Transform.	07
4.	Module: Complex Variables: 4.1 Function $f(z)$ of complex variable, limit, continuity and differentiability of $f(z)$ Analytic function, necessary and sufficient conditions for $f(z)$ to be analytic (without proof). 4.2 Cauchy-Riemann equations in cartesian coordinates (without proof). 4.3 Milne-Thomson method to determine analytic function $f(z)$ when real part (u) or Imaginary part (v) or its combination (u+v or u-v) is given. 4.4 Harmonic function, Harmonic conjugate and orthogonal trajectories. Self-learning Topics: Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations.	07
5.	Module: Linear Algebra: Matrix Theory 5.1 Characteristic equation, Eigen values and Eigen vectors, Example based on properties of Eigen values and Eigen vectors. (Without Proof). 5.2 Cayley-Hamilton theorem (Without proof), Examples based on verification of Cayley-Hamilton theorem and compute inverse of Matrix. 5.3 Similarity of matrices, Diagonalization of matrices, Functions of square matrix. Self-learning Topics: Application of Matrix Theory in machine learning and google page rank algorithms, derogatory and non-derogatory matrices.	06
6.	Module: Vector Differentiation and Integral 6.1 Vector differentiation: Basics of Gradient, Divergence and Curl (Without	06

	Proof).	
	6.2 Properties of vector field: Solenoidal and Irrotational (conservative) vector fields.	
	6.3 Vector integral: Line Integral, Green's theorem in a plane (Without Proof), Stokes' theorem (Without Proof) only evaluation.	
	Self-learning Topics: Gauss' divergence Theorem and applications of Vector calculus.	

Term Work:

General Instructions:

1. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
2. A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Engineering mathematics. This project should be graded for 10 marks depending on the performance of the students.

The distribution of marks for term work shall be as follows:

Class Tutorials on entire syllabus	: 10 Marks
Mini project	: 10 Marks
Attendance (Theory and Tutorial)	: 5 Marks

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first-class test (Internal Assessment I) is to be conducted when approximately 40% syllabus is completed and second class test (Internal Assessment II) when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

References:-

1. Advanced engineering mathematics, H.K. Das, S.Chand, Publications
2. Higher Engineering Mathematics, B. V. Ramana, Tata Mc-Graw Hill Publication
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication
4. Advanced Engineering Mathematics, Wylie and Barret, Tata Mc-Graw Hill.
5. Theory and Problems of Fourier Analysis with applications to BVP, Murray Spiegel, Schaum's Outline Series
6. Vector Analysis Murry R. Spiegel, Schaum's outline series, Mc-Graw Hill Publication
7. Beginning Linear Algebra, Seymour Lipschutz, Schaum's outline series, Mc-Graw Hill Publication
8. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication

Course Code	Course Name	Teaching scheme			Credit assigned			
BMC302	Human Anatomy and Physiology for Engineers (Abbreviated as HAPE)	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme									
		Theory					Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem	Duration (hrs)					
		Test 1	Test 2	Avg.							
BMC302	Human Anatomy and Physiology for Engineers (Abbreviated as HAPE)	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
BMC302	Human Anatomy and Physiology for Engineers	03
Course Objectives	- To understand the anatomical structures of the human body and their relationship to each other. - To understand the different physiological processes taking place inside the human body.	
Course Outcomes	Learners will be able to: - Explain the organization of the human body, homeostasis and its maintenance, structure and functions of a cell and basic tissues. - Explain the components of blood and their functions. - Explain the anatomical parts and physiological processes of the cardiovascular system and respiratory system. - Explain the anatomical parts and physiological processes of the alimentary system and renal system. - Explain the structure and functions of nervous system, eye and skin along with the secretions and functions of all endocrine glands.	

Module	Contents	Hours
1.	Introduction to the Human Body: Levels of structural organization; Characteristics of living human organism; Homeostasis and its maintenance. Cells and Tissues: Structure and functions of a cell; Transport across the plasma membrane	04
2.	Cardiovascular System: Anatomy of the heart; Heart valves, systemic and pulmonary circulation; Conduction system of the heart; Cardiac action potential, electrocardiogram (ECG); Cardiac cycle; Cardiac output; Blood pressure.	05
3.	Blood: Blood cells and their functions and ABO Blood Grouping	02
4.	Renal System: Anatomy of the renal system; Functions of kidney (urine formation, electrolyte balance and <i>pH</i> balance); composition of urine; Micturition.	05
5.	Nervous System: Structure and functions of the brain and spinal cord..	03
6.	Endocrine System: All Glands of the endocrine system, their secretions and functions.	03

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Books Recommended:

Text books:

1. Anatomy and Physiology in Health and Illness: Ross and Wilson. (ELBS Publication)
2. Essentials of Anatomy and Physiology: Elaine N Marieb. (Pearson Education)

Reference Books:

1. Physiology of Human Body: Guyton. (Prism Book)
2. Review of Medical Physiology: William Ganong. (Prentice Hall Int.)
3. Principles of Anatomy and Physiology: Tortora and Grabowski. (Harper collin Pub.)
4. Anatomy and Physiology: Elaine N Marieb. (Pearson Education)

NPTEL/Swayam Course:

Course: Animal Physiology by Prof. Mainak Das - IIT Kanpur

<https://nptel.ac.in/courses/102/104/102104058/>

https://swayam.gov.in/nd1_noc20_bt42/preview

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub-questions of 2 to 5 marks will be asked.
4. Remaining question will be randomly selected from all the modules.

Course Code	Course Name	Teaching scheme			Credit assigned			
BMC303	Medical Sensors (Abbreviated as MS)	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme									
		Theory					Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem	Dur- ation (hrs)					
		Test 1	Test 2	Avg.							
BMC303	Medical Sensors (Abbreviated as MS)	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
BMC303	Medical Sensors	03
Course Objectives	- To provide the knowledge of basic concepts such as generalized medical instrumentation system, input transducer properties, and instrument characteristics. - To provide a thorough understanding of principle and working of transducers and sensors used for measuring displacement, motion, force, pressure, temperature, bio-potentials, biochemical concentrations. - To study the medical applications of the above transducers and sensors. - To perform experiments based on some of the above transducers and sensors.	
Course Outcomes	The learner will be able to : - Explain different components of a generalized medical instrumentation system, input transducer properties, and instrument characteristics. - Apply the knowledge of principles of various types of transducers and sensors including motion, displacement, force, pressure sensors to different medical applications. - Apply the knowledge of principles of various types of temperature sensors to different medical applications. - Apply the knowledge of the various biopotential electrodes for measuring different types of biopotentials. - Apply the principles of various chemical sensors for measuring concentration of biochemical analytes. - Explain the principles of various biosensors and their medical applications.	

Module	Contents	Hours
1.	Introduction: Generalized medical instrumentation system; Static characteristics: Accuracy, precision, resolution, reproducibility, sensitivity, drift, hysteresis, linearity, input impedance and output impedance; Dynamic characteristics: Transfer functions, first order and second order systems	03
2.	Displacement, Motion and Force Sensors and their Medical Applications: Displacement measurement: Strain gauges, bridge circuits, inductive sensor – L.V.D.T., capacitive sensors; Acceleration and force measurement: Piezoelectric sensor, load cell	05
3.	Temperature Sensors and their Medical Applications: Temperature measurement: Thermistor, thermocouple, resistive temperature detector; IC-based temperature measurement; Radiation sensors: Quantum sensors	04
4.	Biopotential electrodes: Half-cell potential, polarization, polarizable and non-polarizable electrodes, calomel electrode; Electrode circuit model, electrode-skin interface and motion artefacts; Body surface electrodes	03
5.	Chemical Sensors and their Medical Applications: Blood gas and acid- base physiology; pH, P_{CO_2} , P_{O_2} electrodes; ISFETs; Transcutaneous arterial O_2 and CO_2 tension monitoring	04
6.	Introduction: Generalized medical instrumentation system; Static characteristics: Accuracy, precision, resolution, reproducibility, sensitivity, drift, hysteresis, linearity, input impedance and output impedance; Dynamic characteristics: Transfer functions, first order and second order systems	03

Books Recommended:

Text Books:

1. Medical Instrumentation-Application and Design, John G. Webster, Wiley India Private Limited.
2. Instrument Transducers: An Introduction to Their Performance and Design, Hermann K. P. Neubert, Oxford University Press.
3. Biomedical Sensors: Fundamentals and Applications, Harry N. Norton, Noyes Publications.
4. Biomedical Transducers and Instruments, Tatsuo Togawa, Toshiyo Tamura and P. Ake Öberg, CRC Press.
5. Electronics in Medicine and Biomedical Instrumentation by Nandini K. Jog, Prentice-Hall of India Pvt. Limited.
6. Biosensors: Fundamentals and Applications, Banshi Dhar Malhotra and Chandra Mouli Pandey, Smithers Rapra Technology.

Reference Books:

1. Principles of Applied Biomedical Instrumentation, L.A. Geddes and L.E. Baker, Wiley India Pvt Ltd.
2. Biomedical Instrumentation and Measurements, Leslie Cromwell, Erich A. Pfeiffer and Fred J. Wiebell, Prentice-Hall of India Pvt. Ltd.
3. Principles of Biomedical Instrumentation and Measurement, Richard Aston, Merrill Publishing Company.
4. Measurement Systems, Application and Design, Ernest O. Doebelin, McGraw Hill Higher Education.
5. Handbook of Modern Sensors – Physics, Design and Application, Jacob Fraden, Springer Publishing Company.
6. Transducers for Biomedical Measurements: Principles and Applications, Richard S. C. Cobbold, John Wiley & Sons.

NPTEL/Swayam Course:

Course: Industrial Instrumentation by Prof. Alok Barua - IIT Kharagpur

<https://nptel.ac.in/courses/108/105/108105064/>

Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on the entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining question will be randomly selected from all the modules.

Course Code	Course Name	Teaching scheme			Credit assigned			
BMC304	Electronic circuit analysis and design (Abbreviated as ECAD)	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme									
		Theory					Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem	Duration (hrs)					
		Test 1	Test 2	Avg.							
BMC304	Electronic Circuit Analysis and Design (ECAD)	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
BMC304	Electronic Circuit Analysis and Design	04
Course Objectives	- To understand transfer characteristics of semiconductor devices and to analyse basic application circuits. - To make learners aware about the mathematical models of BJT and its use in analysing the circuits. - To make the learners aware about different types of coupling and the concept of multistage amplifiers. - Learners will be able to design power amplifier. - To learn types and applications of MOSFET.	
Course Outcomes	Learner will be able to: - Explain the transfer characteristics in analysing the electronic circuits which use diode, BJT etc. - Explain equivalent circuits of BJT and apply them to analyse and design BJT based amplifier circuits - Apply the knowledge of mathematical model to analyse multistage amplifiers. - Design and analyse power amplifiers. - Apply the concept of transfer characteristics, D.C. load line, A.C. load line to analyse MOSFET amplifiers.	

Module	Contents	Hours
1.	Basics of Diodes: Construction, Working, Characteristics, Current Equation & Equivalent circuits of P-N Junction Diode as well as Zener Diode, Applications of Diode: Clipper & Clamper	04
2.	Basics & DC analysis of BJT: Construction, Working and Characteristics of 3 different configurations of BJT.(Circuits, formulas and applications) Quiescent point, DC load line, BJT Biasing need and types. Voltage Divider biasing configuration (include stability factor), BJT as a switch.	05
3.	BJT as an Amplifier: A.C. Equivalent Model: r_e model(for analysis) h-parameter model (Exact and Approximate) and Hybrid- π model(Only concept and relationship) A.C. Analysis (Using r_e model): A.C. load line, A.C. Effects of R_S & R_L . Low frequency and High frequency analysis of Single stage amplifiers	05
4.	Multistage Amplifier: Concept of cascading, Types of coupling, cascade configuration, cascode amplifier, Darlington amplifier	03
5.	Power Amplifiers: Classes of Power amplifiers, Class-A Power Amplifiers analysis (Direct coupled and Transformer coupled), Class-B Power Amplifiers analysis Crossover distortion, Class-AB Push Pull and Complementary Symmetry Power amplifier, Class-C Power Amplifier, Heat Sinks	04
6.	MOSFET: Comparison of BJT & FET, Classification, Characteristics, Biasing of MOSFET, MOSFET as an amplifier, MOSFET as a switch.	05

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Books Recommended:**Textbooks:**

1. Electronics Circuit. Analysis & Design, 2nd ed., Donald A. Neamen, McGraw Hill, 2001
2. Electronics Devices & Circuits Theory, by Robert L. Boylestad and Louis Nashelsky, Pearson Education.
3. Semiconductor Data Manual, BPB Publications.

Reference Books:

1. Electronic Principles, by Albert Paul Malvino 6th edition, McGraw Hill
2. Electronic Devices and Circuits, by Jacob Milliman McGraw Hill.
3. Electronic Design, by Martin Roden, Gordon L.Carpenter, William Wieseman, Fourth edition, Shroff Publishers & Distributors Pvt. Ltd..
4. Electronic Circuits Discrete and Integrated, by Donald Schilling & Charles Belove, Third edition, McGraw Hill.

NPTEL/Swayam Course:

Course: Analog Electronic Circuits by Prof. Pradip Mandal - IIT Kharagpur
<https://nptel.ac.in/courses/108/105/108105158/>

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining question will be randomly selected from all the modules.

Course Code	Course Name	Teaching scheme			Credit assigned			
BMC305	Digital Electronics (Abbreviated as DE)	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme									
		Theory					Term work	Pract	Oral	Pract. / Oral	Total
		Internal Assessment			End sem	Duration (hrs)					
		Test 1	Test 2	Avg							
BMC305	Digital Electronics (DE)	20	20	20	80	03	--	--	--	--	100

Course Code	Course Name	Credits
BMC305	Digital Electronics	03
Course Objectives	- To make learner aware of basics of Digital circuits, logic design, various Logic Families and Flip-flops. - Learner should be able to design various counters, registers and know their applications. - Learner should be able to design sequential circuits as a state machine.	
Course Outcomes	Learner will be able to: - Describe various number systems, logic gates and logic families. - Apply Boolean algebra, K-maps for Logic reduction and implementations in SOP and POS form - Develop combinational circuits such as code converter circuits, parity generator checker circuits and magnitude comparator circuits. Also, circuits using multiplexers, de-multiplexers, and decoders. - Design synchronous sequential circuits and asynchronous counters using flip flops - Design various registers using flip flops.	

Module	Contents	Hours
1.	Fundamentals of Digital Design: Introduction: Number system: Binary, Octal, Hexadecimal and other. Conversion from One system to another. Logic Gates and Families: AND, OR, NOT, XOR, XNOR, operation NAND, NOR used of the universal gate for performing different operations.	04
2.	Combinational Logic Design: Logic Reduction Techniques: K-MAPS and their use in specifying Boolean Expressions, Minterm, Maxterm, SOP and POS Implementation.	03
3.	MSI Combinational Circuits: Binary Arithmetic Circuits: Laws of Boolean algebra, Binary Addition, Binary Subtraction (ones and twos complement). Elementary Designs: Parity Generator and Parity Checker (3 bit), (Half & Full) Adders, (Half & Full) Subtractors, Magnitude Comparators.	04
4.	Use of Multiplexers in Logic Design: Multiplexer, De- Multiplexers.	03
5.	Fundamentals of Sequential Logic Circuits: Flip-Flops: Flip-Flops, SR, T, D, JK. (Truth table and excitation table)	03
6.	Counters: Modulus of a counter, Designing of synchronous and asynchronous counter using flip flop. Registers: Serial input serial output, serial input parallel output, Left Right shift register, Bidirectional shift register, Universal shift register.	05

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Books Recommended:

Text Books:

1. Modern Digital Electronics, by R.P.Jain Tata McGraw Hill, 1984
2. Digital Design, by M Morris Mono Prentice Hall International-1984.
3. Digital Principal and Applications, by Malvino & Leach, Tata McGraw Hill, 1991.
4. Digital Electronics, by Malvino, Tata McGraw Hill, 1997.
5. Digital Logic: Applications and Design, by John Yarbrough Cengage Learning
6. Fundamentals of Digital Circuits, by A. Anand Kumar, Prentice-Hall of India Pvt.Ltd;
7. Digital Design: Principles & Practices, by John F. Wakerly, Prentice Hall

Reference Books:

1. Digital Electronics, by James Bignell & Robert Donovan, Delmar, Thomas Learning,
2. Logic Circuits, by Jog N.K, 2nd edition, Nandu Publisher & Printer Pvt .Ltd. 1998.
3. Introduction to Logic Design, by Alan b. Marcovitz McGraw Hill International 2002.

NPTEL/Swayam Course:

Course: 1. Digital Circuits by Prof. Santanu Chattopadhyay - IIT Kharagpur

<https://nptel.ac.in/courses/108/105/108105113/>

https://swayam.gov.in/nd1_noc20_ee70/preview

Course: 2. Switching Circuits and Logic Design by Prof. Indranil Sengupta - IIT Kharagpur

<https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-cs67/>

https://swayam.gov.in/nd1_noc20_cs67/preview

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining question will be randomly selected from all the modules

Course Code	Course Name	Teaching Scheme			Credit Assigned			
BML301	Human Anatomy and Physiology for Engineers (HAPE)	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme								
		Theory				Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem					
		Test 1	Test 2	Avg.						
BML301	Human Anatomy and Physiology for Engineers (HAPE)	--	--	--	--	25	--	--	--	25

Course Code	Course Name	Credits
BML301	Human Anatomy and Physiology for Engineers	01
Course Objective	- To understand the anatomical structures of the human body and their relationship to each other. - To gain the knowledge of measurement of various physiological parameters of the human body.	
Course Outcome	The learner will be able to : - Demonstrate measurement of blood pressure using occlusive cuff method. - Apply blood cell counting principles for measuring blood composition. - Demonstrate the measurement of electrical activity of heart and the related parameters. - Demonstrate the measurement of various lung volumes and capacities. - Appropriately utilize laboratory equipment, such as microscopes, general lab ware, and virtual simulations. - Locate and identify anatomical structures.	

Syllabus: Same as that of BMC302, Human Anatomy and Physiology for Engineers.

List of Laboratory Experiments: (Any Seven)

1. To measure blood pressure using sphygmomanometer.
2. To find the total red blood cell count using pre-prepared slides.
3. To find the total white blood cell count using pre-prepared slides.
4. To study the conduction system of the heart.
5. To study the twelve lead electrode scheme and operation of the ECG Machine.
6. To record ECG and measure its various parameters (amplitude, intervals/segment).
7. To record lung volumes and capacities using a spirometer.
8. Visit to the anatomy department of a hospital to view specimens (cardiovascular & respiratory systems).
9. Visit to the anatomy department of a hospital to view specimen (alimentary & renal systems).
10. Visit to the anatomy department of a hospital to view specimen (nervous system).
11. Present a case study on a given disease/abnormality that requires medical instruments for diagnosis/treatment.
12. Present case a study on a given disease/abnormality that requires medical instruments for diagnosis/treatment.

Any other experiment/visit to the hospital/case study based on syllabus which will help learner to understand a topic/concept.

Assessment:**Term Work:**

Term work shall consist of minimum 7 experiments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments) : 10 Marks

Laboratory work (Journal) : 10 Marks

Attendance : 05 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Books Recommended:**Text books:**

1. Anatomy and Physiology in Health and Illness: Ross and Wilson. (ELBS Pub.)
2. Essentials of Anatomy and Physiology: Elaine N Marieb. (Pearson Education)

Reference Books:

1. Physiology of Human Body: Guyton. (Prism Book)
2. Review of Medical Physiology: William Ganong. (Prentice Hall Int.)
3. Principles of Anatomy and Physiology: Tortora and Grabowski. (Harper Collin Pub.)
4. Anatomy and Physiology: Elaine N Marieb. (Pearson Education)

NPTEL/Swayam Course:

Course: Animal Physiology by Prof. Mainak Das - IIT Kanpur

<https://nptel.ac.in/courses/102/104/102104058/>

https://swayam.gov.in/nd1_noc20_bt42/preview

Course Code	Course Name	Teaching Scheme			Credits Assigned			
BML302	Medical Sensors (Abbreviated as MS)	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme									
		Theory				End Sem	Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment									
		Test 1	Test 2	Avg.							
BML302	Medical Sensors (Abbreviated as MS)	--	--	--	--	25	--	25	--	50	

Course Code	Course Name	Credits
BML302	Medical Sensors	01
Course Objectives	- To analyse the transient response of a first-order system. - To measure displacement using various displacement sensors. - To measure pressure using a pressure sensor. - To measure force using a force sensor. - To measure temperature using various temperature sensors. - To measure pH of a solution using a pH electrode.	
Course Outcomes	The learner will be able to: - Analyse step response of a first-order system. - Demonstrate the measurement of displacement using various displacement sensors. - Demonstrate the measurement of force and pressure using a force sensor and a pressure sensor respectively. - Demonstrate the measurement of temperature using various temperature sensors. - Distinguish various biopotential electrodes. - Demonstrate the measurement of pH of a solution using a pH electrode.	

Syllabus: Same as that of BMC303 Medical Sensors.

List of Laboratory Experiments: (Any seven)

1. To study the transient response of a first-order system.
2. To study the resistance versus temperature characteristics of a thermistor.
3. To study the thermistor linearization technique.
4. To study the characteristics of a light dependent resistor.
5. To study the principle and working of a thermocouple.
6. To study principle and working of L.V.D.T.
7. To study principle and working of a capacitive sensor.
8. To study principle and working of a strain gage sensor.
9. To study principle and working of a pressure sensor.
10. To study the principle and working of a force sensor.
11. To study the various biopotential electrodes.
12. To study the pH electrode.

Any other experiment/student presentation based on the syllabus which will help the learner to understand a topic/concept.

Books Recommended:**Text Books:**

1. Medical Instrumentation-Application and Design, John G. Webster, Wiley India Private Limited.
2. Instrument Transducers: An Introduction to Their Performance and Design, Hermann K. P. Neubert, Oxford University Press.
3. Biomedical Sensors: Fundamentals and Applications, Harry N. Norton, Noyes Publications.
4. Biomedical Transducers and Instruments, Tatsuo Togawa, Toshiyo Tamura and P. Ake Öberg, CRC Press.
5. Electronics in Medicine and Biomedical Instrumentation by Nandini K. Jog, Prentice-Hall of India Pvt. Limited.
6. Biosensors: Fundamentals and Applications, Bansi Dhar Malhotra and Chandra Mouli Pandey, Smithers Rapra Technology.

Reference Books:

1. Principles of Applied Biomedical Instrumentation, L.A. Geddes and L.E. Baker, Wiley India Pvt Ltd.
2. Biomedical Instrumentation and Measurements, Leslie Cromwell, Erich A. Pfeiffer and Fred J. Wiebell, Prentice-Hall of India Pvt. Ltd.
3. Principles of Biomedical Instrumentation and Measurement, Richard Aston, Merril Publishing Company.
4. Measurement Systems, Application and Design, Ernest O. Doebelin, McGraw Hill Higher Education.
5. Handbook of Modern Sensors – Physics, Design and Application, Jacob Fraden, Springer Publishing Company.
6. Transducers for Biomedical Measurements: Principles and Applications, Richard S. C. Cobbold, John Wiley & Sons.

NPTEL/Swayam Course:

Course: Industrial Instrumentation by Prof. Alok Barua - IIT Kharagpur

<https://nptel.ac.in/courses/108/105/108105064/>

Assessment:***Term Work:***

Term work shall consist of minimum 7 experiments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments) : 10 Marks

Laboratory work (Journal) : 10 Marks

Attendance : 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Oral examination will be based on suggested practical list and entire syllabus.

Course Code	Course Name	Teaching scheme			Credit assigned			
BML303	Electronic Circuit Analysis and Design Lab (ECAD Lab)	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme								
		Theory				Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem					
		Test 1	Test 2	Avg.						
BML303	Electronic Circuit Analysis and Design Lab (ECAD Lab)	--	--	--	--	25	--	--	25	50

Course Code	Course Name	Credits
BML303	Electronic Circuit Analysis and Design Lab	01
Course Objective	- To practically verify characteristics of different electronic components like diodes, BJT, MOSFET etc - To practically verify outputs of few applications of diodes, BJT, MOSFET. - To design and implement small signal amplifier.	
Course Outcome	Learner will be able to: - Explain the transfer characteristics of basic semiconductor devices. - Design and verify the outputs of various electronic circuits such as clipper, clampers etc using bread boards and various lab equipments. - Design amplifier circuits and plot its frequency response.	

Syllabus: Same as that of BMC304 Electronic Circuit Analysis and Design.

List of Laboratory Experiments: (Any Eight)

1. To verify semiconductor diode and Zener diode characteristics.
2. To implement various clipper circuits and verify output.
3. To implement various clamper circuits and verify output.
4. To study line regulation and load regulation of voltage regulator using Zener diode.
5. To verify input and output characteristics of BJT.
6. To implement a switch using BJT.
7. To implementation different biasing circuit of BJT
8. To design and implement CE amplifier.
9. To study frequency response of CE amplifier.
10. To verify input and output characteristics of MOSFET.
11. To implementation different biasing circuit of MOSFET
12. To Study frequency response of an MOSFET amplifier.

Any other experiment based on syllabus can be included in the term work which will help learner to understand topic/concept.

Assessment:**Term Work:**

Term work shall consist of minimum 8 experiments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments) : 10 Marks

Laboratory work (Journal) : 10 Marks

Attendance : 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Books Recommended:**Textbooks:**

1. Electronics Circuit. Analysis & Design, 2nd ed., Donald A. Neamen, McGraw Hill, 2001
2. Electronics Devices & Circuits Theory, by Robert L. Boylestad and Louis Nashelsky, Pearson Education.
3. Semiconductor Data Manual, BPB Publications.

Reference Books:

1. Electronic Principles, by Albert Paul Malvino 6th edition, McGraw Hill
2. Electronic Devices and Circuits, by Jacob Milliman McGraw Hill.
3. Electronic Design, by Martin Roden, Gordon L. Carpenter, William Wieseman , Fourth edition, Shroff Publishers & Distributors Pvt. Ltd..
4. Electronic Circuits Discrete and Integrated, by Donald Schilling & Charles Belove, Third edition, McGraw Hill.

NPTEL/Swayam Course:

Course: Analog Electronic Circuits by Prof. Pradip Mandal - IIT Kharagpur

<https://nptel.ac.in/courses/108/105/108105158/>

Practical exam consists of performance of any one practical from the conducted experiments within the semester and oral based on entire syllabus.

Course Code	Course Name	Teaching scheme			Credit assigned			
BML304	Electronics Lab (Skill Based Lab)	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		--	04	--	--	02	--	02

Course Code	Course Name	Examination Scheme								
		Theory				Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem					
		Test 1	Test 2	Avg.						
BML304	Electronics Lab (Skill Based Lab)	--	--	--	--	25	--	--	25	50

Course Code	Course Name	Credits
BML304	Electronics Lab (Skill Based Lab)	02
Course Objective	- To design and implement voltage regulator circuits. - To design and implement digital circuits. - To learn skills of soldering. - To learn simulation of circuits using one of the simulation software.	
Course Outcome	Learner will be able to: - Design and implement analog and digital electronic circuits on bread board and verify the outputs. - Learn one of the tools for simulating different circuits. - Know the limitations of ideal environment of simulations and also importance of simulation in designing the circuits. - Learn soldering skills for implementing the circuits on PCB.	

List of experiments from Analog electronics:

Skill 1-Soldering the components on PCB (Any 4)

1. Implement diode as full-wave rectifier using centre tap transformer.
2. Implement diode as full-wave rectifier using bridge circuit.
3. Use of Filter components with rectifier circuit.
4. Implement voltage regulators using IC 79XX and/or IC 78XX
5. Implement voltage regulators using IC 317/IC 723
6. Implement of logic gates using diodes.

Skill 2-Simulations using simulation software like Multisim, Pspice etc (Any 4)

1. Simulate CASCODE amplifier.
2. Simulate Darlington amplifier.
3. Simulate power Amplifier
4. Simulate DIAC for transfer characteristics.
5. Simulate TRIAC for transfer characteristics.
6. Simulate UJT for transfer characteristics.

List of experiments from Digital Electronics (Perform using Breadboard or Logisim S/W etc): (Any 8)

1. A step in space vehicle checkout depends on FOUR sensors S1, S2, S3 and S4. Every circuit is working properly if sensor S1 and at least two of the other three sensors are at logic 1. Implement the system using NAND gates only, the output is connected to a red LED which must glow if the circuit is not working properly and the output is connected to a green LED which must glow if the circuit is working properly.
2. To design binary to gray code converter and gray to binary converter.

3. To design parity generator and parity checker circuits.
4. To design adder and subtractor circuits.
5. To design various circuits using multiplexers.
6. To design various circuits using de-multiplexer.
7. To design Asynchronous counter.
8. To design decade counter
9. To design Synchronous counter.
10. To implement shift register and ring counter using MSI shift register.
11. To implement Moore/ Mealy machine.
12. A given finite state machine has an input W and output Z. During four consecutive clock pulses a sequence of four values of W signal is applied. Design a machine that produces $Z = 1$ when it detects either of sequence W: 0010 or W: 1110 otherwise $Z=0$. After the fourth clock pulse the machine has to be again in the reset state ready for next sequence.

Any other experiment based on syllabus can be included in the term work which will help learner to understand topic/concept.

Assessment:

Term Work:

Term work shall consist of minimum 8 experiments from Analog electronics and 8 experiments from digital electronics.

The distribution of marks for term work shall be as follows:

Laboratory work (Lab work and journal):10 Marks

Soldering skills :05 Marks

Simulation skills :05 marks

Attendance :05 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Books Recommended:

Text Books:

1. Op-Amps and linear integrated circuits – Ramakant Gayakwad, Prentice Hall
2. Electronics Devices & Circuits, by Boylestad Robert L., Louis Nashelsky, Pearson Education.
3. Modern Digital Electronics, by R.P.Jain, Tata McGraw Hill, 1984
4. Digital Design, M Morris Mono, Prentice Hall International-1984.

Reference Books:

1. Electronic Principles, by Albert Paul Malvino, 6/e, McGraw Hill
2. Semiconductor Data Manual, BPB Publications.
3. Electronic design, by Martin Roden, Gordon L. Carpenter, William Wieseman Fourth edition, Shroff Publishers & Distributors Pvt. Ltd.
4. Digital Design, by M Morris Mono Prentice Hall International 1984

Practical exam consists of performance of any one practical from digital electronics experiments conducted within the semester and oral based on digital electronics syllabus.

Course code	Course Name	Credits
BMM301	Mini Project - 1 A	02

Course Code	Course Name	Credits
BMM301	Mini Project – 1 A	02
Course Objective	• To acquaint with the process of identifying the needs and converting it into the problem. • To familiarize the process of solving the problem in a group. • To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems. • To inculcate the process of self-learning and research.	
Course Outcome	Learner will be able to: • Identify problems based on societal /research needs. • Apply Knowledge and skill to solve societal problems in a group. • Develop interpersonal skills to work as member of a group or leader. • Draw the proper inferences from available results through theoretical/experimental/simulations. • Analyse the impact of solutions in societal and environmental context for sustainable development. • Use standard norms of engineering practices • Excel in written and oral communication. • Demonstrate capabilities of self-learning in a group, which leads to life long learning. • Demonstrate project management principles during project work.	

Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.

- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;
 - Marks awarded by guide/supervisor based on log book : 10
 - Marks awarded by review committee : 10
 - Quality of Project report : 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.
 - First shall be for finalisation of problem
 - Second shall be on finalisation of proposed solution of problem.
- In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
 - First review is based on readiness of building working prototype to be conducted.
 - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
 - Identification of need/problem
 - Proposed final solution
 - Procurement of components/systems

- Building prototype and testing
- Two reviews will be conducted for continuous assessment,
 - First shall be for finalisation of problem and proposed solution
 - Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project.

Mini Project shall be assessed based on following criteria;

1. Quality of survey/ need identification
 2. Clarity of Problem definition based on need.
 3. Innovativeness in solutions
 4. Feasibility of proposed problem solutions and selection of best solution
 5. Cost effectiveness
 6. Societal impact
 7. Innovativeness
 8. Cost effectiveness and Societal impact
 9. Full functioning of working model as per stated requirements
 10. Effective use of skill sets
 11. Effective use of standard engineering norms
 12. Contribution of an individual's as member or leader
 13. Clarity in written and oral communication
- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
 - In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organizations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on following points;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communicate

UNIVERSITY OF MUMBAI



Bachelor of Engineering

in

Production Engineering

**Direct Second Year (Sem. III) Admitted Students for the
current Academic Year 2020-21(Only)**

(REV- 2019 'C' Scheme) from Academic Year 2019 – 20

**Under
FACULTY OF
SCIENCE & TECHNOLOGY**

As per AICTE guidelines with effect from the academic year 2019–2020)

Program Structure for Second Year Engineering
Semester III & IV
UNIVERSITY OF MUMBAI
(With Effect from 2020-2021)
Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
PEC301	Engineering Mathematics-III	3	--	1	3	--	1	4	
PEC302	Applied Thermodynamics and Fluid Mechanics	3		--	3		--	3	
PEC303	Mechanics of Materials	3	--	--	3	--	--	3	
PEC304	Manufacturing Processes	3	--	--	3	--	--	3	
PEC305	Engineering Materials and Metallurgy	3	--	--	3	--	--	3	
PEL301	Computer Aided Machine Drawing Lab.	--	2*+ 2	--	--	2	--	2	
PEL302	Python Programming Lab.	--	2	--	--	1	--	1	
PEL303	Material testing Lab.	--	2	--	--	1	--	1	
PEL304	Skill based Lab. Course-I	--	4	--	--	2	--	2	
PEM301	Mini Project – 1 A	--	4 ^{\$}	--	--	2	--	2	
Total		15	16	1	15	08	1	24	
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg.					
PEC301	Engineering Mathematics-III	20	20	20	80	3	25	--	125
PEC302	Applied Thermodynamics and Fluid Mechanics	20	20	20	80	3	--	--	100
PEC303	Mechanics of Materials	20	20	20	80	3	--	--	100
PEC304	Manufacturing Processes	20	20	20	80	3	--	--	100
PEC305	Engineering Materials and Metallurgy	20	20	20	80	3	--	--	100
PEL301	Computer Aided Machine Drawing Lab.	--	--	--	--	--	50	25	75
PEL302	Python Programming Lab.	--	--	--	--	--	25	--	25
PEL303	Material testing Lab.	--	--	--	--	--	25	--	25
PEL304	Skill based Lab. Course-I	--	--	--	--	--	50	--	50
PEM301	Mini Project – 1 A	--	--	--	--	--	25	25	50
Total		--	--	100	400	--	200	50	750

* Theory of entire class to be conducted.

\$ indicates work load of Learner (Not Faculty) for Mini Project.

Mini Project 1A:

Faculty Load: 1 hour per week per four groups.

Course Code	Course Name	Credits
PEC301	Engineering Mathematics- III	03+01=04

Contact Hours			Credit Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	-	01	03	-	01	04

Theory					Term work / Practical / Oral			Total
Internal Assessment			End semester	Duration of End semester Exam	TW	PR	OR	
Test I	Test II	Average						
20	20	20	80	03 hrs.	25	-	-	125

Course Objectives:

1. To familiarize with the Laplace Transform, Inverse Laplace Transform of various functions, its applications.
2. To acquaint with the concept of Fourier series, its complex form and enhance the problem solving skills.
3. To familiarize with the concept of complex variables, C-R equations with applications.
4. To study the application of the knowledge of matrices and numerical methods in complex engineering problems.

Course Outcomes: Learner will be able to:

1. Apply the concept of Laplace transform to solve the real integrals in engineering problems.
2. Apply the concept of inverse Laplace transform of various functions in engineering problems.
3. Expand the periodic function by using Fourier series for real life problems and complex engineering problems.
4. Find orthogonal trajectories and analytic function by using basic concepts of complex variable theory.
5. Apply Matrix algebra to solve the engineering problems.
6. Solve Partial differential equations by applying numerical solution and analytical methods for one dimensional heat and wave equations.

Detailed Syllabus: (Module wise)		
Module No.	Description	Duration
1	Module: Laplace Transform 1.1 Definition of Laplace transform, Condition of Existence of Laplace transform, 1.2 Laplace Transform (L) of Standard Functions like e^{at} , $\sin(at)$, $\cos(at)$, $\sinh(at)$, $\cosh(at)$ and t^n , where $n \geq 0$. 1.3 Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by t , Division by t , Laplace Transform of derivatives and integrals (Properties without proof). 1.4 Evaluation of integrals by using Laplace Transformation. Self-learning topics: Heaviside's Unit Step function, Laplace Transform. of Periodic functions, Dirac Delta Function.	06

2	Module: Inverse Laplace Transform 2.1 Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivative 2.2 Partial fractions method & first shift property to find inverse Laplace transform. 2.3 Inverse Laplace transform using Convolution theorem (without proof) Self-learning Topics: Applications to solve initial and boundary value problems involving ordinary differential equations.	06
3	Module: Fourier Series: 3.1 Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof) 3.2 Fourier series of periodic function with period 2π and $2l$, 3.3 Fourier series of even and odd functions 3.4 Half range Sine and Cosine Series. Self-learning Topics: Complex form of Fourier Series, orthogonal and orthonormal set of functions, Fourier Transform.	07
4	Module: Complex Variables: 4.1 Function $f(z)$ of complex variable, limit, continuity and differentiability of $f(z)$, Analytic function, necessary and sufficient conditions for $f(z)$ to be analytic (without proof), 4.2 Cauchy-Riemann equations in cartesian coordinates (without proof) 4.3 Milne-Thomson method to determine analytic function $f(z)$ when real part (u) or Imaginary part (v) or its combination (u+v or u-v) is given. 4.4 Harmonic function, Harmonic conjugate and orthogonal trajectories Self-learning Topics: Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations	07
5	Module: Matrices: 5.1 Characteristic equation, Eigen values and Eigen vectors, Properties of Eigen values and Eigen vectors. (No theorems/ proof) 5.2 Cayley-Hamilton theorem (without proof): Application to find the inverse of the given square matrix and to determine the given higher degree polynomial matrix. 5.3 Functions of square matrix 5.4 Similarity of matrices, Diagonalization of matrices Self-learning Topics: Verification of Cayley Hamilton theorem, Minimal polynomial and Derogatory matrix & Quadratic Forms (Congruent transformation & Orthogonal Reduction)	07
6	Module: Numerical methods for PDE 6.1 Introduction of Partial Differential equations, method of separation of variables, Vibrations of string, Analytical method for one dimensional heat and wave equations. (only problems) 6.2 Crank Nicholson method	06

	6.3 Bender Schmidt method Self-learning Topics: Analytical methods of solving two and three dimensional problems.	
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Term Work:

General Instructions:

1. Batch wise tutorials are to be conducted. The number of students per batch should be as per University pattern for practical's.
2. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
3. A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Engineering Mathematics. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1.	Attendance (Theory and Tutorial)	05 marks
2.	Class Tutorials on entire syllabus	10 marks
3.	Mini project	10 marks

Assessment:

Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests

1. First test based on approximately 40% of curriculum contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I).
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

End Semester Examination:

Weightage of each module in end semester examination will be proportional to the number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks.**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum.**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
4. Only **Four questions need to be solved.**

References:

1. Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication.
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited,
3. Advanced Engineering Mathematics, R. K. Jain and S.R.K. Iyengar, Narosa publication
4. Advanced Engineering Mathematics, H.K. Das, S. Chand Publication
5. Higher Engineering Mathematics B.V. Ramana, McGraw Hill Education
6. Complex Variables and Applications, Brown and Churchill, McGraw-Hill education,
7. Text book of Matrices, Shanti Narayan and P K Mittal, S. Chand Publication
8. Laplace transforms, Murray R. Spiegel, Schaum's Outline Series.

Course Code	Course Name	Credits
PEC302	Applied Thermodynamics and Fluid Mechanics	03

Contact Hours			Credit Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	-	-	03	-	-	03

Theory					Term work / Practical / Oral			Total
Internal Assessment			End semester	Duration of End semester Exam	TW	PR	OR	
Test I	Test II	Average						
20	20	20	80	03 hrs.	-	-	-	100

Objectives:

1. To acquaint with basic concepts, various processes and cycles of Thermodynamics and its applications.
2. To familiarize with the understanding about basic laws of thermodynamics and its applications.
3. To impart the fundamental knowledge of fluid, its properties and behavior under various conditions of internal and external flows.
4. To prepare the students to learn about energy losses during fluid flow through pipes.

Outcomes: learner will be able to:

1. Understand the concept of thermodynamics and laws of thermodynamics.
2. Apply the first law of thermodynamics for various systems.
3. Apply the second law of thermodynamics for various systems.
4. Understand various properties of fluid.
5. Analyze the various types of flow fields analytically and by using flow visualization.
6. Apply fluid mechanics principles to understand the dynamics of flow and various losses during flow through pipe.

Detailed Syllabus: (Module wise)		
Module No.	Description	Duration
01	First law of Thermodynamics: Statement, First law applied to cyclic and non-cyclic process, Application to non-flow processes viz. Constant volume, constant pressure, constant temperature, adiabatic and polytrophic processes.	03
02	First law applied to open systems: Flow work, Steady flow energy equation (SFEE), SFEE applied to nozzle, turbine, compressor, boiler, condenser etc.	03
03	Second law of Thermodynamics: Thermal reservoir, heat engine, thermal efficiency, reversed heat engine, coefficient of performance, Kelvin-Planck, Clausius statements, and their equivalence, Entropy.	03
04	Fluid Kinematics: Eulerian and Lagrangian description of fluid motion, Types of fluid flow, Types of flow lines, continuity equation in Cartesian coordinates, Velocity potential and stream function.	03
05	Fluid dynamics: Euler's equation of motion along a stream line, Bernoulli's equation, Application of Bernoulli's equation to Venturi meter, Orifice meter and Pitot tube (No derivation on rate of flow is required).	03
06	Dynamics of Viscous Flow: Flow of viscous fluid in circular Pipes - Hagen Poiseuille flow. Flow Through Pipes: Major and Minor losses in pipes, Pipes in series, Pipes in parallel and Equivalent pipe. Introduction of CFD: Applications of CFD, Conservation equations, Classification of partial differential equations and physical behavior, Approximate solution of PDE, Finite difference and Finite Volume Method.	05

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

1. First test based on approximately 40% of curriculum contents and second test based on remaining contents (approximately 40%, but excluding contents covered in Test I).
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

End Semester Examination:

Weightage of each module in end semester examination will be proportional to the number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks.**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum.**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
4. Only **Four questions need to be solved.**

Books Recommended:***Text books:***

1. Fluid Mechanics & Hydraulic Machines, 9th Edition by R. K. Bansal, Laxmi Publications.
2. Introduction to Fluid Mechanics, 4th Edition by R. W. Fox, and A. T. McDonald, John Wiley and Sons.
3. Thermal Engineering, R. K. Rajput, Laxmi Publications.
4. Thermal Engineering, Ballaney, Khanna Publications.
5. A Course in Thermal Engineering, Domkundwar, Kothoraman and Khaju.

Reference Books:

1. Fluid Mechanics, 3rd Edition by Frank M. White, McGraw-Hill.
2. Fluid Machines and Fluid Power Engg., 7th Edition by D.S Kumar, S. K. Kataria publications.
3. Thermal Engineering, Mahesh Rathore, Tata McGraw Hill.
4. Engineering Thermodynamics by C.P. Arora, Tata McGraw Hill Publications.
5. Engineering Thermodynamics through Examples by Y V C Rao, Universities Press (India) Pvt. Lt.10.
Internal Combustion Engine, S.L. Beohar.

Course Code	Course Name	Credits
PEC303	Mechanics of Materials	03

Contact Hours			Credit Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	-	-	03	-	-	03

Theory					Term work / Practical / Oral			Total
Internal Assessment			End semester	Duration of End semester Exam	TW	PR	OR	
Test I	Test II	Average						
20	20	20	80	03 hrs.	-	-	-	100

Objectives:

1. To impart the concept of various types of forces, their modes of action and resulting stresses and strains on various materials under various operating conditions.
2. To impart the knowledge of Bending Moment, Shear force and Moment of Inertia as applied on various structures.

Outcomes: Learner will be able to:

1. Illustrate stress-strain behavior of various materials under load.
2. Demonstrate the basic concepts related to material properties and stress strain behavior of material.
3. Illustrate the basic concept of Bending moment and Shear force.
4. Illustrate basic concepts of bending, shear, torsion and buckling.
5. Illustrate basic concepts of deflection.
6. Develop skills for analysis of stresses under various loading conditions.

Detailed Syllabus: (Module wise)		
Module No	Description	Duration
01	Direct stress and direct strain: Concept of different types of stresses; Stress–Strain curves for ductile and brittle material; factor of safety; deformation of uniform/tapering rectangular and circular and circular cross–section bars; deformation of members made of composite materials; shear stress and shear strain, Poisson's ratio, volumetric strain, bulk modulus; relationship between Young's modulus, bulk modulus and modulus of elasticity; temperature stresses in simple and compound bars.	04
02	Theory of Bending: Flexure formula for straight beams; principal axes of inertia; moments of inertia about principal axes; transfer theorem. Simple problems involving application of flexure formula, section modulus and moment of resistance of a section	03

03	Shear Stress in Beams: Distribution of shear stress across plane sections used commonly for structural purposes; shear connectors.	03
04	Deflection of Beams: Deflection of cantilever, simply supported and overhanging beams using Macaulay's method for different types of loadings.	03
05	Theory of Torsion: Torsion of circular shafts-solid and hollow, stresses in shafts transmitting power, shafts in series and parallel.	03
06	Principal Stresses: General equations for transformation of stress; principal planes and principal stresses, determination using Mohr's circle maximum shear stress, principal stresses in beams, principal stresses in shafts subjected to torsion, bending and axial thrust; concept of equivalent torsion and bending moments.	04

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

- 1 First test based on approximately 40% of curriculum contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I).
- 2 Total duration allotted for writing each of the paper is 1 hr.
- 3 Average of the marks scored in both the two tests will be considered for final grading.

End Semester Examination:

Weightage of each module in end semester examination will be proportional to the number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks.**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum.**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3, then part (b) will be from any module other than module 3).
4. Only **Four questions need to be solved.**

Reference books

1. *Bansal, R. K., A Text Book of Strength of Materials*, Lakshmi Publications Pvt. Limited, New Delhi.
2. *Ferdinand P. Beer, and Russell Johnston, E., Mechanics of Materials*, SI Metric Edition, McGraw Hill.
3. *S Ramamrutham, Strength of Materials*, Dhanpat Rai Publications.
4. *Beer and Johnston, Mechanics of Materials*, McGraw Hill Publications.
5. *James M. Gere, Mechanics of Materials Fifth Edition*, Brooks/Cole, USA, 2001.
6. *William A Nash, Theory and problems of strength of materials*, Schaum's outline Series, McGraw Hill International Edition.
7. *Shigley, J. E., Applied Mechanics of Materials*, International Student Edition, McGraw Hill Koyakusha Limited.
8. *Singer, Strength of Materials*, Longman Publishers.

Course Code	Course Name	Credits
PEC304	Manufacturing Processes	03

Contact Hours			Credit Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	-	-	03	-	-	03

Theory					Term work / Practical / Oral			Total
Internal Assessment			End semester	Duration of End semester Exam	TW	PR	OR	
Test I	Test II	Average						
20	20	20	80	03 hrs.	-	-	-	100

Objectives:

1. To impart the knowledge of machine tools and basic machining processes, like turning, drilling, milling and broaching.
2. To impart the fundamentals of various metal cutting practices, fundamentals of machine tools and processes.
3. To familiarize with unconventional machining processes and techniques.
4. To understand the importance of CNC machining in metal cutting.

Outcomes: Learner will be able to:

1. Describe types of machine tools, their classification, specifications and constructional features.
2. Illustrate machine tools' capabilities, limitations of machining operations to generate cylindrical, circular and planar components.
3. Describe features and applications of screw thread processes and gear manufacturing processes.
4. Demonstrate finishing processes, like grinding, reaming, honing, lapping and burnishing.
5. To understand and analyze machining operations on CNC machines and the related programming details.
6. Illustrate the fundamentals of various non-conventional machining processes, its capabilities and their application areas.

Detailed Syllabus: (Module wise)		
Module No.	Description	Duration
01	Introduction to Manufacturing Processes Definition, need and classification of manufacturing process, based on chip-less and chip-removal processes. Various generating & forming processes. Lathe, Drilling, Boring and Broaching Machines: Lathe machine components, lathe accessories, Drilling machine, Boring machine, cutting-off machine, Broaching machine, Milling machine, shaping machine, Planning and Slotting machine.	02
02	Milling Machine: Milling machine components and their difference, Milling accessories, milling machines types, types of Milling cutters.	02

	Reciprocating Machine: Shaping machines: types of shapers, working of shaping machine, quick return mechanisms, shaper operations, Planning machines: types of planning machines. Slotting machines: types of slotting machines.	
03	Thread Cutting, Gear cutting and Finishing processes Thread rolling, Thread chasing, Gear hobbling, Gear shaping and Gear shaving. Grinding machines types, Grinding wheel specification. Trueing, Dressing and balancing of grinding wheel. Finishing processes like Reaming, Honing, Lapping, Buffing and Polishing.	02
04	CNC Basics and Hardware DNC, Motion controller, Interpolation, Adaptive control system, Spindle drive, Axis drive, Actuation and feedback devices, ATC, Tool presetter, Touch probe system. CNC Turning and Milling tools	04
05	CNC Programming Turning and Machining centre programming, Canned cycle, Looping, Jumping and Subprogram.	06
06	Unconventional machining processes: Classification of the Non-traditional machining process. Basic principles, machines, advantage, disadvantages, and applications of Electrical discharge machining (EDM), Electron beam machining (EBM), Plasma arc machining (PAM), Laser beam machining (LBM), Electrochemical machining (ECM), Chemical machining (CHM), Ultrasonic machining (USM), Abrasive jet machining (AJM), Water jet machining (WJM), Abrasive water jet machining (AWJM). Ultrasonic machining (USM), Abrasive jet machining (AJM), Water jet machining (WJM), Abrasive water jet machining (AWJM).	04

Assessment:

Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests

- 1 First test based on approximately 40% of curriculum contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I).
- 2 Total duration allotted for writing each of the paper is 1 hr.
- 3 Average of the marks scored in both the two tests will be considered for final grading.

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks.**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum.**
3. **Remaining questions will be mixed in nature** (for example, if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
4. Only **Four questions need to be solved.**

Reference Books:

1. *Elements of Workshop Technology: Machine Tools* (Volume-2) by S. K. Hajra Choudhary, A. K. Hajra Choudhary, Nirjhar Roy, Media promoters (2010).
2. *A Course in Workshop Technology Vol.II (Machine Tools)* by B. S. Raghuwanshi, Dhanpat Rai & Co. (2001).
3. *Workshop Technology* Part 1, 2 and 3. By W. A. J. Chapman, Taylor & Francis (1972).
4. *Production Technology–HMT*, Tata McGraw-Hill (1980).
5. *Manufacturing, Engineering and Technology*, 4th Edition by Serope Kalpakjian, Steven R. Schmid, Pearson (2005).

6. *A Text Book Of Production Technology* Vol. II by O. P. Khanna, Dhanpat Rai Publications (2000).
7. *CAD CAM, Principle and Applications*, P. N. Rao, Tata McGraw Hill, 3rd edition, 2012.
8. *Fundamentals of Modern Manufacturing-Materials, Processes and Systems*, 3rd Edition by Mikell P. Groover, Wiley India (2002).
9. *Manufacturing Processes for Engineering Materials*, 4th Edition by Serope Kalpakjian, Steven R. Schmid, Pearson (2007).

Course Code	Course Name	Credits
PEC305	Engineering Materials & Metallurgy	03

Contact Hours			Credit Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	-	-	03	-	-	03

Theory					Term work / Practical / Oral			Total
Internal Assessment			End semester	Duration of End semester Exam	TW	PR	OR	
Test I	Test II	Average						
20	20	20	80	03 hrs.	-	-	-	100

Objectives:

1. To acquaint the importance of metallurgy through solidification, defects, deformation, alloying and phase diagrams.
2. To impart the knowledge of fracture and heat treatment of materials.
3. To acquaint with different new age materials like semiconductors, nano materials, smart materials, magnetic materials and biomaterials.

Outcomes: Learner will be able to:

1. Understand the process of solidification of metals along with various types of crystal imperfections and deformation mechanism.
2. Understand the difference between various modes of material failure.
3. Analyze various alloy phase diagrams including iron-carbide diagram with effects of alloying.
4. Select proper heat treatment process for steel in order to attain desirable properties.
5. Understand the properties and application of nano materials, biomaterials and composites.
6. Understand the properties and application of smart materials, semiconductors and magnetic material.

Detailed Syllabus: (Module wise)		
Module No.	Description	Duration
01	Introduction to Metallurgy: Need for Metallurgy, Processing-Structure-Properties-Performance interrelationships. Deformation: Strain hardening and its significance. Recovery, recrystallization and grain growth, Factors affecting recrystallization.	02
02	Alloy phase diagrams: Different types of alloy diagrams and their analysis. Tie bar and Lever rules and their application. Dispersion hardening/age hardening.	04

	The Iron-Iron Carbide Phase Diagram: Importance of Iron as engineering material, Allotropic forms of Iron. Iron-Iron carbide diagram and its analysis. Classification of Plain carbon steels and Cast irons.	
03	Effect of Alloying Elements in Steels: Effect of alloying elements on ferrite, carbide, austenite. Effect of alloying elements on phase transformation, hardening and tempering. Tool steels & Stainless steels: Important compositions and applications. Non Ferrous Metals and their Alloys: Aluminum, Copper, Tin, and Zinc – Their alloys, properties and applications.	04
04	Principles of Heat treatment: Technology of heat treatment. Classification of heat treatment process. TTT Diagram. CCT Diagram and Superimposition of cooling curves on diagram. Heat treatment Process*: Annealing: principle, process, properties and application: Full Annealing, Spheroidizing, Process annealing, Stress relieve annealing. Normalizing: principle, process and its applications. Hardening: Hardening media, Hardenability. Tempering, Austempering, Martempering, Maraging and Ausforming process. Surface hardening: Surface Hardening methods. Their significance and applications. Carburizing, Nitriding. Induction hardening and Flame hardening processes. Heat treatment defects*: Defect during heat treatment process (Causes and remedies).	02
05	Biomaterials: Classes of materials used in medicine. Basic concepts: Tissue and cell interaction with biomaterials. Application of biomaterials: Cardiovascular medical devices, Orthopaedic, Dental applications. Composites: Basic concepts of composites, advantages over metallic materials, various types of composites and their applications, Manufacturing Processes for Thermoset Composites – Hand Lay Up, Spray Up, Filament Winding, Pultrusion, Resin Transfer Molding, Structural Reaction Injection Molding, Compression Molding.	04
06	Smart materials: Shape memory alloys (SMA): Characteristics, properties of NiTi alloy, application, advantages and disadvantages of SMA. Super conductors: Type I and Type II superconductors, applications. Magnetic Material: Introduction. Classification of magnetic materials. Ferromagnetism. Magnetic domain. Magnetisation. Magnetic anisotropy. Magnetostriction. Paramagnetism. Diamagnetism. Hysteresis. Hard and soft magnetic.	04

Assessment:

Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests

- 1 First test based on approximately 40% of curriculum contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I).
- 2 Total duration allotted for writing each of the paper is 1 hr.

- 3 Average of the marks scored in both the two tests will be considered for final grading.

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks.**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum.**
3. **Remaining questions will be mixed in nature** (for example, if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
4. Only **Four questions need to be solved.**

Reference Books:

1. *Materials Science and Engineering - A first course*, V. Raghvan, 'Prentice Hall of India, New Delhi (2001).
2. *Introduction to Physical Metallurgy*, 2nd Edition, S. H. Avner, Tata McGraw Hill (1997).
3. *Material Science and Engineering: An Introduction*, William D Callister, Adapted by R. Balasubramaniam, Wiley India (P) ltd (2010).
4. *Mechanical Metallurgy*, 3rd edition, G. E. Dieter, McGraw Hill International, New Delhi (1988).
5. *Introduction to Engineering Materials*, B. K. Agrawal, McGraw Hill Publishing Co. Ltd. (1988).
6. *Physical Metallurgy: Principles and Practices*, V. Raghvan, PHI Publications.
7. *Composite Manufacturing- Materials, Product and Process Engineering*, Sanjay K Muzumdar, CRC Press (2002).
8. *Material Science and Metallurgy for Engineers*, V. D. Kodgire, Evercast Publishing House.
9. *A textbook of Material Science and Metallurgy* by O P Khanna, Dhanpat Rai Publications.
10. *Biomaterials Science: An Introduction to Materials in Medicine*, edited by B.D. Ratner, A.S. Hoffman, F.J. Schoen, and J.E. Lemons, 2nd Edition, Elsevier Academic Press (2004).
11. *Introduction to Materials Science for Engineer*, James F Shackelford, S 's', 6th edition, Macmillan Publishing Company, New York (2004).

Course Code	Course Name	Credits
PEL301	Computer Aided Machine Drawing Lab.	02

Contact Hours			Credit Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	2* + 2	-	-	02	-	02

Theory					Term work / Practical / Oral			Total
Internal Assessment			End semester	Duration of End semester Exam	TW	PR	OR	
Test I	Test II	Average						
-	-	-	-	-	50	25	-	75

Objectives:

1. To prepare the students for insight of visualizing an object and converting it into a production drawing.
2. To impart the knowledge of conventional representation of various mechanical details.
3. To prepare the students to be conversant with 2D and 3D drafting, using a CAD Software.

Outcomes: Learner will be able to:

1. Prepare drawings, depicting interpenetration of simple solids and auxiliary views of machine parts.
2. Read and interpret detailed drawings from assembly drawings.
3. Prepare assembly drawings from detailed drawings of machine subassemblies.
4. Prepare production drawings.
5. Develop 3D models of machine parts using various CAD softwares.
6. Convert 3D models to 2D drawings using various CAD softwares.

Detailed Syllabus: (Module wise)	
Module No.	Description
01	Machine Elements: Preparation of 2D drawings of standard machine elements (nuts, bolts, keys, cotter, screws, spring etc.). Conventional representation of assembly of threaded parts in external and sectional views, Types of threads; thread designation, Conventional representation of machine components and materials, Designation of standard components.

02	Detailed and assembly drawings: Introduction to the unit assembly drawing, steps involved in preparing assembly drawing from details and vice-versa, Sequence in assembly. Preparation of details and assembly drawings of: Clapper block, Single tool post, square tool post, Lathe Tailstock.
03	Preparation of detailed and assembly drawings of Bearings: Simple, solid, Bushed bearing. I.S. conventional representation of ball & roller bearing. Pedestal bearing & footstep bearing.
04	Preparation of detailed and assembly drawings of pulleys & Pipe Joints. Classification of Pulleys, pipe joints Pulleys: Flat belt, V-belt, rope belt, Fast and loose pulleys. Pipe joints: Flanged joints, Socket and spigot joint, Gland and stuffing box expansion joint. Limits, Fits & Tolerances Representation of Dimensional Tolerances on drawings - Methods of showing limit dimensions, Deviations, Allowances, Types of Fits and Tolerances. Hole basis and Shaft basis systems. Representation of Geometrical Tolerances on drawings.
05	Preparation of detailed and assembly drawings of Valves & I. C. Engine parts: Types of Valves, introduction to I.C. Engine Preparation of detailed and assembly drawings of Stop valve, Non return Valve, I. C. Engine parts: Piston, Connecting rod, Crosshead, Crank shaft and Spark plug.
06	Preparation of detailed and assembly drawings of Jigs and Fixtures: Introduction to Jigs and fixtures. Jigs and Fixtures : Reverse Engineering of a physical model: disassembling of any Physical model having not less than five parts, sketch the minimum views required for each component, measure all the required dimensions of each component, convert the sketches into 3D model and create an assembly drawing with actual dimensions.

Term work:

A. Questions from theory part of each module should be solved as home working A-3size sketch book, as follows: -

1. Minimum 3 questions from module 1.
2. Minimum 2 questions from module 2.
3. Minimum 1 question/module from module 3 to 6.

B. Printouts/plot of the problems solved in practical class from the practical part of each module, as follows: -

1. 3 two dimensional detailed drawings:- Preparation of 3D models of parts from given 2D assembly drawing. Converting the 3D parts into 2-D detailed drawings.
2. 3 two dimensional Assembly drawings:- Preparation of 3D models of parts, from given 2D detailed drawings. Assembling the 3D parts and Converting 3D Assembly into 2D drawing.

Problems from practical parts of each module should be solved using standard CAD packages

Like IDEAS, PRO-E, CATIA, Solid Works or Inventor etc.

The distribution of marks for Term work shall be as follows:

Homework: sketch book		20 marks
Printouts/Plots		20 marks
Attendance (theory and practical)		10 marks

Practical/Oral examination:

1. Practical examination duration is of three hours, based on Part-B of the Term work and should contain two sessions as follows:
Session-I: Preparation of 3D models of parts, assembling parts and preparing production drawings of these parts and assembly with appropriate tolerancing from given 2D detailed drawings.

Session-II: Preparation of minimum five detailed 3D part drawings from given 2D assembly drawings.
Oral examination should also be conducted to check the knowledge of conventional and CAD drawing.
2. Questions provided for practical examination should contain minimum five and not more than ten parts.
3. The distribution of marks for practical examination shall be as follows:

Session-I		25 marks
Session-II		15 marks
Oral		10 marks
4. Evaluation of practical examination to be done, based on the printouts submitted by students.
5. Students' work along with evaluation report to be preserved till the next examination.

Reference Books:

1. *Machine Drawing* by N.D. Bhatt and V. M. Panchal, Charotar Publishing House, Gujarat.
2. *Machine Drawing* by P. S. Gill, S. K. Kataria & Sons.
3. *A textbook of Machine Drawing*, Laxminarayan & M. L. Mathur (Jain brothers, Delhi).
4. *Machine Drawing*, Kamat & Rao.
5. *Machine Drawing*, M.B. Shah.
6. *A text book of Machine Drawing*, R. B .Gupta (Satyaprakashan, Tech. Publication).
7. *Machine Drawing*, K. I. Narayana, P. Kannaiah and K.Venkata Reddy.
8. *Machine Drawing*, Sidheswar, Kannaiah and Sastry, Tata McGraw Hill Education, New Delhi.
9. *Autodesk Inventor 2020 for Designers*, Sham Tickoo, CAD CIM Series.
10. *Text book of Machine Drawing* by K. C. John, PHI, New Delhi.

Course Code	Course Name	Credits
PEL302	Python Programming Lab.	01

Contact Hours			Credit Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	02	-	-	01	-	01

Theory					Term work / Practical / Oral			Total
Internal Assessment			End semester	Duration of End semester Exam	TW	PR	OR	
Test I	Test II	Average						
-	-	-	-	-	25	-	-	25

Objective:

The course will help the students to get familiar with:

1. Basics of Python programming.
2. Decision Making and Functions in Python.
3. Object Oriented Programming, using Python.
4. Files Handling in Python.
5. GUI Programming and Databases operations in Python.
6. Network Programming in Python.

Outcomes: Learner will be able to:

1. Describe the Numbers, Math functions, Strings, List, Tuples and Dictionaries in Python.
2. Express different Decision Making statements and Functions.
3. Interpret Object oriented programming in Python.
4. Understand and summarize different File handling operations.
5. Explain how to design GUI Applications in Python and evaluate different database operations.
6. Design and develop Client Server network applications using Python.

Detailed Syllabus: (Module wise)	
Module No	Description
01	Write python programs to understand Expressions, Variables, Quotes, Basic Math operations, Strings: Basic String Operations & String Methods, List, Tuples, Dictionaries, Arrays. (Minimum Three Programs based on math operations, Strings and List/Tuples/ Dictionaries).
02	Write python programs to understand different decision making statements and Functions. (Minimum Three Programs based on Decision making, Looping Statements and Functions).
03	Write python programs to understand different Object oriented features in Python (Minimum four programs based on a) Classes & objects, b) Constructors, c) Inheritance & Polymorphism and d) Exception handling).
04	Write python programs to understand different File handling operations.

05	Write python programs to understand GUI designing and database operations. (Minimum Three programs based on GUI designing using Tkinter, Mysql database creation & Database connectivity with DML operations using python.
06	Write python programs to understand TCP and UDP Sockets in Python (Minimum One programs based on TCP or UDP Sockets).

Assessment:

Term Work:

Distribution of Term work Marks

Laboratory work20 Marks

Attendance05 Marks

Reference Books:

1. Wesley J Chun," Core Python Applications Programming", Third Edition, Pearson Publication.
2. E. Balguruswamy," Introduction to Computing and Problem Solving using Python", McGraw Hill Publication.
3. Learn to Master Python, from Star EDU solutions, by Script Demics.
4. James Payne,"Beginning Python: Using Python 2.6 and Python 3.1", Wrox Publication.
5. Dr. R. Nageswara Rao,"Core Python Programming", Dreamtech Press, Wiley Publication.
6. Magnus Lie Hetland,"Beginning Python From Novice to Professional", Second Edition", Apress Publication.

Course Code	Course Name	Credits
PEL 303	Materials Testing Lab.	01

Contact Hours			Credit Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	02	-	-	01	-	01

Theory					Term work / Practical / Oral			Total
Internal Assessment			End semester	Duration of End semester Exam	TW	PR	OR	
Test I	Test II	Average						
-	-	-	-	-	25	-	-	25

Objectives:

1. To familiarize with the use of stress and strain measuring instruments.
2. To familiarize with the process of metallographic sample preparation.
3. To familiarize with various Non-Destructive Testing methods.
4. To familiarize with various heat treatment processes.
5. To familiarize with hardness testing methods.

Outcomes: Learner will be able to:

1. Conduct tensile and torsion tests on mild steel specimens.
2. Determine the Young's modulus using deflection test on different structural specimens.
3. Prepare sample for metallographic observations.
4. Conduct impact testing, hardness and hardenability testing of given specimen.
5. Conduct NDT test on materials.
6. Perform the heat treatment processes with its relevance in the manufacturing industry.

Sr. no.	Experiments
01	Tensile test on mild steel rod.
02	Torsion test on mild steel rod.
03	Deflection test on steel/wood / aluminium specimen.
04	Charpy and Izod impact test on steel specimen.
05	Double shear test on steel rod.
06	Compression test on brick/concrete blocks/wood.
07	Tension and compression test on helical springs.
08	Brinell, Rockwell or Vickers hardness test.
09	Sample preparation for metallographic observations.
10	Experiments based on any two heat treatment methods.
11	Jominy end quench test.
12	Experiments based on any two NDT tests.

Term Work

Term work shall consist of any four experiments covering the experiments mentioned from Sr. no 1 to 7. In all, total 7 experiments are to be performed. A detailed report, based on an Industrial visit to a manufacturing firm, covering the syllabus discussed in the subject of Metallurgy & New Age Materials, needs to be submitted along with the write-up on above experiments.

Experiments (1- 7) : **10** marks

Experiments (8 -12) and report on Industrial visit : **10** marks

Attendance : **05** marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work as well as the industrial visit and minimum passing in the term work.

Course	Course Name	Credits
PEL304	Skill based Lab. Course-I Machine Shop Practice Lab.	02

Contact Hours			Credit Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	04	-	-	02	-	02

Theory					Term work / Practical / Oral			Total
Internal Assessment			End semester	Duration of End semester Exam	TW	PR	OR	
Test I	Test II	Average						
-	-	-	-	-	50	-	-	50

Objectives:

1. To prepare the students gain expertise with various lathe operations like turning, taper turning, thread cutting etc.
2. To familiarize with the practice of machining of flat surfaces on shaping and milling machines.

Outcomes: Learner will be able to:

1. Follow safe machine practices while working.
2. Select the right tool, setup of the machine/job for machining.
3. Perform operations like cylindrical turning, thread cutting etc. on lathe machine.
4. Perform operations for flat surfaces like Keyway cutting, T-slot cutting etc. on shaper/miller
5. Understand capabilities of CNC.

List of Experiments:

Sr.no	Experiments/Job
01	One job on Power hacksaw/Band saw and Drilling machine.
02	One job on plain turning, taper turning, screw cutting and other operation performed on lathe machine.
03	One job on shaping /milling machine to make horizontal and inclined surfaces.
04	One job on any unconventional machining process.
05	Demo on CNC Turning and CNC Milling

Term Work

Term work shall consist of exercises as per the above List. A detailed report, based on an Industrial visit to a manufacturing firm, covering various machining practices as mentioned in the subject of

Manufacturing Processes, also needs to be submitted. The report should contain various machining practices, followed as applicable in the industry visited.

The distribution of marks for term work shall be as follows:

Laboratory work (4 Experiments)	:40 Marks.
Industrial visit report on Machining practices	: 05 Marks.
Attendance (Practical)	: 05 Marks.

Course	Course Name	Credits
PEM301	Mini Project - 1A	02

Contact Hours			Credit Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	04	-	-	02	-	02

Theory					Term work / Practical / Oral			Total
Internal Assessment			End semester	Duration of End semester Exam	TW	PR	OR	
Test I	Test II	Average						
-	-	-	-	-	25	-	25	50

Objectives

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Outcome: Learner will be able to:

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as member of a group or leader.
4. Draw the proper inferences from available results through theoretical/ experimental/simulations.
5. Analyze the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to life long learning.
9. Demonstrate project management principles during project work.

Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.

- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;
 - Marks awarded by guide/supervisor based on log book : 10
 - Marks awarded by review committee : 10
 - Quality of Project report : 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.
 - First shall be for finalisation of problem
 - Second shall be on finalisation of proposed solution of problem.
- In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
 - First review is based on readiness of building working prototype to be conducted.
 - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
 - Identification of need/problem
 - Proposed final solution
 - Procurement of components/systems
 - Building prototype and testing
- Two reviews will be conducted for continuous assessment,
 - First shall be for finalisation of problem and proposed solution.
 - Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project.

Mini Project shall be assessed based on following criteria;

1. Quality of survey/ need identification
 2. Clarity of Problem definition based on need.
 3. Innovativeness in solutions
 4. Feasibility of proposed problem solutions and selection of best solution
 5. Cost effectiveness
 6. Societal impact
 7. Innovativeness
 8. Cost effectiveness and Societal impact
 9. Full functioning of working model as per stated requirements
 10. Effective use of skill sets
 11. Effective use of standard engineering norms
 12. Contribution of an individual's as member or leader
 13. Clarity in written and oral communication
- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
 - In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organizations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on following points;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication

UNIVERSITY OF MUMBAI



Bachelor of Engineering

in

Computer Engineering

**Direct Second Year (Sem. III) Admitted Students for the
current Academic Year 2020-21(Only)**

(REV- 2019 'C' Scheme) from Academic Year 2019 – 20

**Under
FACULTY OF
SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2019–2020)

Program Structure for Second Year Computer Engineering
UNIVERSITY OF MUMBAI (With Effect from 2020-2021) Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
CSC301	Engineering Mathematics-III	3	--	1*	3	--	1	4	
CSC302	Discrete Structures and Graph Theory	3		--	3		--	3	
CSC303	Data Structure	3	--	--	3	--	--	3	
CSC304	Digital Logic & Computer Architecture	3	--	--	3	--	--	3	
CSC305	Computer Graphics	3	--	--	3	--	--	3	
CSL301	Data Structure Lab	--	2	--	--	1	--	1	
CSL302	Digital Logic & Computer Architecture Lab	--	2	--	--	1	--	1	
CSL303	Computer Graphics Lab	--	2	--	--	1	--	1	
CSL304	Skill base Lab course: Object Oriented Programming with Java	--	2+2*	--	--	2	--	2	
CSM301	Mini Project – 1 A		4 ^{\$}			2		2	
Total		15	14	1	15	07	1	23	
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract & oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
CSC301	Engineering Mathematics-III	20	20	20	80	3	25	--	125
CSC302	Discrete Structures and Graph Theory	20	20	20	80	3	--	--	100
CSC303	Data Structure	20	20	20	80	3	--	--	100
CSC304	Digital Logic & Computer Architecture	20	20	20	80	3	--	--	100
CSC305	Computer Graphics	20	20	20	80	3	--	--	100
CSL301	Data Structure Lab	--	--	--	--	--	25	25	50
CSL302	Digital Logic & Computer Archit Lab	--	--	--	--	--	25	--	25
CSL303	Computer Graphics Lab	--	--	--	--	--	25	25	50
CSL304	Skill base Lab course: Object Oriented Programming with Java	--	--	--	--	--	50	25	75
CSM301	Mini Project – 1 A						25	25	50
Total		--	--	100	400	--	175	100	775

*Should be conducted batch wise and \$ indicates workload of Learner (Not Faculty), Students can form groups with minimum 2 (Two) and not more than 4 (Four), Faculty Load: 1 hour per week per four groups

Course Code	Course Name	Credits
CSC301	Engineering Mathematics-III	4

Pre-requisite: Engineering Mathematics-I, Engineering Mathematics-II

Course Objectives: The course aims:

1	To learn the Laplace Transform, Inverse Laplace Transform of various functions, its applications.
2	To understand the concept of Fourier Series, its complex form and enhance the problem-solving skills.
3	To understand the concept of complex variables, C-R equations with applications.
4	To understand the basic techniques of statistics like correlation, regression, and curve fitting for data analysis, Machine learning, and AI.
5	To understand some advanced topics of probability, random variables with their distributions and expectations.

Course Outcomes: On successful completion, of course, learner/student will be able to:

1	Understand the concept of Laplace transform and its application to solve the real integrals in engineering problems.
2	Understand the concept of inverse Laplace transform of various functions and its applications in engineering problems.
3	Expand the periodic function by using the Fourier series for real-life problems and complex engineering problems.
4	Understand complex variable theory, application of harmonic conjugate to get orthogonal trajectories and analytic functions.
5	Apply the concept of Correlation and Regression to the engineering problems in data science, machine learning, and AI.
6	Understand the concepts of probability and expectation for getting the spread of the data and distribution of probabilities.

Module	Detailed Contents	Hours
1	Laplace Transform	7
	1.1 Definition of Laplace transform, Condition of Existence of Laplace transform.	
	1.2 Laplace Transform (L) of standard functions like e^{at} , $\sin(at)$, $\cos(at)$, $\sinh(at)$, $\cosh(at)$ and t^n , $n \geq 0$.	
	1.3 Properties of Laplace Transform: Linearity, First Shifting Theorem, Second Shifting Theorem, Change of Scale, Multiplication by t , Division by t , Laplace Transform of derivatives and integrals (Properties without proof).	
	1.4 Evaluation of real improper integrals by using Laplace Transformation.	
	1.5 Self-learning Topics: Laplace Transform: Periodic functions, Heaviside's Unit Step function, Dirac Delta Function, Special functions (Error and Bessel)	

2	Inverse Laplace Transform		7
	2.1	Definition of Inverse Laplace Transform, Linearity property, Inverse Laplace Transform of standard functions, Inverse Laplace transform using derivatives.	
	2.2	Partial fractions method to find Inverse Laplace transform.	
	2.3	Inverse Laplace transform using Convolution theorem (without proof)	
	2.4	Self-learning Topics: Applications to solve initial and boundary value problems involving ordinary differential equations.	
3	Fourier Series:		7
	3.1	Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof).	
	3.2	Fourier series of periodic function with period 2π and $2l$.	
	3.3	Fourier series of even and odd functions.	
	3.4	Half range Sine and Cosine Series.	
	3.5	Self-learning Topics: Orthogonal and orthonormal set of functions, Complex form of Fourier Series, Fourier Transforms.	
4	Complex Variables:		7
	4.1	Function $f(z)$ of complex variable, Limit, Continuity and Differentiability of $f(z)$, Analytic function: Necessary and sufficient conditions for $f(z)$ to be analytic (without proof).	
	4.2	Cauchy-Riemann equations in Cartesian coordinates (without proof).	
	4.3	Milne-Thomson method: Determine analytic function $f(z)$ when real part (u), imaginary part (v) or its combination ($u+v$ / $u-v$) is given.	
	4.4	Harmonic function, Harmonic conjugate and Orthogonal trajectories.	
	4.5	Self-learning Topics: Conformal mapping, Linear and Bilinear mappings, cross ratio, fixed points and standard transformations.	
5	Statistical Techniques		6
	5.1	Karl Pearson's coefficient of correlation (r)	
	5.2	Spearman's Rank correlation coefficient (R) (with repeated and non-repeated ranks)	
	5.3	Lines of regression	
	5.4	Fitting of first- and second-degree curves.	
	5.5	Self-learning Topics: Covariance, fitting of exponential curve.	
6	Probability		6
	6.1	Definition and basics of probability, conditional probability.	
	6.2	Total Probability theorem and Bayes' theorem.	
	6.3	Discrete and continuous random variable with probability distribution and probability density function.	
	6.4	Expectation, Variance, Moment generating function, Raw and central moments up to 4 th order.	
	6.5	Self-learning Topics: Skewness and Kurtosis of distribution (data).	

References:

1	Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication.
2	Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited.

3	Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa Publication.
4	Complex Variables and Applications, Brown and Churchill, McGraw-Hill Education.
5	Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill Education.
6	Theory and Problems of Fourier Analysis with applications to BVP, Murray Spiegel, Schaum's Outline Series.

Term Work:

General Instructions:

1	Batch wise tutorialshave to be conducted. The number of students per batch will be as per University pattern for practical.
2	Students must be encouraged to write at least 6 class tutorials on the entire syllabus.
3	A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This will be considered as a mini project in Engineering Mathematics. This project will be graded out of 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows:

1	Attendance (Theory and Tutorial)	05 marks
2	Class Tutorials on entire syllabus	10 marks
3	Mini project	10 marks

Assessment:

Internal Assessment Test:

The assessment consists of two class tests of 20 marks each. The 1stclass test (Internal Assessment I) has to be conducted when approximately 40% of the syllabus is completed. The 2nd class test has to be conducted(Internal Assessment II) when an additional 35% syllabus is completed. The duration of each test will be for one hour.

End Semester Theory Examination:

1	The question paper will comprise a total of 6 questions, each carrying 20 marks.
2	Out of the 6 questions, 4 questions have to be attempted.
3	Question 1, based on the entire syllabus, will have 4sub-questions of 5 marks each and is compulsory.
4	Question 2 to Question 6 will have 3 sub-questions, each of 6, 6, and 8 marks, respectively.
5	Each sub-question in (4) will be from different modules of the syllabus.
6	Weightage of each module will be proportional to the number of lecture hours, as mentioned in the syllabus.

Course Code	Course Name	Credits
CSC302	Discrete Structures and Graph Theory	3

Pre-requisite: Basic Mathematics

Course Objectives: The course aims:

1	Cultivate clear thinking and creative problem solving.
2	Thoroughly train in the construction and understanding of mathematical proofs. Exercise common mathematical arguments and proof strategies.
3	To apply graph theory in solving practical problems.
4	Thoroughly prepare for the mathematical aspects of other Computer Engineering courses

Course Outcomes: On successful completion, of course, learner/student will be able to:

1	Understand the notion of mathematical thinking, mathematical proofs and to apply them in problem solving.
2	Ability to reason logically.
3	Ability to understand relations, functions, Diagram and Lattice.
4	Ability to understand and apply concepts of graph theory in solving real world problems.
5	Understand use of groups and codes in Encoding-Decoding
6	Analyze a complex computing problem and apply principles of discrete mathematics to identify solutions

Module	Detailed Contents	Hours
1	Logic	6
	Propositional Logic, Predicate Logic, Laws of Logic, Quantifiers, Normal Forms, Inference Theory of Predicate Calculus, Mathematical Induction.	
2	Relations and Functions	6
	2.1 Basic concepts of Set Theory	
	2.2 Relations: Definition, Types of Relations, Representation of Relations, Closures of Relations, Warshall's algorithm, Equivalence relations and Equivalence Classes	
	2.3 Functions: Definition, Types of functions, Composition of functions, Identity and Inverse function	
3	Posets and Lattice	5
	Partial Order Relations, Poset, Hasse Diagram, Chain and Anti chains, Lattice, Types of Lattice, Sub lattice	
4	Counting	6
	4.1 Basic Counting Principle-Sum Rule, Product Rule, Inclusion-Exclusion Principle, Pigeonhole Principle	
	4.2 Recurrence relations, Solving recurrence relations	
5	Algebraic Structures	8
	5.1 Algebraic structures with one binary operation: Semi group, Monoid, Groups, Subgroups, Abelian Group, Cyclic group, Isomorphism	
	5.2 Algebraic structures with two binary operations: Ring	
	5.3 Coding Theory: Coding, binary information and error detection, decoding and error correction	

6	Graph Theory	8
	Types of graphs, Graph Representation, Sub graphs, Operations on Graphs, Walk, Path, Circuit, Connected Graphs, Disconnected Graph, Components, Homomorphism and Isomorphism of Graphs, Euler and Hamiltonian Graphs, Planar Graph, Cut Set, Cut Vertex, Applications.	

Textbooks:

- 1 Bernad Kolman, Robert Busby, Sharon Cutler Ross, Nadeem-ur-Rehman, “Discrete Mathematical Structures”, Pearson Education.
- 2 C. L. Liu “Elements of Discrete Mathematics”, second edition 1985, McGraw-Hill Book Company. Reprinted 2000.
- 3 K. H. Rosen, “Discrete Mathematics and applications”, fifth edition 2003, TataMcGraw Hill Publishing Company

References:

- 1 Y N Singh, “Discrete Mathematical Structures”, Wiley-India.
- 2 J. L. Mott, A. Kandel, T. P. Baker, “Discrete Mathematics for Computer Scientists and Mathematicians”, second edition 1986, Prentice Hall of India.
- 3 J. P. Trembley, R. Manohar “Discrete Mathematical Structures with Applications to Computer Science”, Tata McGraw-Hill
- 4 Seymour Lipschutz, Marc Lars Lipson, “Discrete Mathematics” Schaum’s Outline, McGraw-Hill Education.
- 5 Narsing Deo, “Graph Theory with applications to engineering and computer science”, PHI Publications.
- 6 P. K. Bisht, H.S. Dhami, “Discrete Mathematics”, Oxford press.

Assessment:

Internal Assessment Test:

The assessment consists of two class tests of 20 marks each. The 1st class test (Internal Assessment I) has to be conducted when approximately 40% of the syllabus is completed. The 2nd class test has to be conducted (Internal Assessment II) when an additional 40% syllabus is completed. The duration of each test will be for one hour.

End Semester Theory Examination:

- 1 The question paper will comprise a total of 6 questions, each carrying 20 marks.
- 2 Out of the 6 questions, 4 questions have to be attempted.
- 3 Question 1, based on the entire syllabus, will have 4 sub-questions of 5 marks each and is compulsory.
- 4 Question 2 to Question 6 will have 3 sub-questions, each of 6, 6, and 8 marks, respectively.
- 5 Each sub-question in (4) will be from different modules of the syllabus.
- 6 Weightage of each module will be proportional to the number of lecture hours, as mentioned in the syllabus.

Useful Links

- 1 <https://www.edx.org/learn/discrete-mathematics>
- 2 <https://www.coursera.org/specializations/discrete-mathematics>
- 3 <https://nptel.ac.in/courses/106/106/106106094/>
- 4 https://swayam.gov.in/nd1_noc19_cs67/preview

Course Code	Course Name	Credit
CSC303	Data Structure	03

Pre-requisite: C Programming

Course Objectives: The course aims:

1	To understand the need and significance of Data structures as a computer Professional.
2	To teach concept and implementation of linear and Nonlinear data structures.
3	To analyze various data structures and select the appropriate one to solve a specific real-world problem.
4	To introduce various techniques for representation of the data in the real world.
5	To teach various searching techniques.

Course Outcomes:

1	Students will be able to implement Linear and Non-Linear data structures.
2	Students will be able to handle various operations like searching, insertion, deletion and traversals on various data structures.
3	Students will be able to explain various data structures, related terminologies and its types.
4	Students will be able to choose appropriate data structure and apply it to solve problems in various domains.
5	Students will be able to analyze and Implement appropriate searching techniques for a given problem.
6	Students will be able to demonstrate the ability to analyze, design, apply and use data structures to solve engineering problems and evaluate their solutions.

Module		Detailed Content	Hours
1		Introduction to Data Structures	1
	1.1	Introduction to Data Structures, Concept of ADT	
2		Stack and Queues	4
	2.1	Introduction, ADT of Stack, Applications of Stack-Well form-ness of Parenthesis	
	2.2	Introduction of Double Ended Queue, Applications of Queue.	
3		Linked List	5
	3.1	Introduction of-Linked List v/s Array, Types of Linked List, Circular Linked List, Doubly Linked List, Operations on- Doubly Linked List, Stack and Queue using Singly Linked List, Singly Linked List Application-Polynomial Representation and Addition.	
4		Trees	5
	4.1	Introduction, Tree-Operations on Binary Search Tree, Applications of Binary Tree, Huffman Encoding, Search Trees-AVL, rotations in AVL Tree, operations on AVL Tree, Introduction of B Tree, B+ Tree.	
5		Graphs	3

	5.1	Introduction of Graph Terminologies,–Graph Traversals-Depth First Search (DFS) and Breadth First Search (BFS), Graph Application-Topological Sorting.	
6		Searching Techniques	2
	6.1	Hashing-Concept, Hash Functions, Collision resolution Techniques	

Textbooks:	
1	Aaron M Tenenbaum, Yedidyah Langsam, Moshe J Augenstein, “Data Structures Using C”, Pearson Publication.
2	Reema Thareja, “Data Structures using C”, Oxford Press.
3	Richard F. Gilberg and Behrouz A. Forouzan, “Data Structures: A Pseudocode Approach with C”, 2 nd Edition, CENGAGE Learning.
4	Jean Paul Tremblay, P. G. Sorenson, “Introduction to Data Structure and Its Applications”, McGraw-Hill Higher Education
5	Data Structures Using C, ISRD Group, 2 nd Edition, Tata McGraw-Hill.
References:	
1	Prof. P. S. Deshpande, Prof. O. G. Kakde, “C and Data Structures”, DreamTech press.
2	E. Balagurusamy, “Data Structure Using C”, Tata McGraw-Hill Education India.
3	Rajesh K Shukla, “Data Structures using C and C++”, Wiley-India
4	GAV PAI, “Data Structures”, Schaum’s Outlines.
5	Robert Kruse, C. L. Tondo, Bruce Leung, “Data Structures and Program Design in C”, Pearson Edition

<u>Assessment:</u>	
Internal Assessment:	
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.	
End Semester Theory Examination:	
1	Question paper will consist of 6 questions, each carrying 20 marks.
2	The students need to solve a total of 4 questions.
3	Question No.1 will be compulsory and based on the entire syllabus.
4	Remaining question (Q.2 to Q.6) will be selected from all the modules.

Useful Links	
1	https://nptel.ac.in/courses/106/102/106102064/
2	https://www.coursera.org/specializations/data-structures-algorithms
3	https://www.edx.org/course/data-structures-fundamentals
4	https://swayam.gov.in/nd1_noc19_cs67/preview

Course Code	Course Name	Credit
CSC304	Digital Logic & Computer Organization and Architecture	3

Pre-requisite: Knowledge on number systems

Course Objective:

1	To have the rough understanding of the basic structure and operation of basic digital circuits and digital computer.
2	To discuss in detail arithmetic operations in digital system.
3	To discuss generation of control signals and different ways of communication with I/O devices.
4	To study the hierarchical memory and principles of advanced computing.

Course Outcome:

1	To learn different number systems and basic structure of computer system.
2	To demonstrate the arithmetic algorithms.
3	To understand the basic concepts of digital components and processor organization.
4	To understand the generation of control signals of computer.
5	To demonstrate the memory organization.
6	To describe the concepts of parallel processing and different Buses.

Module		Detailed Content	Hours
1		Computer Fundamentals	2
	1.1	Overview of computer organization and architecture.	
	1.2	Basic Organization of Computer and Block Level functional Units, Von-Neumann Model.	
2		Data Representation and Arithmetic algorithms	4
	2.2	Booths Multiplication Algorithm, Restoring and Non-restoring Division Algorithm.	
	2.3	IEEE-754 Floating point Representation.	
3		Processor Organization and Architecture	3
	3.1	Introduction to Flip Flop	
	3.3	Register Organization, Instruction Formats, Addressing modes, Instruction Cycle, Interpretation and sequencing.	
4		Control Unit Design	5
	4.1	Hardwired Control Unit: State Table Method, Delay Element Methods.	
	4.2	Microprogrammed Control Unit: Micro Instruction-Format, Sequencing and execution, Micro operations, Examples of microprograms.	
5		Memory Organization	5
	5.1	Introduction and characteristics of memory	
	5.2	Cache Memory: Concept, locality of reference, Design problems based on mapping techniques, Cache coherence and write policies. Interleaved and Associative Memory.	
6		Principles of Advanced Processor and Buses	6
	6.1	Basic Pipelined Data path and control, data dependencies, data hazards, branch hazards, delayed branch, and branch prediction, Performance measures-CPI, Speedup, Efficiency, throughput, Amdhal's law.	
	6.2	Flynn's Classification, Introduction to multicore architecture.	
	6.3	Introduction to buses: ISA, PCI, USB. Bus Contention and Arbitration.	

Textbooks:	
1	R. P. Jain, “Modern Digital Electronic”, McGraw-Hill Publication, 4 th Edition.
2	William Stalling, “Computer Organization and Architecture: Designing and Performance”, Pearson Publication 10 TH Edition.
3	John P Hayes, “Computer Architecture and Organization”, McGraw-Hill Publication, 3 RD Edition.
4	Dr. M. Usha and T. S. Shrikanth, “Computer system Architecture and Organization”, Wiley publication.
References:	
1	Andrew S. Tanenbaum, “Structured Computer Organization”, Pearson Publication.
2	B. Govindarajalu, “Computer Architecture and Organization”, McGraw-Hill Publication.
3	Malvino, “Digital computer Electronics”, McGraw-Hill Publication, 3 rd Edition.
4	Smruti Ranjan Sarangi, “Computer Organization and Architecture”, McGraw-Hill Publication.

<u>Assessment:</u>	
Internal Assessment:	
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.	
End Semester Theory Examination:	
1	Question paper will comprise of 6 questions, each carrying 20 marks.
2	The students need to solve total 4 questions.
3	Question No.1 will be compulsory and based on entire syllabus.
4	Remaining question (Q.2 to Q.6) will be selected from all the modules.

Useful Links	
1	https://www.classcentral.com/course/swayam-computer-organization-and-architecture-a-pedagogical-aspect-9824
2	https://nptel.ac.in/courses/106/103/106103068/
3	https://www.coursera.org/learn/comparch
4	https://www.edx.org/learn/computer-architecture

Course Code	Course Name	Credits
CSC305	Computer Graphics	3

Prerequisite: Knowledge of C Programming and Basic Mathematics.

Course Objectives

- | | |
|---|--|
| 1 | To equip students with the fundamental knowledge and basic technical competence in the field of Computer Graphics. |
| 2 | To emphasize on implementation aspect of Computer Graphics Algorithms. |
| 3 | To prepare the student for advance areas and professional avenues in the field of Computer Graphics |

Course Outcomes: At the end of the course, the students should be able to

- | | |
|---|---|
| 1 | Describe the basic concepts of Computer Graphics. |
| 2 | Demonstrate various algorithms for basic graphics primitives. |
| 3 | Apply 2-D geometric transformations on graphical objects. |
| 4 | Use various Clipping algorithms on graphical objects |
| 5 | Explore 3-D geometric transformations, curve representation techniques and projections methods. |
| 6 | Explain visible surface detection techniques and Animation. |

Module		Detailed Content	Hours
1		Introduction and Overview of Graphics System:	01
	1.1	Definition and Representative uses of computer graphics.	
2		Output Primitives:	05
	2.1	Scan conversions of point, line, midpoint algorithm for ellipse drawing (Mathematical derivation for above algorithms is expected)	
	2.2	Aliasing, Antialiasing techniques like Pre and post filtering, super sampling, and pixel phasing).	
	2.3		
3		Two Dimensional Geometric Transformations	3
	3.1	Basic transformations: Translation, Scaling, Rotation	
	3.2	Matrix representation and Homogeneous Coordinates	
4		Two-Dimensional Viewing and Clipping	3
	4.1	Viewing transformation pipeline and Window to Viewport coordinate transformation	
	4.2	Clipping operations: Point clipping, Line	
5		Three Dimensional Geometric Transformations, Curves and Fractal Generation	3
	5.1	3D Transformations: Translation, Rotation, Scaling and Reflection	
6		Visible Surface Detection and Animation	5
	6.1	Visible Surface Detection: Classification of Visible Surface Detection algorithm, Back Surface detection method, Depth Buffer method, Area Subdivision method	
	6.2	Animation: Introduction to Animation, Traditional Animation Techniques, Principles of Animation, Key framing: Character and Facial Animation, Deformation, Motion capture	

Textbooks:	
1	Hearn & Baker, “Computer Graphics C version”, 2nd Edition, Pearson Publication
2	James D. Foley, Andries van Dam, Steven K. Feiner, John F. Hughes, “Computer Graphics Principles and Practice in C”, 2 nd Edition, Pearson Publication
3	Samit Bhattacharya, “Computer Graphics”, Oxford Publication
References:	
1	D. Rogers, “Procedural Elements for Computer Graphics”, Tata McGraw-Hill Publications.
2	Zhigang Xiang, Roy Plastock, “Computer Graphics”, Schaum’s Outlines McGraw-Hill Education
3	Rajesh K. Maurya, “Computer Graphics”, Wiley India Publication.
4	F.S. Hill, “Computer Graphics using OpenGL”, Third edition, Pearson Publications.

<u>Assessment:</u>	
Internal Assessment:	
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.	
End Semester Theory Examination:	
1	Question paper will comprise of 6 questions, each carrying 20 marks.
2	The students need to solve total 4 questions.
3	Question No.1 will be compulsory and based on entire syllabus.
4	Remaining question (Q.2 to Q.6) will be selected from all the modules

Useful Links	
1	https://www.classcentral.com/course/interactivegraphics-2067
2	https://swayam.gov.in/nd2_ntr20_ed15/preview
3	https://nptel.ac.in/courses/106/106/106106090/
4	https://www.edx.org/course/computer-graphics-2

Lab Code	Lab Name	Credit
CSL301	Data Structures Lab	1

Prerequisite: C Programming Language.

Lab Objectives:

- | | |
|---|--|
| 1 | To implement basic data structures such as arrays, linked lists, stacks and queues |
| 2 | Solve problem involving graphs, and trees |
| 3 | To develop application using data structure algorithms |
| 4 | Compute the complexity of various algorithms. |

Lab Outcomes:

- | | |
|---|--|
| 1 | Students will be able to implement linear data structures & be able to handle operations like insertion, deletion, searching and traversing on them. |
| 2 | Students will be able to implement nonlinear data structures & be able to handle operations like insertion, deletion, searching and traversing on them |
| 3 | Students will be able to choose appropriate data structure and apply it in various problems |
| 4 | Students will be able to select appropriate searching techniques for given problems. |

Suggested Experiments: Students are required to complete at least 6-7 experiments.

Sr. No.	Name of the Experiment
1	Implement Stack ADT using array.
2	Convert an Infix expression to Postfix expression using stack ADT.
3	Evaluate Postfix Expression using Stack ADT.
4	Applications of Stack ADT.
5	Implement Priority Queue ADT using array.
6	Implement Doubly Linked List ADT.
7	Implement Stack / Linear Queue ADT using Linked List.
8	Implement Graph Traversal techniques:) Depth First Search b) Breadth First Search
9	Applications of Binary Search Technique.
Useful Links:	
1	www.leetcode.com
2	www.hackerrank.com
3	www.cs.usfca.edu/~galles/visualization/Algorithms.html
4	www.codechef.com

Term Work:

- | | |
|---|--|
| 1 | Term work should consist of 6-7 experiments. |
| 2 | Journal must include at least 1 assignment. |
| 3 | The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work. |
| 4 | Total 25 Marks (Experiments: 15-marks, Attendance Theory& Practical: 05-marks, Assignments: 05-marks) |

Oral & Practical exam

	Based on the entire syllabus of CSL301and CSC303
--	--

Lab Code	Lab Name	Credit
CSL302	Digital Logic & Computer Organization and Architecture Lab	1

Prerequisite: C Programming Language.

Lab Objectives:

- | | |
|---|--|
| 1 | To implement operations of the arithmetic unit using algorithms. |
| 2 | Design and simulate different digital circuits. |
| 3 | To design memory subsystem including cache memory. |
| 4 | To demonstrate CPU and ALU design. |

Lab Outcomes:

- | | |
|---|--|
| 1 | To understand the basics of digital components |
| 2 | Design the basic building blocks of a computer: ALU, registers, CPU and memory |
| 3 | To recognize the importance of digital systems in computer architecture |
| 4 | To implement various algorithms for arithmetic operations. |

Suggested Experiments: Students are required to complete at least 6-7 experiments.

Sr. No.	Name of the Experiment
1	To verify the truth table of various logic gates using ICs.
2	To implement Booth's algorithm.
3	To implement restoring division algorithm.
4	To implement non restoring division algorithm.
5	To implement ALU design.
6	To implement CPU design.
7	To implement memory design.
8	To implement cache memory design.

Note:

- | | |
|---|--|
| 1 | Any Four experiments from Exp. No. 1 to Exp. No. 7 using hardware. |
| 2 | Any Six experiments from Exp. No. 8 to Exp. No. 16 using Virtual Lab, except Exp. No 10,11 and 12. |
| 3 | Exp. No. 10 to Exp. No. 12 using Programming language. |

Digital Material:

- | | |
|---|---|
| 1 | Manual to use Virtual Lab simulator for Computer Organization and Architecture developed by the Department of CSE, IIT Kharagpur. |
| 2 | Link http://cse10-iitkgp.virtual-labs.ac.in/ |

Term Work:

- | | |
|---|--|
| 1 | Term work should consist of 6-7 experiments. |
| 2 | Journal must include at least 1 assignments on content of theory and practical of "Digital Logic & Computer Organization and Architecture" |
| 3 | The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work. |
| 4 | Total 25 Marks (Experiments: 15-marks, Attendance Theory& Practical: 05-marks, Assignments: 05-marks) |

Course Code	Lab Name	Credits
CSL303	Computer Graphics Lab	1

Prerequisite: C Programming Language.

Lab Objectives:

- | | |
|---|---|
| 1 | Understand the need of developing graphics application |
| 2 | Learn algorithmic development of graphics primitives like: line, circle, polygon etc. |
| 3 | Learn the representation and transformation of graphical images and pictures |

Lab Outcomes: At the end of the course, the students should be able to

- | | |
|---|--|
| 1 | Implement various output and filled area primitive algorithms |
| 2 | Apply transformation, projection and clipping algorithms on graphical objects. |
| 3 | Perform curve and fractal generation methods. |
| 4 | Develop a Graphical application/Animation based on learned concept |
| | |

Suggested Experiments: Students are required to complete at least 6-7 experiments.

Sr. No.	Name of the Experiment
1	Implement Line Drawing algorithm
2	Implement midpoint Ellipse algorithm.
3	Implement Area Filling Algorithm:
4	Implement Scan line Polygon Filling algorithm.
5	Implement Curve: Bezier for n control points, B Spline (Uniform)(at least one)
6	Implement 2D Transformations:..
7	Program to perform 3D transformation.
8	Program to perform projection of a 3D object on Projection Plane: Parallel and Perspective.
9	Program to perform Animation (such as Rising Sun, Moving Vehicle, Smileys, Screen saver etc.)

Term Work:

- | | |
|---|---|
| 1 | Term work should consist of 6-7 experiments. |
| 2 | Journal must include at least 1 assignments |
| 3 | Mini Project to perform using C /C++/Java/OpenGL/Blender/ any other tool (2/3 students per group).Possible Ideas: Animation using multiple objects, Game development, Graphics editor: Like Paint brush, Text editor etc. |
| 4 | The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work. |
| 5 | Total 25 Marks (Experiments: 10-marks, Attendance Theory& Practical: 05-marks, Assignments: 05-marks, Mini Project: 5-marks) |

Oral & Practical exam

Based on the above contents and entire syllabus of CSC305 Computer Graphics

Lab Code	Lab Name	Credits
CSL304	Skill based Lab Course: Object Oriented Programming with Java	2

Prerequisite: Structured Programming Approach

Lab Objectives:

1	To learn the basic concepts of object-oriented programming
2	To study JAVA programming language
3	To study various concepts of JAVA programming like multithreading, exception Handling, packages, etc.
4	To explain components of GUI based programming.

Lab Outcomes: At the end of the course, the students should be able to

1	To apply fundamental programming constructs.
2	To illustrate the concept of packages, classes and objects.
3	To elaborate the concept of strings, arrays and vectors.
4	To implement the concept of inheritance and interfaces.
5	To implement the concept of exception handling and multithreading.
6	To develop GUI based application.

Module		Detailed Content	Hours
1		Introduction to Object Oriented Programming	1
	1.1	OOP concepts: Objects, class, Encapsulation, Abstraction, Inheritance, Polymorphism, message passing.	
2		Class, Object, Packages and Input/output	1
	2.1	Overview of Class, object, data members, member functions Overview Method overloading	
3		Array, String and Vector	2
	3.1	Array, Strings, Vectors	
4		Inheritance	2
	4.1	Types of inheritance, Method overriding,	
5		Exception handling and Multithreading	3
	5.1	Overview of Exception handling methods	
6		GUI programming in JAVA	3
	6.1	Applet and applet life cycle, creating applets, AWT: working with windows, using AWT controls for GUI design Swing class in JAVA Introduction to JDBC,	

Textbooks:

1	Herbert Schildt, 'JAVA: The Complete Reference', Ninth Edition, Oracle Press.
2	E. Balagurusamy, 'Programming with Java', McGraw Hill Education.

References:

1	Ivor Horton, "Beginning JAVA", Wiley India.
2	Dietal and Dietal, "Java: How to Program", 8th Edition, PHI .
3	"JAVA Programming", Black Book, Dreamtech Press.
4	"Learn to Master Java programming", Staredu solutions

Digital material:

1	www.nptelvideos.in
2	www.w3schools.com
3	www.tutorialspoint.com
4	https://starcertification.org/Certifications/Certificate/securejava

Suggested Experiments: Students are required to complete at least 6-7 experiments.

Sr. No.	Name of the Experiment
1	Programs on class and objects
2	Program on Packages
3	Program on 2D array, strings functions
4	Program on String Buffer and Vectors
5	Program on Multiple Inheritance
6	Program on abstract class and abstract methods.
7	Program using super and final keyword
8	Program on Exception handling
9	Program on Graphics class
10	Program on applet class
11	Program to create GUI application
*Mini Project based on the content of the syllabus(Group of 2-3 students)	

Term Work:

1	Term work should consist of 6-7 experiments.
2	Journal must include at least 1 assignments
3	Mini Project based on the content of the syllabus(Group of 2-3 students)
4	The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
5	Total 50-Marks (Experiments: 15-marks, Attendance: 05-marks, Assignments: 05-marks, Mini Project: 20-marks, MCQ as a part of lab assignments: 5-marks)

Oral & Practical exam

Based on the entire syllabus of CSL 304: **Skill based Lab Course: Object Oriented Programming with Java**

Course code	Course Name	Credits
CSM301	Mini Project A	02

Objectives	
1	To acquaint with the process of identifying the needs and converting it into the problem.
2	To familiarize the process of solving the problem in a group.
3	To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4	To inculcate the process of self-learning and research.
Outcome: Learner will be able to...	
1	Identify problems based on societal /research needs.
2	Apply Knowledge and skill to solve societal problems in a group.
3	Develop interpersonal skills to work as member of a group or leader.
4	Draw the proper inferences from available results through theoretical/experimental/simulations.
5	Analyze the impact of solutions in societal and environmental context for sustainable development.
6	Use standard norms of engineering practices
7	Excel in written and oral communication.
8	Demonstrate capabilities of self-learning in a group, which leads to lifelong learning.
9	Demonstrate project management principles during project work.
Guidelines for Mini Project	
1	Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
2	Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
3	Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
4	A logbook to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
5	Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
6	Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
7	Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
8	The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
9	With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.

10	However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.
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Term Work	
The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.	
In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.	
Distribution of Term work marks for both semesters shall be as below:	
	Marks
1	Marks awarded by guide/supervisor based on logbook
2	Marks awarded by review committee
3	Quality of Project report
	10
	10
	05
Review / progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines	
One-year project:	
1	In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group. • First shall be for finalisation of problem • Second shall be on finalisation of proposed solution of problem.
2	In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester. • First review is based on readiness of building working prototype to be conducted. • Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.
Half-year project:	
1	In this case in one semester students' group shall complete project in all aspects including, • Identification of need/problem • Proposed final solution • Procurement of components/systems • Building prototype and testing
2	Two reviews will be conducted for continuous assessment, • First shall be for finalisation of problem and proposed solution • Second shall be for implementation and testing of solution.
Assessment criteria of Mini Project.	
Mini Project shall be assessed based on following criteria;	
1	Quality of survey/ need identification
2	Clarity of Problem definition based on need.

3	Innovativeness in solutions
4	Feasibility of proposed problem solutions and selection of best solution
5	Cost effectiveness
6	Societal impact
7	Innovativeness
8	Cost effectiveness and Societal impact
9	Full functioning of working model as per stated requirements
10	Effective use of skill sets
11	Effective use of standard engineering norms
12	Contribution of an individual's as member or leader
13	Clarity in written and oral communication
	In one year, project , first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
	In case of half year project all criteria's in generic may be considered for evaluation of performance of students in mini project.
Guidelines for Assessment of Mini Project Practical/Oral Examination:	
1	Report should be prepared as per the guidelines issued by the University of Mumbai.
2	Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organisations having experience of more than five years approved by head of Institution.
3	Students shall be motivated to publish a paper based on the work in Conferences/students competitions.
Mini Project shall be assessed based on following points;	
1	Quality of problem and Clarity
2	Innovativeness in solutions
3	Cost effectiveness and Societal impact
4	Full functioning of working model as per stated requirements
5	Effective use of skill sets
6	Effective use of standard engineering norms
7	Contribution of an individual's as member or leader
8	Clarity in written and oral communication

UNIVERSITY OF MUMBAI



Bachelor of Engineering

in

Mechanical Engineering

**Direct Second Year (Sem. III) Admitted Students for the
current Academic Year 2020-21(Only)**

(REV- 2019 'C' Scheme) from Academic Year 2019 – 20

**Under
FACULTY OF
SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2019–2020)

Program Structure for Second Year Engineering

UNIVERSITY OF MUMBAI (With Effect from 2020-2021)

Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract .	Tut.	Theory	Pract.	Tut.	Total
MEC301	Engineering Mathematics-III	3	--	1	3	--	1	4
MEC302	Strength of Materials	3		--	3		--	3
MEC303	Production Processes	4	--	--	4	--	--	4
MEC304	Materials and Metallurgy	3	--	--	3	--	--	3
MEC305	Thermodynamics	3	--	--	3	--	--	3
MEL301	Materials Testing	--	2	--	--	1	--	1
MEL302	Machine Shop Practice	--	4	--	--	2	--	2
MESBL301	CAD –Modeling	--	4	--	--	2	--	2
MEPBL301	Mini Project – 1A	--	4 ^{\$}	--	--	2	--	2
Total		16	14	1	16	07	1	24

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg .					
MEC301	Engineering Mathematics-III	20	20	20	80	3	25	--	125
MEC302	Strength of Materials	20	20	20	80	3	--	--	100
MEC303	Production Processes	20	20	20	80	3	--	--	100
MEC304	Materials and Metallurgy	20	20	20	80	3	--	--	100
MEC305	Thermodynamics	20	20	20	80	3	--	--	100
MEL301	Materials Testing	--	--	--	--	--	25	25	50
MEL302	Machine Shop Practice	--	--	--	--	--	50	--	50
MESBL301	CAD – Modeling	--	--	--	--	--	25	25	50
MEPBL301	Mini Project – 1A	--	--	--	--	--	25	25	50
Total		--	--	100	400	--	150	75	725

^{\$} indicates work load of Learner (Not Faculty), for Mini Project

SBL – Skill Based Laboratory

PBL – Project Based Learning

Course Code	Course Name	Credits
MEC301	Engineering Mathematics-III	4

Pre-requisite: Engineering Mathematics-I, Engineering Mathematics-II,

Objectives: The course is aimed

1. To familiarize with the Laplace Transform, Inverse Laplace Transform of various functions, its applications.
2. To acquaint with the concept of Fourier Series, its complex form and enhance the problem solving skills
3. To familiarize with the concept of complex variables, C-R equations with applications.
4. To study the application of the knowledge of matrices and numerical methods in complex engineering problems.

Outcomes: On successful completion of course learner/student will be able to:

1. Apply the concept of Laplace transform to solve the real integrals in engineering problems.
2. Apply the concept of inverse Laplace transform of various functions in engineering problems.
3. Expand the periodic function by using Fourier series for real life problems and complex engineering problems.
4. Find orthogonal trajectories and analytic function by using basic concepts of complex variable theory.
5. Apply Matrix algebra to solve the engineering problems.
6. Solve Partial differential equations by applying numerical solution and analytical methods for one dimensional heat and wave equations

Module	Detailed Contents	Hrs.
01	Module: Laplace Transform 1.1 Definition of Laplace transform, Condition of Existence of Laplace transform, 1.2 Laplace Transform (L) of Standard Functions like e^{at} , $\sin(at)$, $\cos(at)$, $\sinh(at)$, $\cosh(at)$ and t^n , where $n \geq 0$. 1.3 Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by t , Division by t , Laplace Transform of derivatives and integrals (Properties without proof). 1.4 Evaluation of integrals by using Laplace Transformation. Self-learning topics: Heaviside's Unit Step function, Laplace Transform. of Periodic functions, Dirac Delta Function.	07
02	Module: Inverse Laplace Transform 2.1 Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivative 2.2 Partial fractions method & first shift property to find inverse Laplace transform. 2.3 Inverse Laplace transform using Convolution theorem (without proof) Self-learning Topics: Applications to solve initial and boundary value problems involving ordinary differential equations.	06
03	Module: Fourier Series: 3.1 Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof) 3.2 Fourier series of periodic function with period 2π and $2l$, 3.3 Fourier series of even and odd functions 3.4 Half range Sine and Cosine Series. Self-learning Topics: Complex form of Fourier Series, orthogonal and orthonormal set of functions, Fourier Transform.	07
04	Module: Complex Variables: 4.1 Function $f(z)$ of complex variable, limit, continuity and differentiability of $f(z)$, Analytic function, necessary and sufficient conditions for $f(z)$ to be analytic (without	07

	proof), 4.2 Cauchy-Riemann equations in cartesian coordinates (without proof) 4.3 Milne-Thomson method to determine analytic function $f(z)$ when real part (u) or Imaginary part (v) or its combination (u+v or u-v) is given. 4.4 Harmonic function, Harmonic conjugate and orthogonal trajectories Self-learning Topics: Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations	
05	Module: Matrices: 5.1 Characteristic equation, Eigen values and Eigen vectors, Properties of Eigen values and Eigen vectors. (No theorems/ proof) 5.2 Cayley-Hamilton theorem (without proof): Application to find the inverse of the given square matrix and to determine the given higher degree polynomial matrix. 5.3 Functions of square matrix 5.4 Similarity of matrices, Diagonalization of matrices Self-learning Topics: Verification of Cayley Hamilton theorem, Minimal polynomial and Derogatory matrix & Quadratic Forms (Congruent transformation & Orthogonal Reduction)	06
06	Module: Numerical methods for PDE 6.1 Introduction of Partial Differential equations, method of separation of variables, Vibrations of string, Analytical method for one dimensional heat and wave equations. (only problems) 6.2 Crank Nicholson method 6.3 Bender Schmidt method Self-learning Topics: Analytical methods of solving two and three dimensional problems.	06

Term Work:

General Instructions:

1. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
2. A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Engineering Mathematics. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1.	Attendance (Theory and Tutorial)	05 marks
2.	Class Tutorials on entire syllabus	10 marks
3.	Mini project	10 marks

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment II) when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.

5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

References:

1. Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited,
3. Advanced Engineering Mathematics, R. K. Jain and S.R.K. Iyengar, Narosa publication
4. Advanced Engineering Mathematics, H.K. Das, S. Chand Publication
5. Higher Engineering Mathematics B.V. Ramana, McGraw Hill Education
6. Complex Variables and Applications, Brown and Churchill, McGraw-Hill education,
7. Text book of Matrices, Shanti Narayan and P K Mittal, S. Chand Publication
8. Laplace transforms, Murray R. Spiegel, Schaum's Outline Series

Links for online NPTEL/SWAYAM courses:

1. <https://nptel.ac.in/courses/111/104/111104085/>
2. <https://nptel.ac.in/courses/111/106/111106139/>

Course Code	Course Name	Credits
MEC302	Strength of Materials	03

Objectives:

1. To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres subjected to various types of simple loads.
2. To calculate the elastic deformation occurring in various simple geometries for different types of Loading.
3. To study distribution of various stresses in the mechanical elements under different types of loads.

Outcomes: Learner will be able to...

1. Demonstrate fundamental knowledge about various types of loading and stresses induced.
2. Draw the SFD and BMD for different types of loads and support conditions.
3. Analyse the bending and shear stresses induced in beam.
4. Analyse the deflection in beams and stresses in shaft.
5. Analyse the stresses and deflection in beams and Estimate the strain energy in mechanical elements.
6. Analyse buckling phenomenon in columns.

Module	Detailed Contents	Hrs
1.	Uni axial, biaxial and tri axial stresses. Principal stresses and Principal planes-Mohr's circle.	3
2.	Shear Force and Bending Moment in Beams: Concept & Examples of SFD & BMD for uniformly varying loads, couple and their combinations.	5
3.	Deflection of Beams: Deflection of a beam: Double integration method, Maxwell's reciprocal theorems for computation of slopes and deflection in beams for point and distributed loads.	6
4.	Thin Cylindrical and Spherical Shells: Stresses and deformation in Thin Cylindrical and Spherical Shells subjected to internal pressure Strain Energy: Strain energy stored in the member due to gradual, sudden and impact loads, Strain energy due to bending and torsion.	4
5.	Columns: Buckling load, Types of end conditions for column, Euler's column theory and its limitations and Rankine formula.	2

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

References:

1. Strength of Materials by Ryder, Macmillan
2. Mechanics of Materials by James M. Gere and Barry J. Goodno, Cengage Learning, 6thEd, 2009
3. Mechanics of Materials by Gere and Timoshenko, CBS 2nd Edition
4. Elements of Strength of Materials by Timoshenko and Youngs, Affiliated East -West Press
5. Mechanics of Materials by Beer, Johnston, Dewolf and Mazurek, TMHPvt Ltd., New Delhi
6. Mechanics of Structures by S.B.Junnarkar, Charotar Publication
7. Mechanics of Materials by S.S.Ratan, Tata McGraw Hill Pvt. Ltd
8. Introduction to Solid Mechanics by Shames, PHI
9. Strength of Materials by S. Ramamrutham, Dhanpat Rai Pvt. Ltd
10. Strength of Materials by W.Nash, Schaum's Outline Series, McGraw Hill Publication, Special Indian Edition
11. Strength of Materials by R. Subramanian, Oxford University Press, Third Edition 2016

Links for online NPTEL/SWAYAM courses:

1. <http://www.nptelvideos.in/2012/11/strength-of-materials-prof.html>
2. https://swayam.gov.in/nd1_noc20_ce34

Course Code	Course Name	Credits
MEC303	Production Processes	04

Objectives:

1. To familiarize with the various production processes used on shop floors
2. To study appropriate production processes for a specific application.
3. To introduce to the learner various machine tools used for manufacturing
4. To familiarize with principle and working of non-traditional manufacturing
5. To introduce to them the Intelligent manufacturing in the context of Industry 4.0

Outcomes: Learner will be able to....

1. Demonstrate an understanding of casting process
2. Illustrate principles of forming processes.
3. Demonstrate applications of various types of welding processes.
4. Differentiate chip forming processes such as turning, milling, drilling, etc.
5. Illustrate the concept of producing polymer components and ceramic components.
6. Illustrate principles and working of non-traditional manufacturing
7. Understand the manufacturing technologies enabling Industry 4.0

Module	Details	Hrs.
1	Introduction to Production Processes and Metal Casting: Classification of Production Processes and applications areas Machine moulding, Types of riser, types of gates, solidification Special casting processes: CO ₂ and shell moulding, Investment casting, Die casting, Vacuum casting, Inspection	4
2	Joining Processes: Classification of various joining processes; Applicability, advantages and limitations of Adhesive bonding, Mechanical Fastening; Welding and allied processes, Hybrid joining processes. Classification and Working of various welding methods: Chemical, Radiant, Solid State, Welding Joints, Welding Positions and their remedies.	5
3	Forming processes: Introduction and classification of metalworking processes, hot and cold working processes. Defects in rolled and forged components, Classification and analysis of wire and tube drawing processes. Sheet metal working processes: Classification of Sheet metal operations	3
4	Machine Tools and Machining Processes: Grinding Machines and selection of grinding wheel (Dressing and Truing), Broaching machines, Lapping/Honing machines (Super Finishing Operations) and planning Machines. Gear Manufacturing Gear milling, standard cutters and limitations, Tool Engineering Taylor's tool life equation	3
5	Polymer Processing: Polymer Moulding Techniques for thermoplastic and thermosetting plastics. Applications of Plastics in engineering field. Powder Metallurgy: Introduction to PM, Powder making processes, Steps in PM. Compaction and Sintering processes. Secondary and finishing operations in PM Intelligent manufacturing in the context of Industry 4.0, Cyber-physical systems (CPS)	5

	Internet of Things (IoT) enabled manufacturing Cloud Manufacturing	
--	---	--

Assessment:

Internal Assessment for 20 marks: Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

End Semester Examination: Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Welding technology by O P Khanna
2. Foundry technology by O P Khanna
3. Elements of workshop technology. Vol. 1 & II by S K HajraChoudhury
4. Manufacturing Science by Ghosh and Malik
5. Rapid Manufacturing –An Industrial revolution for the digital age by N.Hopkinson, R.J.M.Hauge, P M, Dickens, Wiley
6. Rapid Manufacturing by Pham D T and Dimov, Springer Verlag
7. Production Technology by WAJ Chapman Vol I, II, III
8. Production Technology by P C Sharma.
9. Production Technology by Raghuvanshi.
10. Industry 4.0: The Industrial Internet of Things by Alasdair Gilchrist, 2016, Apress.
11. Cyber-Physical Systems: From Theory to Practice by Danda B. Rawat, Joel Rodrigues, Ivan Stojmenovic, 2015, C.R.C. Press.
12. Optimization of Manufacturing Systems using Internet of Things by Yingfeng Zhang, Fei Tao, 2017, Academic Press (AP), Elsevier.

Links for online NPTEL/SWAYAM courses:

1. <https://nptel.ac.in/courses/112/107/112107219/>
2. <https://nptel.ac.in/courses/112/107/112107215/>
3. <https://nptel.ac.in/courses/112/107/112107084/>
4. <https://nptel.ac.in/courses/112/107/112107144/>
5. <https://nptel.ac.in/courses/112/107/112107078/>
6. <https://nptel.ac.in/courses/112/107/112107239/>
7. <https://nptel.ac.in/courses/112/104/112104195/>
8. <https://nptel.ac.in/courses/112/107/112107219/>
9. <https://nptel.ac.in/courses/112/107/112107144/>
10. <https://nptel.ac.in/courses/112/107/112107213/>
11. <https://nptel.ac.in/courses/112/107/112107090/>
12. <https://nptel.ac.in/courses/113/106/113106087/>
13. <https://nptel.ac.in/courses/112/103/112103263/>
14. <https://nptel.ac.in/courses/112/107/112107239/>
15. <https://nptel.ac.in/courses/112/106/112106153/>
16. <https://nptel.ac.in/courses/112/107/112107250/>
17. <https://nptel.ac.in/courses/112/107/112107144/>
18. <https://nptel.ac.in/courses/112/107/112107239/>
19. <https://nptel.ac.in/courses/112/107/112107219/>

Course Code	Course Name	Credits
MEC304	Materials and Metallurgy	03

Objectives:

1. To familiarize the structure -property correlation in materials
2. To acquaint with the processing dependency on the performance of the various materials
3. To study the role of alloying in the development of steels.
4. To familiarize with the advances in materials development

Outcomes: Learner will be able to

1. Identify the various classes of materials and comprehend their properties
2. Apply phase diagram concepts to engineering applications
3. Apply particular heat treatment for required property development
4. Identify the probable mode of failure in materials and suggest measures to prevent them
5. Choose or develop new materials for better performance
6. Decide an appropriate method to evaluate different components in service

Module	Contents	Hrs.
1	Introduction to engineering materials – significance of structure property correlations in all classes of engineering materials Concepts of crystals- Crystalline and Non-crystalline, Crystal systems, Crystallographic planes and directions, Crystal Defects: Crystal Imperfections-definition, classification and significance of imperfections -point defects, line defects, Surface defects and volume defects. Importance of dislocations in deformation and its mechanisms. Critical Resolved shear stress, Slip systems and deformability of FCC, BCC and HCP lattice systems. Cold Working and Recrystallization annealing: Definition, effects and mechanism of cold work, Need for Recrystallization Annealing, the stages of recrystallization annealing and factors affecting it	5
2	Mechanism of Crystallization- Nucleation-Homogeneous and Heterogeneous Nucleation and Growth. Solidification of metals and -alloys– Cooling curves Classification of Alloys based on phases and phase diagram- Binary alloy phase diagram – Isomorphous, Eutectics type I and II, Peritectic Microstructural changes of hypo and hyper-eutectoid steel- TTT and CCT diagram-Hardenability and its tests, Graphitization in cast irons.	3
3	Heat treatment: Overview – Objectives – Thorough treatments: austempering and martempering – microstructure changes Surface hardening processes: Carbonitriding, induction and flame hardening, Laser and Electron beam hardening– principles and case depths Alloy steels - Maraging steels and Ausformed steels	3
4	Strengthening mechanisms in materials Fracture of metals – Ductile Fracture, Brittle Fracture, Ductile to Brittle Transition Temperature (DBTT), Griffith's criteria and Orowan's modification Fatigue – Endurance limit of ferrous and non-ferrous metals -Fatigue test, S-N curves, factors affecting fatigue, structural changes accompanying fatigue;	4

	Creep – mechanism of creep – stages of creep and creep test, creep resistant materials	
5	Basic concepts of composites, Processing of composites, advantages over metallic materials, various types of composites Introduction, Concepts, synthesis of nanomaterials, examples, and Nano composites, Classification of Smart materials, Shape Memory Alloys	2
6	Processing- of ceramics and composites through Injection Moulding Non-destructive Testing of Materials -ultrasonic testing, radiographic methods, magnetic particle testing	3

Assessment:

Internal Assessment for 20 marks: Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

End Semester Examination: Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

Textbooks:

1. Callister's Materials Science and Engineering, 2nd edition by R.Balasubramaniam
Wiley India Pvt. Ltd

References:

1. Introduction to Materials Science for Engineers; 8th Edition by James F. Shackelford Pearson
2. Introduction to Physical Metallurgy, 2nd edition by Sidney Avner, TataMcGrawHill
3. Mechanical Metallurgy, 3rd edition by GH Dieter, TataMcGraw Hill
4. Fundamentals of Materials Science and Engineering: An Integrated Approach, 5th Edition by William D. Callister, Jr., David G. Rethwisch, Wiley & Sons.
5. Materials Science and Engineering, 5th edition by V.Raghavan, Prentice Hall India

Links for online NPTEL/SWAYAM courses:

1. <https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-mm09/>
2. <https://nptel.ac.in/courses/113/102/113102080/>
3. <https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-mm09/>
4. https://nptel.ac.in/content/syllabus_pdf/113104074.pdf
5. https://nptel.ac.in/content/storage2/courses/112108150/pdf/PPTs/MTS_09_m.pdf
6. https://nptel.ac.in/content/storage2/courses/112108150/pdf/PPTs/MTS_08_m.pdf
7. <https://nptel.ac.in/courses/112/104/112104229/>
8. <https://nptel.ac.in/courses/118/104/118104008/>
9. https://nptel.ac.in/content/storage2/courses/112104173/Mod_1_smart_mat_lec_6.pdf[https://nptel.ac.i](https://nptel.ac.in/courses/112/104/112104229/)
10. [n/courses/112/104/112104229/](https://nptel.ac.in/courses/118/104/118104008/)
11. https://nptel.ac.in/content/storage2/courses/112104173/Mod_1_smart_mat_lec_6.pdf

Course Code	Course Name	Credits
MEC305	Thermodynamics	03

Objectives:

1. To familiarize the concepts of Energy in general and Heat and Work in particular
2. To study the fundamentals of quantification and grade of energy
3. To study the effect of energy transfer on properties of substances in the form of charts and diagrams
4. To familiarize the application of the concepts of thermodynamics in vapour power, gas power cycles, compressible fluid flow

Outcomes: Learners will be able to....

1. Demonstrate application of the laws of thermodynamics to a wide range of systems.
2. Compute heat and work interactions in thermodynamics systems
3. Demonstrate the interrelations between thermodynamic functions to solve practical problems.
4. Compute thermodynamic interactions using the steam table and Mollier chart
5. Compute efficiencies of heat engines, power cycles.
6. Apply the fundamentals of compressible fluid flow to the relevant systems

Module	Detailed contents	Hrs.
1	Basic Concepts: Thermodynamics system and types, Macroscopic and Microscopic approach, Thermodynamic properties of the system, state, path, process and cycle, Point and Path functions, Quasi-static process & Equilibrium, Perpetual Motion Machine of the First Kind, Application of first law to non-flow systems (Ideal gas processes with numerical) and flow systems, throttling device. Significance of $-VdP$ work, Relation between flow and non-flow work	3
2	Second Law of Thermodynamics: Perpetual Motion Machine of the second kind, Carnot cycle, Carnot theorem. Entropy: Entropy is property of a system, Temperature-Entropy diagram, Increase of entropy principle, $T ds$ relations, Entropy change During a process.	3
3	Availability: High grade and low-grade energy, Available and Unavailable energy, Dead State, Useful work, Irreversibility, Availability of closed system & steady flow process, Helmholtz & Gibbs function Thermodynamic Relations: Maxwell relations, Clausius-Clapeyron Equation, Mayer relation, Joule-Thomson coefficient (Only Theory)	3
4	Properties of Pure Substance: Vapour Power cycle: Principal components of a simple steam power plant, Carnot cycle and its limitations as a vapour cycle, Rankine cycle with different turbine inlet conditions, Mean temperature of heat addition, Reheat Rankine Cycle, Revision on steam table and Mollier chart.	4
5	Gas Power cycles: Comparison of Otto and Diesel cycle for same compression ratio, Brayton Cycle. Sterling Cycle, Ericsson Cycle, Lenoir cycle, and Atkinson cycle (Only theory).	3
6	Compressible Fluid flow: Propagation of sound waves through compressible fluids, Sonic velocity and Mach number; Stagnation properties, Application of continuity, momentum and energy equations for steady-state conditions; Steady flow through the nozzle, Isentropic flow through ducts of	4

	varying cross-sectional area, Effect of varying back pressure on nozzle performance, Critical pressure ratio	
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Assessment:

Internal Assessment for 20 marks: Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

End Semester Examination: Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Thermodynamics: An Engineering Approach by Yunus A. Cengel and Michael A. Boles, 9th edition, TMH
2. Basic Engineering Thermodynamics by Rayner Joel, 5th edition, Longman Publishers
3. Engineering Thermodynamics by P Chattopadhyay, 2nd edition, Oxford University Press India
4. Thermodynamics by P K Nag, 6th Edition, TMH
5. Thermodynamics by Onkar Singh, 4th Edition New Age International
6. Thermodynamics by C P Arora, 1st Edition TMH
7. Thermal Engineering By Ajoy Kumar, G. N. Sah, 2nd Edition, Narosa Publishing house
8. Engineering Thermodynamics Through Examples by Y V C Rao, Universities Press (India) Pvt Ltd
9. Fundamentals of Thermodynamics by Moran & Shapiro, Eighth Edition, Wiley
10. Fundamentals of Classical Thermodynamics by Van Wylen G.H. & Sonntag R.E., 9th Edition John Wiley & Sons
11. Thermodynamics by W.C. Reynolds, McGraw-Hill & Co
12. Thermodynamics by J P Holman, 4th Edition McGraw-Hill & Co

Links for online NPTEL/SWAYAM courses:

1. <https://nptel.ac.in/courses/112/105/112105266/>
2. <https://nptel.ac.in/courses/112/103/112103275/>
3. <https://nptel.ac.in/courses/112/105/112105220/>
4. <https://nptel.ac.in/courses/101/104/101104063/>

Course Code	Course Name	Credits
MEL301	Materials Testing	01

Objectives:

1. To familiarize with the use of metallurgical microscope for study of metals
2. To study the microstructures of ferrous (steel and cast iron) metals
3. To acquaint with the material testing by performing experiment related to Hardness , Fatigue, Tension, Torsion, Impact and Flexural Test

Outcomes: Learner will be able to...

1. Prepare metallic samples for studying its microstructure following the appropriate procedure.
2. Identify effects of heat treatment on microstructure of medium carbon steel and hardenability of steel using Jominy end Quench test
3. Perform Fatigue Test and draw S-N curve
4. Perform Tension test to Analyze the stress - strain behaviour of materials
5. Measure torsional strength, hardness and impact resistance of the material
6. Perform flexural test with central and three point loading conditions

a)List of Experiments: Total four experiments are required to be performed.

Experiment Number	Detailed Contents	Laboratory Sessions (Hrs.)
1	Comparison of Microstructures and hardness before and after Annealing, Normalizing and Hardening in medium carbon steel	2
2	Study of tempering characteristics of hardened steel	2
3	Determination of hardenability of steel using Jominy end Quench Test (Using different hardness testers to measure the Hardness)	2
4	Fatigue test – to determine number of cycles to failure of a given material at a given stress	2

b) Assignments: At least one problem on each of the following topics:

1. Simple stress strain
2. SFD and BMD
3. Stresses in beams
4. Torsion and deflection.
5. Thin cylinder and strain energy
6. Buckling of Columns

Note: Preferably, the assignments shall be based on live problems.**Project Based Learning may be incorporated by judiciously reducing number of assignments.**

Assessment:

Term Work: Including Part a and b both

Distribution of marks for Term Work shall be as follows:

Part a: 10 marks.

Part b:10 Marks

Attendance: 05 marks.

End Semester Practical/Oral Examination:

Pair of Internal and External Examiner should conduct practical examination followed by Oral

Course Code	Course Name	Credits
MEL302	Machine Shop Practice	02

Objectives:

1. To familiarize with basic machining processes.
2. To familiarize various machining operations and machine protocols

Outcomes: Learner will be able to...

1. Know the specifications, controls and safety measures related to machines and machining operations.
2. Use the machines for making various engineering jobs.
3. Perform various machining operations
4. Perform Tool Grinding
5. Perform welding operations

Module	Details	Hrs
1	One composite job consisting minimum four parts employing operations performed of various machine tools.	40
2	Tool Grinding – To know basic tool Nomenclature	04
3	One Job on Welding – Application of Metal Arc Welding	04

Assessment:

Term Work:

1. **Composite job** mentioned above and the **Welding Job**
2. Complete Work-Shop Book giving details of drawing of the job and timesheet

The distribution of marks for Term work shall be as follows:

1. Job Work with complete workshop book 40 marks
2. Attendance 10 marks

Course Code	Course Name	Credits
MESBL301	Skill Based Lab: CAD – Modeling	02

Prerequisites: Engineering Drawing

Objectives:

1. To impart the 3D modeling skills for development of 3D models of basic engineering components.
2. To introduce Product data exchange among CAD systems.
3. To familiarize with production drawings with important features like GD &T, surface finish, heat treatments etc.

Outcomes: Learner will be able to...

1. Illustrate basic understanding of types of CAD model creation.
2. Visualize and prepare 2D modeling of a given object using modeling software.
3. Build solid model of a given object using 3D modeling software.
4. Visualize and develop the surface model of a given object using modeling software.
5. Generate assembly models of given objects using assembly tools of a modeling software
6. Perform product data exchange among CAD systems.

Sr. No.	Exercises	Hrs.
1	CAD Introduction CAD models Creation, Types and uses of models from different perspectives. Parametric modeling.	10
2	2D Modeling Geometric modeling of an Engineering component, demonstrating skills in sketching commands of creation (line, arc, circle etc.) modification (Trim, move, rotate etc.) and viewing using (Pan, Zoom, Rotate etc.)	
3	Solid Modeling 3D Geometric modeling of an Engineering component, demonstrating modeling skills using commands like Extrude, Revolve, Sweep, Blend, Loft etc.	
4	Surface Modeling Extrude, Sweep, Trim etc and Mesh of curves, free form surfaces etc. Feature manipulation using Copy, Edit, Pattern, Suppress, History operations etc.	
5	Assembly Constraints, Exploded views, interference check. Drafting (Layouts, Standard & Sectional Views, Detailing & Plotting).	
6	Data Exchange CAD data exchange formats Like IGES, PDES, PARASOLID, DXF and STL along with their comparison and applicability.	

Assessment:

Term work

Using the above knowledge and skills acquired through six modules students should complete Minimum six assignments/Experiments from the given sets of assignments **(Two from each set)** using standard CAD modeler like PTC Creo/CATIA/ Solid work/UG /any other suitable software.

Set 1: Beginner Level:

3D modeling of basic Engineering components likes Nuts, Bolts, Keys, cotter, Screws, Springs etc.

Set 2: Intermediate Level:

3D modeling of basic Machine components like Clapper block, Single tool post, Lathe and Milling tail stock, Shaper tool head slide, jigs and fixtures Cotter, Knuckle joint, Couplings: simple, muff, flanged Protected flange coupling, Oldham's coupling, Universal coupling, element of engine system and Miscellaneous parts.

Set 3: Advance Level:

1) Generation of any Assembly model (minimum five child parts) along with Production drawing for any of the system by creating 3D modeling with assembly constraints, Interference check, Exploded view, GD&T, Bill of material.

2) Reverse Engineering of a physical model: disassembling of any physical model having not less than five parts, measure the required dimensions of each component, sketch the minimum views required for each component, convert these sketches into 3-D model and create an assembly drawing with actual dimensions

The distribution of marks for Term work shall be as follows:

1. Printouts/Plots: 20 marks
2. Attendance : 05 marks

End Semester Practical/Oral examination:

To be conducted by pair of Internal and External Examiner

1. Practical examination duration is two hours, based on Advance level of the Term work.
Oral examination should also be conducted to check the knowledge of CAD Modeling Tools.
2. The distribution of marks for practical examination shall be as follows:
 - a. Practical Exam15 marks
 - b. Oral Exam10 marks
3. Evaluation of practical examination to be done based on the printout of students work
4. Students work along with evaluation report to be preserved till the next examination

References:

1. Machine Drawing by N.D. Bhatt.
2. A textbook of Machine Drawing by Laxminarayan and M.L.Mathur, Jain brothers Delhi
3. Machine Drawing by Kamat and Rao
4. Machine Drawing by M.B.Shah
5. A text book of Machine Drawing by R.B.Gupta, Satyaprakashan, Tech. Publication
6. Machine Drawing by K.I. Narayana, P. Kannaiah, K.Venkata Reddy
7. Machine Drawing by Sidheshwar and Kanheya
8. Autodesk Inventor 2011 for Engineers and Designers by ShamTickoo and SurinderRaina, Dreamtech Press

NOTE –

1: For Detailed Course Schemes, Course Objectives, Internal & External Assessment process, End Semester Examination, Recommended & reference Books please refer MU syllabus of Second year (C-Scheme / R-19) Mechanical Engineering.

2: Theory and Practical Examination will be strictly based on above compressed syllabus.

UNIVERSITY OF MUMBAI



Bachelor of Engineering

in

Automobile Engineering

**Direct Second Year (Sem. III) Admitted Students for the
current Academic Year 2020-21(Only)**

(REV- 2019 'C' Scheme) from Academic Year 2019 – 20

**Under
FACULTY OF
SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2019–2020)

Program Structure for Second Year Engineering

UNIVERSITY OF MUMBAI
(With Effect from 2020-2021)

Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract .	Tut.	Theory	Pract.	Tut.	Total
AEC301	Engineering Mathematics-III [#]	3	--	1	3	--	1	4
AEC302	Strength of Materials [#]	3		--	3		--	3
AEC303	Production Processes [#]	4	--	--	4	--	--	4
AEC304	Materials and Metallurgy [#]	3	--	--	3	--	--	3
AEC305	Thermodynamics [#]	3	--	--	3	--	--	3
AEL301	Materials Testing [#]	--	2	--	--	1	--	1
AEL302	Machine Shop Practice [#]	--	4	--	--	2	--	2
AESBL301	CAD –Modeling [#]	--	4	--	--	2	--	2
AEPBL301	Mini Project – 1A	--	4 ^{\$}	--	--	2	--	2
Total		16	14	1	16	07	1	24

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract /oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test2	Avg .					
AEC301	Engineering Mathematics-III [#]	20	20	20	80	3	25	--	125
AEC302	Strength of Materials [#]	20	20	20	80	3	--	--	100
AEC303	Production Processes [#]	20	20	20	80	3	--	--	100
AEC304	Materials and Metallurgy [#]	20	20	20	80	3	--	--	100
AEC305	Thermodynamics [#]	20	20	20	80	3	--	--	100
AEL301	Materials Testing [#]	--	--	--	--	--	25	25	50
AEL302	Machine Shop Practice [#]	--	--	--	--	--	50		50
AESBL301	CAD –Modeling [#]	--	--	--	--	--	25	25	50
AEPBL301	Mini Project – 1A	--	--	--	--	--	25	25	50
Total		--	--	100	400	--	150	75	725

^{\$} indicates work load of Learner (Not Faculty), for Mini Project

[#] indicates common with Mechanical Engineering

SBL – Skill Based Laboratory, PBL – Project Based Learning

Course Code	Course Name	Credits
MEC301	Engineering Mathematics-III	4

Pre-requisite: Engineering Mathematics-I, Engineering Mathematics-II,

Objectives: The course is aimed

1. To familiarize with the Laplace Transform, Inverse Laplace Transform of various functions, its applications.
2. To acquaint with the concept of Fourier Series, its complex form and enhance the problem solving skills
3. To familiarize with the concept of complex variables, C-R equations with applications.
4. To study the application of the knowledge of matrices and numerical methods in complex engineering problems.

Outcomes: On successful completion of course learner/student will be able to:

1. Apply the concept of Laplace transform to solve the real integrals in engineering problems.
2. Apply the concept of inverse Laplace transform of various functions in engineering problems.
3. Expand the periodic function by using Fourier series for real life problems and complex engineering problems.
4. Find orthogonal trajectories and analytic function by using basic concepts of complex variable theory.
5. Apply Matrix algebra to solve the engineering problems.
6. Solve Partial differential equations by applying numerical solution and analytical methods for one dimensional heat and wave equations

Module	Detailed Contents	Hrs.
01	Module: Laplace Transform 1.1 Definition of Laplace transform, Condition of Existence of Laplace transform, 1.2 Laplace Transform (L) of Standard Functions like e^{at} , $\sin(at)$, $\cos(at)$, $\sinh(at)$, $\cosh(at)$ and t^n , where $n \geq 0$. 1.3 Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by t , Division by t , Laplace Transform of derivatives and integrals (Properties without proof). 1.4 Evaluation of integrals by using Laplace Transformation. Self-learning topics: Heaviside's Unit Step function, Laplace Transform. of Periodic functions, Dirac Delta Function.	07
02	Module: Inverse Laplace Transform 2.1 Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivative 2.2 Partial fractions method & first shift property to find inverse Laplace transform. 2.3 Inverse Laplace transform using Convolution theorem (without proof) Self-learning Topics: Applications to solve initial and boundary value problems involving ordinary differential equations.	06
03	Module: Fourier Series: 3.1 Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof) 3.2 Fourier series of periodic function with period 2π and $2l$, 3.3 Fourier series of even and odd functions 3.4 Half range Sine and Cosine Series. Self-learning Topics: Complex form of Fourier Series, orthogonal and orthonormal set of functions, Fourier Transform.	07
04	Module: Complex Variables: 4.1 Function $f(z)$ of complex variable, limit, continuity and differentiability of $f(z)$, Analytic function, necessary and sufficient conditions for $f(z)$ to be analytic (without	07

	proof), 4.2 Cauchy-Riemann equations in cartesian coordinates (without proof) 4.3 Milne-Thomson method to determine analytic function $f(z)$ when real part (u) or Imaginary part (v) or its combination (u+v or u-v) is given. 4.4 Harmonic function, Harmonic conjugate and orthogonal trajectories Self-learning Topics: Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations	
05	Module: Matrices: 5.1 Characteristic equation, Eigen values and Eigen vectors, Properties of Eigen values and Eigen vectors. (No theorems/ proof) 5.2 Cayley-Hamilton theorem (without proof): Application to find the inverse of the given square matrix and to determine the given higher degree polynomial matrix. 5.3 Functions of square matrix 5.4 Similarity of matrices, Diagonalization of matrices Self-learning Topics: Verification of Cayley Hamilton theorem, Minimal polynomial and Derogatory matrix & Quadratic Forms (Congruent transformation & Orthogonal Reduction)	06
06	Module: Numerical methods for PDE 6.1 Introduction of Partial Differential equations, method of separation of variables, Vibrations of string, Analytical method for one dimensional heat and wave equations. (only problems) 6.2 Crank Nicholson method 6.3 Bender Schmidt method Self-learning Topics: Analytical methods of solving two and three dimensional problems.	06

Term Work:

General Instructions:

1. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
2. A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Engineering Mathematics. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1.	Attendance (Theory and Tutorial)	05 marks
2.	Class Tutorials on entire syllabus	10 marks
3.	Mini project	10 marks

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment II) when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.

5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

References:

1. Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited,
3. Advanced Engineering Mathematics, R. K. Jain and S.R.K. Iyengar, Narosa publication
4. Advanced Engineering Mathematics, H.K. Das, S. Chand Publication
5. Higher Engineering Mathematics B.V. Ramana, McGraw Hill Education
6. Complex Variables and Applications, Brown and Churchill, McGraw-Hill education,
7. Text book of Matrices, Shanti Narayan and P K Mittal, S. Chand Publication
8. Laplace transforms, Murray R. Spiegel, Schaum's Outline Series

Links for online NPTEL/SWAYAM courses:

1. <https://nptel.ac.in/courses/111/104/111104085/>
2. <https://nptel.ac.in/courses/111/106/111106139/>

Course Code	Course Name	Credits
MEC302	Strength of Materials	03

Objectives:

1. To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres subjected to various types of simple loads.
2. To calculate the elastic deformation occurring in various simple geometries for different types of Loading.
3. To study distribution of various stresses in the mechanical elements under different types of loads.

Outcomes: Learner will be able to...

1. Demonstrate fundamental knowledge about various types of loading and stresses induced.
2. Draw the SFD and BMD for different types of loads and support conditions.
3. Analyse the bending and shear stresses induced in beam.
4. Analyse the deflection in beams and stresses in shaft.
5. Analyse the stresses and deflection in beams and Estimate the strain energy in mechanical elements.
6. Analyse buckling phenomenon in columns.

Module	Detailed Contents	Hrs
1.	Uni axial, biaxial and tri axial stresses. Principal stresses and Principal planes-Mohr's circle.	3
2.	Shear Force and Bending Moment in Beams: Concept & Examples of SFD & BMD for uniformly varying loads, couple and their combinations.	5
3.	Deflection of Beams: Deflection of a beam: Double integration method, Maxwell's reciprocal theorems for computation of slopes and deflection in beams for point and distributed loads.	6
4.	Thin Cylindrical and Spherical Shells: Stresses and deformation in Thin Cylindrical and Spherical Shells subjected to internal pressure Strain Energy: Strain energy stored in the member due to gradual, sudden and impact loads, Strain energy due to bending and torsion.	4
5.	Columns: Buckling load, Types of end conditions for column, Euler's column theory and its limitations and Rankine formula.	2

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

References:

1. Strength of Materials by Ryder, Macmillan
2. Mechanics of Materials by James M. Gere and Barry J. Goodno, Cengage Learning, 6thEd, 2009
3. Mechanics of Materials by Gere and Timoshenko, CBS 2nd Edition
4. Elements of Strength of Materials by Timoshenko and Youngs, Affiliated East -West Press
5. Mechanics of Materials by Beer, Johnston, Dewolf and Mazurek, TMHPvt Ltd., New Delhi
6. Mechanics of Structures by S.B.Junnarkar, Charotar Publication
7. Mechanics of Materials by S.S.Ratan, Tata McGraw Hill Pvt. Ltd
8. Introduction to Solid Mechanics by Shames, PHI
9. Strength of Materials by S. Ramamrutham, Dhanpat Rai Pvt. Ltd
10. Strength of Materials by W.Nash, Schaum's Outline Series, McGraw Hill Publication, Special Indian Edition
11. Strength of Materials by R. Subramanian, Oxford University Press, Third Edition 2016

Links for online NPTEL/SWAYAM courses:

1. <http://www.nptelvideos.in/2012/11/strength-of-materials-prof.html>
2. https://swayam.gov.in/nd1_noc20_ce34

Course Code	Course Name	Credits
MEC303	Production Processes	04

Objectives:

1. To familiarize with the various production processes used on shop floors
2. To study appropriate production processes for a specific application.
3. To introduce to the learner various machine tools used for manufacturing
4. To familiarize with principle and working of non-traditional manufacturing
5. To introduce to them the Intelligent manufacturing in the context of Industry 4.0

Outcomes: Learner will be able to....

1. Demonstrate an understanding of casting process
2. Illustrate principles of forming processes.
3. Demonstrate applications of various types of welding processes.
4. Differentiate chip forming processes such as turning, milling, drilling, etc.
5. Illustrate the concept of producing polymer components and ceramic components.
6. Illustrate principles and working of non-traditional manufacturing
7. Understand the manufacturing technologies enabling Industry 4.0

Module	Details	Hrs.
1	Introduction to Production Processes and Metal Casting: Classification of Production Processes and applications areas Machine moulding, Types of riser, types of gates, solidification Special casting processes: CO ₂ and shell moulding, Investment casting, Die casting, Vacuum casting, Inspection	4
2	Joining Processes: Classification of various joining processes; Applicability, advantages and limitations of Adhesive bonding, Mechanical Fastening; Welding and allied processes, Hybrid joining processes. Classification and Working of various welding methods: Chemical, Radiant, Solid State, Welding Joints, Welding Positions and their remedies.	5
3	Forming processes: Introduction and classification of metalworking processes, hot and cold working processes. Defects in rolled and forged components, Classification and analysis of wire and tube drawing processes. Sheet metal working processes: Classification of Sheet metal operations	3
4	Machine Tools and Machining Processes: Grinding Machines and selection of grinding wheel (Dressing and Truing), Broaching machines, Lapping/Honing machines (Super Finishing Operations) and planning Machines. Gear Manufacturing Gear milling, standard cutters and limitations, Tool Engineering Taylor's tool life equation	3
5	Polymer Processing: Polymer Moulding Techniques for thermoplastic and thermosetting plastics. Applications of Plastics in engineering field. Powder Metallurgy: Introduction to PM, Powder making processes, Steps in PM. Compaction and Sintering processes. Secondary and finishing operations in PM Intelligent manufacturing in the context of Industry 4.0, Cyber-physical systems (CPS)	5

	Internet of Things (IoT) enabled manufacturing Cloud Manufacturing	
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Assessment:

Internal Assessment for 20 marks: Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

End Semester Examination: Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Welding technology by O P Khanna
2. Foundry technology by O P Khanna
3. Elements of workshop technology. Vol. 1 & II by S K HajraChoudhury
4. Manufacturing Science by Ghosh and Malik
5. Rapid Manufacturing –An Industrial revolution for the digital age by N.Hopkinson, R.J.M.Hauge, P M, Dickens, Wiley
6. Rapid Manufacturing by Pham D T and Dimov, Springer Verlag
7. Production Technology by WAJ Chapman Vol I, II, III
8. Production Technology by P C Sharma.
9. Production Technology by Raghuvanshi.
10. Industry 4.0: The Industrial Internet of Things by Alasdair Gilchrist, 2016, Apress.
11. Cyber-Physical Systems: From Theory to Practice by Danda B. Rawat, Joel Rodrigues, Ivan Stojmenovic, 2015, C.R.C. Press.
12. Optimization of Manufacturing Systems using Internet of Things by Yingfeng Zhang, Fei Tao, 2017, Academic Press (AP), Elsevier.

Links for online NPTEL/SWAYAM courses:

1. <https://nptel.ac.in/courses/112/107/112107219/>
2. <https://nptel.ac.in/courses/112/107/112107215/>
3. <https://nptel.ac.in/courses/112/107/112107084/>
4. <https://nptel.ac.in/courses/112/107/112107144/>
5. <https://nptel.ac.in/courses/112/107/112107078/>
6. <https://nptel.ac.in/courses/112/107/112107239/>
7. <https://nptel.ac.in/courses/112/104/112104195/>
8. <https://nptel.ac.in/courses/112/107/112107219/>
9. <https://nptel.ac.in/courses/112/107/112107144/>
10. <https://nptel.ac.in/courses/112/107/112107213/>
11. <https://nptel.ac.in/courses/112/107/112107090/>
12. <https://nptel.ac.in/courses/113/106/113106087/>
13. <https://nptel.ac.in/courses/112/103/112103263/>
14. <https://nptel.ac.in/courses/112/107/112107239/>
15. <https://nptel.ac.in/courses/112/106/112106153/>
16. <https://nptel.ac.in/courses/112/107/112107250/>
17. <https://nptel.ac.in/courses/112/107/112107144/>
18. <https://nptel.ac.in/courses/112/107/112107239/>
19. <https://nptel.ac.in/courses/112/107/112107219/>

Course Code	Course Name	Credits
MEC304	Materials and Metallurgy	03

Objectives:

1. To familiarize the structure -property correlation in materials
2. To acquaint with the processing dependency on the performance of the various materials
3. To study the role of alloying in the development of steels.
4. To familiarize with the advances in materials development

Outcomes: Learner will be able to

1. Identify the various classes of materials and comprehend their properties
2. Apply phase diagram concepts to engineering applications
3. Apply particular heat treatment for required property development
4. Identify the probable mode of failure in materials and suggest measures to prevent them
5. Choose or develop new materials for better performance
6. Decide an appropriate method to evaluate different components in service

Module	Contents	Hrs.
1	Introduction to engineering materials – significance of structure property correlations in all classes of engineering materials Concepts of crystals- Crystalline and Non-crystalline, Crystal systems, Crystallographic planes and directions, Crystal Defects: Crystal Imperfections-definition, classification and significance of imperfections -point defects, line defects, Surface defects and volume defects. Importance of dislocations in deformation and its mechanisms. Critical Resolved shear stress, Slip systems and deformability of FCC, BCC and HCP lattice systems. Cold Working and Recrystallization annealing: Definition, effects and mechanism of cold work, Need for Recrystallization Annealing, the stages of recrystallization annealing and factors affecting it	5
2	Mechanism of Crystallization- Nucleation-Homogeneous and Heterogeneous Nucleation and Growth. Solidification of metals and -alloys– Cooling curves Classification of Alloys based on phases and phase diagram- Binary alloy phase diagram – Isomorphous, Eutectics type I and II, Peritectic Microstructural changes of hypo and hyper-eutectoid steel- TTT and CCT diagram-Hardenability and its tests, Graphitization in cast irons.	3
3	Heat treatment: Overview – Objectives – Thorough treatments: austempering and martempering – microstructure changes Surface hardening processes: Carbonitriding, induction and flame hardening, Laser and Electron beam hardening– principles and case depths Alloy steels - Maraging steels and Ausformed steels	3
4	Strengthening mechanisms in materials Fracture of metals – Ductile Fracture, Brittle Fracture, Ductile to Brittle Transition Temperature (DBTT), Griffith's criteria and Orowan's modification Fatigue – Endurance limit of ferrous and non-ferrous metals -Fatigue test, S-N curves, factors affecting fatigue, structural changes accompanying fatigue;	4

	Creep – mechanism of creep – stages of creep and creep test, creep resistant materials	
5	Basic concepts of composites, Processing of composites, advantages over metallic materials, various types of composites Introduction, Concepts, synthesis of nanomaterials, examples, and Nano composites, Classification of Smart materials, Shape Memory Alloys	2
6	Processing- of ceramics and composites through Injection Moulding Non-destructive Testing of Materials -ultrasonic testing, radiographic methods, magnetic particle testing	3

Assessment:

Internal Assessment for 20 marks: Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

End Semester Examination: Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

Textbooks:

1. Callister's Materials Science and Engineering, 2nd edition by R.Balasubramaniam
Wiley India Pvt. Ltd

References:

1. Introduction to Materials Science for Engineers; 8th Edition by James F. Shackelford Pearson
2. Introduction to Physical Metallurgy, 2nd edition by Sidney Avner, TataMcGrawHill
3. Mechanical Metallurgy, 3rd edition by GH Dieter, TataMcGraw Hill
4. Fundamentals of Materials Science and Engineering: An Integrated Approach, 5th Edition by William D. Callister, Jr., David G. Rethwisch, Wiley & Sons.
5. Materials Science and Engineering, 5th edition by V.Raghavan, Prentice Hall India

Links for online NPTEL/SWAYAM courses:

1. <https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-mm09/>
2. <https://nptel.ac.in/courses/113/102/113102080/>
3. <https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-mm09/>
4. https://nptel.ac.in/content/syllabus_pdf/113104074.pdf
5. https://nptel.ac.in/content/storage2/courses/112108150/pdf/PPTs/MTS_09_m.pdf
6. https://nptel.ac.in/content/storage2/courses/112108150/pdf/PPTs/MTS_08_m.pdf
7. <https://nptel.ac.in/courses/112/104/112104229/>
8. <https://nptel.ac.in/courses/118/104/118104008/>
9. https://nptel.ac.in/content/storage2/courses/112104173/Mod_1_smart_mat_lec_6.pdf<https://nptel.ac.in/courses/112/104/112104229/>
10. <https://nptel.ac.in/courses/118/104/118104008/>
11. https://nptel.ac.in/content/storage2/courses/112104173/Mod_1_smart_mat_lec_6.pdf

Course Code	Course Name	Credits
MEC305	Thermodynamics	03

Objectives:

1. To familiarize the concepts of Energy in general and Heat and Work in particular
2. To study the fundamentals of quantification and grade of energy
3. To study the effect of energy transfer on properties of substances in the form of charts and diagrams
4. To familiarize the application of the concepts of thermodynamics in vapour power, gas power cycles, compressible fluid flow

Outcomes: Learners will be able to....

1. Demonstrate application of the laws of thermodynamics to a wide range of systems.
2. Compute heat and work interactions in thermodynamics systems
3. Demonstrate the interrelations between thermodynamic functions to solve practical problems.
4. Compute thermodynamic interactions using the steam table and Mollier chart
5. Compute efficiencies of heat engines, power cycles.
6. Apply the fundamentals of compressible fluid flow to the relevant systems

Module	Detailed contents	Hrs.
1	Basic Concepts: Thermodynamics system and types, Macroscopic and Microscopic approach, Thermodynamic properties of the system, state, path, process and cycle, Point and Path functions, Quasi-static process & Equilibrium, Perpetual Motion Machine of the First Kind, Application of first law to non-flow systems (Ideal gas processes with numerical) and flow systems, throttling device. Significance of $-VdP$ work, Relation between flow and non-flow work	3
2	Second Law of Thermodynamics: Perpetual Motion Machine of the second kind, Carnot cycle, Carnot theorem. Entropy: Entropy is property of a system, Temperature-Entropy diagram, Increase of entropy principle, $T ds$ relations, Entropy change During a process.	3
3	Availability: High grade and low-grade energy, Available and Unavailable energy, Dead State, Useful work, Irreversibility, Availability of closed system & steady flow process, Helmholtz & Gibbs function Thermodynamic Relations: Maxwell relations, Clausius-Clapeyron Equation, Mayer relation, Joule-Thomson coefficient (Only Theory)	3
4	Properties of Pure Substance: Vapour Power cycle: Principal components of a simple steam power plant, Carnot cycle and its limitations as a vapour cycle, Rankine cycle with different turbine inlet conditions, Mean temperature of heat addition, Reheat Rankine Cycle, Revision on steam table and Mollier chart.	4
5	Gas Power cycles: Comparison of Otto and Diesel cycle for same compression ratio, Brayton Cycle. Sterling Cycle, Ericsson Cycle, Lenoir cycle, and Atkinson cycle (Only theory).	3
6	Compressible Fluid flow: Propagation of sound waves through compressible fluids, Sonic velocity and Mach number; Stagnation properties, Application of continuity, momentum and energy equations for steady-state conditions; Steady flow through the nozzle, Isentropic flow through ducts of	4

	varying cross-sectional area, Effect of varying back pressure on nozzle performance, Critical pressure ratio	
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Assessment:

Internal Assessment for 20 marks: Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

End Semester Examination: Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Thermodynamics: An Engineering Approach by Yunus A. Cengel and Michael A. Boles, 9th edition, TMH
2. Basic Engineering Thermodynamics by Rayner Joel, 5th edition, Longman Publishers
3. Engineering Thermodynamics by P Chattopadhyay, 2nd edition, Oxford University Press India
4. Thermodynamics by P K Nag, 6th Edition, TMH
5. Thermodynamics by Onkar Singh, 4th Edition New Age International
6. Thermodynamics by C P Arora, 1st Edition TMH
7. Thermal Engineering By Ajoy Kumar, G. N. Sah, 2nd Edition, Narosa Publishing house
8. Engineering Thermodynamics Through Examples by Y V C Rao, Universities Press (India) Pvt Ltd
9. Fundamentals of Thermodynamics by Moran & Shapiro, Eighth Edition, Wiley
10. Fundamentals of Classical Thermodynamics by Van Wylen G.H. & Sonntag R.E., 9th Edition John Wiley & Sons
11. Thermodynamics by W.C. Reynolds, McGraw-Hill & Co
12. Thermodynamics by J P Holman, 4th Edition McGraw-Hill & Co

Links for online NPTEL/SWAYAM courses:

1. <https://nptel.ac.in/courses/112/105/112105266/>
2. <https://nptel.ac.in/courses/112/103/112103275/>
3. <https://nptel.ac.in/courses/112/105/112105220/>
4. <https://nptel.ac.in/courses/101/104/101104063/>

Course Code	Course Name	Credits
MEL301	Materials Testing	01

Objectives:

1. To familiarize with the use of metallurgical microscope for study of metals
2. To study the microstructures of ferrous (steel and cast iron) metals
3. To acquaint with the material testing by performing experiment related to Hardness , Fatigue, Tension, Torsion, Impact and Flexural Test

Outcomes: Learner will be able to...

1. Prepare metallic samples for studying its microstructure following the appropriate procedure.
2. Identify effects of heat treatment on microstructure of medium carbon steel and hardenability of steel using Jominy end Quench test
3. Perform Fatigue Test and draw S-N curve
4. Perform Tension test to Analyze the stress - strain behaviour of materials
5. Measure torsional strength, hardness and impact resistance of the material
6. Perform flexural test with central and three point loading conditions

a)List of Experiments: Total four experiments are required to be performed.

Experiment Number	Detailed Contents	Laboratory Sessions (Hrs.)
1	Comparison of Microstructures and hardness before and after Annealing, Normalizing and Hardening in medium carbon steel	2
2	Study of tempering characteristics of hardened steel	2
3	Determination of hardenability of steel using Jominy end Quench Test (Using different hardness testers to measure the Hardness)	2
4	Fatigue test – to determine number of cycles to failure of a given material at a given stress	2

b) Assignments: At least one problem on each of the following topics:

1. Simple stress strain
2. SFD and BMD
3. Stresses in beams
4. Torsion and deflection.
5. Thin cylinder and strain energy
6. Buckling of Columns

Note: Preferably, the assignments shall be based on live problems.**Project Based Learning may be incorporated by judiciously reducing number of assignments.**

Assessment:

Term Work: Including Part a and b both

Distribution of marks for Term Work shall be as follows:

Part a: 10 marks.

Part b:10 Marks

Attendance: 05 marks.

End Semester Practical/Oral Examination:

Pair of Internal and External Examiner should conduct practical examination followed by Oral

Course Code	Course Name	Credits
MEL302	Machine Shop Practice	02

Objectives:

1. To familiarize with basic machining processes.
2. To familiarize various machining operations and machine protocols

Outcomes: Learner will be able to...

1. Know the specifications, controls and safety measures related to machines and machining operations.
2. Use the machines for making various engineering jobs.
3. Perform various machining operations
4. Perform Tool Grinding
5. Perform welding operations

Module	Details	Hrs
1	One composite job consisting minimum four parts employing operations performed of various machine tools.	40
2	Tool Grinding – To know basic tool Nomenclature	04
3	One Job on Welding – Application of Metal Arc Welding	04

Assessment:

Term Work:

1. **Composite job** mentioned above and the **Welding Job**
2. Complete Work-Shop Book giving details of drawing of the job and timesheet

The distribution of marks for Term work shall be as follows:

1. Job Work with complete workshop book 40 marks
2. Attendance 10marks

Course Code	Course Name	Credits
MESBL301	Skill Based Lab: CAD – Modeling	02

Prerequisites: Engineering Drawing

Objectives:

1. To impart the 3D modeling skills for development of 3D models of basic engineering components.
2. To introduce Product data exchange among CAD systems.
3. To familiarize with production drawings with important features like GD &T, surface finish, heat treatments etc.

Outcomes: Learner will be able to...

1. Illustrate basic understanding of types of CAD model creation.
2. Visualize and prepare 2D modeling of a given object using modeling software.
3. Build solid model of a given object using 3D modeling software.
4. Visualize and develop the surface model of a given object using modeling software.
5. Generate assembly models of given objects using assembly tools of a modeling software
6. Perform product data exchange among CAD systems.

Sr. No.	Exercises	Hrs.
1	CAD Introduction CAD models Creation, Types and uses of models from different perspectives. Parametric modeling.	10
2	2D Modeling Geometric modeling of an Engineering component, demonstrating skills in sketching commands of creation (line, arc, circle etc.) modification (Trim, move, rotate etc.) and viewing using (Pan, Zoom, Rotate etc.)	
3	Solid Modeling 3D Geometric modeling of an Engineering component, demonstrating modeling skills using commands like Extrude, Revolve, Sweep, Blend, Loft etc.	
4	Surface Modeling Extrude, Sweep, Trim etc and Mesh of curves, free form surfaces etc. Feature manipulation using Copy, Edit, Pattern, Suppress, History operations etc.	
5	Assembly Constraints, Exploded views, interference check. Drafting (Layouts, Standard & Sectional Views, Detailing & Plotting).	
6	Data Exchange CAD data exchange formats Like IGES, PDES, PARASOLID, DXF and STL along with their comparison and applicability.	

Assessment:

Term work

Using the above knowledge and skills acquired through six modules students should complete Minimum six assignments/Experiments from the given sets of assignments **(Two from each set)** using standard CAD modeler like PTC Creo/CATIA/ Solid work/UG /any other suitable software.

Set 1: Beginner Level:

3D modeling of basic Engineering components likes Nuts, Bolts, Keys, cotter, Screws, Springs etc.

Set 2: Intermediate Level:

3D modeling of basic Machine components like Clapper block, Single tool post, Lathe and Milling tail stock, Shaper tool head slide, jigs and fixtures Cotter, Knuckle joint, Couplings: simple, muff, flanged Protected flange coupling, Oldham's coupling, Universal coupling, element of engine system and Miscellaneous parts.

Set 3: Advance Level:

1) Generation of any Assembly model (minimum five child parts) along with Production drawing for any of the system by creating 3D modeling with assembly constraints, Interference check, Exploded view, GD&T, Bill of material.

2) Reverse Engineering of a physical model: disassembling of any physical model having not less than five parts, measure the required dimensions of each component, sketch the minimum views required for each component, convert these sketches into 3-D model and create an assembly drawing with actual dimensions

The distribution of marks for Term work shall be as follows:

1. Printouts/Plots: 20 marks
2. Attendance : 05 marks

End Semester Practical/Oral examination:

To be conducted by pair of Internal and External Examiner

1. Practical examination duration is two hours, based on Advance level of the Term work.
Oral examination should also be conducted to check the knowledge of CAD Modeling Tools.
2. The distribution of marks for practical examination shall be as follows:
 - a. Practical Exam15 marks
 - b. Oral Exam10 marks
3. Evaluation of practical examination to be done based on the printout of students work
4. Students work along with evaluation report to be preserved till the next examination

References:

1. Machine Drawing by N.D. Bhatt.
2. A textbook of Machine Drawing by Laxminarayan and M.L.Mathur, Jain brothers Delhi
3. Machine Drawing by Kamat and Rao
4. Machine Drawing by M.B.Shah
5. A text book of Machine Drawing by R.B.Gupta, Satyaprakashan, Tech. Publication
6. Machine Drawing by K.I. Narayana, P. Kannaiah, K.Venkata Reddy
7. Machine Drawing by Sidheshwar and Kanheya
8. Autodesk Inventor 2011 for Engineers and Designers by ShamTickoo and SurinderRaina, Dreamtech Press

NOTE –

1: For Detailed Course Schemes, Course Objectives, Internal & External Assessment process, End Semester Examination, Recommended & reference Books please refer MU syllabus of Second year (C-Scheme / R-19) Automobile Engineering.

2: Theory and Practical Examination will be strictly based on above compressed syllabus.

UNIVERSITY OF MUMBAI



Bachelor of Engineering

in

Printing and Packaging Technology

**Direct Second Year (Sem. III) Admitted Students for the
current Academic Year 2020-21(Only)**

(REV- 2019 'C' Scheme) from Academic Year 2019 – 20

**Under
FACULTY OF
SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2019–2020)

UNIVERSITY OF MUMBAI



Bachelor of Engineering **in** **Printing and Packaging Technology**

**Direct Second Year Admitted Students for the Academic Year
2020-21 (Only)**

(As per AICTE guidelines with effect from the academic year 2019–2020)

(REV- 2019 ‘C’ Scheme) from Academic Year 2019 – 20

Under

**FACULTY OF
SCIENCE & TECHNOLOGY**

Program Structure for Second Year Engineering
Semester III & IV
UNIVERSITY OF MUMBAI
(With Effect from 2020-2021)
Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
PPC301	Engineering Mathematics – III	3	--	1	3	--	1	4	
PPC302	Packaging Introduction and Concepts	3		--	3		--	3	
PPC303	Introduction to Printing Technology	3	--	--	3	--	--	3	
PPC304	Paper based Packaging Materials	3	--	--	3	--	--	3	
PPC305	Glass, Metal and Textile based Packaging Materials	3	--	--	3	--	--	3	
PPL301	Principles of Graphic Arts and Design I	--	3	--	--	1.5	--	1.5	
PPL302	Screen Printing Laboratory	--	4	--	--	2	--	2	
PPSBL301	Packaging Material Testing - I	--	3	--	--	1.5	--	1.5	
PPPBL301	Mini Project – 1 A	--	4 ^{\$}	--	--	2	--	2	
Total		15	14	1	15	07	1	23	
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg.					
PPC301	Engineering Mathematics – III	20	20	20	80	3	25	--	125
PPC302	Packaging Introduction and Concepts	20	20	20	80	3	--	--	100
PPC303	Introduction to Printing Technology	20	20	20	80	3	--	--	100
PPC304	Paper based Packaging Materials	20	20	20	80	3	--	--	100
PPC305	Glass, Metal and Textile based Packaging Materials	20	20	20	80	3	--	--	100
PPL301	Principles of Graphic Arts and Design I	--	--	--	--	--	25	25	50
PPL302	Screen Printing Laboratory	--	--	--	--	--	50	--	50
PPSBL301	Packaging Material Testing - I	--	--	--	--	--	25	25	50
PPPBL301	Mini Project – 1 A	--	--	--	--	--	25	25	50
Total		--	--	100	400	--	150	75	725

\$ indicates work-load of Learner (Not Faculty), for Mini Project

PBL – Project Based Learning

SBL – Skill Based Laboratory

Course Code	Course / Subject Name	Credits
PPC 301	Engineering Mathematics - III	3 + 1

Pre-requisite:

- 1) Engineering Mathematics-I
- 2) Engineering Mathematics-II

Objectives:

1. Study the concept of Laplace Transform and its applications in engineering
2. Understand the fundamental aspects of vector calculus and matrices
3. Study the concept of and complex variables

Outcomes: Upon successful completion of this course, the learner will be able to.....

1. Obtain Laplace Transform using standard results and shifting theorem.
2. Obtain Inverse Laplace Transform using Convolution theorem
3. Determine eigenvalues and eigenvectors of a matrix and using them to diagonalize a matrix
4. Determine the diagonal form of a matrix
5. Apply the concept of Vector calculus to evaluate line integrals, surface integrals using Green's theorem
6. Determine whether a given function is analytic and find its derivative.

Module	Details.	Hrs.
1	Laplace Transform: Laplace Transform of standard functions, Properties (Linearity, Change of scale) First shifting theorem (without proof), Laplace Transform of derivatives, $L\left[\frac{f(t)}{t}\right]$, $L[t^n f(t)]$, $L\left[\int_0^t f(u)du\right]$ Self-Learning Topics Heaviside Unit Step Function, Second shifting theorem	08
2	Inverse Laplace Transform: Inverse Laplace Transform by using partial fraction method, Convolution theorem Self-Learning Topics Application of Laplace Transform to solve ordinary differential equations	06
3	Matrices: Eigen values and Eigen vectors, properties (without proof), Caley Hamilton Theorem (only statement) and its applications. Diagonalization of a matrix. Self-Learning Topics Verification of Caley Hamilton Theorem.	08
4	Vector Calculus: Irrotational and Solenoidal vectors. Line integrals – definition and problems. Green's theorem (without proof) in a plane. Self-Learning Topics Scalar and Vector Point function, Vector differential operator. Gradient, Divergence and Curl. Verification of Green's theorem	08
5	Complex Variable: Functions of complex variable, Analytic functions, necessary and sufficient condition for a function to be analytic (without proof), Harmonic functions Self-Learning Topics Cauchy Riemann Equation in Polar form, Orthogonal trajectories	06

Assessment:

Term Work:**General Instructions:**

- 1) Batch wise tutorials are to be conducted. The number of students per batch should be as per University pattern for practical.
- 2) Students must be encouraged to write at least 6 class tutorials on entire syllabus.

A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Engineering mathematics. This project should be graded for 10 marks depending on the performance of the students

The distribution of Term Work marks will be as follows –

1.	Attendance (Theory and Tutorial)	05 marks
2.	Class Tutorials on entire syllabus	10 marks
3.	Mini project	10 marks

Internal Assessment for 20 marks: Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

End Semester Examination: Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited,
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication,
4. Vector Analysis, Murray R. Spiegel, Schaum Series
4. Complex Variables and Applications, Brown and Churchill, McGraw Hill education

Course Code	Course / Subject Name	Credits
PPC302	Packaging Introduction and Concepts	3

Objectives:

1. Study the basic concepts of packaging technology.
2. Understand marketing as an integral tool to packaging.
3. Recognize the importance of product-package interaction and its quality aspects in packaging.
4. Study the overall perspective of the packaging industry.

Outcomes: Upon successful completion of this course, the learner will be able to.....

1. Effectively observe and compare the different package forms.
2. Describe the importance of compatibility studies and their associated parameters.
3. Analyze the various hazards and environmental issues related to Packaging.
4. Analyze the aesthetics of a package and the differentiating factors.
5. Elaborate the importance of quality in packaging.
6. Explain significance of packaging in terms of today's market.

Module	Details.	Hrs.
1	Packaging Introduction: Packaging – History, Need and Evolution; Packaging Functions – Contain, Preserve, Protect, Inform, Identify, Sell; Packaging Hazards, Packaging Classifications. Importance of Packaging in Supply Chain	4
2	Packaging as a Marketing Tool: Market Considerations – Importance of Demography and Psychography, Retail Market (POP), Equity and Brand Name; Package Embellishment – Graphic Design Elements; Shelf Appeal Studies - Recall Questioning, Focus Group, Eye-Tracking, S-scope studies.	4
3	Product-Package Compatibility Studies: Product Characteristics: Physical (nature, shape, size, texture, Centre of gravity, etc.), Chemical, Biological and Effect of moisture, oxygen and other gases; Package Characteristics: Material, Physical, Chemical, Biological, Permeability. Live Problems / Case Studies.	6
4	Introduction to Quality: Quality Control and Quality Assurance - Significance in packaging; Role of specifications in defect free packaging; Significance of Testing; Introduction to Standards, Conditioning, Sampling; Read & understand the standards & their revisions and Examples; Certification for product safety and quality	4
5	Packaging Perspectives: Packaging Costs – Various elements of costing; Packaging – Environmental considerations and waste management; Introduction to Packaging Laws and Regulations; Packaging Scenario – World and India – Comparison, Scope and Growth in India.	3

Theory Examinations:

a) End Semester Examination: Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

b) Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

References:

- a. Soroka W., "Fundamentals of Packaging Technology", 3rd Ed, IoPP, 2002.
- b. Paine F. A., "The Packaging User's Handbook", 1st Ed, Blackie Academic & Professional, 1991.
- c. Byett J. et al., "Packaging Technology", 2nd Ed, The Institute of Packaging (SA), 2001.
- d. Selke, S. E. M., Culter, J. D. and Hernandez, R. J., "Plastics Packaging: Properties, processing, Applications and Regulation", Carl Hanser Verlag, USA, 2004.
- e. Joseph F. H, Robert J. K, Hallie F, "Handbook of Package Engineering", Third Edition, Technomic Publishing, 1998.
- f. Yam K. L., "The Wiley Encyclopedia of Packaging Technology", Third Edition, Wiley, 2009.

Course Code	Course / Subject Name	Credits
PPC303	Introduction to Printing Technology	3

Objectives:

1. Introducing concepts of printing technology along with its evolution and necessity in today's society.
2. Understand the basic principles of various Printing processes.
3. Study basic image reproduction process, contribution of various elements in designing and typesetting.
4. Study of various materials used in printing processes.

Outcomes: Upon successful completion of this course, the learner will be able to

1. Distinguish various printing principles like planography, intaglio and relief.
2. Compare the process of image generation based on typography, reprography and layout making.
3. Analyze the various Press configurations of Offset, Gravure, Flexography and Letterpress.
4. Classify Inks and Substrates used in various Printing technologies.
5. Recognize various materials used in printing operations and distinguish Print finishing operations.
6. Choose an appropriate Printing process for any given Printing job.

Module	Details.	Hrs.
1	Introduction Printing – History, Need and Evolution. Definition of Printing- Various forms of communication- Conventional Printing & Digital Printing processes	02
2	Pre-Press Typography, Typesetting Original and its types Films Types of films, generation of positive and negative films, line and half tone film generation, latent image formation and development. Exposure – definition, types, effect of over and under exposure on films. Need of color separation, Additive and subtractive color theories. Layout and imposition- need and significance of imposition technique. DTP Introduction to DTP. Proofing technique: press proofers- offset, flexography, and gravure. Digital proofers.	06
3	Press Letter press printing technology- Flat bed, Platen press, Rotary Press and its applications. Offset- Sheet fed and Web fed machines- Inline, Stack, CIC and Perfecting mechanism and its applications. Gravure and Flexography- Inline, Stack and CIC Configurations and its applications in Package Printing. Screen printing. Hybrid press and its application in Packaging Industry. Introduction to Security features in Printing	06
4	Post Press Cutting, slitting, trimming. Binding, gathering, collating, inseting. Binding style-saddle stitching, section binding, perfect binding. Finishing- Die-cutting, Foil stamping, Embossing, Coating, Varnishing and Lamination	03

5	Ink and Substrate Classification of ink- paste, liquid. Basic ingredients of inks pigment resin, vehicle, additive etc. Printing inks-Rheological properties of inks,Drying methods-Chemical drying, Physical drying. Substrates used in Package printing-Standard paper sizes-British and ISO. Basic properties of Paper, Paperboard, Plastic and Foils and their importance in Package Printing	04
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Theory Examinations:

a) End Semester Examination: Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

b) Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

References:

1. Handbook of Print Media, Helmet Kipphan, Springer Publications
2. Handbook of Print and Production – Michael Barnard, John Peacock.
3. Printing Materials Science and Technology Vol. 24, J. Anthony Bristow
4. The Complete technology book on Printing Inks, Asia Pacific Business Press
5. Typesetting – Composition – Geoff, Barlow
6. Handbook of Typography – Kailas Tahle
7. Printing Technology 5th edition, Michael Adams
8. The Print and Production manual, PIRA

Course Code	Course / Subject Name	Credits
PPC 304	Paper based Packaging Materials	3

Objectives:

1. Gain the basic knowledge of pulping and paper making process.
2. Study the different types of paper-based packages and their manufacturing process.
3. Understand the designing process and estimation of material requirements for major forms of paper-based packaging
4. Study the major testing standards and properties of paper-based packaging materials as per standards

Outcomes: Upon successful completion of this course, the learner will be able to.....

1. Explain the raw materials involved in pulping and paper making process.
2. Explain the operations involved in pulping and paper making process
3. Identify the manufacturing process for different types of paper-based Packages.
4. Design and estimate material requirements for major forms of paper-based packaging.
5. Test and analyze the major properties of paper-based packaging materials.
6. Describe the manufacturing process for different types of paper-based Packages.

Module	Details.	Hrs.
1	Raw Materials and Preparation: Fibrous raw materials, Wood structure and morphology, Non-wood fibers and recycled paper, Non fibrous Additives, Sizing Agents, Binders, Fillers and Additives, Wood harvesting, logging, sorting, Debarking, Chipping, Screening and Storage. Pulping: Types- & Processing of pulp for paper making.	03
2	Paper Making: Preparation of pulp – Repulping/dispersion, Beating and Refining, Bleaching, Recycled paper – Deinking, Washing and Flotation Fourdrinier Paper Machine- Dry and Wet end operations- Surface treatments- Sizing, Coating and Super calendaring. Board making: Multiply Board, Cylinder Forming machine, Vat types - Pressure and suction forming. Pressing, drying and finishing.	05
3	Paper properties: Optical properties – Colour, brightness, smoothness, gloss, opacity and rub resistance, Strength properties–thickness, grammage, tensile, tear, bursting strength, stiffness, Grain direction, Wire and Felt sides	02
4	Types of papers: Printing grades-uncoated papers, coated papers, Newsprint, office paper-Packaging paper grades, properties and applications - Tissue, Parchment, greaseproof, glassine, wet strength paper, stretchable paper, coated paper- Boards used in packaging- Solid bleached/unbleached, folding box board, white lined chip board.	05

	Paper based packaging: Paper bags and Sacks–Manufacturing and Applications- Types of bags- Multiwall Paper bags – Composite containers Manufacturing and Applications Fiber drums- Regenerated Cellulosic films.	
5	Cartons and Boxes: Folding Cartons – Styles and Applications- Designing and manufacturing Set up – Creasing and Cutting operations - Box applications. Corrugated Fiber Board(CFB) - Types of flutes and their characteristics - Manufacturing process of CFB- Properties and Significance of starch glue and Making of CFB box- Styles of boxes- Calculation on weight of box of various styles. Solid Fiber board box manufacturing, materials, and applications- Moulded pulp board – moulding process, applications	06

Theory Examinations:

a) End Semester Examination: Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

b) Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

References:

1. Hand book of Paper and Board, Herbert Holik, Wiley-VCH, 2006.
2. Paper and paperboard Packaging Technology, Mark J. Kirwan, Blackwell Publishing, 2005.
3. Handbook of Pulp Vol.1, Herbert Sixta, Wiley-VCH, 2005.
4. Handbook for pulp and paper technologists, G.A. Smook, Angus Wilde Publications, 2001.

Course Code	Course / Subject Name	Credits
PPC 305	Glass, Metal and Textile based Packaging Materials	3

Objectives:

1. Understand the use and application of primary packaging materials i.e. glass and metal.
2. Study the types of textile materials and their application
3. Learn the basics package forms and the technology to manufacture them for the above listed materials.

Outcomes: Upon successful completion of this course, the learner will be able to.....

1. Describe and interpret the various manufacturing process for glass bottles, metal cans and tubes and textile-based bags.
2. Explain various design aspects for various types of package forms made up of glass.
3. Explain various design aspects for various types of package forms made up of metal.
4. Summarize the aerosol technology and its wide application in packaging.
5. Discuss various quality control and testing procedures for these package forms.
6. Describe the basics of fabric and textile technology to produce bags of various materials like jute, hemp etc.

Module	Details.	Hrs.
1	Glass in Packaging Introduction and History of Glass Materials - Composition - Chemical Structure - Glass properties - Glass Industry - Market Overview - Glass Manufacturing Process Types of Glass - Types of glass containers - Advantages and Disadvantages - Applications	04
2	Glass Design and Testing Glass bottle design - Specifications and Quality Control - Defects Standards for Testing: Glass - Alkalinity, verticality test, Annealing defects, dimensions and capacity along with its significance, melting point of glass, thermal shock, chemical resistance, constituents testing etc.	03
3	Metals in Packaging - I Important Metals in Packaging and their properties - Market and Industry Overview Aluminium based: Conversion processes for Sheets - Aluminium Foil, properties and their applications Steel based: Stainless and Galvanized Steel - Coated steels like Tinplate, Tin-free Steel, Polymer coated - Manufacturing Process and Description Metal Cans: History of Metal Cans – Three-piece and Two-piece Cans - Types Cans - Welded and Seamless Cans - Can Dimensioning - Specifications and Quality Control – Defects	05
4	Metals in Packaging - II Collapsible Tubes - Manufacturing process - Design of Metal Collapsible Tubes - Advantages and Disadvantages of Metal Collapsible tubes	06

	Aerosol Containers - Classification of Aerosols - Design Features - Components - Filling Process - Advantages and Disadvantages of Aerosols - Applications Overview of metal corrosion and anticorrosion techniques Standards for testing: Metal - Coating thickness, Scotch Tape test for tin lacquers, lacquer curing test for metals, rust resistance, salt drop test for corrosion etc.	
5	Textile based Packaging Materials for textile-based packaging - Raw materials like Jute, Hemp etc. - Terminologies - Sack Manufacturing Process - Jute Bag classification like Hessians, Tarpaulins and Twilled - Significance - Applications - Comparison with Plastic Bags Textile - Weight of Hessian, Properties Woven and Nonwoven plastics bags	03

Theory Examinations:

a) End Semester Examination: Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

b) Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

References:

1. K. L. Yam, The Wiley Encyclopedia of Packaging Technology, 3rd ed., Wiley, 2009
2. W. Soroka, Fundamentals of Packaging Technology, 4th ed., IoPP, 2009
3. J. F. Hanlon, Handbook of Package Engineering, 3rd ed., CRC Press, 1998
4. F. A. Paine, The Packaging User's Handbook, Springer, 1990

Course Code	Course / Subject Name	Credits
PPL301	Principles of Graphic Arts and Design-I	1.5

Objectives:

1. Study the basics of how to create a design.
2. Understand the fundamental principles of graphic design and their types.
3. Study the concept of colour and their effects on design.
4. Understand the method to create visual image and layout.
5. Learn and understand the various software used for designing.

Outcomes: Upon successful completion of this course, the learner will be able to

1. Create a design based on specific requirement.
2. Analyze the usage of particular colour and text in Package design.
3. Generate various design layouts with proper visual impacts.
4. Create a design for folding carton with appropriate software.
5. Edit an image and use it in a Package design.
6. Generate Logos for a given concept or product.

Term Work: (Comprises both a & b)

a) List of Experiments:

Sr. No.	Details
1	To create thumbnails and rough sketches for logos, visiting cards as well as stationery design using Corel DRAW
2	To prepare a brochure using Corel DRAW
3	To create a label design for any given product using Corel DRAW
4	To create a design layout for folding carton of given dimensions using Corel DRAW
5	To create step and repeat (ups) using Corel DRAW
6	To create a social media ad newspaper ad using Corel DRAW
7	To cut-out an image using Adobe Photoshop
8	To apply various effects on the image using Adobe Photoshop
9	To used curves on image using Adobe Photoshop

b) Mini-Project: A group of 4-6 students should be given a design assignment. This should be considered as mini project in PGAD-I. This project should be graded for 10 marks depending on the performance of the students

The distribution of Term Work marks will be as follows –

1.	Attendance	05 marks
2.	Laboratory Work	10 marks
3.	Mini project	10 marks

End Semester Practical/Oral Examination (for 25 marks): Under single head of examination, including Practical (15 marks assessment) followed by oral (10 marks assessment) to be conducted by internal and external examiners.

Course Code	Course Name	Credits
PPL302	Screen Printing Laboratory	2

Objectives:

1. Introduce the concept of screen-printing techniques.
2. Understand the screen-printing technology for four color printing.
3. Gain knowledge about different applications of screen printing.

Outcomes: Upon successful completion of this course, the learner will be able to....

1. Prepare screen printing image carrier by direct, indirect photographic methods.
2. Demonstrate the use of different photographic films for mesh preparation according to image.
3. Produce different printed samples for various substrates like fabric, glass, acrylic, wood by selecting suitable inks and coatings for that material.
4. Produce and analyze a halftone dot image generated for four color printing and registration of color.
5. Analyze the common faults in Screen Printing Process

Term Work: (Comprises both a & b)

a) List of Experiments:

Sr. No.	Details
1	Screen preparation and printing by direct method.
2	Screen preparation and printing by indirect method.
3	Screen preparation and printing by direct indirect method.
4	Printing two colour image on paper and textile.
5	To Planning, Designing and Production of 16 page brochure using screen printing.
6	Screen Printing on textile/PVC/Glass – T-Shirt.

b) Mini Project: A group of 4-6 students should be assigned a mini project on Screen Printing. This project should be graded for 10 marks depending on the performance of the students

The distribution of Term Work marks will be as follows –

1.	Attendance	05 marks
2.	Laboratory Work	10 marks
3.	Mini project	10 marks

Course Code	Course Name	Credits
PPSBL301	Skill Based Lab: Packaging Material Testing - I	1.5

Objectives:

1. To understand various standards w.r.t testing of paper, paper board and plastic films.
2. To understand the difference in physical properties of paper and plastics used in packaging.

Outcomes: Upon successful completion of this course, the learner will be able to....

1. Check grammage and thickness of paper, paper board and plastic films.
2. Find out water absorption capacity of paper / board.
3. Perform strength tests related to Stiffness, Burst, Puncture and Tear.
4. Evaluate the strength characteristics of paper and plastic films.
5. Analyse the plies in a CFB and identify its flute type.
6. Evaluate the strength of a CFB.

Term Work: (Comprises both a & b)

a) List of Experiments :

Sr. No.	Details
1	To find Tearing Strength of paper.
2	To find Stiffness of board.
3	To Identify flute types and dimensions of CFB.
4	To find individual grammage of CFB plies.
5	To find Box Compression strength of a CFB
6	To find RCT of paper and ECT of CFB
7	To perform tensile strength on paper and plastic films.
8	To perform Dart Impact Test on Plastic Films.
9	To find the specular gloss of plastics / paper / paperboard.

b) Mini Project: A group of 4-6 students should be assigned a mini project on various aspects of Packaging Material Testing. This project should be graded for 10 marks depending on the performance of the students

The distribution of Term Work marks will be as follows –

1.	Attendance	05 marks
2.	Laboratory Work	10 marks
3.	Mini project	10 marks

End Semester Practical/Oral Examination (for 25 marks): Under single head of examination, including Practical (15 marks assessment) followed by oral (10 marks assessment) to be conducted by internal and external examiners.

Course Code	Course Name	Credits
PPPBL301	Mini Project 1A	2

Objectives

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Outcome: Learner will be able to...

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as member of a group or leader.
4. Draw the proper inferences from available results through theoretical/ experimental/simulations.
5. Analyse the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to lifelong learning.
9. Demonstrate project management principles during project work.

Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A logbook to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below:
 - Marks awarded by guide/supervisor based on logbook : 10
 - Marks awarded by review committee : 10
 - Quality of Project report : 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.
 - First shall be for finalisation of problem
 - Second shall be on finalisation of proposed solution of problem.
- In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
 - First review is based on readiness of building working prototype to be conducted.
 - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
 - Identification of need/problem
 - Proposed final solution
 - Procurement of components/systems
 - Building prototype and testing
- Two reviews will be conducted for continuous assessment,
 - First shall be for finalisation of problem and proposed solution
 - Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project:

Mini Project shall be assessed based on following criteria:

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness
6. Societal impact
7. Innovativeness
8. Cost effectiveness and Societal impact
9. Full functioning of working model as per stated requirements
10. Effective use of skill sets
11. Effective use of standard engineering norms
12. Contribution of an individual's as member or leader
13. Clarity in written and oral communication

- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
- In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organisations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on following points:

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication

UNIVERSITY OF MUMBAI



Bachelor of Engineering

in

Mechatronics Engineering

**Direct Second Year (Sem. III) Admitted Students for the
current Academic Year 2020-21(Only)**

(REV- 2019 'C' Scheme) from Academic Year 2019 – 20

**Under
FACULTY OF
SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2019–2020)

**Program Structure for Second Year
Engineering Semester III & IV
UNIVERSITY OF MUMBAI
(With Effect from 2020-**

2021) Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract .	Tut.	Theory	Pract.	Tut.	Total	
MTC301	Engineering Mathematics-III	3	--	1	3	--	1	4	
MTC302	Data Structures and Algorithms	3		--	3		--	3	
MTC303	Engineering Materials and Metallurgy	3	--	--	3	--	--	3	
MTC304	Basic Electronics and Digital Circuit Design	3	--	--	3	--	--	3	
MTC305	Electrical Circuits and Machines	3	--	--	3	--	--	3	
MTL301	Data Structures and Algorithms Laboratory	--	2	--	--	1	--	1	
MTL302	Applied Electronics Laboratory-I	--	2	--	--	1	--	1	
MTL303	Electrical and Electronics Workshop	--	2	--	--	1	--	1	
MTSBL301	CAD – Modeling Laboratory#	--	4	--	--	2	--	2	
MTPBL301	Mini Project – 1A	--	4 ^{\$}	--	--	2	--	2	
Total		15	14	1	15	07	1	23	
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract /Oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg .					
MTC301	Engineering Mathematics-III	20	20	20	80	3	25	--	125
MTC302	Data Structures and Algorithms	20	20	20	80	3	--	--	100
MTC303	Engineering Materials and Metallurgy	20	20	20	80	3	--	--	100
MTC304	Basic Electronics and Digital Circuit Design	20	20	20	80	3	--	--	100
MTC305	Electrical Circuits and	20	20	20	80	3	--	--	100

	Machines								
MTL301	Data Structures and Algorithms Laboratory	--	--	--	--	--	25	25	50
MTL302	Applied Electronics Laboratory-I	--	--	--	--	--	25	25	50
MTL303	Electrical and Electronics Workshop	--	--	--	--	--	25	25	50
MTSBL301	CAD – Modeling Laboratory [#]	--	--	--	--	--	25	25	50
MTPBL301	Mini Project – 1A	--	--	--	--	--	25	25	50
Total		--	--	100	400	--	150	125	775

\$ indicates work load of Learner (Not Faculty), for Mini Project
 #Course common with Mechanical Engineering,
 SBL – Skill Based
 Laboratory PBL –
 Project Based Learning

Course Code	Course Name	Credits
MTC301	Engineering Mathematics-III	04

Pre-requisite: Engineering Mathematics-I, Engineering Mathematics-II,

Objectives: The course is aimed

1. To familiarize with the Laplace Transform, Inverse Laplace Transform of various functions, its applications.
2. To acquaint with the concept of Fourier Series, its complex form and enhance the problem solving skills
3. To familiarize with the concept of complex variables, C-R equations with applications.
4. To study the application of the knowledge of matrices and numerical methods in complex engineering problems.

Outcomes: On successful completion of course learner/student will be able to:

1. Apply the concept of Laplace transform to solve the real integrals in engineering problems.
2. Apply the concept of inverse Laplace transform of various functions in engineering problems.
3. Expand the periodic function by using Fourier series for real life problems and complex engineering problems.
4. Find orthogonal trajectories and analytic function by using basic concepts of complex variable theory.
5. Apply Matrix algebra to solve the engineering problems.
6. Solve Partial differential equations by applying numerical solution and analytical methods for one dimensional heat and wave equations

Module	Detailed Contents	Hrs.
01	Module: Laplace Transform 1.1 Definition of Laplace transform, Condition of Existence of Laplace transform, 1.2 Laplace Transform (L) of Standard Functions like e^{at}, $\sin(at)$, $\cos(at)$, $\sinh(at)$, $\cosh(at)$ and t^n, where $n \geq 0$. 1.3 Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by t, Division by t, Laplace Transform of derivatives and integrals (Properties without proof). 1.4 Evaluation of integrals by using Laplace Transformation.] Self-learning topics: Heaviside's Unit Step function, Laplace Transform. of Periodic functions, Dirac Delta Function.	07
02	Module: Inverse Laplace Transform 2.1 Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivative 2.2 Partial fractions method & first shift property to find inverse Laplace transform. 2.3 Inverse Laplace transform using Convolution theorem (without proof) Self-learning Topics: Applications to solve initial and boundary value problems involving ordinary differential equations.	06

03	Module: Fourier Series: 3.1 Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof) 3.2 Fourier series of periodic function with period 2π and $2l$, 3.3 Fourier series of even and odd functions 3.4 Half range Sine and Cosine Series. Self-learning Topics: Complex form of Fourier Series, orthogonal and orthonormal set of functions, Fourier Transform.	07
04	Module: Complex Variables: 4.1 Function $f(z)$ of complex variable, limit, continuity and differentiability of $f(z)$, Analytic function, necessary and sufficient conditions for $f(z)$ to be analytic (without proof), 4.2 Cauchy-Riemann equations in cartesian coordinates (without proof) 4.3 Milne-Thomson method to determine analytic function $f(z)$ when real part (u) or Imaginary part (v) or its combination (u+v or u-v) is given. 4.4 Harmonic function, Harmonic conjugate and orthogonal trajectories Self-learning Topics: Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations	07
05	Module: Matrices: 5.1 Characteristic equation, Eigen values and Eigen vectors, Properties of Eigen values and Eigen vectors. (No theorems/proof) 5.2 Cayley-Hamilton theorem (without proof): Application to find the inverse of the given square matrix and to determine the given higher degree polynomial matrix. 5.3 Functions of square matrix 5.4 Similarity of matrices, Diagonalization of matrices Self-learning Topics: Verification of Cayley Hamilton theorem, Minimal polynomial and Derogatory matrix & Quadratic Forms (Congruent transformation & Orthogonal Reduction)	06
06	Module: Numerical methods for PDE 6.1 Introduction of Partial Differential equations, method of separation of variables, Vibrations of string, Analytical method for one dimensional heat and wave equations. (only problems) 6.2 Crank Nicholson method 6.3 Bender Schmidt method Self-learning Topics: Analytical methods of solving two and three dimensional problems.	06

Term Work:

General Instructions:

1. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
2. A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Engineering Mathematics. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1.	Attendance (Theory and Tutorial)	05 marks
2.	Class Tutorials on entire syllabus	10 marks
3.	Mini project	10 marks

Assessment:**Internal Assessment Test:**

Assessment consists of two class tests of 20 marks each. The first class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment II) when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

References:

1. Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited,
3. Advanced Engineering Mathematics, R. K. Jain and S.R.K. Iyengar, Narosa Publication
4. Advanced Engineering Mathematics, H.K. Das, S. Chand Publication
5. Higher Engineering Mathematics B.V. Ramana, McGraw Hill Education
6. Complex Variables and Applications, Brown and Churchill, McGraw-Hill Education,
7. Text book of Matrices, Shanti Narayan and P K Mittal, S. Chand Publication
8. Laplace transforms, Murray R. Spiegel, Schaum's Outline Series

Links for online NPTEL/SWAYAM courses:

1. <https://nptel.ac.in/courses/111/104/111104085/>
2. <https://nptel.ac.in/courses/111/106/111106139/>

Course Code	Course Name	Credits
MTC302	Data Structures and Algorithms	03

Prerequisite: FEC205 C programming

Objectives:

1. To design and implement various data structures and their operations.
2. To introduce the concept of algorithm and its analysis.
3. To learn various algorithm designing strategies.
4. To introduce the appropriate search method on a given problem
5. To develop application using suitable data structure and algorithms.

Outcomes: Learner will be able to...

1. Implement various operations using linear data structures.
2. Apply concepts of Trees and Graphs to a given problem.
3. Analyse time and space complexity of an algorithm.
4. Apply divide and conquer strategy to solve problems.
5. Apply the concept of Greedy and Dynamic Programming approach to solve problems.
6. Apply the concept of backtracking, branch and bound strategy to solve problems.

Module	Detailed Contents	Hrs.
01	Introduction : Introduction to Data Structures, Types of Data Structures : Linear and non-linear data structures Stack: Introduction to Stack, Stack as ADT, Operations on stack,] Queues Introduction to Queue, Queue as ADT, Operations on Queue,	03
02	Linked List: Introduction to Linked List, Types of Linked List: Singly Linked list, Circular linked list, Operations on linked list,	02
03	Trees: Introduction to Trees, Types of Trees: Binary tree, Operations on binary tree, Traversal of binary trees, Binary search tree, Graph: Graph Terminologies, Graph Representation, Graph traversal techniques: Depth first search (DFS) and Breadth First search(BFS)	05
04	Analysis of Algorithms: Introduction to Algorithm, Analysis of algorithm and it's characteristics, Time and Space complexity, Asymptotic notations. Divide and Conquer: Introduction, Binary search, Merge sort, Quick sort	03
05	Greedy Method Approach : General Method, Knapsack problem, Minimum cost spanning tree- Kruskal's algorithm and Prim's algorithm Dynamic Programming Approach : General Method Travelling salesman problem	04

06	Uninformed Search Techniques: DFS, BFS, Uniform cost search, Informed Search Methods: Best First Search, A*, IDA*,	05
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Assessment:

Internal Assessment for 20 marks: Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of 2 to 5 marks will be asked.
4. Remaining questions will be mixed in nature. (e.g. Suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
5. In question paper weightage of each module will be proportional to number of respective lecture hrs as mentioned in the syllabus.

Text Books:

1. Data structures using C by Tenenbaum, Langsam, Augenstein, Pearson.
2. Data Structures using C, Reema Thareja, Oxford.
3. C and Data structures, Prof. P.S. Deshpande, Prof. O.G. Kakde, Dreamtech Press.
4. Introduction to Data Structure and its Applications Jean-Paul Tremblay, P. G. Sorenson
5. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern approach", 3rd Edition Prentice Hall, New Jersey, 1995.

References:

1. Data Structures Using C & C++, Rajesh K. Shukla, Wiley-India.
2. Computer Algorithms by Ellis Horowitz and Sartaj Sahni, Universities Press.
3. Data Structures and Algorithm Analysis in C, Mark A. Weiss, Pearson
4. ALGORITHMS Design and Analysis, Bhasin, OXFORD. Elaine Rich and Kelvin Knight, "Artificial Intelligence", 3rd Edition Tata McGraw Hill, New Delhi, 1991.

Links for online NPTEL/SWAYAM courses:

1. <https://nptel.ac.in/courses/106/102/106102064/>
2. <https://nptel.ac.in/courses/106/106/106106127/>
3. https://swayam.gov.in/nd1_noc20_cs71
4. https://swayam.gov.in/nd1_noc20_cs93

Course Code	Course Name	Credits
MTC303	Engineering Materials and Metallurgy	03

Prerequisite : FEC103 Engineering Chemistry-I, FEC203 Engineering Chemistry-II

Objectives

1. To prepare the students understand basic engineering materials, their properties & selection and applications.
2. To familiarize the students with various types and causes of failure of components in different engineering applications.
3. To acquaint the students with the new concepts of Nano Science and Technology.
4. To prepare the students acquire basic understanding of advanced materials, their functions and properties for technological applications.

Outcomes: Learner will be able to...

1. Distinguish different types of materials and composites used in manufacturing.
2. Select a material for specific applications
3. Read and interpret Iron-Iron Carbide phase diagram, TTT diagram and CCT diagram.
4. Demonstrate a deeper understanding of materials in engineering applications.

Module	Detailed Contents	Hrs.
01	1.1 Introduction: Classification of materials, functional classification and classification based on structure. (0.5 hrs) 1.2 Solidification of Metals: Formation of solids from liquids of pure metals and alloys. Single crystal and polycrystalline structure. (0.5 hrs) 1.3 Crystal Imperfection: Definition, classification, Point defects: their formation and effects. Dislocations: Edge and screw dislocations, their significance. Surface defects: Grain boundary, sub-angle grain boundary, stacking fault, and their significance. (2 hrs)	03
02	2.1 Ferrous Metals and Alloys: Classification of Alloys based on phases and phase diagram- Binary alloy phase diagram – Isomorphous, Eutectics type I and II, Peritectic. The Iron-Iron Carbide Phase Diagram. Classification of Plain Carbon Steels and Cast Irons. Effect of alloying elements in steels. TTT diagram & CCT diagram. Annealing, normalizing, tempering, hardening and surface hardening processes. (5 hrs) 2.2 Nonferrous Metals and Alloys: Basics only. Important nonferrous materials like aluminium, copper, nickel, tin, zinc and their alloys, properties and applications. (1 hr) 2.3 Powder Metallurgy: Powder manufacturing methods; Powder Metallurgy Process. Applications such as oil impregnated Bearings and Cemented Carbides. Limitations of Powder Metallurgy. (1 hr)	07
03	3.1 Ceramics: Definition, comparative study of structure and properties of Engineering Ceramics with reference to metallic materials. Toughening mechanisms in ceramics. Engineering application of Ceramics. (1 hrs) 3.2 Polymers: Classification of polymers. Thermoplastics, effect of temperature on thermoplastics, mechanical properties of thermoplastics. Thermosetting polymers and elastomers. (1 hrs) 3.3 Composites: Definition; Classification; Particle-reinforced composites and fibre-reinforced composites. Rule of mixtures; Sandwich structures. Classification of composites on basis of matrix materials. (1 hrs)	03

04	4.1 Fracture: Definition and types of fracture. Brittle fracture and Ductile fracture. Ductility transition. 4.2 Fatigue Failure: Definition of fatigue and significance of cyclic stress. Mechanism of fatigue. Fatigue testing. Test data presentation. S.N. Curve and its interpretation. Influence of important factors on fatigue. Creep: Definition and significance of creep. Effect of temperature and creep on mechanical behavior of materials. Creep testing.	03
05	51 Electronic Materials: Band structure of solids. Conductivity of metals and alloys. Semiconductors and superconducting materials. Insulators and dielectric properties. Electrostriction, piezoelectricity and ferroelectricity. 52 Photonic Materials: Refraction, reflection, absorption and transmission. Luminescence, Photoconductivity, Lasers, optical fibres in communications. 53 Magnetic Materials: classification of magnetic materials. Diamagnetic, paramagnetic, ferromagnetic, ferromagnetic and super paramagnetic materials. Metallic and ceramic magnetic materials. Applications of magnetic materials.	04
06	61 Nano-structured Materials: Definition and Introduction to nanotechnology. Unique features of nano-structured materials. Typical applications. (1 hr) 62 Modern Engineering Materials: Smart materials, Shape memory alloys, Chromic materials (Thermo, Photo and Electro), Rheological fluids, Metallic glasses. (1 hr)	02

Assessment:

Internal Assessment for 20 marks: Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of 2 to 5 marks will be asked.
4. Remaining questions will be mixed in nature. (e.g. Suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
5. In question paper weightage of each module will be proportional to number of respective lecture hrs as mentioned in the syllabus.

Text Books:

1. Callister's Materials Science and Engineering, 2nd edition by R. Balasubramaniam, Wiley India Pvt. Ltd

References:

1. The Science and Engineering of Materials (6th Edition), by Donald R. Askeland, Pradeep P. Fulay, Wendelin J. Wright, Cengage Learning, Inc., Stamford, USA., (2010)
2. Materials Science and Engineering: An Introduction (8th Edition), by William D. Callister, Jr. Adapted by R. Balasubramaniam. Wiley India (P) Ltd., (2010).
3. Introduction to Physical Metallurgy (2nd Edition), by S H Avner, Tata McGraw Hill (1997).
4. A Text Book of Nanoscience and Nanotechnology, by Pradeep. T, Tata McGraw Hill, New Delhi, (2012).
5. Material Science, by S.L. Kakani, New Age International, (2006).
6. Electronic Properties of Materials (4th Edition), by Rolf F. Hummel, Springer, New York, (2011).

7. Photonic Crystals: Theory, Applications, and Fabrication, by Dennis W Prather, John Wiley & Sons, Hoboken, (2009).

Links for online NPTEL/SWAYAM courses:

1. <https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-mm09/>
2. <https://nptel.ac.in/courses/113/102/113102080/>
3. <https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-mm09/>
4. https://nptel.ac.in/content/syllabus_pdf/113104074.pdf
5. https://nptel.ac.in/content/storage2/courses/112108150/pdf/PPTs/MTS_09_m.pdf
6. https://nptel.ac.in/content/storage2/courses/112108150/pdf/PPTs/MTS_08_m.pdf
7. <https://nptel.ac.in/courses/112/104/112104229/>
8. <https://nptel.ac.in/courses/118/104/118104008/>
9. https://nptel.ac.in/content/storage2/courses/112104173/Mod_1_smart_mat_lec_6.pdf
10. <https://nptel.ac.in/courses/118/104/118104008/>
11. https://nptel.ac.in/content/storage2/courses/112104173/Mod_1_smart_mat_lec_6.pdf

Course Code	Course Name	Credits
MTC304	Basic Electronics and Digital Circuit Design	03

Prerequisite: **FEC105** Basic Electrical Engineering, **FEC102** Engineering Physics-I, **FEC202** Engineering Physics-II

Objectives

1. To understand working and performance of electronic devices
2. To understand applications of electronic devices.
3. To teach fundamental principles of digital circuit design.
4. To impart the testing knowledge of digital circuits.

Outcomes: Learner will be able to...

1. Illustrate working of Transistors & its applications.
2. Describe several JFET applications including switch & amplifiers.
3. Describe the number system and operations of logical gates
4. Design combinational digital logic circuits
5. Design Sequential digital logic circuits
6. Describe the testing technologies in digital electronics.

Module	Detailed Contents	Hrs.
01	2.1 Junction Field Effect Transistor JFET: Construction, pinch off voltage, transfer characteristic, trans-conductance. Application: JFET as switch, JFET as amplifier 2.2 Metal-Oxide Effect Transistor (MOSFET): Working of MOSFET, Application: MOSFET as switch	04
02	Fundamentals of Digital Design 3.1 Number System - Review of Number System, Binary Code, Binary Coded Decimal, Hexadecimal Code, Gray Code and their conversions, 3.2 Logic Gates: Basic gates, Universal gates, Sum of products and products of sum, minimization with Karnaugh Map (upto four variables) and realization. 3.3 Combinational Circuits using basic gates as well as MSI devices: Half adder, Full adder, Half Subtractor, Full Subtractor, multiplexer, demultiplexer, decoder, Comparator (Multiplexer and demultiplexer gate level upto 4:1).	08
03	Elements of Sequential Logic Design : 4.1 Sequential Logic: Latches and Flip-Flops, Conversion of flip flops (timing considerations and metastability are not expected) 4.2 Counters: Asynchronous, Synchronous Counters, Up Down Counters, Mod Counters, Ring Counters, Shift registers, Universal Shift Register.	08

04	Testability: Fault Models, Stuck at faults, ATPG, Design for Testability, Boundary Scan Logic, JTAG and Built in self test.	02
Self-study Topic	VHDL: Data types, Structural Modeling using VHDL, attributes, data flow, behavioral, VHDL implementation of basic combinational and sequential Circuits.	--

Assessment:

Internal Assessment for 20 marks: Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be onehour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of 2 to 5 marks will be asked.
4. Remaining questions will be mixed in nature. (e.g. Suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
5. In question paper weightage of each module will be proportional to number of respective lecture hrs as mentioned in the syllabus.

Text Books:

1. R. P. Jain, Modern Digital Electronics, Tata McGraw Hill Education, Third Edition 2003
2. Applied Electronics by R. S. Sedha, S. Chand Limited, 2008
3. Prin. Of Electronic Devices & Circuit by B.L. Theraja and R. S. Sedha

References:

1. Donald A. Neamen, Electronic Circuit Analysis and Design, TATA McGraw Hill, 2nd Edition, New Delhi
2. William I. Fletcher, 'An Engineering Approach to Digital Design', PHI.
3. B. Holdsworth and R. C. Woods, 'Digital Logic Design', Newnes, 4th Edition
4. Morris Mano, Digital Design, Pearson Education, Asia 2002.
5. John F. Wakerley, Digital Design Principles And Practices, third Edition Updated, Pearson Education, Singapore, 2002
6. Anil K. Maini, Digital Electronics, Principles, Devices and Applications, Wiley
7. Stephen Brown and Zvonko Vranesic, Fundamentals of digital logic design with VHDL, McGraw Hill, 2nd Edition
8. Electronic Principles 8th Edition By Albert Malvino and David Bates

Links for online NPTEL/SWAYAM courses:

1. <https://nptel.ac.in/courses/117/106/117106086/>
2. <https://nptel.ac.in/courses/117/106/117106114/>
3. <https://nptel.ac.in/courses/117/103/117103063/>
4. <https://nptel.ac.in/courses/117/103/117103064/>
5. https://swayam.gov.in/nd1_noc20_ee32
6. https://swayam.gov.in/nd1_noc19_ee51
7. https://swayam.gov.in/nd1_noc20_ee45

Course Code	Course Name	Credits
MTC305	Electrical Circuits and Machines	03

Prerequisite: FEC105 Basic Electrical Engineering, FEC102 Engineering Physics-I
FEC202 Engineering Physics-II

Objectives

1. Network Synthesis of DC and AC circuits.
2. Understand characteristics of R-L-C networks in time and Frequency domain.
3. Understand constructional features and characteristics of Electrical Machines

Outcomes: Learner will be able to...

1. Analyse and Synthesis of network theorems for DC and AC circuits
2. Find two port circuit parameters
3. Analyse and Synthesis R-L-C circuits in time and Frequency domain
4. Illustrate working and performance characteristics of DC Motors
5. Illustrate working and performance characteristics of three phase Induction Motor
6. Implement systems using low power motors specially designed motors

Module	Detailed Contents	Hrs.
01	Analysis of DC and AC Circuits 1.1 Analysis of DC Circuits: Analysis of DC circuits with dependent sources using generalized loop, node matrix analysis (Simple numerical problems) 1.2 Application of Network Theorems to DC Circuits: Superposition, Thevenin, Norton, Maximum Power Transfer theorem (Simple numerical problems)	05
02	Two Port Networks Introduction to 2 port networks	02
03	Time and Frequency Response Analysis 3.1 Transient and steady state response to step, ramp and impulse signals	04
04	DC Motors 4.1 Construction, principle of working, classification, EMF equation, Torque equation, characteristics of DC Motors 4.2 Speed Control: basic principle and working of different methods	03
05	Three Phase Induction Motor 5.1 Construction, working principle of squirrel cage induction motor 5.2 Torque speed characteristics, power 5.3 Speed control methods	04

	Single phase Induction Motors: 5.4 Construction, working, 5.5 Starting methods, 5.6 Torque-speed characteristics and applications	
06	Special Types of Motors Construction, working Principle, Types and applications of 6.1 BLDC Motor 6.2 Reluctance Motor 6.3 Universal Motor 6.4 Stepper Motor 6.5 Servo Motor	04
Self-study Topic	Introduction, Basic principle, Construction, E.M.F Equation, Losses in a transformer, Applications of Pulse, Isolation, center tapped transformer	--

Assessment:

Internal Assessment for 20 marks: Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of 2 to 5 marks will be asked.
4. Remaining questions will be mixed in nature. (e.g. Suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books:

1. Bimbhra P. S., Electric Machinery, Khanna Publisher,
2. Bimbhra P. S., Generalized Machine Theory, Khanna Publisher,
3. E. G. Janardanan, Special Electrical Machines, PHI
4. W. H. Hayt, Jr., S. D. Durbin, J. E. Kemmerly, „Engineering Circuit Analysis“, 7th Edition Tata McGraw-Hill Education.
5. M. E. Van Valkenburg, „Network Analysis“, 3rd Edition, PHI Learning.
6. D. Roy Choudhury, „Networks and Systems“, 2nd Edition, New Age International.

References Books:

1. M. G. Say and E. O. Taylor, Direct current machines, Pitman publication
2. Ashfaq Husain, Electric Machines, Dhanpat Rai and co. publications
3. M. V. Deshpande, Electric Machines, PHI
4. N. Balabanian and T. A. Bickart, Linear Network Theory: Analysis, Properties, Design and Synthesis“, Matrix Publishers, Inc.
5. C. L. Wadhwa, Network Analysis and synthesis“, New Age international.
6. B. Somanathan Nair, “Network Analysis and Synthesis“, Elsevier Publications

Links for online NPTEL/SWAYAM courses:

1. <https://nptel.ac.in/courses/108/102/108102042/>
2. <https://nptel.ac.in/courses/108/104/108104139/>
3. <https://nptel.ac.in/courses/108/102/108102146/>
4. <https://nptel.ac.in/courses/108/105/108105053/>
5. <https://nptel.ac.in/courses/108/105/108105159/>
6. <https://nptel.ac.in/courses/108/105/108105017/>
7. <https://nptel.ac.in/courses/108/108/108108076/>
8. https://swayam.gov.in/nd1_noc19_ee69
9. https://swayam.gov.in/nd1_noc19_ee35

Course Code	Course Name	Credits
MTL301	Data Structures and Algorithms Laboratory	01

Objectives:

1. To design and implement various data structures and their operations.
2. To Apply the appropriate search method on a given problem
3. To develop application using suitable data structure and algorithms.

Outcomes: Students will be able to...

1. Implement various operations using linear data structures.
2. Apply concepts of Trees and Graphs to a given problem.
3. Analyze time and space complexity of an algorithm.
4. Apply divide and conquer strategy to solve problems.
5. Apply the concept of Greedy and Dynamic Programming approach to solve problems.
6. Apply the concept of backtracking, branch and bound strategy to solve problems.

Suggested List of laboratory experiments (Minimum Eight):

Experiments to be conducted using C language. Also minimum one experiment from each course outcome shall be covered.

Sr. No.	Experiment List
1	Implementation of any one application of stack / Queue
2	Implementation of operations on Linked Lists
5	Implementation of Binary search/ merge sort/quick sort
6	Implementation of operations on Binary Tree/Binary Search Tree
7	Implementation Greedy method algorithms Prim's
8	Implementation of Dynamic programming approach algorithms Traveling sales persons problem
10	Implementation of any game based on uninformed/informed search algorithms BFS/DFS/A*algorithm Like Maze problems, 4 connect etc

Term Work:

Term work consists of performing minimum 06 practical mentioned as above. Final certification and acceptance of the term work ensures satisfactory performance of laboratory work.

The distribution of marks for term work shall be as follows:

- Laboratory work (Experiment/journal) : 20 marks.
- Attendance (Theory and Practical) : 05 Marks

End Semester Examination:

Pair of Internal and External Examiner should conduct Practical and Oral. Practical exam (15 marks) will be on any one of the experiments from the list and oral exam (10 marks) will be based on the entire syllabus of the laboratory.

Links for online NPTEL/SWAYAM courses:

1. <https://nptel.ac.in/courses/106/105/106105085/>
- ii.

Course Code	Course Name	Credits
MTL302	Applied Electronics Laboratory-I	01

Objectives

1. To understand performance and characteristics of transistors and Digital Electronics components
2. To study electrical networks synthesis
3. To study characterization of different Electrical Machines

Outcomes: Learner will be able to...

1. Implement switching circuits using BJT, MOSFET, JFET
2. Implement different LOGIC circuits
3. Analyse operational characteristics of different Electrical Machines
4. Simulation of Electrical Networks.

Suggested List of laboratory experiments (Minimum 10):

A. List of experiment based on MTC304

1	To find and draw the input output characteristics of BJT in common emitter configuration or BJT as switch.
2	Implementation of BJT/FET as an amplifier
3	To find transfer characteristics of JFET.
4	To find transfer characteristics of MOSFET.
5	Implementation of the truth table of various logic gates.
6	Implementation of NOR Gate & NAND Gate as universal gates.
7	Implementation of full adder circuit using gates.
8	Verification of state tables of RS, JK, T and D flip-flops using NAND & nor gates.
9	Design and implementation of counters using flip-flops using simulation software like QUCS

B. List of experiment based on MTC305

1	Study of different network theorems for DC and AC circuits
2	To find two port network parameters for electrical network
3	Time domain response of R-L-C series circuit: under, over and critically damped. This can be studied by writing a simple programme using any software tool. Plot time domain response and study effect of change in values of R-L-C
4	Write a simple programme for the transfer function of any R-L-C circuit. Plot frequency domain response and study effect of change in values of R-L-C
5	Speed control of DC shunt and series motor
6	Plot torque speed characteristics of DC shunt motor
7	Speed control of three phase/ single phase Induction Motor
8	Characterization of Stepper motor/ Servo Motor/ Reluctance motor.

Term Work:

Term work consists of performing minimum 10 (5 from Part A & 5 from Part B) practical mentioned as above. Final certification and acceptance of the term work ensures satisfactory performance of laboratory work.

The distribution of marks for term work shall be as follows:

- Laboratory work Part A (Experiment/journal) : 10 marks.
- Laboratory work Part A (Experiment/journal) : 10 marks
- Attendance (Theory and Practical) : 05 Marks
-

End Semester Examination:

Pair of Internal and External Examiner should conduct Practical and Oral. Practical exam (15 marks) will be on any one of the experiments from the list and oral exam (10 marks) will be based on the entire syllabus of the laboratory.

Links for online NPTEL/SWAYAM courses:

1. <https://nptel.ac.in/courses/108/102/108102042/>
2. <https://nptel.ac.in/courses/108/102/108102146/>
3. https://swayam.gov.in/nd1_noc19_ee51
4. https://swayam.gov.in/nd1_noc20_ee45

Course Code	Course Name	Credits
MTL303	Electrical and Electronics Workshop	01

Objectives

1. To introduce the basic laboratory instruments and household electrical & electronic equipments
2. To design PCB and develop small circuits
3. To understand working of different network simulation softwares

Outcomes: Learner will be able to...

1. Understand working of different lab equipment
2. Demonstrate skills in handling electrical components
3. Repair and do maintenance of household appliances.
4. Demonstrate PCB design and soldering skills
5. Understand working of different parts of Computer
6. Simulate Electrical networks using software techniques.

PART A

List of laboratory Work:

Exp No.	Name of the Experiment and content
1	Study of construction and operation of different lab equipment : Introduction to different equipment in the lab (multi-meter, CRO, DSO, power supplies, function generators); Resistors, presets, potentiometers, inductors (iron core and ferrite core), capacitors of different ratings.
2	Introduction to Household electrical wiring Wiring materials, selection of wire, different switching and protection devices (MCBs/ Fuses/Relays), Cables and cable management Estimation and costing of residential wiring (Simple numerical on wiring of single room), connection of energy meter and distribution board, wiring standards (IS-732, section 4)
3	Repair of house hold appliances and machines: Testing, fault finding, Dismantling, assembling and testing after repairs of house hold appliances like fan and regulator, heater, geyser, mixer, washing machine, microwave oven etc
4	Hardware implementation of Electronics circuits: Soldering techniques and equipments, PCB Layout (artwork) design using software and Fabrication etching process. Testing and debugging process of assembled circuits. Making small Switching circuits using electronic components.
5	Study of Computer hardware. Functional block diagram, unmounting computer CPU, study internal structure of Computer parts.
6	Introduction to simulating Softwares Study different simulating softwares like Qucs, Scilab, Matlab. Simulation of small networks using it.
7	Study of ICT(In circuit Test) and FCT (Function Test) Fixture in electronic mass production. Test Systems architecture, Automated testing, Types of contact, Bead probe technology , Types of probes, Tip styles, Fixture components, Actuation and hold down mechanisms

Any other experiment based on syllabus which will help students to understand topic/concept.

Books Recommended:

1. J. B. Gupta “Electrical Installation Estimating & costing” S. K. Kataria & Sons, 2009
2. K.B. Raina, S.K. Bhattacharya “Electrical Design Estimating and Costing”, New Age Inter. 2018
3. Alagappan N. & Ekambaram S. Electrical Estimating & costing Tata McGraw hill Ltd.
4. S.L. Uppal and G.C. Garg “Electrical Wiring Estimating and Costing” Khanna Publishers 1987
5. Surjit Singh “Electric Estimating and Costing” Dhanpat Rai & Co. (P) Limited (2016)
6. K B. Bhatia “Study of Electrical Appliances and Devices” Khanna Publishers
7. John T. Bateson “In Circuit Testing” Springer 2012

Links for online NPTEL/SWAYAM courses:

1. <https://nptel.ac.in/courses/122/106/122106025/>
2. <https://nptel.ac.in/courses/108/101/108101091/>
3. <https://nptel.ac.in/courses/108/108/108108076/>
4. https://swayam.gov.in/nd2_aic20_sp59/

PART B**Industrial Visit**

One compulsory visit to any Electrical Machines or Electronics Equipments Manufacturing Industry

Term Work: It comprises both part A and B

Term work consists of performing minimum 06 practical as mentioned above. Final certification and acceptance of the term work ensures satisfactory performance of laboratory work.

The distribution of marks for term work shall be as follows:

- Laboratory work (Experiment/journal) : 15 marks.
- Industrial Visit Report : 05 marks.
- Attendance : 05 Marks

End Semester Examination:

Pair of Internal and External Examiner should conduct Oral on the entire syllabus of the laboratory.

Course Code	Course Name	Credits
MTSBL301	Skill Based Lab: CAD – Modeling	02

Prerequisites: Engineering Drawing

Objectives:

1. To impart the 3D modeling skills for development of 3D models of basic engineering components.
2. To introduce Product data exchange among CAD systems.
3. To familiarize with production drawings with important features like GD &T, surface finish, heat treatments etc.

Outcomes: Learner will be able to...

1. Illustrate basic understanding of types of CAD model creation.
2. Visualize and prepare 2D modeling of a given object using modeling software.
3. Build solid model of a given object using 3D modeling software.
4. Visualize and develop the surface model of a given object using modeling software.
5. Generate assembly models of given objects using assembly tools of a modeling software.
6. Perform product data exchange among CAD systems.

Sr. No.	Exercises	Hrs.
1	CAD Introduction CAD models Creation, Types and uses of models from different perspectives. Parametric modeling.	10
2	2D Modeling Geometric modeling of an Engineering component, demonstrating skills in sketching commands of creation (line, arc, circle etc.) modification (Trim, move, rotate etc.) and viewing using (Pan, Zoom, Rotate etc.)	
3	Solid Modeling 3D Geometric modeling of an Engineering component, demonstrating modeling skills using commands like Extrude, Revolve, Sweep, Blend, Loft etc.	
4	Surface Modeling Extrude, Sweep, Trim etc and Mesh of curves, free form surfaces etc. Feature manipulation using Copy, Edit, Pattern, Suppress, History operations etc.	
5	Assembly Constraints, Exploded views, interference check. Drafting (Layouts, Standard & Sectional Views, Detailing & Plotting).	
6	Data Exchange CAD data exchange formats Like IGES, PDES, PARASOLID, DXF and STL along with their comparison and applicability.	

Assessment:

Term work

Using the above knowledge and skills acquired through six modules students should complete Minimum six assignments/Experiments from the given sets of assignments (**Two from each set**) using standard CAD modeler like PTC Creo/CATIA/ Solid work/UG /any other suitable software.

Set 1: Beginner Level:

3D modeling of basic Engineering components likes Nuts, Bolts, Keys, cotter, Screws, Springs etc.

Set 2: Intermediate Level:

3D modeling of basic Machine components like Clapper block, Single tool post, Lathe and Milling tail stock, Shaper tool head slide, jigs and fixtures Cotter, Knuckle joint, Couplings: simple, muff, flanged Protected flange coupling, Oldham's coupling, Universal coupling, element of engine system and Miscellaneous parts.

Set 3: Advance Level:

1) Generation of any Assembly model (minimum five child parts) along with Production drawing for any of the system by creating 3D modeling with assembly constraints, Interference check, Exploded view, GD&T, Bill of material.

2) Reverse Engineering of a physical model: disassembling of any physical model having not less than five parts, measure the required dimensions of each component, sketch the minimum views required for each component, convert these sketches into 3-D model and create an assembly drawing with actual dimensions

The distribution of marks for Term work shall be as follows:

1. Printouts/Plots : 20marks
2. Attendance : 05marks

End Semester Practical/Oral examination:

To be conducted by pair of Internal and External Examiner

1. Practical examination duration is two hours, based on Advance level of the Termwork.
Oral examination should also be conducted to check the knowledge of CAD Modeling Tools.
2. The distribution of marks for practical examination shall be as follows:
 - a. Practical Exam15marks
 - b. Oral Exam10 marks
3. Evaluation of practical examination to be done based on the printout of students work
4. Students work along with evaluation report to be preserved till the next examination

References:

1. Machine Drawing by N.D.Bhatt.
2. A textbook of Machine Drawing by Laxminarayan and M.L.Mathur, Jain brothers Delhi
3. Machine Drawing by Kamat and Rao
4. Machine Drawing by M.B.Shah
5. A text book of Machine Drawing by R.B. Gupta, Satyaprakashan, Tech.Publication
6. Machine Drawing by K.I. Narayana, P. Kannaiah, K.Venkata Reddy
7. Machine Drawing by Sidheshwar and Kanheya
8. Autodesk Inventor 2011 for Engineers and Designers by Sham Tickoo and Surinder Raina, Dreamtech Press

Links for online NPTEL/SWAYAM courses:

1. <https://nptel.ac.in/courses/112/102/112102102/>
2. <https://nptel.ac.in/courses/112/104/112104031/>
3. <https://nptel.ac.in/courses/112/102/112102101/>

Course code	Course Name	Credits
MTPBL301	Mini Project-1A	02

Objectives:

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Outcome: Learner will be able to...

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as member of a group or leader.
4. Draw the proper inferences from available results through theoretical/experimental/simulations.
5. Analyse the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to lifelong learning.
9. Demonstrate project management principles during project work.

Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs during mini project activity; however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;

○ Marks awarded by guide/supervisor based on log book	10
○ Marks awarded by review committee	10
○ Quality of Project report	05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by student's group.
 - First shall be for finalisation of problem
 - Second shall be on finalisation of proposed solution of problem.
- In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
 - First review is based on readiness of building working prototype to be conducted.
 - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
 - Identification of need/problem
 - Proposed final solution
 - Procurement of components/systems
 - Building prototype and testing
- Two reviews will be conducted for continuous assessment,
 - First shall be for finalisation of problem and proposed solution
 - Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project

Mini Project shall be assessed based on following criteria;

1. Quality of survey/ need identification
 2. Clarity of Problem definition based on need.
 3. Innovativeness in solutions
 4. Feasibility of proposed problem solutions and selection of best solution
 5. Cost effectiveness
 6. Societal impact
 7. Innovativeness
 8. Cost effectiveness and societal impact
 9. Full functioning of working model as per stated requirements
 10. Effective use of skillsets
 11. Effective use of standard engineering norms
 12. Contribution of an individual's as member or leader
 13. Clarity in written and oral communication
- In **one year project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
 - In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organisations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on following points;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skillsets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication

NOTE –

1: For Detailed Course Schemes, Course Objectives, Internal & External Assessment process, End Semester Examination, Recommended & reference Books please refer MU syllabus of Second year (C-Scheme / R-19) Mechatronics Engineering.

2: Theory and Practical Examination will be strictly based on above compressed syllabus.

UNIVERSITY OF MUMBAI



Bachelor of Engineering

in

Information Technology

**Direct Second Year (Sem. III) Admitted Students for the
current Academic Year 2020-21(Only)**

(REV- 2019 'C' Scheme) from Academic Year 2019 – 20

**Under
FACULTY OF
SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2019–2020)

**Program Structure for Second Year
Engineering Semester III
UNIVERSITY OF MUMBAI
(With Effect from 2020-2021)**

Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
ITC301	Engineering Mathematics-III	3	--	1	3	--	1	4	
ITC302	Data Structure and Analysis	3		--	3		--	3	
ITC303	Database Management System	3	--	--	3	--	--	3	
ITC304	Principle of Communication	3	--	--	3	--	--	3	
ITC305	Paradigms and Computer Programming Fundamentals	3	--	--	3	--	--	3	
ITL301	Data Structure Lab	--	2	--	--	1	--	1	
ITL302	SQL Lab	--	2	--	--	1	--	1	
ITL303	Computer programming Paradigms Lab	--	2	--	--	1	--	1	
ITL304	Java Lab (SBL)	--	4	--	--	2	--	2	
ITM301	Mini Project – 1 A for Front end /backend Application using JAVA	--	4 ^s	--	--	2	--	2	
Total		15	14	1	15	07	1	23	
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test2	Avg.					
ITC301	Engineering Mathematics-III	20	20	20	80	3	25	--	125
ITC302	Data Structure and Analysis	20	20	20	80	3	--	--	100
ITC303	Database Management System	20	20	20	80	3	--	--	100
ITC304	Principle of Communication	20	20	20	80	3	--	--	100
ITC305	Paradigms and Computer Programming Fundamentals	20	20	20	80	3	--	--	100
ITL301	Data Structure Lab	--	--	--	--	--	25	25	50
ITL302	SQL Lab	--	--	--	--	--	25	25	50
ITL303	Computer programming Paradigms Lab	--	--	--	--	--	25	25	50
ITL304	Java Lab (SBL)	--	--	--	--	--	25	25	50
ITM301	Mini Project – 1 A for Front end /backend Application using JAVA	--	--	--	--	--	25	25	50
Total		--	--	100	400	--	150	125	775

\$ indicates work load of Learner (Not Faculty), for Mini-Project. Students can form groups with minimum 2 (Two) and not more than 4 (Four) Faculty Load: 1 hour per week per four groups.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
ITC301	Engineering Mathematics-III	03	-	01	03	-	01	04

Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Avg of Test 1 & 2					
ITC301	Engineering Mathematics-III	20	20	20	80	25	-	-	125

Pre-requisite: Engineering Mathematics-I, Engineering Mathematics-II

Course Objectives:

Sr. No.	Course Objectives
	The course aims:
1	To familiarize with the Laplace Transform, Inverse Laplace Transform of various functions, and its applications.
2	To acquaint with the concept of Fourier series, its complex form and enhance the problem solving skills.
3	To familiarize the concept of complex variables, C-R equations with applications.
4	The fundamental knowledge of Trees, Graphs etc.
5	To study the basic techniques of statistics like correlation, regression and curve fitting for data analysis, Machine learning and AI.
6	To understand some advanced topics of probability, random variables with their distributions and expectations.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
	On successful completion, of course, learner/student will be able to:	
1	Apply the concept of Laplace transform to solve the real integrals in engineering problems.	L1, L2
2	Apply the concept of inverse Laplace transform of various functions in engineering problems.	L1, L2

3	Expand the periodic function by using Fourier series for real life problems and complex engineering problems.	L1, L2, L3
4	Find orthogonal trajectories and analytic function by using basic concepts of complex variable theory.	L1, L2, L3
5	Apply the concept of Correlation and Regression to the engineering problems in data science, machine learning and AI.	L2, L3
6	Illustrate understanding of the concepts of probability and expectation for getting the spread of the data and distribution of probabilities.	L1, L2

Module	Detailed Contents	Hours	CO Mapping
01	Module: Laplace Transform 1.1 Definition of Laplace transform, Condition of Existence of Laplace transform, 1.2 Laplace Transform (L) of Standard Functions like e^{at} , $\sin(at)$, $\cos(at)$, $\sinh(at)$, $\cosh(at)$ and $t^n, n \geq 0$. 1.3 Properties of Laplace Transform: Linearity, First Shifting Theorem, Second Shifting Theorem, change of scale Property, multiplication by t , Division by t , Laplace Transform of derivatives and integrals (Properties without proof). 1.4 Evaluation of real integrals by using Laplace Transformation. Self-learning Topics: Heaviside's Unit Step function, Laplace Transform. of Periodic functions, Dirac Delta Function.	7	CO1
02	Module: Inverse Laplace Transform 2.1 Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivatives, 2.2 Partial fractions method to find inverse Laplace transform. 2.3 Inverse Laplace transform using Convolution theorem (without proof) Self-learning Topics: Applications to solve initial and boundary value problems involving ordinary differential equations	6	CO1, CO2
03	Module: Fourier Series: 3.1 Dirichlet's conditions, Definition of Fourier series and Parseval's Identity(without proof) 3.2 Fourier series of periodic function with period 2π and $2l$, 3.3 Fourier series of even and odd functions 3.4 Half range Sine and Cosine Series. Self-learning Topics: Complex form of Fourier Series, orthogonal and orthonormal set of functions, Fourier Transform.	7	CO3

04	Module: Complex Variables: 4.1 Function $f(z)$ of complex variable, limit, continuity and differentiability of $f(z)$, Analytic function, necessary and sufficient conditions for $f(z)$ to be analytic (without proof), 4.2 Cauchy-Riemann equations in cartesian coordinates (without proof) 4.3 Milne-Thomson method to determine analytic function $f(z)$ when real part (u) or Imaginary part (v) or its combination (u+v or u-v) is given. 4.4 Harmonic function, Harmonic conjugate and orthogonal trajectories Self-learning Topics: Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations	7	CO4
05	Module: Statistical Techniques 5.1 Karl Pearson's Coefficient of correlation (r) 5.2 Spearman's Rank correlation coefficient (R) (with repeated and non-repeated ranks) 5.3 Lines of regression 5.4 Fitting of first and second degree curves. Self-learning Topics: Covariance, fitting of exponential curve.	6	CO5
06	Module: Probability 6.1 Definition and basics of probability, conditional probability, 6.2 Total Probability Theorem and Baye's theorem 6.3 Discrete and continuous random variable with probability distribution and probability density function. 6.4 Expectation of random variables with mean, variance and standard deviation, moment generating function up to four moments. Self-learning Topics: Skewness and Kurtosis of distribution (data)	6	CO6

References:

1. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited.
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication,
4. Complex Variables and Applications, Brown and Churchill, McGraw-Hill education.
5. Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill education.
6. Theory and Problems of Fourier Analysis with applications to BVP, Murray Spiegel, Schaum's Outline Series.

Online References:

Sr. No.	Website Name
1.	https://www.nptel.ac.in

Term Work:

General Instructions:

1. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
2. A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Engineering Mathematics. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1.	Attendance (Theory and Tutorial)	05 marks
2.	Class Tutorials on entire syllabus	10 marks
3.	Mini project	10 marks

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment II) when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
 2. Total 04 questions need to be solved.
 3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
 4. Remaining questions will be randomly selected from all the modules.
 5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
-

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC302	Data Structure and Analysis	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITC302	Data Structure and Analysis	20	20	20	80	--	--	100

Course Objectives:

Sr. No.	Course Objectives
	The course aims:
1	The fundamental knowledge of data structures.
2	The programming knowledge which can be applied to sophisticated data structures.
3	The fundamental knowledge of stacks queue, linked list etc.
4	The fundamental knowledge of Trees, Graphs etc.
5	The fundamental knowledge of different sorting, searching, hashing and recursion techniques
6	The real time applications for stacks, queue, linked list, trees, graphs etc.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
	On successful completion, of course, learner/student will be able to:	
1	Classify and Apply the concepts of stacks, queues and linked list in real life problem solving.	L1, L2, L3
2	Classify, apply and analyze the concepts trees in real life problem solving.	L2, L3,L4
3	Illustrate and justify the concepts of graphs in real life problem solving.	L3, L5
4	List and examine the concepts of sorting, searching techniques in real life problem solving.	L2, L3, L4
5	Use and identify the concepts of recursion, hashing in real life problem solving.	L3, L4
6	Examine and justify different methods of stacks, queues, linked list, trees and graphs to various applications.	L3, L4, L5

Prerequisite: C Programming

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Introduction to Stacks, Queues and Linked Lists	Concept of Linked Lists. Singly linked lists, doubly linked lists and circular linked lists. Insertion, deletion, update and copying operations with Singly linked lists, doubly linked lists and circular linked lists. Reversing a singly linked list. Self-learning Topics: Double Ended Queue, Priority Queue.	04	CO1
II	Trees	Non recursive Preorder, in-order and post-order traversal. Creation of binary trees from the traversal of binary trees. Binary search tree: Traversal, searching, insertion and deletion in binary search tree. Threaded Binary Tree: Finding in-order successor and predecessor of a node in threaded tree. Insertion and deletion in threaded binary tree. AVL Tree: Searching and traversing in AVL trees. Tree Rotations: Right Rotation, Left Rotation. Insertion and Deletion in an AVL Tree. B-tree: Searching, Insertion, Deletion from leaf node and non-leaf node. B+ Tree, Digital Search Tree, Game Tree & Decision Tree Self-learning Topics: Implementation of AVL and B+ Tree	06	CO1, CO 2
III	Graphs	Representation of graph: adjacency matrix, adjacency list, Transitive closure of a directed graph and path matrix. Traversals: Breadth First Search, Depth First Search. Self-learning Topics: Implementation of BFS, DFS	03	CO1, CO3
IV	Searching and Sorting	Searching: Hashing: Hash Functions: Truncation, Mid-square Method, Folding Method, Division Method. Collision Resolution: Open Addressing: Linear Probing, Quadratic Probing, Double Hashing, Separate Chaining Bucket Hashing. Analysis of all searching techniques Self-learning Topics: Implementation of different sorting techniques and searching.	03	CO 4, CO5
V	Applications of Data Structures	Applications of Linked Lists: Addition of 2 Polynomials and Multiplication of 2 polynomials. Applications of Stacks: Reversal of a String, Checking validity of an expression containing nested parenthesis, Function calls, Polish Notation: Introduction to infix, prefix and postfix expressions and their evaluation and conversions.	04	CO6

		Applications of Trees: Huffman Tree and Heap Sort. Applications of Graphs: Minimum Spanning Tree: Prim's Algorithm, Kruskal's Algorithm. Self-learning Topics: Implementation of applications for Stack, Queues, Linked List, Trees and Graph.		
--	--	--	--	--

Text Books:

1. S. K Srivastava, Deepali Srivastava; Data Structures through C in Depth; BPB Publications; 2011.
2. Yedidya Langsam, Moshej Augenstein, Aaron M. Tenenbaum; Data Structure Using C & C++; Prentice Hall of India; 1996.
3. Reema Thareja; Data Structures using C; Oxford.

References:

1. Ellis Horowitz, Sartaj Sahni; Fundamentals of Data Structures; Galgotia Publications; 2010.
2. Jean Paul Tremblay, Paul G. Sorenson; An introduction to data structures with applications; Tata McGrawHill; 1984.
3. Rajesh K. Shukla; Data Structures using C and C++; Wiley India; 2009.

Online References:

Sr. No.	Website Name
2.	https://www.nptel.ac.in
3.	https://opendatastructures.org/
3.	https://www.coursera.org/

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➤ Question paper format

- Question Paper will comprise of a total of **six questions each carrying 20 marks**. Q.1 will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC303	Database Management System	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITC303	Database Management System	20	20	20	80	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To learn the basics and understand the need of database management system.
2	To construct conceptual data model for real world applications
3	To Build Relational Model from ER/EER.
4	To introduce the concept of SQL to store and retrieve data efficiently.
5	To demonstrate notions of normalization for database design.
6	To understand the concepts of transaction processing- concurrency control & recovery procedures.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Identify the need of Database Management System.	L1, L2
2	Design conceptual model for real life applications.	L6
3	Create Relational Model for real life applications	L6
4	Formulate query using SQL commands.	L3
5	Apply the concept of normalization to relational database design.	L3
6	Demonstrate the concept of transaction, concurrency and recovery.	L2

Prerequisite: C Programming

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	The Entity-Relationship Model	Conceptual Modeling of a database, The Entity-Relationship (ER) Model, Entity Type, Entity Sets, Attributes and Keys, Relationship Types, Relationship Sets, Weak entity Types Generalization, Specialization and Aggregation, Extended Entity-Relationship (EER) Model. Self-learning Topics: Design an ER model for any real time case study.	05	CO2
II	Relational Model & Relational Algebra	Introduction to Relational Model, Relational Model Constraints and Relational Database Schemas, Concept of Keys: Primary Key, Secondary key, Foreign Key, Mapping the ER and EER Model to the Relational Model, Introduction to Relational Algebra, Relational Algebra expressions for Unary Relational Operations, - Set Theory operations, - Binary Relational operation Relational Algebra Queries Self-learning Topics: Map the ER model designed in module II to relational schema..	05	CO3
III	Structured Query Language (SQL) & Indexing	Overview of SQL, Data Definition Commands, Set operations, aggregate function, null values, Data Manipulation commands, Data Control commands. Integrity constraints in SQL. Database Programming with JDBC, Security and authorization: Grant & Revoke in SQL Functions and Procedures in SQL and cursors. Self-learning Topics: Physical design of database for the relational model designed in module III and fire various queries.	06	CO4
IV	Relational Database Design	Design guidelines for relational Schema, Functional Dependencies, Database tables and normalization, The need for normalization, The normalization process, Improving the design, Self-learning Topics: Consider any real time application and normalization up-to 3NF/BCNF	04	CO5

Text Books:

1. Korth, Silberchatz, Sudarshan, Database System Concepts, 6th Edition, McGraw Hill
2. Elmasri and Navathe, Fundamentals of Database Systems, 6th Edition, Pearson education
3. Raghu Ramkrishnan and Johannes Gehrke, Database Management Systems, TMH

References:

1. Peter Rob and Carlos Coronel, — Database Systems Design, Implementation and Management, Thomson Learning, 9th Edition.

2. SQL & PL / SQL for Oracle 11g Black Book, Dreamtech Press
3. G. K. Gupta : “Database Management Systems”, McGraw – Hill

Online References:

Sr. No.	Website Name
1.	https://www.nptel.ac.in
2.	https://www.oreilly.com
3.	https://www.coursera.org/

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➤ **Question paper format**

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**
 - **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
 - A total of **four questions** need to be answered
-

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC304	Principle of Communication	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITC304	Principle of Communication	20	20	20	80	--	--	100

Course Objectives:

Sr. No.	Course Objectives
	The course aims:
1	Study the basic of Analog and Digital Communication Systems.
2	Describe the concept of Noise and Fourier Transform for analyzing communication systems.
3	Acquire the knowledge of different modulation techniques such as AM, FM and study the block diagram of transmitter and receiver.
4	Study the Sampling theorem and Pulse Analog and digital modulation techniques
5	Learn the concept of multiplexing and digital band pass modulation techniques
6	Gain the core idea of electromagnetic radiation and propagation of waves.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
	On successful completion, of course, learner/student will be able to:	
1	Describe analog and digital communication systems	L1,L2
2	Differentiate types of noise, analyses the Fourier transform of time and frequency domain.	L1, L2, L3, L4
3	Design transmitter and receiver of AM, DSB, SSB and FM.	L1,L2,L3,L4
4	Describe Sampling theorem and pulse modulation systems.	L1,L2,L3
5	Explain multiplexing and digital band pass modulation techniques.	L1, L2
6	Describe electromagnetic radiation and propagation of waves.	L1,L2

Prerequisite: Basic of electrical engineering

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Introduction	Basics of analog communication and digital communication systems (Block diagram), Electromagnetic Spectrum and application, Types of Communication channels. Self-learning Topics: Applications areas of analog and digital communication.	02	CO1
II	Noise and Fourier Representation of Signal and System	Basics of signal representation and analyses, Introduction to Fourier Transform, its properties (time and frequency shifting, Fourier transform of unit step, delta and gate function. Types of Noise, Noise parameters –Signal to noise ratio, Noise factor, Noise figure, Friss formula and Equivalent noise temperature. Self-learning Topics: Practice Numerical on above topic.	06	CO2
III	Amplitude and Angle modulation Techniques.	Need for modulation, Amplitude Modulation Techniques: DSBFC AM,DSBSC-AM, SSB SC AM- block diagram spectrum, waveforms, bandwidth, Power calculations. Generation of AM using Diode, generation of DSB using Balanced modulator, Generation of SSB using Phase Shift Method. AM Transmitter (Block Diagram) AM Receivers – Block diagram of TRF receivers and Super heterodyne receiver and its characteristics- Sensitivity, Selectivity, Fidelity, Image frequency and its rejection and double spotting Angle Modulation FM: Principle of FM- waveforms, spectrum, bandwidth. Pre- emphasis and de-emphasis in FM, FM generation: Direct method –Varactor diode Modulator, Indirect method (Armstrong method) block diagram and waveforms. FM demodulator: Foster Seeley discriminator, Ratio detector. Self-learning Topics: Use of AM and FM in Modern Communication Technology. Challenges faced by radio business.	12	CO1, CO2, CO3

Text Books:

- [1]. George Kennedy, Bernard Davis, SRM Prasanna, Electronic Communication Systems, Tata McGraw Hill, 5th Ed
- [2]. Simon Haykin, Michael Moher, Introduction to Analog & Digital Communications, Wiley India Pvt. Ltd., 2nd Ed.
- [3].Wireless Communication and Networking, Vijay Garg

References:

- [1]. Wayne Tomasi, Electronic Communications Systems, Pearson Publication, 5th Ed.
- [2]. B P Lathi, Zhi Ding, Modern Digital and Analog Communication Systems, Oxford University
- [3]. Herbert Taub, Donald L Schilling, Goutam Saha, Principles of Communication Systems, Tata

McGraw Hill, 3rdEd.

[4]. K Sam Shanmugam, Digital and Analog Communication Systems, Wiley India Pvt. Ltd, 1st Ed.

Online References:

Sr. No.	Website Name
1.	https://www.nptel.ac.in
2.	https://www.classcentral.com
3.	http://www.vlab.co.in/

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➤ Question paper format

- Question Paper will comprise of a total of **six questions each carrying 20 marks** Q.1 will be **compulsory** and should **cover maximum contents of the syllabus**
 - **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
 - A total of **four questions** need to be answered
-

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC305	Paradigms and Computer Programming Fundamentals	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITC305	Paradigms and Computer Programming Fundamentals	20	20	20	80	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To introduce various programming paradigms and the basic constructs that underline any programming language.
2	To understand data abstraction and object orientation
3	To introduce the basic concepts of declarative programming paradigms through functional and logic programming.
4	To design solutions using declarative programming paradigms through functional and logic programming.
5	To introduce the concepts of concurrent program execution.
6	To understand use of scripting language for different problem domains

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand and Compare different programming paradigms.	L1, L2
2	Understand the Object Oriented Constructs and use them in program design.	L1, L2
3	Understand the concepts of declarative programming paradigms through functional and logic programming.	L1, L2
4	Design and Develop programs based on declarative programming paradigm using functional and/or logic programming.	L5, L6
5	Understand the role of concurrency in parallel and distributed programming.	L1, L2
6	Understand different application domains for use of scripting languages.	L1. L2

Prerequisite: Students must have learned C Programming (FEC205 and FEL204),

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Introduction to Programming Paradigms and Core Language Design Issues	Introduction to different programming paradigms. Names, Scopes, and Bindings, Scope Rules, Storage Management. Subroutine and Control Abstraction: Stack Layout, Calling sequence, parameter passing Generic subroutines and modules. Self-Learning Topic: Implementation of basic concepts using programming language.	07	CO1
II	Declarative Programming Paradigm: Functional Programming	Introduction to Lambda Calculus, Functional Programming Concepts, Evaluation order, Higher order functions, I/O-Streams and Monads. Self-Learning Topic: Implementation of programs using functional programming Language Haskell can refer to hacker rank website for problem statements.	07	CO3, CO4
III	Declarative Programming Paradigm: Logic Programming	Logic Programming with PROLOG - Resolution and Unification, Lists, Arithmetic execution order, imperative control flow, database manipulation, PROLOG facilities and deficiencies. Self-Learning Topic: Identification of different application domains for use of Prolog and Logic programming	06	CO3, CO4

Text Books:

1. Scott M L, Programming Language Pragmatics, 3rd Edn., Morgan Kaufmann Publishers, 2009
2. Graham Hutton, Programming in Haskell, 2nd Edition, Cambridge University Press, 2016
3. Programming Languages: Concepts and Constructs; 2nd Edition, Ravi Sethi, Pearson Education Asia, 1996.

References:

1. Harold Abelson and Gerald Jay Sussman with Julie Sussman foreword by Alan J. Perlis, Structure and Interpretation of Computer Programs (2nd Edition) (February 2, 2016)
2. Programming Languages: Design and Implementation (4th Edition), by Terrence W. Pratt, Marvin V. Zelkowitz, Pearson, 2000
3. Rajkumar Buyya, Object-oriented Programming with Java: Essentials and Applications, Tata McGraw Hill Education Private Limited
4. Max Bramer, Logic Programming with Prolog, Springer ISBN-13: 978-1852-33938-8

Online References:

Sr No	Website Name	Link
<u>1</u>	Principles of programming Languages (Videos)	https://nptel.ac.in/courses/106/102/106102067/
2	Edx course Paradigms of Computer	https://www.classcentral.com/course/edx-

	Programming – Fundamentals	paradigms-of-computer-programming-fundamentals-2298
3	Udemy Couses	https://www.udemy.com

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

► Question paper format

- Question Paper will comprise of a total of six questions each carrying 20 marks Q.1 will be compulsory and should cover maximum contents of the syllabus.
 - Remaining questions will be mixed in nature (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
 - A total of four questions need to be answered
-

Lab Code	Lab Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITL301	Data Structure Lab	--	02	--	--	01	--	01

Lab Code	Lab Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITL301	Data Structure Lab	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The Lab experiments aims:	
1	To use data structures as the introductory foundation for computer automation to engineering problems.
2	To use the basic principles of programming as applied to complex data structures.
3	To learn the principles of stack, queue, linked lists and its various operations.
4	To learn fundamentals of binary search tree, implementation and use of advanced tree like AVL, B trees and graphs.
5	To learn about searching, hashing and sorting.
6	To learn the applications of linked lists, stacks, queues, trees and graphs.

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand and use the basic concepts and principles of various linked lists, stacks and queues.	L1, L2, L3
2	Understand the concepts and apply the methods in basic trees.	L1, L2
3	Use and identify the methods in advanced trees.	L3, L4
4	Understand the concepts and apply the methods in graphs.	L2, L3
5	Understand the concepts and apply the techniques of searching, hashing and sorting	L2, L3
6	Illustrate and examine the methods of linked lists, stacks, queues, trees and graphs to various real time problems	L3, L4

Prerequisite: C Programming

Hardware & Software Requirements:

Hardware Requirement:	Software requirement:
PC i3 processor and above	Turbo/Borland C complier

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
I	Linked Lists	• Insertion, deletion operations with Singly linked lists • Insertion, deletion operations Doubly linked lists • Insertion, deletion operations Circular linked lists. • Reversing a singly linked list. • * Linked List implementation	03	LO 1
II	Trees	• * Implementation of operations (insertion, deletion, counting of nodes, counting of leaf nodes etc.) in a binary search tree.	02	LO 2
III	Advanced Trees	• * Implementation of AVL tree. • Implementation of operations in a B tree.	04	LO 3
IV	Graphs	• Implementation of adjacency matrix creation. • Implementation of addition and deletion of edges in a directed graph using adjacency matrix.	02	LO 4
V	Applications of Data Structures	• * Implementation of infix to postfix conversion and evaluation of postfix expression • * Implementation of Josephus Problem using circular linked list • *Implementation of hashing functions with different collision resolution techniques	02	LO 6

Text Books:

1. S. K Srivastava, Deepali Srivastava; Data Structures through C in Depth; BPB Publications; 2011.
2. Yedidya Langsam, Moshej Augenstein, Aaron M. Tenenbaum; Data Structure Using C & C++; Prentice Hall of India; 1996.
3. Reema Thareja; Data Structures using C; Oxford.

References:

1. Ellis Horowitz, Sartaj Sahni; Fundamentals of Data Structures; Galgotia Publications; 2010.
2. Jean Paul Tremblay, Paul G. Sorenson; An introduction to data structures with applications; Tata McGrawHill; 1984.
3. Rajesh K. Shukla; Data Structures using C and C++; Wiley India; 2009.

Term Work: Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

Lab Code	Lab Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITL302	SQL Lab	--	02	--	--	01	--	01

Lab Code	Lab Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITL302	SQL Lab	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
	The Lab experiments aims:
1	To identify and define problem statements for real life applications
2	To construct conceptual data model for real life applications
3	To Build Relational Model from ER/EER and demonstrate usage of relational algebra.
4	To Apply SQL to store and retrieve data efficiently
5	To implement database connectivity using JDBC
6	To understand the concepts of transaction processing- concurrency control & recovery procedures.

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
	On successful completion, of course, learner/student will be able to:	
1	Define problem statement and Construct the conceptual model for real life application.	L1, L3, L4, L6
2	Create and populate a RDBMS using SQL.	L3, L4
3	Formulate and write SQL queries for efficient information retrieval	L3, L4
4	Apply view, triggers and procedures to demonstrate specific event handling.	L1, L3, L4
5	Demonstrate database connectivity using JDBC.	L3
6	Demonstrate the concept of concurrent transactions.	L3, L4

Prerequisite: C Programming

Hardware & Software Requirements:

Hardware Requirement:	Software requirement:
PC i3 processor and above	Any SQL Compiler, Java Programming Language

DETAILED SYLLABUS:

Sr. No.	Detailed Content	Hours	LO Mapping
1.	Identify real world problem and develop the problem statement. Design an Entity-Relationship (ER) / Extended Entity-Relationship (EER) Model.	02	LO1
2.	Create a database using DDL and apply integrity constraints.	02	LO2, LO3
3.	Perform data manipulations operations on populated database.	02	LO3
4.	Implement Basic and complex SQL queries.	02	LO3, LO4
5.	Implementation of Views and Triggers.	02	LO4
6.	Demonstrate database connectivity using JDBC.	01	LO5
7.	Implement functions and procedures in SQL	02	LO3, LO4

Text Books:

1. Korth, Silberchatz, Sudarshan, Database System Concepts, 6th Edition, McGraw Hill
2. Elmasri and Navathe, Fundamentals of Database Systems, 6th Edition, Pearson education
3. Raghu Ramkrishnan and Johannes Gehrke, Database Management Systems, TMH

References:

1. Peter Rob and Carlos Coronel, — Database Systems Design, Implementation and Management, Thomson Learning, 9th Edition.
2. SQL & PL / SQL for Oracle 11g Black Book, Dreamtech Press
3. G. K. Gupta : “Database Management Systems”, McGraw – Hill

Term Work:

Term Work shall consist of at least 10 Practical's based on the above list, but not limited to. Also, Term work Journal must include at least 2 assignments:

The first assignment may be based on: Relational Algebra and Second may be based on Transactions

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

Lab Code	Lab Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITL303	Computer programming Paradigms Lab	--	02	--	--	01	--	01

Lab Code	Lab Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITL303	Computer programming Paradigms Lab	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
	The Lab experiments aims:
1	Understand data abstraction and object orientation
2	Design and implement declarative programs in functional and logic programming languages
3	Introduce the concepts of concurrent program execution
4	Understand run time program management
5	Understand how to implement a programming solution using different programming paradigms.
6	Learn to compare implementation in different programming paradigms.

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
	On successful completion, of course, learner/student will be able to:	
1	Implement Object Oriented concepts in C++.	L1, L2, L3
2	Design and Develop solution based on declarative programming paradigm using functional and logic programming.	L6
3	Understand the multi threaded programs in Java and C++	L1, L2
4	Understand the need and use of exception handling and garbage collection in C++ and JAVA	L2, L3
5	Implement a solution to the same problem using multiple paradigms.	L6
6	Compare the implementations in multiple paradigms at coding and execution level.	L4

Prerequisite: Students must have learned C Programming (FEC205 and FEL204)

Hardware & Software Requirements:

Hardware Requirement: PC i3 processor and above	Software requirement: C++ compiler, Java Language support, SWI Prolog, GHC Compiler.
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DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
I	Declarative Programming Paradigm: Functional Programming	• Tutorial Introduction to Haskell programming environment • Tutorial exercise on operators, types etc. in Haskell • At least 5 Haskell Programs to demonstrate Functional Programming Concepts. • Sample Programs but not limited to: ◦ Implement safetail function that behaves in the same way as tail, except that safetail maps the empty list to the empty list, whereas tail gives an error in this case. Define safetail using: (a) a conditional expression; (b) guarded equations; (c) pattern matching. Hint: the library function <code>null :: [a] -> Bool</code> can be used to test if a list is empty. ◦ Simple List Comprehension ◦ Higher-Order Functions ◦ Write recursive function to multiply two natural numbers that uses pre defined add funion. ◦ Implement the game of nim in Haskell to apply list processing. ◦ Haskell code to represent infinite list e.g. fibobacci series ◦ Implement simple Calculator Students should clearly understand the syntax and the execution of the Functional Implementation using Haskell.	06	LO2
II	Declarative Programming Paradigm: Logic Programming	• Tutorial Installation and working of SWI Prolog Environment • Implement at least 5 Prolog programs to understand declarative programming concepts. Students should clearly understand the syntax and the execution of the Prolog code Implementation.	05	LO2
III	Programming Assignment For comparative study of Different Paradigms	At Least two implementations each implemented on multiple paradigms like procedural, object oriented, functional, logic. The implementations should be done in a group of two/three students with appropriate difficulty level.	02	LO5, LO6

		Student should prepare small report and present the solution code and demonstrate execution for alternative solutions they build.		
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Text Books:

1. Scott M L, Programming Language Pragmatics, 3rd Edn., Morgan Kaufmann Publishers, 2009
2. Harold Abelson and Gerald Jay Sussman with Julie Sussman foreword by Alan J. Perlis, Structure and Interpretation of Computer Programs (2nd Edition)
3. Graham Hutton, Programming in Haskell, 2nd Edition, Cambridge University Press, 2016
- 4.

References:

1. Sethi R, Programming Languages Concepts and Constructs , 2nd Ed, Pearson Education
2. Yogesh Sajanikar, Haskell Cookbook, Packt Publishing, 2017

Online References:

Sr No	Website Description	Link
1	University Stuttgart Germany Lab Course on Programming Paradigms	http://software-lab.org/teaching/winter2019/pp/
2	Course at MIT Structure and Interpretation of Computer Programs [2019]	https://web.mit.edu/u/6.037
3	Edx Course Paradigms of Computer Programming – Fundamentals,	https://www.edx.org/course/paradigms-of-computer-programming-fundamentals
4	Tutorials point link for Haskell	https://www.tutorialspoint.com/haskell

Term Work: Term Work shall consist of at least 15 Practicals based on the above modules, but not limited to. Also, Term work Journal must include at least 3 tutorial reports and 01 report of programming assignment as mentioned in module VI.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiments/Tutorials) + 5 Marks (Assignment write up) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & 1 Hr Practical exam will be held based on the above syllabus

Lab Code	Lab Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITL304	Java Lab (SBL)	--	04	--	--	02	--	02

Lab Code	Lab Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITL304	Java Lab (SBL)	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
	The Lab experiments aims:
1	To understand the concepts of object-oriented paradigm in the Java programming language.
2	To understand the importance of Classes & objects along with constructors, Arrays ,Strings and vectors
3	To learn the principles of inheritance, interface and packages and demonstrate the concept of reusability for faster development.
4	To recognize usage of Exception Handling, Multithreading, Input Output streams in various applications
5	To learn designing, implementing, testing, and debugging graphical user interfaces in Java using Swings and AWT components that can react to different user events.
6	To develop graphical user interfaces using JavaFX controls.

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
	On successful completion, of course, learner/student will be able to:	
1	Explain the fundamental concepts of Java Programing.	L1, L2
2	Use the concepts of classes, objects, members of a class and the relationships among them needed for a finding the solution to specific problem.	L3
3	Demonstrate how to extend java classes and achieve reusability using Inheritance, Interface and Packages.	L3
4	Construct robust and faster programmed solutions to problems using concept of Multithreading, exceptions and file handling	L3
5	Design and develop Graphical User Interface using Abstract Window Toolkit and Swings along with response to the events.	L6
6	Develop Graphical User Interface by exploring JavaFX framework based on MVC architecture.	L6

Prerequisite: Basics of Computer Programming

Hardware & Software Requirements:

Hardware Requirements	Software Requirements	Other Requirements
PC With Following Configuration 1. Intel PIV Processor 2. 2 GB RAM 3. 500 GB Harddisk 4. Network interface card	1. Windows or Linux Desktop OS 2. JDK 1.8 or higher 3. Notepad ++ 4. JAVA IDEs like Netbeans or Eclipse	1. Internet Connection for installing additional packages if required

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
I	Inheritance, Interfaces.	Inheritance: Inheritance Basics, Types of Inheritance in Java, member access, using Super- to call superclass Constructor, to access member of super class(variables and methods), method overriding, Abstract classes and methods, using final. Interfaces: Defining, implementing and extending interfaces, variables in interfaces, Default Method in Interface ,Static Method in interface, Abstract Classes vs Interfaces. (Perform any 3 programs covering Inheritance, Interfaces). Experiments 1) Create a Teacher class and derive Professor/ Associate_Professor/Assistant_Professor class from Teacher class. Define appropriate constructor for all the classes. Also define a method to display information of Teacher. Make necessary assumptions as required. 2) Create a class Book and define a display method to display book information. Inherit Reference_Book and Magazine classes from Book class and override display method of Book class in Reference_Book and Magazine classes. Make necessary assumptions required. 3) A university has two types of students — graduate students and research students. The University maintains the record of name, age and programme of every student. For graduate students, additional information like percentage of marks and stream, like science, commerce, etc. is recorded; whereas for research students, additionally, specialization and years of working experience, if any, is recorded. Each class has a constructor. The constructor of subclasses makes a call to constructor of the superclass. Assume that every constructor has the same number of parameters as the number of instance variables. In addition, every subclass has a method that may update the instance variable values of that subclass. All the classes have a	08	LO1 LO3

		function <code>display_student_info()</code>, the subclasses must override this method of the base class. Every student is either a graduate student or a research student. Perform the following tasks for the description given above using Java : (i) Create the three classes with proper instance variables and methods, with suitable inheritance. (ii) Create at least one parameterised constructor for each class. (iii) Implement the <code>display_student_info()</code> method in each class. 4) An employee works in a particular department of an organization. Every employee has an employee number, name and draws a particular salary. Every department has a name and a head of department. The head of department is an employee. Every year a new head of department takes over. Also, every year an employee is given an annual salary enhancement. Identify and design the classes for the above description with suitable instance variables and methods. The classes should be such that they implement information hiding. You must give logic in support of your design. Also create two objects of each class. 5) Consider a hierarchy, where a sportsperson can either be an athlete or a hockey player. Every sportsperson has a unique name. An athlete is characterized by the event in which he/she participates; whereas a hockey player is characterised by the number of goals scored by him/her. Perform the following tasks using Java : (i) Create the class hierarchy with suitable instance variables and methods. (ii) Create a suitable constructor for each class. (iii) Create a method named <code>display_all_info</code> with suitable parameters. This method should display all the information about the object of a class. (iv) Write the main method that demonstrates polymorphism. 6) Create an interface <code>vehicle</code> and classes like <code>bicycle</code>, <code>car</code>, <code>bike</code> etc, having common functionalities and put all the common functionalities in the interface. Classes like <code>Bicycle</code>, <code>Bike</code>, <code>car</code> etc implement all these functionalities in their own class in their own way		
II	Exception Handling, Multithreading.	Exception Handling: Exception-Handling Fundamentals, Exception Types, Exception class Hierarchy, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally , Java's Built-in Exceptions, Creating Your Own Exception Subclasses Multithreaded Programming: The Java Thread Model and Thread Life Cycle, Thread Priorities, Creating a Thread, Implementing Runnable, Extending	05	LO1 LO3 LO4

		Thread, Creating Multiple Threads, Synchronization: Using Synchronized Methods, The synchronized Statement (Perform any 3 programs that cover Exception Handling, Multithreading) Experiments: 1) Write java program where user will enter loginid and password as input. The password should be 8 digit containing one digit and one special symbol. If user enter valid password satisfying above criteria then show “Login Successful Message”. If user enter invalid Password then create InvalidPasswordException stating Please enter valid password of length 8 containing one digit and one Special Symbol. 2) Java Program to Create Account with 1000 Rs Minimum Balance, Deposit Amount, Withdraw Amount and Also Throws LessBalanceException. It has a Class Called LessBalanceException Which returns the Statement that Says WithDraw Amount(_Rs) is Not Valid. It has a Class Which Creates 2 Accounts, Both Account Deposit Money and One Account Tries to WithDraw more Money Which Generates a LessBalanceException Take Appropriate Action for the Same. 3) Create two threads such that one thread will print even number and another will print odd number in an ordered fashion. 4) Assume that two brothers, Joe and John, share a common bank account. They both can, independently, read the balance, make a deposit, and withdraw some money. Implement java application demonstrate how the transaction in a bank can be carried out concurrently.		
III	GUI programming- I (AWT, Event Handling, Swing)	Designing Graphical User Interfaces in Java: Components and Containers, Basics of Components, Using Containers, Layout Managers, AWT Components, Adding a Menu to Window, Extending GUI Features Event-Driven Programming in Java: Event-Handling Process, Event-Handling Mechanism, Delegation Model of Event Handling, Event Classes, Event Sources, Event Listeners, Adapter Classes as Helper Classes in Event Handling. Introducing Swing: AWT vs Swings, Components and Containers, Swing Packages, A Simple Swing Application, Painting in Swing, Designing Swing GUI Application using Buttons, JLabels, Checkboxes, Radio Buttons, JScrollPane, JList, JComboBox, Trees, TableScrollPane Menus and Toolbar	12	LO1 LO4 LO5

		(Perform any 3 programs that contain AWT, Event handling and Swing to build GUI application). 1) Write a Java program to implement Swing components namely Buttons, JLabels, Checkboxes, Radio Buttons, JScrollPane, JList, JComboBox, Trees, Tables Scroll pane Menus and Toolbars to design interactive GUI. 2) Write a program to create a window with four text fields for the name, street, city and pincode with suitable labels. Also windows contains a button MyInfo. When the user types the name, his street, city and pincode and then clicks the button, the types details must appear in Arial Font with Size 32, Italics. 3) Write a Java program to create a simple calculator using java AWT elements. .Use a grid layout to arrange buttons for the digits and basic operation +, -, /, *. Add a text field to display the results. 4) Write a Java Program to create a Student Profile form using AWT controls. 5) Write a Java Program to simulate traffic signal light using AWT and Swing Components. 6) Write a Java Program to create a color palette. Declare a grid of Buttons to set the color names. Change the background color by clicking on the color button. 7) Build a GUI program that allows the user to add objects to a collection and perform search and sort on that collection.(Hint. Use Swing components like JButton, JList, JFrame, JPanel and JOptionPane.)		
IV	GUI Programming-II (JavaFX)	JavaFX Basic Concepts, JavaFX application skeleton, Compiling and running JavaFX program, Simple JavaFX control: Label, Using Buttons and events, Drawing directly on Canvas.	01	LO1 LO5 LO6

Text Books:

1. Herbert Schildt, "Java-The Complete Reference", Tenth Edition, Oracle Press, Tata McGraw Hill Education.
2. E. Balguruswamy, "Programming with Java A primer", Fifth edition, Tata McGraw Hill Publication
3. Anita Seth, B.L. Juneja, "Java One Step Ahead", oxford university press.

References:

1. D.T. Editorial Services, "Java 8 Programming Black Book", Dreamtech Press.
2. Learn to Master Java by Star EDU Solutions
3. Yashvant Kanetkar, "Let Us Java", 4th Edition, BPB Publications.

Term Work:

The Term work shall consist of at least 15 practical based on the above list. The term work Journal must include at least 2 Programming assignments. The Programming assignments should be based on real world

applications which cover concepts from more than one modules of syllabus.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments/tutorial/write up) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITM301	Mini Project – 1 A for Front end /backend Application using JAVA	--	04	--	--	02	--	02

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITM301	Mini Project – 1 A for Front end /backend Application using JAVA	--	--	--	--	25	25	50

Course Objectives

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Course Outcome: Learner will be able to...

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as member of a group or leader.
4. Draw the proper inferences from available results through theoretical/ experimental/simulations.
5. Analyse the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to life long learning.
9. Demonstrate project management principles during project work.

Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.

- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;
 - Marks awarded by guide/supervisor based on log book : 10
 - Marks awarded by review committee : 10
 - Quality of Project report : 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.
 - First shall be for finalisation of problem
 - Second shall be on finalisation of proposed solution of problem.
- In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
 - First review is based on readiness of building working prototype to be conducted.
 - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
 - Identification of need/problem
 - Proposed final solution
 - Procurement of components/systems
 - Building prototype and testing
 - Two reviews will be conducted for continuous assessment,
 - First shall be for finalisation of problem and proposed solution
 - Second shall be for implementation and testing of solution.
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Assessment criteria of Mini Project.

Mini Project shall be assessed based on following criteria;

1. Quality of survey/ need identification
 2. Clarity of Problem definition based on need.
 3. Innovativeness in solutions
 4. Feasibility of proposed problem solutions and selection of best solution
 5. Cost effectiveness
 6. Societal impact
 7. Innovativeness
 8. Cost effectiveness and Societal impact
 9. Full functioning of working model as per stated requirements
 10. Effective use of skill sets
 11. Effective use of standard engineering norms
 12. Contribution of an individual's as member or leader
 13. Clarity in written and oral communication
- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
 - In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organisations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on following points;

1. Quality of problem and Clarity
 2. Innovativeness in solutions
 3. Cost effectiveness and Societal impact
 4. Full functioning of working model as per stated requirements
 5. Effective use of skill sets
 6. Effective use of standard engineering norms
 7. Contribution of an individual's as member or leader
 8. Clarity in written and oral communication
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