University of Mumbai

No. AAMS(UG)/ 13 of 2022-23

CIRCULAR:-

Attention of the Principals of the Affiliated Colleges, Directors of the Recognized Institutions in Faculty of Science & Technology is invited to this office circular No. UG/44 of 2021 dated 21st January, 2021 relating to the Scheme (Sem. III to VIII) and revised syllabus (Rev-2019 'C' Scheme) for the B.E. in Mechatronics Engineering (Sem. III & IV).

They are hereby informed that the recommendations made by the Board of Studies in Mechanical Engineering at its meeting held on 19th November, 2021 and subsequently passed by the Board of Deans at its meeting held on 27th December 2021 vide item No. 6.5 have been accepted by the Academic Council at its meeting held on 28th December, 2021 **vide** item No. 6.5 and that in accordance therewith, the reduced syllabus for B.E. (Mechatronics Engineering) (Rev-2019 'C' Scheme) for Direct Second Year (Sem.III) as Direct Second Year (DSE) students admission is delayed by the six months due to COVID-19 situation, has been brought into force with effect from the academic year 2021-22 only. (The same is available on the University's website www.mu.ac.in).

(Sudhir S. Puranik)
REGISTRAR

MUMBAI – 400 032
4th May, 2022

To

The Principals of the Affiliated Colleges, and Directors of the Recognized Institutions in Faculty of Science & Technology.

A.C/6.5/28/12/2021

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No. AAMS(UG)/ 13 -A of 2022-23 4th May, 2022

Copy forwarded with Compliments for information to:-

1) The Dean, Faculty of Science & Technology,
2) The Chairman, Board of Studies Mechanical Engineering,
3) The Director, Board of Examinations and Evaluation,
4) The Director, Board of Students Development,
5) The Director, Department of Information & Communication Technology,
6) The Co-ordinator, MKCL.

(Sudhir S. Puranik)
REGISTRAR

Copy for information and necessary action :-

1. **The Deputy Registrar, College Affiliations & Development Department (CAD),**
2. **College Teachers Approval Unit (CTA),**
3. **The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Department (AEM),**
4. **The Deputy Registrar, Academic Appointments & Quality Assurance (AAQA)**
5. **The Deputy Registrar, Research Administration & Promotion Cell (RAPC),**
6. **The Deputy Registrar, Executive Authorities Section (EA)**
   He is requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to the above circular.
7. **The Deputy Registrar, PRO, Fort, (Publication Section),**
8. **The Deputy Registrar, Special Cell,**
9. **The Deputy Registrar, Fort Administration Department (FAD) Record Section,**
10. **The Deputy Registrar, Vidyanagari Administration Department (VAD),**

Copy for information :-

1. **The Director, Dept. of Information and Communication Technology (DICT), Vidyanagari,**
   He is requested to upload the Circular University Website
2. **The Director of Department of Student Development (DSD),**
3. **The Director, Institute of Distance and Open Learning (IDOL Admin), Vidyanagari,**
4. **All Deputy Registrar, Examination House,**
5. **The Deputy Registrars, Finance & Accounts Section,**
6. **The Assistant Registrar, Administrative sub-Campus Thane,**
7. **The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan,**
8. **The Assistant Registrar, Ratnagiri sub-centre, Ratnagiri,**
9. **P.A to Hon'ble Vice-Chancellor,**
10. **P.A to Pro-Vice-Chancellor,**
11. **P.A to Registrar,**
12. **P.A to All Deans of all Faculties,**
13. **P.A to Finance & Account Officers, (F & A.O),**
14. **P.A to Director, Board of Examinations and Evaluation,**
15. **P.A to Director, Innovation, Incubation and Linkages,**
16. **P.A to Director, Department of Lifelong Learning and Extension (DLLE),**
17. **The Receptionist,**
18. **The Telephone Operator,**

Copy with compliments for information to :-

19. **The Secretary, MUASA**
20. **The Secretary, BUCTU.**

AC – 28/12/2021
Item No. - 6.5

UNIVERSITY OF MUMBAI

Bachelor of Engineering
(Mechatronics Engineering)

Direct Second Year (Sem. III) Admitted Students for the current Academic Year 2021-22 Only due to Covid Pandemic

(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
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, itsapplications.
2. To acquaint with the concept of Fourier Series, its complex form and enhance the problem solvingskills
3. To familiarize with the concept of complex variables, C-R equations withapplications.
4. To study the application of the knowledge of matrices and numerical methods in complexengineering 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 engineeringproblems.
2. Apply the concept of inverse Laplace transform of various functions in engineeringproblems.
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 variabletheory.
5. Apply Matrix algebra to solve the engineeringproblems.
6. Solve Partial differential equations by applying numerical solution and analytical methods for one dimensional heat and waveequations

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 formulaeto find inverse Laplace Transform, finding Inverse Laplace transform using derivative 2.2 Partial fractions method & first shift property to find inverseLaplace transform. 2.3 Inverse Laplace transform using Convolution theorem (withoutproof) **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'sIdentity (withoutproof) *3.2* Fourier series of periodic function with period 2π and2*l,* 3.3 Fourier series of even and oddfunctions 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 (withoutproof) 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) isgiven. 4.4 Harmonic function, Harmonic conjugate and orthogonaltrajectories **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 ofEigen 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 polynomialmatrix. 5.3 Functions of square matrix 5.4 Similarity of matrices, Diagonalization ofmatrices **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 heatand wave equations. (onlyproblems) 6.2 Crank Nicholsonmethod 6.3 Bender Schmidtmethod **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 entiresyllabus.
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 thestudents.

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 besolved.
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 themodules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned inthe syllabus.

References:

1. Engineering Mathematics, Dr. B. S. Grewal, KhannaPublication
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley EasternLimited,
3. Advanced Engineering Mathematics, R. K. Jain and S.R.K. Iyengar, Narosapublication
4. Advanced Engineering Mathematics, H.K. Das, S. ChandPublication
5. Higher Engineering Mathematics B.V. Ramana, McGraw HillEducation
6. Complex Variables and Applications, Brown and Churchill, McGraw-Hilleducation,
7. Text book of Matrices, Shanti Narayan and P K Mittal, S. ChandPublication
8. Laplace transforms, Murray R. Spiegel, Schaum's OutlineSeries

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 theiroperations.
2. To introduce the concept of algorithm and itsanalysis.
3. To learn various algorithm designingstrategies.
4. To introduce the appropriate search method on a givenproblem
5. To develop application using suitable data structure andalgorithms.

Outcomes: Learner will be able to…

1. Implement various operations using linear datastructures.
2. Apply concepts of Trees and Graphs to a givenproblem.
3. Analyse time and space complexity of analgorithm.
4. Apply divide and conquer strategy to solveproblems.
5. Apply the concept of Greedy and Dynamic Programming approach to solveproblems.
6. Apply the concept of backtracking, branch and bound strategy to solveproblems.

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 SearchTechniques:** DFS, BFS, Uniform cost search, **Informed SearchMethods:** Best First Search, A*, IDA*,	**05**

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 carrying20marks.
2. Total 04 questions need to besolved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub- questions of 2 to 5 marks will beasked.
4. Remaining questions will be mixed in nature.(e.g. Suppose Q.2 has part (a)from module3 then part (b) will be from any module other than module3)
5. In question paper weightage of each module will be proportional to numberof respective lecture hrs as mentioned in thesyllabus.

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, DreamtechPress.
4. Introduction to Data Structure and its Applications Jean-Paul Tremblay, P. G.Sorenson
5. Stauart Russell and Peter Norvig, "Artificial Intelligence: A Modern approach", 3rd Edition PrenticeHall, New Jersey, 1995.2)

References:

1. Data Structures Using C & C++, Rajesh K. Shukla, Wiley-India.
2. Computer Algorithms by Ellis Horowitz and Sartaj Sahni, UniversitiesPress.
3. Data Structures and Algorithm Analysis in C,MarkA.Weiss ,Pearson
4. ALGORITHMS Design and Analysis, Bhasin, OXFORD. Elaine Rich and Kelvin Knight, "Artificial Intelligence", 3 rd 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 andapplications.
2. To familiarize the students with various types and causes of failure of components indifferent engineeringapplications.
3. To acquaint the students with the new concepts of Nano Science andTechnology.
4. To prepare the students acquire basic understanding of advanced materials, their functions and properties for technologicalapplications.

Outcomes: Learner will be able to...

1. Distinguish different types of materials and composites used inmanufacturing.
2. Select a material for specificapplications
3. Read and interpret Iron-Iron Carbide phase diagram, TTT diagram and CCT diagram.
4. Demonstrate a deeper understanding of materials in engineeringapplications.

Module	Detailed Contents	Hrs.
01	**1.1 Introduction:** Classification of materials, functional classification and classification based onstructure. (0.5 hrs) **1.2 Solidification of Metals:** Formation of solids from liquids of pure metals and alloys. Single crystal and polycrystallinestructure.(0.5 hrs) **1.3 CrystalImperfection:**Definition,classification,Pointdefects:theirformationandeffects. 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 hardeningprocesses. (5 hrs) **2.2 Nonferrous Metals and Alloys:** Basics only. Important nonferrous materials like aluminium, copper, nickel, tin, zinc and their alloys, properties andapplications.(1 hr) **2.3 Powder Metallurgy:** Powder manufacturing methods; Powder MetallurgyProcess. 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 ofCeramics.(1 hrs) **3.2 Polymers:** Classification of polymers. Thermoplastics, effect of temperature on thermoplastics, mechanical properties of thermoplastics. Thermosetting polymers and elastomers. (1 hrs) **3.3Composites**: 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 facture. 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	**5.1 Electronic Materials:** Band structure of solids. Conductivity of metals and alloys. Semiconductors and superconducting materials. Insulators and dielectric properties. Electrostriction, piezoelectricity andferroelectricity. **5.2 Photonic Materials:** Refraction, reflection, absorption and transmission.Luminescence, Photoconductivity, Lasers, optical fibres in communications. **5.3 Magnetic Materials:** classification of magnetic materials. Diamagnetic,paramagnetic, ferromagnetic, ferromagnetic and super paramagnetic materials. Metallic and ceramic magnetic materials. Applications of magneticmaterials.	**04**
06	**6.1 Nano-structured Materials:** Definition and Introduction to nanotechnology. Unique features of nano-structured materials. Typicalapplications.(1 hr) **6.2 Modern Engineering Materials**: Smart materials, Shape memory alloys, Chromic materials (Thermo, Photo and Electro), Rheological fluids, Metallicglasses. (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 onehour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, eachcarrying20marks.
2. Total 04 questions need tobesolved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of 2 to 5 marks willbeasked.
4. Remaining questions will be mixed in nature.(e.g. Suppose Q.2 has part (a) frommodule3 then part (b) will be from any module other thanmodule3)
5. In question paper weightage of each module will be proportional to number ofrespective lecture hrs as mentioned inthesyllabus.

Text Books:

1. Callister's Materials Science and Engineering, 2nd edition by R. Balasubramanium, Wiley India Pvt. Ltd

References:

1. The Science and Engineering of Materials (6 th Edition), byDonald R. Askeland, Pradeep P. Fulay, Wendelin J. Wright, Cengage Learning, Inc., Stanford, 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 E. Hummel, Springer, NewYork,(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.pdfhttps://nptel.ac.in/cours es/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
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 electronicdevices
2. To understand applications of electronicdevices.
3. To teach fundamental principles of digital circuitdesign.
4. To impart the testing knowledge of digitalcircuits.

Outcomes: Learner will be able to…

1. Illustrate working of Transistors & itsapplications.
2. Describe several JFET applications including switch &amplifiers.
3. Describe the number system and operations of logicalgates
4. Design combinational digital logiccircuits
5. Design Sequential digital logiccircuits
6. Describe the testing technologies in digitalelectronics.

Module	**Detailed Contents**	**Hrs.**
01	2.1 **Junction Field Effect Transistor JFET: C**onstruction, 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 asswitch	**04**
02	**Fundamentals of Digital Design** **3.1 Number System -** Review of Number System, Binary Code, Binary Coded Decimal, Hexadecimal Code, Gray Code and theirconversions, **3.2 Logic Gates**: Basic gates, Universal gates, Sum of products and products of sum, minimization with Karnaugh Map (upto four variables) andrealization. **3.3 CombinationalCircuitsusingbasicgatesaswellasMSIdevices**:Halfadder,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 notexpected) 4.2 **Counters**:Asynchronous,SynchronousCounters,UpDownCounters,ModCounters, 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 carrying20marks.
2. Total 04 questions need to besolved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of 2 to 5 marks will beasked.
4. Remaining questions will be mixed in nature.(e.g. Suppose Q.2 has part (a) from module3 then part (b)will be from any module other than module3)
5. In question paper weightage of each module will be proportional to number of respective lecture hrsas mentioned in thesyllabus.

Text Books:

1. R. P. Jain, Modern Digital Electronics, Tata McGraw Hill Education, Third Edition2003
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, NewDelhi
2. William I. Fletcher, 'An Engineering Approach to Digital Design',PHI.
3. B. Holdsworth and R. C. Woods, 'Digital Logic Design', Newnes, 4 thEdition
4. Morris Mano, Digital Design, Pearson Education, Asia 2002.
5. John F. Wakerley, Digital Design Principles And Practices, third Edition Updated, PearsonEducation, Singapore,2002
6. Anil K. Maini, Digital Electronics, Principles, Devices and Applications,Wiley
7. Stephen Brown and ZvonkoVranesic, Fundamentals of digital logic design with VHDL, McGraw Hill,2nd Edition
8. Electronic Principles 8th Edition By Albert Malvino and DavidBates

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 ACcircuits.
2. Understand characteristics of R-L-C networks in time and Frequencydomain.
3. Understand constructional features and characteristics of ElectricalMachines

Outcomes: Learner will be able to…

1. Analyse and Synthesis of network theorems for DC and ACcircuits
2. Find two port circuitsparameters
3. Analyse and Synthesis R-L-C circuits in time and Frequencydomain
4. Illustrate working and performance characteristics of DCMotors
5. Illustrate working and performance characteristics of three phase InductionMotor
6. Implement systems using low power motors specially designedmotors

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 matrixanalysis (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 impulsesignals	**04**
04	**DC Motors** 4.1 Construction, principle of working, classification, EMF equation, Torque equation, characteristics of DCMotors 4.2 Speed Control: basic principle and working of differentmethods	**03**
05	**Three Phase Induction Motor** 5.1 Construction, working principle of squirrel cage inductionmotor 5.2 Torque speed characteristics,power 5.3 Speed controlmethods	**04**

	Single phase Induction Motors: 5.4 Construction,working, 5.5 Startingmethods, 5.6 Torque-speed characteristics andapplications	
06	**Special Types of Motors** Construction, working Principle, Types and applications of 6.1 BLDCMotor 6.2 ReluctanceMotor 6.3 UniversalMotor 6.4 StepperMotor 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 onehour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying20marks.
2. Total 04 questions need to besolved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub- questions of 2 to 5 markswill beasked.
4. Remaining questions will be mixed in nature.(e.g. Suppose Q.2 has part (a)from module3 then part (b) will be from any module other than module3)
5. In question paper weightage of each module will be proportional to number of respective lecture hrsas mentioned inthesyllabus.

Text Books:

1. Bimbhra P. S., Electric Machinery, KhannaPublisher,
2. Bimbhra P. S., Generalized Machine Theory, KhannaPublisher,
3. E. G. Janardanan, Special Electrical Machines, PHI
4. WHHayt,SMDurbin,JEKemmerly,„EngineeringCircuitAnalysis‟,7thEditionTataMcGraw-Hill Education.
5. M. E. Van Valkenburg, „Network Analysis‟, 3rd Edition, PHI Learning.
6. D. Roy Choudhury, „Networks and Systems‟, 2nd Edition, New AgeInternational.

References Books:

1. M. G. Say and E. O. Taylor, Direct current machines, Pitmanpublication
2. Ashfaq Husain, Electric Machines, Dhanpat Rai and co.publications
3. M. V. Deshpande, Electric Machines,PHI
4. NBalabanianandT.A.Bickart,LinearNetworkTheory:Analysis,Properties,DesignandSynthesis‟, Matrix Publishers,Inc.
5. C. L.Wadhwa, Network Analysis and synthesis‟, New Ageinternational.
6. B. Somanathan Nair, “Network Analysis and Synthesis”, ElsevierPublications

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 theiroperations.
2. To Apply the appropriate search method on a givenproblem
3. To develop application using suitable data structure andalgorithms.

Outcomes: Students will be able to…

1. Implement various operations using linear datastructures.
2. Apply concepts of Trees and Graphs to a givenproblem.
3. Analyze time and space complexity of analgorithm.
4. Apply divide and conquer strategy to solveproblems.
5. Apply the concept of Greedy and Dynamic Programming approach to solveproblems.
6. Apply the concept of backtracking, branch and bound strategy to solveproblems.

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:

- Laboratorywork (Experiment/journal) : 20 marks.
- Attendance (Theoryand Practical) : 05Marks

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 Electronicscomponents
2. To study electrical networksynthesis
3. To study characterization of different ElectricalMachines

Outcomes: Learner will be able to…

1. Implement switching circuits using BJT, MOSFET,JFET
2. Implement different LOGICcircuits
3. Analyse operational characteristics of different ElectricalMachines
4. Simulation of ElectricalNetworks.

Suggested List of laboratory experiments (Minimum 10):

A.List of experiment based onMTC304

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 onMTC305

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) : 10marks.
- Laboratory work PartA(Experiment/journal) : 10 marks
- Attendance (Theoryand Practical) : 05Marks
-

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 & electronicequipments
2. To design PCB and develop smallcircuits
3. To understand working of different network simulationsoftwares

Outcomes: Learner will be able to…

1. Understand working of different labequipment
2. Demonstrate skills in handling electricalcomponents
3. Repair and do maintenance of households appliances.
4. Demonstrate PCB design and solderingskills
5. Understand working of different parts ofComputer
6. Simulate Electrical networks using softwaretechniques.

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 itching 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 massproduction.** Test Systems architecture, Automated testing, Types of contact, Bead probe technology , Types of probes, Tip styles, Fixture components, Actuation and hold downmechanisms

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 hillLtd.
4. S.L. Uppal and G.C. Garg “Electrical Wiring Estimating and Costing” Khanna Publishers1987
5. Surjit Singh “Electric Estimating and Costing” Dhanpat Rai & Co. (P) Limited(2016)
6. K B. Bhatia “Study of Electrical Appliances and Devices” KhannaPublishers
7. John T. Bateson “In Circuit Testing” Springer2012

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:

- Laboratorywork (Experiment/journal) : 15 marks.
- Industrial VisitReport : 05 marks.
- Attendance : 05Marks

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 engineeringcomponents.
2. To introduce Product data exchange among CADsystems.
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 modelcreation.
2. Visualize and prepare 2D modeling of a given object using modelingsoftware.
3. Build solid model of a given object using 3D modelingsoftware.
4. Visualize and develop the surface model of a given object using modelingsoftware.
5. Generate assembly models of given objects using assembly tools of a modelingsoftware
6. Perform product data exchange among CADsystems.

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 suitablesoftware.

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 actualdimensions

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 asfollows:
    a. Practical Exam ….15marks
    b. OralExam .....10 marks
3. Evaluation of practical examination to be done based on the printout of studentswork
4. Students work along with evaluation report to be preserved till the nextexamination

References:

1. Machine Drawing by N.D.Bhatt.
2. A textbook of Machine Drawing byLaxminarayan and M.L.Mathur, Jain brothersDelhi
3. Machine Drawing by Kamat andRao
4. Machine Drawing byM.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.VenkataReddy
7. Machine Drawing by Sidheshwar andKanheya
8. Autodesk Inventor 2011 for Engineers and Designers by Sham Tickoo and Surinder Raina, DreamtechPress

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 theproblem.
2. To familiarize the process of solving the problem in agroup.
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 andresearch.

Outcome: Learner will be able to…

1. Identify problems based on societal /researchneeds.
2. Apply Knowledge and skill to solve societal problems in agroup.
3. Develop interpersonal skills to work as member of a group orleader.
4. Draw the proper inferences from available results through theoretical/experimental/simulations.
5. Analyse the impact of solutions in societal and environmental context for sustainabledevelopment.
6. Use standard norms of engineeringpractices
7. Excel in written and oralcommunication.
8. Demonstrate capabilities of self-learning in a group, which leads to lifelonglearning.
9. Demonstrate project management principles during projectwork.

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 offaculties.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of miniproject.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and recordnotes/comments.
- Faculty supervisor may give inputs during mini project activity; however, focus shall be onself-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 anddemonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University ofMumbai.
- 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 andVI.
- 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 casebasis.

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 eachsemester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response toquestions.
- Distribution of Term work marks for both semesters shall be asbelow;
    - Marks awarded by guide/supervisor based onlog book 10
    - Marks awarded byreviewcommittee 10
    - Quality ofProjectreport 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 studentsgroup.
    - First shall be for finalisation ofproblem
    - Second shall be on finalisation of proposed solution ofproblem.
- 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 beconducted.
    - Second review shall be based on poster presentation cum demonstration of working model in last month of the saidsemester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspectsincluding,
    - Identification ofneed/problem
    - Proposed finalsolution
    - Procurement ofcomponents/systems
    - Building prototype andtesting

- Two reviews will be conducted for continuousassessment,
    - First shall be for finalisation of problem and proposedsolution
    - Second shall be for implementation and testing ofsolution.

Assessment criteria of Mini Project

Mini Project shall be assessed based on followingcriteria;
1. Quality of survey/ needidentification
2. Clarity of Problem definition based onneed.
3. Innovativeness insolutions
4. Feasibility of proposed problem solutions and selection of bestsolution
5. Costeffectiveness
6. Societalimpact
7. Innovativeness
8. Cost effectiveness and societalimpact
9. Full functioning of working model as per statedrequirements 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 miniproject.

- In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in miniproject.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University ofMumbai.

- 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 ofInstitution.

- Students shall be motivated to publish a paper based on the work inConferences/students competitions.

Mini Project shall be assessed based on following points;
1. Quality of problem andClarity
2. Innovativeness insolutions
3. Cost effectiveness and societalimpact
4. Full functioning of working model as per statedrequirements
5. Effective use of skillsets
6. Effective use of standard engineeringnorms
7. Contribution of an individual's as member orleader
8. Clarity in written and oralcommunication

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.