Item No. – 6.10 (N)
AC – 28/6/2024

As Per NEP 2020

University of Mumbai

Bachelor of Engineering (Biomedical Engineering)

Semester I & II

A- U.G. Certificate in **Biomedical Engineering.**
B- U.G. Diploma in **Biomedical Engineering.**
C- B.Sc. **(Biomedical Engineering).**
D- B.E. **(Biomedical Engineering) with Multidisciplinary Minor in (Discipline).**
E- B.E. **(Biomedical Engineering) with Honors in (Emerging Area) and Multidisciplinary Minor in (Discipline).**
F- B.E. (**Biomedical Engineering) Honors with Research and Multidisciplinary Minor in (Discipline).**
G- B.E. **(Biomedical Engineering) with Multidisciplinary Minor in (Discipline) and with Emerging Minor in (Emerging Area).**

From the Academic Year 2024-25 Progressively

Under

FACULTY OF SCIENCE & TECHNOLOGY

Ref: As per GR dated 4th July 2023 for Credit Structure of UG
(As per AICTE & NEP 2020 Guidelines)

University of Mumbai

(As per NEP 2020)

Sr. No.	Heading	Particulars	
1	**Title of program** **O: TEU-505A**	**A**	**U.G. Certificate in Biomedical Engineering.**
	O: TEU-505B	**B**	**U.G. Diploma in Biomedical Engineering.**
	O: TEU-505C	**C**	**B.Sc. (Biomedical Engineering).**
	O: TEU-505D	**D**	**B.E. (Biomedical Engineering) with Multidisciplinary Minor in (Discipline).**
	O: TEU-505E	**E**	**B.E. (Biomedical Engineering) with Honors in (Emerging Area) and Multidisciplinary Minor in (Discipline).**
	O: TEU-505F	**F**	**B.E. (Biomedical Engineering) Honors with Research and Multidisciplinary Minor in (Discipline).**
	O: TEU-505G	**G**	**B.E. (Biomedical Engineering) with Multidisciplinary Minor in (Discipline) and with Emerging Minor in (Emerging Area).**

2	**Eligibility** **O: TEU-506A**	**A**	For Undergraduate, Integrated, or Dual Degree courses. - Candidates passing SSC and HSC or 10+2 Examination or Diploma in Engineering or D. Voc. Examination from a recognized institution. As per the criteria of the Government of Maharashtra State Circular. **OR** Passed Equivalent Academic Level 4.0
	O: TEU-506B	**B**	For Under Graduate course in Engineering and Technology.- Candidates passing SSC or HSC or 10+2 Examination and also Diploma in Engineering or Technology or Bachelor of Science or D.Voc. or its equivalent from a recognized Institution. **OR** Under Graduate **Certificate in Engineering** (in any Engineering or Technology discipline) **OR** Passed Equivalent Academic Level 4.5.
	O: TEU-506C	**C**	Under Graduate **Diploma in Engineering (All Engineering Discipline)** **OR** Passed Equivalent Academic Level 5.0

	O: TEU-506D	**D**	Bachelor of Engineering **Biomedical Engineering** with minimum CGPA of 7.5 **OR** Passed Equivalent Academic Level 5.5
	O: TEU-506E	**E**	Bachelor of Engineering **Biomedical Engineering** with minimum CGPA of 7.5 **OR** Passed Equivalent Academic Level 5.5
	O: TEU-506F	**F**	Bachelor of Engineering **Biomedical Engineering** with minimum CGPA of 7.5 **OR** Passed Equivalent Academic Level 5.5
	O: TEU-506G	**G**	Bachelor of Engineering **Biomedical Engineering** with minimum CGPA of 7.5 **OR** Passed Equivalent Academic Level 5.5
3	**Duration of program** **R: TEU-511**	**A**	One Year
		B	Two Years
		C	Three Years
		D	Four Years
		E	Four Years

		F	Four Years
		G	Four Years
4	**Intake Capacity** **R: TEU-512**		
5	**Scheme of Examination** **R: TEU-513**	NEP 40% Internal 60% External, Semester End Examination Individual Passing in Internal and External Examination	
6	**Standards of Passing** **R: TEU-514**	40%	
7	**Credit Structure** **R: TEU-515A** **R: TEU-515B** **R: TEU-515C** **R: TEU-515D** **R: TEU-515E** **R: TEU-515F** **R: TEU-515G** **R: TEU-515H**		Attached herewith **Sem I & II R: <u>45 Credit</u>** **Sem. I - R: <u>23 Credit</u>** **Sem. II - R: <u>22 Credit</u>**
8	**Semesters**	A	Sem I & II
		B	Sem III & IV
		C	Sem V & VI
		D	Sem VII & VIII
		E	Sem VII & VIII
		F	Sem VII & VIII
		G	Sem VII & VIII
9	**Program Academic Level**	A	4.5
		B	5.0
		C	5.5

		D	6.0
		E	6.0
		F	6.0
		G	6.0
10	**Pattern**	Semester	
11	**Status**	New	
12	**To be implemented from Academic Year Progressively**	From Academic Year: 2024-25	

Sd/-	**Sd/-**	**Sd/-**
Dr. G. D. Jindal	**Dr. Deven Shah**	**Prof. Shivram S. Garje**
BoS-Chairman-Biomedical Engineering	**Associate Dean**	**Dean**
Faculty of Technology	**Faculty of Science & Technology**	**Faculty of Science & Technology**

Preamble

To meet the challenge of ensuring excellence and NEP 2020 policy in engineering education, the issue of quality needs to be addressed, debated, and taken forward systematically. Accreditation is the principal means of quality assurance in higher education. The major emphasis of the accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Science and Technology (in particular Engineering) of the University of Mumbai has taken the lead in incorporating the philosophy of NEP 2020 education in the process of curriculum development.

The First Year Engineering course is a broad foundation training program to impart scientific and logical thinking Training to learners in general with a choice of course selection in the Basic sciences and Engineering Sciences. Simultaneously NEP- 2020 objectives demand nurturing the basic skills required for familiarizing within the respective chosen Branch of Engineering by the learner. Keeping this in view, a pool of courses is offered in Basic sciences covering fundamentals required to understand modern engineering practices and emerging trends in technology. Considering the change in pedagogy and the convenience of the stress-free learning process, in the course work under heads of Engineering Sciences, a choice-based subject pool is offered in the second semester. Essentially to give a glimpse of trends in the industry under vocational skill practices, the pool is offered to nurture and develop creative skills in contemporary industrial practices. Criteria met in the structure is the opportunity for learners to choose the course of their interest in all disciplines.

Basic sciences cover Applied Physics and Elective Physics, Applied Chemistry and Elective Chemistry, and Applied Mathematics where a pool of subjects are given for selection, the rationale for the same is that generalized basic science courses are not feasible from learners' point of view. Considering the present scenario, diverse choices need to be made available to fulfill the expectation of a learner to aspire for a career in the field of current trends of Technology and interdisciplinary research. Ability enhancement can be achieved in Undergraduate training by giving an objective viewpoint to the learning process and transitioning a learner from a rote learner to a creative professional, for the purpose Design Thinking is introduced in the First Semester to orient a journey learner to become a skilled professional. Considering the NEP-2020 structure of award of Certificate & Diploma at multiple exit-point pools of Vocational skills is arranged for giving exposure to the current Industry practices.

Faculty resolved that course objectives and course outcomes are to be clearly defined for every course so that all faculty members in affiliated higher education institutes understand the depth and approach of the course to be taught, which will enhance the learner’s learning process. NEP 2020 grading system enables a much-required shift in focus from teacher-centric to continuous-based 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 a 15-week teaching-learning process for NEP 2020, however, the content of courses is to be taught in 12-13 weeks and the remaining 2-3 weeks are to be utilized for revision, tutorial, guest lectures, coverage of content beyond the syllabus, etc.

There was a concern that in the present system, the first-year syllabus must not be heavily loaded to the learner and it is of utmost importance that the learner entering into the first year of an engineering course should feel at ease by lowering the burden of syllabus and credits. This is necessary for a learner to get accustomed to the new environment of a college and to create a bond between the teacher and the learner. The present curriculum will be implemented for the First Year of Engineering from the academic year 2024-25. Subsequently, this system will be carried forward for Second Year Engineering in the academic year 2025-26, and for Third Year and Final Year Engineering in the academic years 2026-27, and 2027-28, respectively.

Sd/-	Sd/-	Sd/-
Dr. G. D. Jindal	**Dr. Deven Shah**	**Prof. Shivram S. Garje**
BoS-Chairman-Biomedical Engineering	**Associate Dean**	**Dean**

1) Credit Structure of the Program (Sem I, II)

UnderGraduateCertificate in (Biomedical Engineering)

Credit Structure (Sem. I & II)

Level	Semester	Major				Minor	OE	VSC,SEC (VSEC)	AEC,VEC,IKS		OJT, FP,CEP, CC,RP		Cum.Cr. / Sem.	Degree/Cum.Cr.
		Mandatory		Electives										
4.5	I	BSC101	3			-			AEC101	2	CC101	2	23	UG Certificate 45
		BSC102	2						AEL101	1				
		BSC103	2						VSEC101	1				
		ESC101	2						VSEC102	2				
		ESC102	3											
		BSL101	0.5											
		BSL102	0.5											
		ESL101	1											
		ESL102	1											
	II	BSC201	3	BSC2021	2				IKS201	2	CC201	2	22	
		ESC201	3	BSC2022	2				VSEC201	1				
		ESL201	1	BSC2023	2				VSEC202	2				
		PCC2011	2	BSC2031	2									
		PCL2011	1	BSC2032	2									
				BSC2033	2									
				BSL2011	0.5									
				BSL2012	0.5									
				BSL2013	0.5									
				BSL2021	0.5									
				BSL2022	0.5									
				BSL2023	0.5									
	CumCr.												45	

Program Structure for First Year Engineering

UNIVERSITY OF MUMBAI
(NEP 2020 With Effect from Academic Year 2024-2025)

Semester I

Course Code	CourseDescription	TeachingScheme (Contact Hours)			Credit Assigned			
		Theory	Practical	Tutorial	Theory	Tutorial	Practical	Total Credits
BSC101	AppliedMathematics-I	2	--	1	2	1	--	3
BSC102	AppliedPhysics	2	--	-	2	-	--	2
BSC103	Applied Chemistry	2	-	-	2	-	-	2
ESC101	EngineeringMechanics	2	-	-	2	-	-	2
ESC102	BasicElectrical&Electronics Engineering	3	--	-	3	-	--	3
BSL101	AppliedPhysics Lab	-	1	-	-	-	0.5	0.5
BSL102	Applied Chemistry Lab	-	1	-	-	-	0.5	0.5
ESL101	EngineeringMechanics Lab	-	2	-	-	-	1	1
ESL102	BasicElectrical&Electronics Engineering Lab	--	2	-	--	-	1	1
AEC101	ProfessionalandCommunicationEthics	2	--	-	2	-	--	2
AEL101	ProfessionalandCommunicationEthics	--	2		--	--	1	1
VSEC101	Engineering Workshop-I	-	2	-	-	-	1	1
VSEC102	C Programming	-	2*+2	-	-	-	2	2
CC101	Inductioncum Universal HumanValues	2#	-	-	2	-	--	2
Total		**15**	**14**	**1**	**15**	**01**	**07**	**23**

* Two hours of practical class to be conducted for full class as demo/discussion.

Course evaluation is activity-based which may be an individual or group of four students.

Theory / Tutorial 1 credit for 1 hour and Practical 1 credit for 2 hours

Semester I

Course Code	CourseDescription	Examinationscheme							
		Internal Assessment Test (IAT)			End Sem. Exam Marks	End Sem. Exam Duration (Hrs)	Term Work (Tw)	Oral & Pract.	Total
		IAT-I	IAT-II	Total (IAT-I) + IAT-II)					
BSC101	AppliedMathematics-I	20	20	40	60	02	25	--	125
BSC102	AppliedPhysics	15	15	30	45	1.5	--	--	75
BSC103	Applied Chemistry	15	15	30	45	1.5	--	--	75
ESC101	EngineeringMechanics	20	20	40	60	02	--	--	100
ESC102	BasicElectrical&Electronics Engineering	20	20	40	60	02	--	--	100
BSL101	AppliedPhysics Lab	--	--	--	--	--	25	--	25
BSL102	Applied Chemistry Lab	--	--	--	--	--	25	--	25
ESL101	EngineeringMechanics Lab	--	--	--	--	--	25	25	50
ESL102	BasicElectrical&Electronics Engineering Lab	--	--	--	--	--	25	25	50
AEC101	ProfessionalandCommunicationEthics	15	15	30	45	1.5	--	--	75
AEL101	ProfessionalandCommunicationEthics	--	--	--	--	--	25	--	25
VSEC101	Engineering Workshop-I	--	--	--	--	--	25	--	25
VSEC102	C Programming	--	--	--	--	--	25	25	50
CC101	Inductioncum Universal HumanValues	--	--	--	--	--	-	--	-
Total		**105**	**105**	**210**	**315**	**10.5**	**200**	**75**	**800**

Program Structure for First Year Engineering

UNIVERSITY OF MUMBAI
(NEP 2020 With Effect from Academic Year 2024-2025)

Semester II

Course Code	CourseDescription	TeachingScheme (Contact Hours)			Credit Assigned			
		Theory	Practical	Tutorial	Theory	Tutorial	Practical	Total Credits
BSC201	Applied Mathematics– II	2	-	1	2	1	--	3
BSC202X	Elective Physics	2	-	-	2	-	--	2
BSC203X	Elective Chemistry	2	-	-	2	-	--	2
ESC201	EngineeringGraphics	3	-	-	3	-	--	3
PCC201X	Program Core Course	2	-	-	2	-	--	2
BSL201X	Elective Physics Lab	-	1	-	-	-	0.5	0.5
BSL202X	Elective Chemistry Lab	-	1	-	-	-	0.5	0.5
ESL201	EngineeringGraphics Lab	-	2	--	-	-	1	1
PCL201X	Program Core Lab	-	2	-	-	-	1	1
CC201	Social Science & Community Services	-	2*+2	-	-	-	2	2
IKS201	IndianknowledgeSystem	-	2*+2	-	-	-	2	2
VSEC201	Engineering Workshop-II	-	2	-	-	-	1	1
VSEC202	Python Programming	-	2*+2	-	-	-	2	2
Total		**11**	**20**	**01**	**11**	**01**	**10**	**22**

* Two hours of practical class to be conducted for full class as demo/discussion

Course evaluation is activity-based which may be individual or group of four students.

Theory / Tutorial 1 credit for 1 hour and Practical 1 credit for 2 hours.

Semester II

Course Code	CourseDescription	Examinationscheme							
		Internal Assessment Test (IAT)			End Sem. Exam Marks	End Sem. Exam Duration (Hrs)	Term Work (Tw)	Oral & Pract.	Total
		IAT-I	IAT-II	Total (IAT-I) + IAT-II)					
BSC201	Applied Mathematics– II	20	20	40	60	02	25	--	125
BSC202X	Elective Physics	15	15	30	45	1.5	--	--	75
BSC203X	Elective Chemistry	15	15	30	45	1.5	--	--	75
ESC201	EngineeringGraphics	20	20	40	60	02	--	--	100
PCC201X	Program Core Course	20	20	40	60	02	--	--	100
BSL201X	Elective Physics Lab	--	--	--	--	--	25	--	25
BSL202X	Elective Chemistry Lab	--	--	--	--	--	25	--	25
ESL201	EngineeringGraphics Lab	--	--	--	--	--	25	25	50
PCL201X	Program Core Lab	--	--	--	--	--	25	25	50
CC201	Social Science & Community Services	--	--	--	--	--	25	--	25
IKS201	IndianknowledgeSystem	--	--	--	--	--	25	--	25
VSEC201	Engineering Workshop-II	--	--	--	--	--	25	--	25
VSEC202	Python Programming	--	--	--	--	--	25	25	50
Total		**90**	**90**	**180**	**270**	**09**	**225**	**75**	**750**

Elective Physics

BSC202X	Elective Physics Theory
BSC2021	Physics for Emerging Fields
BSC2022	Semiconductor Physics
BSC2023	Physics of Measurements and Sensors

BSL201X	Elective Physics Lab
BSL2011	Physics for Emerging Fields Lab
BSL2012	Semiconductor Physics Lab
BSL2013	Physics of Measurements and Sensors Lab

Elective Chemistry

BSC203X	Elective Chemistry
BSC2031	Engineering Materials
BSC2032	Environmental Chemistry and Non-conventional energy sources
BSC2033	Introduction to Computational Chemistry

BSL202X	Elective Chemistry Lab
BSL2021	Engineering Materials Lab
BSL2022	Environmental Chemistry and Non-conventional energy sources Lab
BSL2023	Introduction to Computational Chemistry Lab

Program Core Course

PCC201X	Name of Program as per Cluster	Name of Program Core Course
PCC2013	Biomedical Engineering, Biotechnology Engineering	**Elements of Biomedical Engineering**

Program Core Lab

PCL201X	Name of Program as per Cluster	Name of Program Core Course
PCL2013	Biomedical Engineering, Biotechnology Engineering	**Elements of Biomedical Engineering Lab**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut.	Theory	TW/Pract	Tut.	Total
BSC101	**Applied Mathematics-I**	02	--	01	02	--	01	**03**

Course Code	Course Name	Examination Scheme								
		Theory								
		Internal Assessment Test (IAT)			End Sem Exam	Exam Duration (in Hrs)	Term Work	Pract	Oral	Total
		IAT-I	IAT-II	IAT-I + IAT-II (Total)						
BSC101	**Applied Mathematics-I**	20	20	40	60	02	25	--	--	125

Course Objectives: The course is aimed

1. To develop the basic Mathematical skills of engineering students that are imperative for effective understanding of engineering subjects. The topics introduced will serve as basic tools for specialized studies in many fields of engineering and technology.
2. To provide hands-on experience using SCILAB software to handle applications to real-life problems.

Course Outcomes: Students will be able to

1. Apply the basic concepts of Complex Numbers and will be able to use themto analyze for engineering problems.
2. Apply hyperbolic functions and logarithms insubjects like electrical circuits and electromagnetic wave theory for cutting-edge tools and technology.
3. Apply the basic concepts of partial differentiation of function of several variables and will be able to use in subjects like Electromagnetic Theory, Heat and Mass Transfer, etc.
4. Apply the concept of Maxima, Minima, and Successive differentiation and will be able to use it for optimization and tuning the systems in emerging and computing areas.
5. Apply the concept of Matrices and be able to use it for solving the KVL and KCL in electrical networks in emerging and telecommunications areas.

6. Apply the concept of Numerical Methods for solving engineering problems with help of SCILAB software.

Module	Detailed Contents	Hrs.	CO Mapping
01	**Complex Numbers** **Pre-requisite:** Review of Complex Numbers-Algebra of Complex Numbers, Cartesian, polar and exponential form of complex number, Statement of D'Moivre'sTheorem. 1.1. Expansion of $\sin^n\theta$, $\cos^n\theta$in terms of sines and cosines of multiples of θ andExpansion of $\sin n\theta$, $\cos n\theta$ in powers of $\sin\theta$, $\cos\theta$. 1.2. Powers and Roots of a complex number. # **Self-learning topic:**Basic of Complex Number.	**2** **2**	**CO1**
02	**Hyperbolic Functions & Logarithms of Complex Numbers** 2.1. Circular functions of complex number and Hyperbolic functions. Inverse Circular and Inverse Hyperbolic Functions. Separation of real and imaginary parts of all types of Functions. (Simple Examples) 2.2. Logarithm of Complex Number (Simple Examples) # **Self-learning topic:** Applications of complex numbers in Electrical circuits.	**3** **1**	**CO2**
03	**Partial Differentiation** 3.1.Partial Differentiation: Function of two and three variables, Partial derivatives of first and higher order. Differentiation of composite function. 3.2.Euler's Theorem on Homogeneous functions with two independent variables (with proof). Deductions from Euler's Theorem. (without proof). # **Self-learning topics:**Total differentials, implicit functions, Euler's Theorem on Homogeneous functions with three independent variables.	**3** **2**	**CO3**

04	**Applications of Partial Differentiation and Successive Differentiation.** 4.1.Maxima and Minima of a function of two independent variables, 4.2.Successive differentiation: nth derivative of standard functions. Leibnitz's Theorem (without proof) and simple examples. # **Self-learning topics:** Jacobian's of two and three independent variables (simpleproblems) Lagrange's Multiplier method.	**1** **3**	**CO4**
05	**Matrices** **Pre-requisite:** Inverse of a matrix, addition, multiplication, and transpose of a matrix, symmetric, skew-symmetric Matrix (Only Definition). 5.1.Types of Matrices (Hermitian, Skew Hermitian, Unitary, Orthogonal Matrices and properties of Matrices(without proof)). The rank of a Matrix using Echelon form, reduction to normal form, and PAQ form(Only 3X3 Matrix) 5.2.System of homogeneous and non –non-homogeneous equations, their consistency, and solutions. # **Self-learning topics:** Application of inverse of a matrix to coding theory. Reduction to normal form and PAQ form.(m x n Matrix)	**3** **2**	**CO5**
06	**Numerical Solutions of Transcendental Equations and System of Linear Equations and Expansion of Function.** 6.1.Solution of Transcendental Equations: Solution by Newton Raphsonmethod and Regula –Falsi method. 6.2.Solution of a system of linear algebraic equations, by (1) Gauss Jacobi Iteration Method, (2) Gauss Seidel Iteration Method. # **Self-learning topics:**Indeterminate forms, L- Hospital Rule, Gauss EliminationMethod, Gauss Jordan Method.	**2** **2**	**CO6**

References:

1. Higher Engineering Mathematics, Dr.B.S.Grewal, Khanna Publication
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley EasternLimited, 9th Ed.
3. Engineering Mathematics by Srimanta Pal and Subodh,C.Bhunia, Oxford University Press
4. Matrices, Shanti Narayan, S. Chand publication.
5. Applied Numerical Methods with Matlab for Engineers and Scientists by Steven Chapra, McGraw Hill

6. Elementary Linear Algebra with Application by Howard Anton and Christ Rorres. 6th edition.

John Wiley & Sons,INC.
7. A textbook of Engineering Mathematics by N.P. Bali & Manish Goyal. Laxmi Publication.
8. A textbook of Applied Mathematics Vol-I & Vol-II by P. N. Wartikar& J.N. Wartikar.

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 SCILAB Programs in tutorial class only. Each Student has to write at least 2 SCILAB tutorials (including print out) and at least 6 class tutorials on entire syllabus.
3. SCILAB Tutorials will be based on (i) Gauss Jacobi Iteration Method (ii) GuassSeidal Iteration method (iii) Newton Raphson Method (iv)Regula –Falsi method.

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.	SCILAB Tutorials	10 marks

Assessment:

Internal Assessment Test (IAT) for 20 marks each:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

End Semester Theory Examination:

- **Question paper format**

  - Question Paper will comprise a total of **six questions each carrying 15 marks Q.1** will be **compulsory** and should **cover the 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	Pract.	Tut.	Theory	Pract.	Tut.	Total
BSC102	Applied Physics	2	--	-	2	--	-	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment Test (IAT)			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)					
BSC102	Applied Physics	15	15	30	45	02	--	--	75

Rationale:

Most of the engineering branches are being off-spring of basic sciences where physics is playing a pivotal role in concept and understanding of foundation of core engineering branches. This syllabus is developed by keeping in mind, needs of all branches that we offer in University of Mumbai. In the distribution of modules, core physics and its applied form are given priority. Further, it is ensured that these modules will cover prerequisites needed for engineering courses to be introduced in higher semesters as core subjects or as interdisciplinary subjects in respective branches.

Course Objectives:

1. To provide students with a basic understanding of laser operation.
2. To explain the basic working principle of Optical fiber and its use in communication technology.
3. To demonstrate principles of interference in thin film.
4. To describe Maxwell's equations and their significance.
5. To build a foundation of quantum mechanics needed for modern technology.

6. To give exposure to the concept of Fermi level in semiconductors.

Course Outcomes:

1. Learners will be able to ILLUSTRATE the use of laser in LiDAR and Barcode reading.
2. Learners will be able to APPLY the foundation of fiber optics in the development of modern communication technology
3. Learners will be able to determinethe wavelength of light and refractive index of liquid using the interference phenomenon.
4. Learners will be able to ARTICULATE the significance of Maxwell's equations.
5. Learners will be able to RELATE the foundations of quantum mechanics with the development of modern technology.
6. Learner will be able to CLASSIFY semiconductors and EXPLAIN variation of Fermi level with temperature and doping concentration.

DETAILED SYLLABUS:

	Name of Module	**Detailed Content**	**Hours**	**CO Mapping**
	Prerequisite	Basic knowledge of optics and atomic structure, Wavefront and Huygens principle, reflection and refraction, Interference by division of wavefront, Refractive index of a material, Snell's law, Basics of vector algebra, partial differentiation concepts, Dual nature of radiation, Photoelectric effect, Matter waves, Davisson-Germer experiment. Intrinsic and extrinsic semiconductors, electrical resistivity and conductivity concepts	--	--
I	**Lasers**	Lasers: Spontaneous and stimulated emission, population inversion, pumping, active medium & active center, resonant cavity, coherence length and coherence time, Characteristics of lasers, He-Ne laser: construction and working. Fiber laser Construction and working Application : (i)Elementary knowledge of LiDAR(ii) Barcode reader (iii) Application of laser in metal work	**04**	**CO1**
II	**Fibre Optics**	Optical fibers: Critical angle, acceptance angle,	**04**	**CO2**

		acceptance cone, numerical aperture, total internal reflection andpropagation of light, Types of optical fibers: Single mode & multimode, step index & graded index, attenuation,attenuation coefficient, factors affecting attenuation, Fibre Optic Communication System, Advantages of optical fiber communication, numerical		
III	**Interfenence In Thin Films**	Interference in thin film of uniform thickness, conditions of maxima and minima for reflected system, Conditions for maxima and minima for wedge shaped film (qualitative), engineering applications – (i) Newton's rings for determination of unknown monochromatic wavelength and refractive Index of transparent liquid (ii) AntiReflecting Coating	**04**	**CO3**
IV	**Electrodynamics**	Vector Calculus : Gradient, Divergence, Curl. Gauss's law, Amperes' circuital Law, Faraday's law, Divergence theorem , Stokes theorem Maxwell's equations in point form, Integral form and their significance(Cartesian coordinate only)	**04**	**CO4**
V	**Quantum Physics**	de Broglie hypothesis of matter waves, de Broglie wavelength for electron, Properties of matter waves, Wave function and probability density, mathematicalconditions for wave function, problems on de Broglie wavelength, Need and significance of Schrödinger'sequations, Schrödinger's time independent and time dependent equations, Energy of a particle enclosed in a rigidbox and related numerical problems, Quantum mechanical tunneling, Principles of quantum computing: concept of Qubit.	**06**	**CO5**
VI	**Basics Of Semiconductor Physics**	Direct and Indirect Band Gap Semiconductors, Electrical Conductivity of Semiconductors, Drift Velocity, Mobility and Conductivity in Conductors	**04**	**CO6**

		Fermi- Dirac distribution function, Position of Fermi Level in Intrinsic and Extrinsic Semiconductors.		

Text Books:

1. A Text book of Engineering Physics -Dr. M. N. Avadhanulu, Dr. P. G. Kshirsagar, S. Chand, Revised Edition 2014
2. Modern Engineering Physics - A. S. Vasudeva, S. Chand, Revised Edition 2013
3. Engineering Physics D. K Bhattacharya,PoonamTandon, Oxford Higher Education, 1st Edition 2015
4. Engineering Physics -R. K. Gaur,S. L. Gupta, DhanpatRai Publications, 2012
5. Engineering Physics -V. Rajendran, McGraw Hill Educations, 2017
6. A Textbook of Nanoscience and Nanotechnology, T. Pradeep Tata McGraw Hill Education Pvt. Ltd., 2012

References:

1. Concepts of Modern Physics - ArtherBeiser, ShobhitMahajan, S. Choudhury, McGraw Hill, 7thEdition 2017
2. Fundamentals of optics - Francis A. Jenkins, Harvey E. White, McGraw Hill Publication, India, 4th Edition
3. Fundamentals of Physics, Halliday and Resnick, Wiley publication
4. Introduction to Electrodynamics, D. J. Griffiths, Pearson PublicationOnline

References:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/115/102/115102124/
2.	https://archive.nptel.ac.in/courses/115/102/115102025/
3.	https://archive.nptel.ac.in/courses/115/105/115105132/

Assessment:
Internal Assessment Test (IAT) for 15 marks each:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

End Semester Theory Examination:
Question paper format

- Question Paper will comprise a total of **five questions each carrying 15 marks Q.1** will be **compulsory** and should **cover the 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)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BSL101	Applied Physics Lab	--	1	-	--	0.5	-	0.5

- A total of **three questions** need to be answered

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment Test (IAT)			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)					
BSL101	Applied Physics Lab	--	--	--	--	--	25	--	25

Lab Objectives:

1. To develop scientific understanding of the physics concepts.
2. To develop the ability to explain the processes and applications related to science subjects.
3. To apply skills and knowledge in real life situations.
4. To improve the knowledge about the theory concepts of Physics learned in the class.
5. To improve ability to analyse experimental result and write laboratory report.
6. To develop understanding about inferring and predicting.

Lab Outcomes: Learners will be able to..

1. Determine wavelength / divergence of laser beam.
2. Determine parameters like numerical aperture / power attenuation of an optical fibre.
3. Perform experiments based on interference in thin film and determine radius of curvature of lens / diameter of wire / thickness of paper.
4. Calculate basic parameters / constants using semiconductors.
5. Determine energygap / resistivity of a semiconductor.

6. Learner to understand the concept for virtual lab as per syllabus.

List of Experiments. (Minimum five experiments required)

Sr No	List of Experiments	Hrs	LO Mapping
01	Determination of wavelength using Diffraction grating. (Laser source)	**01**	**LO1**
02	Study of divergence of laser beam	**01**	**LO1**
03	Determination of Numerical Aperture of an optical fibre.	**01**	**LO2**
04	Measuring optical power attenuation in your plastic optical fiber	**01**	**LO2**
05	Determination of radius of curvature of a lens using Newton's ring set up.	**01**	**LO3**
06	Determination of diameter of wire/hair or thickness of paper using Wedge shape film method.	**01**	**LO3**
07	Determination of 'h' ..photo cell	**01**	**LO4**
08	Determination of 'h' using LED	**01**	**LO4**
09	Determination of energy band gap of semiconductor.	**01**	**LO5**
10	Determination of resistivity by four probe method.	**01**	**LO5**
11	Any other experiment based on syllabus may be included, which would help the learner to understand concept. Virtual lab may be developed and used for performing the experiments , after defining a suitable LO	**01**	**LO6**

Term Work Marks: 25 Marks (Total marks) = 10 Marks (Experiment) + 10 Marks Project + 5 Marks (Attendance)

Project work will be extended to semester-2 as well. In semester 1, a group of four students will be formed; a domain may be provided by faculty, the group will frame a problem statement in consultation with faculty. A PPT presentation with problem statement, preliminary literature survey, execution plan and a probable outcome is to be considered for awarding marks. Proper rubrics must be framed by faculty member

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BSC103	Applied Chemistry	2	--	-	2	--	-	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment Test (IAT)			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)					
BSC103	Applied Chemistry	15	15	30	45	02	--	--	75

Rationale:

Chemical science has contributed in many ways to most of the Engineering branches where "Environmental Chemistry" is the modern approach to learn impact of Technology on habitat and can be common to all Core Groups, "Engineering Materials" can be prerequisites to many subjects of all core groups and Impact of corrosion on metals as engineering materials is the important area of concern. "Conventional and Non Conventional Energy Study" is the matter of general approach to all Core groups as Energy issue is the most recent concern even for designing computational engines (Include hardware & software energy efficient).

Course Objectives:

1) To study Coal as a conventional source of energy.
2) To study the effect of corrosion by different mechanisms on metals and methods of corrosion control.
3) To recognise importance of alloys and can apply the phase rule on it to study the effect of temperature and composition.
4) To introduce important properties of polymers as Engineering material.
5) To recognise the composition, properties and functions of various composite materials.

6) To study importance of Green Chemistry by comparative study of conventional and Green routes of syntheses, solvents and fuels.

Course Outcomes: Student will be able to -

1) Determine the quality of coal and quantify the oxygen required for combustion of coal.
2) Apply different methods to minimize corrosion in industries.
3) Interpret various phase transformations of alloy using thermodynamics.
4) Use the polymers for specific engineering applications on the basis of the properties.
5) Identify different types of composite materials for engineering applications.
6) Apply the principles of Green chemistry and study environmental impact for sustainable development

Prerequisite:

1) Knowledge about basic difference in Conventional and non-conventional energy sources.
2) Knowledge about concepts of Electrochemistry.
3) Knowledge of basic properties of metals and nonmetals.
4) Knowledge of 12 principles of Green Chemistry

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Fuels and Combustion**	A) cFuel: - Definition, Characteristics of good fuel. B) Calorific value (Definition, Types, Determination, Dulong's formula, Numerical) C) Coal: - Analysis of coal – Proximate analysis, Ultimate analysis, Numerical) D) Combustion of coal – Numerical	**04**	**CO1**
II	**Corrosion**	A) Introduction: - Definition, Types of Corrosion – i) Dry or Atmospheric Corrosion, ii) Wet or Electrochemical corrosion (In Acidic medium, In Neutral medium) B) Factors affecting rate of corrosion:-i) Position of metal in galvanic series, ii) Purity of Metal, iii) Nature of Corrosion product, iv) Temperature, v) pH of medium, vi) concentration of medium, vii) moisture, viii) Relative Cathodic and Anodic area, ix) overvoltage C) Methods to control corrosion: - i) Selection of metal, ii) Proper Designing, iii) Cathodic protection, iv) Use of Corrosion Inhibitors, v) Metallic Coating D) Corrosion in Electronic devices	**04**	**CO2**
III	**Alloys**	A) Purpose of making alloys. B) i) Gibbs Phase rule – Statement, Terms involved with examples. ii) Reduced phase rule, Two-component system (Pb-Ag) & Numerical. iii) Merits and Limitations of Phase rule.	**04**	**CO3**

IV	**Introduction to Polymers**	A) Macro-molecular science, basic concept of polymers, Chemical bonding in polymers, Classification of Polymers. B) Properties of Polymers:- i) Molecular weight - Number average molecular weight, Weight average molecular weight, Numerical, ii) Crystallinity - Crystalline and amorphous polymers – Glass transition temperature, iii) Mechanical Properties: Hardness, tensile strength, creep, fatigue, impact resistance (introduction), iv) Electrical properties: dielectric strength, insulation resistance, surface resistivity (Introduction), v) Optical properties: refractive index, transmittance, photoelectric property, colour	**05**	**CO4**
V	**Introduction to Composites**	A) Definition, Characteristics of Composites, B) Constituents of Composites – Matrix Phase and Dispersed Phase (Definition and Functions) C) Classification of Composites	**04**	**CO5**
VI	**Green Chemistry for sustainable development**	A) Comparative study of synthesis of following industrially important molecules by conventional and green route:-i) Indigo dye, ii) Adipic acid, iii) Carbaryl B) Green Solvents: - characteristics and applications of Supercritical solvents and ionic liquids C) Green Fuels:- Synthesis and Advantages of i) Biodiesel, ii) Ethanol	**05**	**CO6**

Recommended Books:

1. Engineering Chemistry, Jain and Jain, Dhanpat Rai Publication
2. A textbook of Engineering Chemistry, S. S. Dara, S. Chand and Company
3. Polymer science: Vasant Gowarikar, Wiley Estern Ltd, new Delhi
4. Green Chemistry: V. K. Ahluwalia

Online References:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/103/106/105106205/
2.	https://courses.nptel.ac.in/noc20_ch41/preview

Assessment:

Internal Assessment Test (IAT) for 15 marks each:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

End Semester Theory Examination:

Question paper format

- Question Paper will comprise a total of **five questions each carrying 15 marks Q.1** will be **compulsory** and should **cover the 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)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BSL102	Applied Chemistry Lab	--	1	-	--	0.5	-	0.5

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment Test (IAT)			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)					

- A total of **three questions** need to be answered.

BSL102	**Applied Chemistry Lab**	--	--	--	--	--	25	--	25

Lab Objectives:

1. To apply knowledge acquired during the theory class in carrying out the experiments for qualitative and quantitative determination.
2. To analyse experimental results and write laboratory report.

Lab Outcomes: After completion of experiment, the learners will be able to:

1. Understand the significance of proximate analysis of coal and determine quality of coal sample.
2. Learn various quantitative analytical techniques to determine % of elements from alloy samples.
3. Synthesize biodiesel at laboratory level and calculate % atom economy from Green chemistry point of view.
4. Learn the effect of various factors on the rate of corrosion.
5. Synthesize bioplastic at laboratory level using from Green chemistry.
6. Quantitative determination of N2 / Flue gas.

Prerequisite:

1. Knowledge of basic safety practices in the Chemistry Laboratory
2. Knowledge of Proximate analysis of coal
3. Knowledge of volumetric analysis

List of Experiments.

Sr No	List of Experiments	Hrs	LO Mapping
01	Determination of moisture content of coal	**01**	**LO1**
02	Determination of ash content of coal	**01**	**LO1**
03	Determination of Zn in Brass	**01**	**LO2**
04	Synthesis of Biodiesel from vegetable oil	**02**	**LO3**
05	Determination of Cu in Brass	**01**	**LO2**
06	Flue gas analysis by Orsats Apparatus	**02**	**LO6**
07	Synthesis of biodegradable plastics	**02**	**LO5**
08	Determination of nitrogen by Kjeldahl's method	**02**	**LO6**
09	To compare rate of corrosion of various metals in acidic medium	**01**	**LO4**

Sr No	List of Assignments / Tutorials	LO Mapping
01	Numerical based on calorific value determination, proximate and ultimate analysis of coal	**LO1**
02	Phase Diagram on Electrochemical corrosion in different medium	**LO4**
03	Diagrams and numerical based on two component system	**LO2**
04	Numerical based on average molecular weight of polymers	**LO5**
05	Synthesis of at least two Industrially important molecules	**LO3, LO5**

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment Test (IAT)			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)					
ESC101	**Engineering**	20	20	40	60	02	--	--	100

Assessment :

Term Work: Term Work shall consist of at least 5 to 6 practicals based on the above list. Also, Term work Journal must include at least 4 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

	Mechanics								

Course Code	**Course Name**	**Teaching Scheme (Contact Hours)**			**Credits Assigned**			
		Theory	**Pract.**	**Tut.**	**Theory**	**Pract.**	**Tut.**	**Total**
ESC101	**Engineering Mechanics**	**02**	**-**	**-**	**02**	**-**	**-**	**02**

Rationale:

Engineering mechanics is a branch of science that deals with the behavior of solid bodies when subjected to external forces or loads and the effects of these forces on the bodies. It is a fundamental discipline within engineering and provides the basis for understanding and analyzing various types of structures and mechanisms.

Course Objectives:

1. To acquaint with basic principles of centroid and its application
2. To familiarize with the concepts of force, moment, Resultant and Equilibrium of system of coplanar force.
3. To acquaint with the basic concept of friction and its application in real-life problems.
4. To understand the parameters required to quantify the Kinematics of Particle and Rigid body.
5. To understand the parameters required to quantify the Kinetics of rigid body.
6. To acquaint with the basics of Robot kinematics

Course Outcomes:

1. Determine the equivalent force-couple system for a given system of forces.(L3)
2. DemonstratetheunderstandingofCentroidanditssignificanceandlocatethesame. (L3)
3. Illustrate the concept of force, moment and apply the same along with theconcept of equilibrium in two- and three-dimensional systems with the help of FBD. (L3)
4. Calculate position, velocity and acceleration etc. of particle/rigid body using principles of kinematics (L3)
5. Analyzeparticlesinmotionusingforceandacceleration,work-energyandimpulse- momentum principles (L4)
6. Establish the relation between robot joints and parameters (L2)

DETAILED SYLLABUS:

Sr. No.	**Name of Module**	**Detailed Content**	**Hours**	**CO Mapping**
0	Prerequisite	Resolution of a force. Use of trigonometry functions. Parallelogram law of forces. Law of triangle. Polygon	**01**	**CO1**

		law of forces, Lami's theorem. Concepts of Vector Algebra. Uniformly accelerated motion along a straight line, motion under gravity, projectile motion, Time of flight, Horizontal range, Maximum height of a projectile. Law of conservation of Energy, Law of conservation of Momentum, and Collision of Elastic Bodies. Work-Energy Principle (Note: There will be no questions from the prerequisite in the theory examination)		
I	**System of Forces**	Classification of force systems, Principle of transmissibility, composition and resolution of forces. Resultant of coplanar force system (Concurrent forces, parallel forces and general system of forces). Moment of force about a point, Couples, Varignon's Theorem. Resultant of Non-Coplanar (Space Force): Concurrent force system	**04**	**CO1**
II	**Centroid**	Centroids of plane laminas: Plane lamina consisting of primitive geometrical shapes.	**03**	**CO2**
III	**Equilibrium of Force system and Friction**	**3.1Equilibrium**: Conditions of equilibrium for concurrent forces, parallel forces and general forces, Couples. Equilibrium of rigid bodies, free body diagrams. **3.2Equilibrium of Beams:** Types of beams, simple and compound beams, type of supports and reaction: Determination of reactions at supports for various types of loads on beams. (Excluding problems on internal hinges) **3.3 Friction:** Laws of friction. Cone of friction. angle of repose, angle of friction, equilibrium of bodies on a horizontal and inclined plane.	**06**	**CO3**
IV	**Kinematics of particle and rigid bodies**	**4.1** Motion of particle with variable acceleration. Motion along plane curved path. velocity and acceleration in terms of rectangular components, tangential and normal component of acceleration. **4.2** Introduction to general plane motion, problem based on Instantaneous center (ICR) method for general plane motion (up to 2 linkage mechanism and no relative velocity method)	**05**	**CO4**
V	**Kinetics of particle**	**5.1** Force and Acceleration: -Introduction to basic concepts, D'Alembert's Principle, concept of Inertia force, Equations of dynamic equilibrium. **5.2** Principle of linear impulse and momentum. Impact and collision: Law of conservation of momentum, Coefficient of Restitution. Direct Central Impact and Oblique Central Impact. Loss of Kinetic Energy in collision of inelastic bodies.	**05**	**CO5**

VI	**Introduction to Robot Kinematics**	Fundamental of Robot Mechanics, Degree of Freedom, D-H Parameters, robot kinematics (Forward), Homogeneous transformation (limited to 2 DOF Serial robot)	**02**	**CO6**

Text Books:

1. EngineeringMechanicsbyAKTayal,Umesh Publication.
2. EngineeringMechanicsbyKumar,TataMcGraw Hill
3. EngineeringMechanicsbyBeer&Johnston,TataMcGraw Hill

References:

1. EngineeringMechanics byR. C. Hibbeler.
2. EngineeringMechanicsbyF. L.Singer,Harper&Raw Publication
3. EngineeringMechanicsbyMacklin&Nelson,Tata McGraw Hill
4. EngineeringMechanicsbyShaum Series
5. EngineeringMechanics(Statics)byMeriamandKraige,Wiley Bools
6. EngineeringMechanics(Dynamics)byMeriamandKraige, Wiley Bools
7. Introduction to Industrial Robotics by RamchandranNagrajan, Pearson publication

Online References:

Sr. No.	Website Name
3.	https://archive.nptel.ac.in/courses/112/106/112106286/
4.	https://onlinecourses.nptel.ac.in/noc21_me70/preview
3.	https://archive.nptel.ac.in/courses/112/106/112106180/

Assessment:

Internal Assessment Test (IAT) for 20 marks each:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

End Semester Theory Examination:

- **Question paper format**

  - Question Paper will comprise a total of **six questions each carrying 15 marks Q.1** will be **compulsory** and should **cover the 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** needs to be answered

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment Test (IAT)			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I + IAT-II					
Course Code	Course Name	Teaching Scheme (Contact Hours)				Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
ESL101	Engineering Mechanics Lab	--	--	--	--	--	25	25	50
ESL101	Engineering Mechanics Lab	--	02	-	--	01	-	01	

Lab Objectives:

1. To acquaint with basic principles of centroid and its application
2. To familiarize with the concepts of force, moment, Resultant and Equilibrium of system of coplanar force.
3. To acquaint with the basic concept of friction and its application in real-life problems.
4. To understand the parameters required to quantify the Kinematics of Particle and Rigid body.
5. To understand the parameters required to quantify the Kinetics of rigid body.
6. To acquaint with the basics of Robot kinematics

Lab Outcomes:

1. Determine the equivalent force-couple system for a given system of forces (L3)
2. DemonstratetheunderstandingofCentroidanditssignificanceandlocatethesame. (L3)
3. Illustrate the concept of force, moment and apply the same along with theconcept of equilibrium in two- and three-dimensional systems with the help of FBD. (L3)
4. Calculate position, velocity and acceleration etc of particle and rigid body using principles of kinematics. (L3)
5. Analyzeparticlesinmotionusingforceandacceleration,work-energyandimpulse- momentum principles (L4)
6. Establish the relation between robot joints and parameters (L2)

List of Experiments:

Minimumsixexperimentsfromthefollowinglistofwhich a minimumoneshould be fromdynamics.

Sr No	List of Experiments	Hrs	CO mapping
01	VerificationofPolygonlawofcoplanarforces	**01**	**LO1**
02	Verificationof the Principle ofMoments(Bellcranklever)	**01**	**LO3**
03	Determinationofsupportreactionsof aSimplySupportedBeam.	**01**	**LO3**
04	Determinationofcoefficientoffriction)usinginclined plane	**01**	**LO3**
05	Verificationoftheequationsofequilibriumfornon-concurrentnon-parallel(General)forcesystem.	**02**	**LO3**

06	Collisionofelasticbodies (Lawofconservationofmomentum).	**02**	**LO5**
07	Kinematicsofparticles.(Uniformmotionofaparticle,Projectilemotion,motionundergravity)	**02**	**LO4**
08	Kineticsofparticles.(collisionofbodies)	**02**	**LO5**

Sr No	List of Assignments / Tutorials	**Hrs**	**CO mapping**
01	ResultantofCoplanarforcesystem	**02**	**LO1**
02	Resultantofnon-coplanarforcesystem: Concurrent force system	**01**	**LO1**
03	CentroidofCompositeplaneLaminas	**01**	**LO2**
04	Equilibrium of System of Coplanar Forces including support reaction of beams	**02**	**LO3**
05	Equilibrium of bodies on inclined plane and problems involving ladder.	**02**	**LO3**
06	Kinematics of particles (Variable acceleration)	**02**	**LO4**
07	Kinetics of particles (D'Alembert's Principle, Impulse momentum Principle, Impact and Collisions.)	**02**	**LO5**
08	Homogeneous transformation, Direct Kinematics of robot	**02**	**LO6**

Term Work: Term Work shall consist of at least 6 practical's and 8 assignments based on the above list

Term Work Marks: 25 Marks (Total marks) = 10 Marks (Experiment) + 10 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on entire syllabus.

Course Code	**Course Name**	**Teaching Scheme (Contact Hours)**			**Credits Assigned**			
		Theory	**Pract.**	**Tut.**	**Theory**	**Pract.**	**Tut.**	**Total**
ESC102	**Basic Electrical and Electronics Engineering**	**3**	--	-	**3**	--	-	**3**

Course Code	**Course Name**	**Theory**			**Term work**	**Pract / Oral**	**Total**
		Internal Assessment Test (IAT)	**End Sem**	**Exam Duration**			

		IAT-I	IAT-II	IAT-I + IAT-II (Total)	Exam	(in Hrs)			
ESC102	**Basic Electrical and Electronics Engineering**	20	20	40	60	2	-	-	100

Course Objectives:

1. To provide knowledge on fundamentals of DC circuits
2. To provide knowledge of single phase and three phase AC circuits.
3. To inculcate fundamental knowledge of 1-Φ transformer.
4. To provide basic knowledge on fundamentals of DC and AC machines.
5. To provide knowledge of special purpose Diodes.
6. To provide knowledge of Transistor.

Course Outcomes:

1) Apply various network theorems to determine the circuit response / behavior.
2) Evaluate and analyze 1-Φ and 3-Φ AC circuits.
3) Understand the construction, operation and applications of 1-Φ transformers.
4) Illustrate the working principle of 3-Φ, 1-Φ Induction motors and DC Motors.
5) Study the construction, operation and applications of some special purpose Diodes.
6) Study construction, operation and applications of some Transistors.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Resistance, inductance, capacitance, series and parallel connections of resistance, concepts of voltage, current, power and energy and its units. Magnetic circuits, MMF, Magnetic field strength, reluctance.		
I	01	DC Circuits: (Only independent sources) Kirchhoff's Laws, Ideal and Practical Voltage and Current Sources, Source Transformation, Mesh and Nodal Analysis (no super node and super mesh) Star-Delta / Delta-Star Transformations, Superposition Theorem, Thevenin's Theorem, Norton's Theorem and Maximum Power Transfer Theorem.	**10**	**CO1**
II	02	AC Circuits: Generation of alternating voltage, basic definitions, average and RMS values, phasor and phase difference, sums on phasors, Single-phase ac series and parallel circuits consisting of R, L, C, RL, RC, RLC combinations, definitions - real, reactive and apparent power, admittance (Y), Series and parallel resonance (only theory). Generation of Three-Phase Voltages, voltage & current relationships in Star and Delta Connections.	**12**	**CO2**

III	03	Single Phase Transformer: (Numerical are not expected) Working principle of single-phase transformer, types of single- phase transformer, transformation ratio, actual (practical) and ideal transformer, Transformer losses, efficiency, applications of transformer.	**04**	**CO3**
IV	04	Electrical Machines: (Numerical are not expected) principle of operation, constructional details, classification and applications of DC Motor, three-phase induction motor, Single-Phase induction motors and BLDC motor	**05**	**CO4**
V	05	Special Purpose Diodes: (Numerical are not expected)Characteristics and operation of Zener Diode and application as a voltage regulator. Basic and structure of LED.Application of LED in indicative and lighting displays.	**04**	**CO5**
VI	06	Introduction to Transistors: (Numerical are not expected) structure and operation of BJT. BJT configurations (only common emitter). FET structure and operation. Application of BJT and FET in amplification, switching and oscillators.	**04**	**CO6**

Text Books:

1**.** V. N. Mittal and Arvind Mittal "Basic Electrical Engineering" Tata McGraw Hill, (Revised Edition)

2. Vincent Del Toro "Electrical Engineering Fundamentals", PHI Second edition, 2011

3. Edward Hughes "Hughes Electrical and Electronic Technology", Pearson Education (Tenth edition)

4. D P Kothari and I J Nagrath "Theory and Problems of Basic Electrical Engineering", PHI 13th edition 2011.

5. M. Naidu,S.Kamakshaiah "Introduction to Electrical Engineering" McGraw-Hill Education, 2004.

6. B.R Patil "Basic Electrical Engineering" Oxford Higher Education,

7. Electronic Devices and Circuit Theory" by Robert L. Boylestad and Louis Nashelsky

References:

1. B.L. Theraja "Electrical Engineering " Vol-I and II

2. S.N. Singh, "Basic Electrical Engineering" PHI , 2011Book

Assessment:

Internal Assessment Test (IAT) for 20 marks each:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

End Semester Theory Examination:

- **Question paper format**

  - Question Paper will comprise a total of **six questions each carrying 15 marks Q.1** will be **compulsory** and should **cover the 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	Pract.	Tut.	Theory	Pract.	Tut.	Total
ESL102	Basic Electrical and Electronics Engineering Lab	--	2	-	--	1	-	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment Test (IAT)			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)					
ESL102	Basic Electrical and Electronics Engineering Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1. To impart the basic concept of network analysis and its application.
2. To provide the basic concept of AC circuit analysis and its application.
3. To illustrate the operation of the transformer.
4. To illustrate the operation of machines.
5. To explain the Zener diode voltage regulation characteristic.
6. To explain the BJT and FET as switches and amplifiers.

Lab Outcomes:

1) Interpret and analyze the behavior of DC circuits using network theorems.
2) Perform and infer experiments on single-phase and three-phase AC circuits

3) Illustrate the performance of a single-phase transformer
4) Illustrate the performance of A.C. machine and DC Motor
5) Perform an experiment on voltage regulation characteristics of Special diode
6) Perform an experiment on the VI characteristic Transistor.

List of Experiments.

Sr No	List of Experiments	Hrs	LO Mapping
01	Basic safety precautions. Introduction and use of measuring instruments - voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors, and inductors	**01**	**LO1**
02	To measure output voltage across load resistor/current through load resistor and verify the result using Mesh and Nodal analysis	**01**	**LO1**
03	Verification of Superposition Theorem.	**02**	**LO1**
04	Verification Thevenin's and Norton's theorem	**02**	**LO1**
05	Verification Maximum Power Transfer Theorem.	**02**	**LO1**
06	To find the resistance and inductance of a coil connected in series with a pure resistance using the voltmeter method	**02**	**LO2**
07	To measure the relationship between phase and line, currents and voltages in three-phase system (star & delta)	**02**	**LO2**
08	To demonstrate cut-out sections of the single-phase transformer.	**02**	**LO3**
09	To demonstrate cut-out sections of the DC machine	**02**	**LO4**
10	To plot Zener diode voltage regulation characteristics	**02**	**LO5**
11	To demonstrate the application of LED in indicative and lighting display	**02**	**LO5**
12	To demonstrate the application of BJT as a switch	**02**	**LO5**
13	To demonstrate BJT/FET as an amplifier	**02**	**LO6**

Sr No	List of Assignments / Tutorials	Hrs	LO Mapping
01	Assignment on Basic electrical safety practices	**02**	**LO1**
02	Numerical assignment on Mesh analysis and nodal analysis		**LO1**
03	Numerical assignment on Thevenin, Norton, and maximum power transfer theorem		**LO1**
04	Numerical assignment on series and parallel circuits		**LO2**
05	Assignment on single-phase transformer		**LO2**
06	Assignment on DC and AC machine		**LO4**
07	Assignment on special purpose diodes		**LO5**
08	Assignment on BJT and FET		**LO6**

Online Resources:

Sr. No.	Website Name

1.	All About Circuits (https://www.allaboutcircuits.com)
2.	Circuit Lab (https://www.circuitlab.com)
3.	Tinkercad (https://www.tinkercad.com)

Assessment:
Term Work: Term Work shall consist of at least 08 to 10practicals based on the above list. Also, Term work Journal must include at least 6 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.

Course Code	**Course Name**	**Teaching Scheme (Contact Hours)**			**Credits Assigned**			
		Theory	**Pract.**	**Tut.**	**Theory**	**Pract.**	**Tut.**	**Total**
AEC101	**Professional Communication and Ethics**	02	**-**	-	02	**-**	**-**	**02**

Course Code	**Course Name**	**Theory**					**Term work**	**Pract / Oral**	**Total**
		Internal Assessment Test (IAT)			**End Sem Exam**	**Exam Duration (in Hrs)**			
		IAT-I	**IAT-II**	**IAT-I + IAT-II (Total)**					
AEC101	**Professional Communication and Ethics**	15	15	30	45	1.5	--	--	75

Rationale

This course has been designed to hone the communicative abilities of First Year Engineering students by providing them skill-based training on LSRW (Listening-Speaking-Reading-Writing) to

prepare them for a career in the industry and for competitive exams pertaining to higher studies.

Course Objectives - The learners should be able to:

1. Effectively evaluate the dynamics of communication and navigate professional arenas
2. Competently acquire active listening skills by comprehending various types of Speech Acts
3. Critically analyse communication barriers, audience and purpose to speak proficiently
4. Minutely comprehend extensive texts, technical and non-technical, to execute relevant tasks
5. Efficiently organize and create purposeful technical writing for professional transaction
6. Successfully manage teams, by applying ethical standards to deliver synergistic solutions

Course Outcomes - The learners will be able to:

1. Evaluate the dynamics of communication and effectively navigate professional arenas
2. Acquire active listening skills by comprehending various types of Speech Acts
3. Analyse different communication barriers, audience and purpose, and speak proficiently
4. Comprehend extensive texts, technical and non-technical, to execute relevant tasks
5. Organize and create purposeful technical writing for professional transactions
6. Manage teams successfully, by applying ethical standards to deliver synergistic solutions

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
01	**Module 1- Fundamentals of Communication**	**1.1. Basic Concepts of Communication** • Definition, Objectives, Postulates **1.2. Process of Communication** • Stimulus, Sender, Encoding, Message, Medium, Channel, Receiver, Decoding, Feedback **1.3. Methods of Communication** • Verbal (*Written & Spoken*). • Non-verbal cues perceived through the five senses (*Visual, Auditory, Tactile, Olfactory, Gustatory*) • Non-verbal cues transmitted cues through (*The body, Voice, Space, Time, Silence*) **1.4. Barriers to Communication** • Mechanical, Physical, Semantic & Linguistic, Psychological, Socio-cultural **1.5. Organisational Communication** • Formal (*Upward, Downward, Horizontal*). • Informal (*Grapevine*)	**08**	**CO1**

02	**Module 2 - Developing Basic Listening Skills**	**2.1.Concepts of Active Listening** • Listening for Details • Listening for Gist • Listening for Inference **(*For details please refer to Lab. Syllabus*)** **2.2. Enhancing Listening Proficiency Using Language Labs or on Open Source Platforms**	**02**	**CO2**
03	**Module 3 - Developing Basic Speaking Skills**	**3.1. Conversational Activities - Monologues** • Introducing yourself, Introducing others, One-minute impromptu speeches, Scaffolded story telling **3.2. Conversational Activities - Dialogues** • Role plays on everyday interactions, Interviews (Find out if…), Information Gap Activities, Picture descriptions and feedback, Situational conversations. **3.3. Conversational Activities - Pronunciation, Stress & Rhythm, Intonation** • Neutralisation of accent, Word stress, Rhythm & Pauses, Tonal variations/inflections ***(For details please refer to Lab. Syllabus)***	**02**	**CO3**

04	**Module 4 - Developing Basic Reading Skills**	**4.1. Verbal Aptitude** • Root Words, Meanings, Word Forms, Synonyms, Antonyms, Collocations, Prefixes, Suffixes at a similar difficulty level of entrance tests like **CAT/GRE/GMAT & proficiency tests like TOEFL/IELTS** **4.2. Grammar** • Identifying Common Errors (*Subject-verb agreement, Articles. Prepositions, Misplaced modifiers and Punctuations*) Redundancies, Idioms, Cliches at a similar difficulty level of entrance tests like **CAT/GRE/GMAT & proficiency tests like TOEFL/IELTS** **4.3. Techniques to Improve Reading Fluency and Comprehension** • Intensive Reading • Extensive Reading • Skimming • Scanning • SQ5R Method *(Survey, Question, Reading, Recording, Recall, Review and Revise)* **4.4. Reading &Summarisation Skills** • Summarising text to Graphic Organisers (GO) and visa-versa. Venn diagrams, Radial Diagrams (*Mindmaps*), Tree Diagrams, Cyclic Diagrams, Flow Charts, Timelines, Matrix (*Tables*), Pyramids • Summarising text in point form • Summarising text in one-sentence central idea	**02**	**CO4**
05	**Module 5 - Developing Basic Writing Skills**	**5.1.Coherence & Cohesion in Writing** • Basic Units of Writing (W*ords, Sentences, Paragraphs*) • Coherence (*Structure of written pieces, CSI Order of Organisation*) • Cohesive Devices (*Referencing, Repetition, Substitution, Ellipsis, Transition Signals*). • Structure of a Paragraph (*Topic Sentence, Supporting Ideas, Concluding Sentence*). **5.2. Seven Cs of Business Writing** • Completeness, Conciseness, Consideration, Concreteness, Clarity,	**09**	**CO5**

		Courtesy, Correctness. **5.3. Format & Types of Formal Letters** • Parts of a Formal Letter in **Complete Block Style** • Request/Permission Letter • Claim and Adjustment Letter • Sales Letter • E-mails **5.4. Writing User Instructions** • Styles of Instruction Presentation (*Impersonal, Indirect, Direct, Imperative*) • Describing general function/purpose of an object/process, • Drawing labelled diagrams • Describing labelled parts • Writing User Instructions • Writing Special Notices (*Note, Caution, Warning, Danger*) **5.5. Content Creation for Social Media and e-Commerce Platforms** • Blogs • Poetry • Keynote speeches • Podcast titles • Landing pages • Social media posts • YouTube video description • Screenwriting/Script Writing ***(Ensure minimum 3 of these categories are covered in the form of competitions)***		
06	**Module 6 - Ethical and Managerial Skills for Engineers**	**6.1.Team building** • Five stages of Team, (Forming, Storming, Norming, Performing and Adjourning) **6.2.Goal setting** • SMART goals – short term and long-term goals **6.3.Ethical Considerations for Professional Integrity** • Fairness and Honesty • Difference between Values and Ethics	**03**	**CO6**

		• Ethical principles • Ethical use of AI Tools • Plagiarism and copyright infringement • Ethical-dilemma case studies		

References:

1. Communication Skills by Sanjay Kumar &Pushp Lata
2. Business Communication with Writing Improvement Exercises. Hemphill, McCormick and Hemphill
3. Business Communication: Building Critical Skills by Locker, Kitty O. Kaczmarek, Stephen Kyo
4. Effective Business Communication by Herta Murphy
5. Technical Communication: Principles and Practice by Raman and Sharma
6. Effective Technical Communication: A Guide for Scientists and Engineers by Rizvi
7. Oxford Guide to Effective Writing & Speaking by John Seely
8. English Grammar by Raymond Murphy
9. Word Power Made Easy by Norman Lewis

Online References:

1.	https://bbclearningenglish.org
2.	https://www.bbc.co.uk/learningenglish

Assessment:

Internal Assessment Test (IAT) for 15 marks each:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

End Semester Theory Examination:

Question paper format

- Question Paper will comprise a total of **five questions each carrying 15 marks Q.1** will be **compulsory** and should **cover the 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**three questions** need to be answered.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
AEL101	Professional Communication and Ethics	-	2	-	-	1	-	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment Test (IAT)			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)					
AEL101	Professional Communication and Ethics	--	--	--	--	--	25	--	25

Lab Objectives: The learners should be able to:

1. Effectively evaluate the dynamics of communication and navigate professional arenas
2. Competently acquire active listening skills by comprehending various types of Speech Acts
3. Critically analyse communication barriers, audience and purpose to speak proficiently
4. Minutely comprehend extensive texts, technical and non-technical, to execute relevant tasks
5. Efficiently organize and create purposeful technical writing for professional transactions
6. Successfully manage teams, by applying ethical standards to deliver synergistic solutions

Lab Outcomes: The learners will be able to:

1. Apply the understanding of communication dynamics and navigate professional arenas
2. Appreciate other's point of view and apply effective listening strategies
3. Analyse different communication barriers, audience and purpose to speak proficiently
4. Comprehend extensive technical and non-technical texts to execute specific tasks
5. Plan and create purposeful technical writing for professional transactions
6. Employ ethical standards and managerial skills in various professional situation

DETAILED SYLLABUS:

Sr. No.	Module No.	Practical/ Tutorial	Detailed Content	Hours	LO Mapping
1	Fundamentals of Communication	1	1.1. Situational Application of Fundamentals of Communication 1.2. Case Studies on Fundamentals of Communication	**02**	**LO1**
2	Developing Basic Listening Skills	2	2.1. Listening for Details • Listen to a song and fill in the blanks, Listen to a telephonic conversation and fill in the blanks, Listen to a story/lecture/podcast and fill in the blanks, Listen to a monologue and complete the sentences 2.2. Listening for Gist • Listen to an audio recording and identify the gist/main idea/theme in the form of MCQs or True/False statements 2.3.Listening for Inference • Listen to short passages and draw inferences in the form of MCQs or True/False statements 2.4. Listening Comprehension Exercises in the Language Lab or on Open Source Platforms • Listening to a telephonic conversation, Listen to a Podcast Examples of the Activities That Can Be Done under the Above 4 Heads: Listen to a Formal Speech • Martin Luther King Jr., • Swami Vivekananda • Dr.A.P.J.Abdul Kalam • John F. Kennedy • Mr.Ratan Tata • Steve Jobs	**04**	**LO2**

			Note-taking & Designing Quizzes • Listen to a lecture, take notes and prepare a quiz for others Dictations • Take old-fashioned dictation with special focus on punctuations and spellings Draw a Story • Listen to a descriptive passage read out by the teacher on a scenery/item and draw a picture based on what you hear Labelling a Map, Plan, Diagram, Table & Flow Charts • Listen to your teacher and write labels on a plan (*e.g. of a building*), map (*e.g. of part of a town*) diagram (*e.g. of a piece of equipment*), table (*e.g. place/time/price*), flow chart (*e.g. a process which has clear stages*).		
3	Developing Basic Speaking Skills	3	3.1. Conversational Activities - Monologues • Introducing yourself, Introducing others, One-minute impromptu speeches, Scaffolded story telling 3.2. Conversational Activities - Dialogues • Role plays on everyday interactions, Interviews (Find out if…), Information Gap Activities, Picture descriptions and feedback, Situational conversations. 3.3. Conversational Activities - Pronunciation, Stress and Rhythm, Intonation • Neutralisation of accent, Word stress, Rhythm & Pauses, Tonal variations/inflections	**04**	**LO3**

			Suggested Examples of Functional Communication Activities That Can Be Done under the Above 3 Heads: • Asking for and giving information • Taking initiative • Seeking and giving favour/offers • Requesting and responding to requests • Apologizing and forgiving • Seeking and giving permission • Congratulating people on their success • Expressing opinions, likes and dislikes, agreements and disagreements • Expressing condolences • Asking questions and responding politely • Giving instructions • Agreeing and disagreeing • Asking for and giving advice and suggestions • Expressing sympathy • Using mobile phone • Live commentary on videos on mute • Debates		
4	Developing Basic Reading Skills	4	4.1.Verbal Aptitude Reading Fluency & Comprehension Monitoring • Reading short/long passages to answer MCQs based on factual, general and inferential comprehension skills • Reading short/long passages to answer MCQs based on factual, general and inferential comprehension skills *(Passages should be of a technical nature and minimum length of passages should be 350-400 words)* 4.2. Vocabulary Building Activities Examples of Word Games: • Crosswords • Bingo • Word Ladders	**04**	**LO4**

			• Hangman • Word Association		

			4.3. Reading &Summarisation Skills
			• Summarising text to Graphic Organisers and visa-versa
			  ○ Venn diagrams
			  ○ Radial Diagrams (*Mindmaps*)
			  ○ Tree Diagrams
			  ○ Cyclic Diagrams
			  ○ Flow Charts
			  ○ Timelines
			  ○ Matrix (*Tables*)
			  ○ Pyramids
			• Summarising text in bullet points
			• Summarising text in one-sentence central idea		

5	Developing Basic Writing Skills	5	5.1. Mechanics of Writing - Paragraph Writing • Building paragraphs developing coherence (*Structure of written pieces, CSI Order of Organisation*) • Coherence (*Structure of written pieces, CSI Order of Organisation*) • Cohesive Devices (*Referencing, Repetition, Substitution, Ellipsis, Transition Signals*). • Structure of a Paragraph (*Topic Sentence, Supporting Ideas, Concluding Sentence*). 5.2. Write Letters and eMails • Request/Permission Letter • Claim & Adjustment Letter • Sales Letter *(Complete Block format applying the seven Cs)* • eMails USE ONLY COMPLETE BLOCK FORMAT 5.3 Writing User Instructions on: Examples: • Installing a software • Ordering food on delivery apps (Zomato, Swiggy)	**04**	**LO5**

			• Using payment system (Google Pay, PhonePe, Paytm) • Using AI Tools (ChatGPT, Gemini, ZeroGPT and GPTZero) • Electronic Devices/ Gadget *(Gaming Console, Smartwatch)* • Home Appliances *(Mixer-Grinder, Microwave Oven, Air Fryer)* • Tools *(Chisel, Screw-driver)* 5.4 Content Creation for Social Media and e-Commerce Platforms Examples • Blogs • Poetry • Keynote speeches • Podcast Titles • Landing Pages • Social media posts • YouTube Video Description • Screenwriting/Script Writing *(Ensure minimum 3 of these categories are covered in the form of competitions)*		
6	Ethical and Managerial Skills for Engineers	6	6.1. Ethics • Case Studies on Ethical dilemma 6.2. Team building Examples • Newspaper Bridges/ Towers/ Dress Building • Best out of waste • Obstacle Race	**02**	**LO6**

Nos.	List of Assignments	Details	Hrs.
01	Application-based Assignment on Communication Theory	Must include Methods and Barriers from Module 1	**01**
02	Consolidated Listening	At least 4 type of listening activities must be taken from	**01**

	Skills Activity Sheet with Students' Answers	Module 2	
03	Performance-based Oral Activities *(Refer below for further details)*	Should be based on Continuous Evaluation of minimum 5 activities from entire lab syllabus.Follow the Common European Framework of Reference (CEFR) Rubrics for assessment.	**01**
04	**A.** MCQ on Reading Comprehension and Summarisation with GO **B.** Objective Test on Verbal Aptitude & Grammar	**A.** Must cover sub-topics under Module 4 **B.** Must be based on Module 4 at the same difficulty level of entrance tests like CAT/GRE/GMAT & proficiency tests like TOEFL/IELTS	**01**
05	Assignment on Writing Skills	Must include 3 types of letters from Module 5	**01**
06	Application-based Assignment on Ethics	Case studies on ethical dilemma from Module 6	**01**

References:

1. Communication Skills by Sanjay Kumar &Pushp Lata
2. Business Communication with Writing Improvement Exercises. Hemphill, McCormick and Hemphill
3. Business Communication: Building Critical Skills by Locker, Kitty O. Kaczmarek, Stephen Kyo
4. Effective Business Communication by Herta Murphy
5. Technical Communication: Principles and Practice by Raman and Sharma
6. Effective Technical Communication: A Guide for Scientists and Engineers by Rizvi
7. Oxford Guide to Effective Writing & Speaking by John Seely
8. English Grammar by Raymond Murphy
9. Word Power Made Easy by Norman Lewis

Online References:

Sr. No.	Website Name
1.	https://bbclearningenglish.org
2.	https://www.bbc.co.uk/learningenglish

Term Work: Term Work shall consist of at least 6 practicals' based on the above list. Also, Term work Journal must include at least 9 assignments.
Term Work Marks: 25 Marks (Total marks) = 10 Marks (Experiment) + 10 Marks (Assignments) + 5 Marks (Attendance)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
VSEC101	Engineering Workshop-I	-	2	-	-	-	-	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment Test (IAT)			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)					
VSEC101	Engineering Workshop-I	--	--	--	--	--	25	--	25

Lab Objectives

1. Toimpart trainingto helpthe studentsdevelop engineeringskill sets.
2. Toinculcaterespectforphysicalworkandhard labor.
3. Togetexposureto the interdisciplinaryengineeringdomain.

Lab Outcomes: Learnerswillbeableto…

1. Developthenecessaryskill requiredtohandle/usedifferentfittingtools.
2. Developskillrequired forhardwaremaintenance.

3. Ableto installan operatingsystem andsystem drives.
4. Ableto identifythe networkcomponents and performbasic networkingand crimping.
5. Abletopreparetheedgesofjobsand dosimplearcwelding.
6. Developthenecessaryskill requiredto handle/use differentplumbingtools and simple job.

Sr. No.	DetailedContent	Hrs.	LO Mapping
	Note: Trade 1 and 2 are compulsory. Select any ONE trade topics out of the topic at trade 3 to 5.Demonstrations and hands on experience to be provided during the periods allotted for thesame. Report on the demonstration including suitable sketches is also to be included in the termwork CO-1isrelatedtoTrade-1 CO-2to CO-4isrelatedtoTrade-2CO-5is related to Trade-3 CO-6 is related to Trade-4CO-7isrelatedtoTrade-5 COevaluationis tobedoneaccordingtotheoptedTradesin additionto**CompulsoryTrades.**		
Trade-1	**Fitting(Compulsory):** • Useandsettingoffittingtoolsforchipping,cutting,filing,marking, centerpunching, drilling,tapping. • Termworktoincludeonejobinvolvingfollowingoperations:filing tosize, onesimple male-femalejoint, drillingandtapping	**04**	**LO1**
Trade-2	**HardwareandNetworking:(Compulsory)** • DismantlingofaPersonalComputer(PC),IdentificationofComponentsofaPCsuchaspowersupply,motherboard,processor,hard disk, memory (RAM, ROM), CMOS battery, CD drive, monitor,keyboard,mouse,printer,scanner,pendrives,diskdrivesetc. AssemblingofPC,InstallationofOperatingSystem(Anyone)and Device drivers,Boot-upsequence.Installation of application software(at least one) Basic troubleshooting and maintenance Identificationof network components: LAN card, wireless card, switch, hub, router,differenttypesofnetworkcables(straightcables,crossovercables,rollovercables)Basicnetworkingandcrimping.NOTE:Handsonexperienceto be given inagroup ofnot morethanfourstudents	**06**	**LO2, LO3, LO4**
Trade-3	**Welding:** • Edge preparation for welding jobs. Arc welding for different job like,Lap welding of two plates, butt welding of plates with simple cover, arcweldingto join plates at right angles.	**06**	**LO5**

Trade4	**Plumbing:** • Useofplumbingtools,spanners,wrenches,threadingdies,demonstration of preparation of a domestic line involving fixing of awatertapand useofcoupling, elbow, tee, and unionetc.	**04**	**LO6**
Trade-5	**MachineShop:** • Atleastoneturningjobistobedemonstratedandsimplejobtobemadeforterm Work in a group of4 students.	**06**	**LO6**

Term Work: Term Work shall consist of at least 3 Trade based on the above list. Also, Term work.
Term Work Marks: 25 Marks (Total marks) = 20 Marks (Workshop Experiment) + 5 Marks (Attendance)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
VSEC102	C Programming	--	2*+2	-		2	-	2

Course Code	Course Name	Examination Scheme							
		Theory					Term work	Pract / Oral	Total
		Internal Assessment Test (IAT)			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)					
VSEC102	C Programming	-	-	-	-	-	25	25	50

Lab Objectives: This subject aims to provide students with an understanding of the role computation can play in solving problems. The Course will be taught using C-Programming Language.

1. Understand and use basic terminology in computer programming.

2. Use various data types in C programs effectively.
3. Design and implement programs involving decision structures, loops, and functions.
4. Design Implement Arrays , String, and Structure
5. Describe and utilize memory dynamics through the use of pointers.
6. Use different data structures and create/update basic data files in C.

Lab Outcomes: Learners will be able to

1. Illustrate the basic terminology used in computer programming.
2. Use different data types in a computer program.
3. Design programs involving decision structures, loops and functions.
4. Implement Arrays , String, and Structure
5. Describe the dynamics of memory by the use of pointers.
6. Use different data structures and create/update basic data files.

DETAILED SYLLABUS

Sr. No.	Module	Detailed Content	Hours	LO mapping
1	**Fundamentals of C-Programming**	1.1 Character Set, Identifiers and keywords, Data types, Constants, Variables. 1.2 **Operators**-Arithmetic, Relational and logical, Assignment, Unary, Conditional, Bitwise, Comma, other operators. Expression, statements, Library Functions, Preprocessor. 1.3 **Data Input and Output** – getchar( ), putchar( ), scanf( ), printf( ), gets( ), puts( ), Structure of C program .	**06**	**LO1, LO2**
2	**Control Structures**	**2.1 Branching -** If statement, If-else Statement, Multiway decision. **2.2 Looping** – while, do-while, for **2.3 Nested control structure**- Switch statement, Continue statement Break statement, Goto statement.	**05**	**LO3**

3	**Functions and Parameter**	**3.1** Function -Introduction of Function, Function Main, defining a Function, accessing a Function, Function Prototype, Passing Arguments to a Function, Recursion. **3.2** Storage Classes –Auto , Extern , Static, Register	**05**	**LO3**
4	**Arrays , String Structure**	**4.1** **Array**-Concepts, Declaration, Definition, Accessing array element, One-dimensional and Multidimensional array. **4.2** **String**- Basic of String, Array of String, Functions in String.h **4.3** **Structure**- Declaration, Initialization, structure within structure, Operation on structures, Array of Structure.	**05**	**LO4**
5	**Pointer**	**5.1** **Pointer:** Introduction, Definition and uses of Pointers, Address Operator, Pointer Variables, Dereferencing Pointer, Void Pointer, Pointer Arithmetic, Pointers to Pointers, Pointers and Array.	**03**	**LO5**
6	**Files**	**6.1** **File**s: File operation- Opening, Closing, Creating, Reading, Processing File.	**02**	**LO6**

Text Books

1. "Basics of Computer Science", by BehrouzForouzan , Cengage Learning .
2. "Programming Techniques through C", by M. G. Venkateshmurthy, Pearson Publication.
3. "Programming in ANSI C", by E. Balaguruswamy, Tata McGraw-Hill Education.
4. "Programming in C", by Pradeep Day and Manas Gosh, Oxford University Press.
5. "Let Us C", by Yashwant Kanetkar, BPB Publication.

Reference Books

1. "The C Programming Language" by Brian W. Kernighan and Dennis M. Ritchie, Publisher: Prentice Hall
   Publication Date: February 22, 1988 ,ISBN-13: 978-0131103627 ,
2. "C Programming: A Modern Approach" by K. N. King, Publisher: W. W. Norton & Company
   Publication Date: April 26, 2008 (2nd Edition), ISBN-13: 978-0393979503
3. "C Primer Plus" by Stephen Prata, Publisher: Addison-Wesley Professional Publication Date: December 27, 2013 (6th Edition) ISBN-13: 978-0321928429
4. "Programming in C" by Stephen G. Kochan Publisher: Addison-Wesley Professional Publication Date: August 18, 2014 (4th Edition) ISBN-13: 978-0321776419

Online Resources:

Sr. No.	Website Name
1.	Learn C - This website offers a free, interactive tutorial to learn C programming, covering both basic and advanced topics.
2.	Codecademy - Codecademy provides a comprehensive, interactive course for learning C, complete with real-world projects and skill paths.
3.	Coursera - Coursera, in collaboration with Duke University, offers a specialization in C programming, including hands-on projects and a certificate upon completion.
4.	edX - This course, offered by edX, covers C programming with a focus on Linux, including professional certification.

Sr No	Suggested List of Experiments	Hrs
01	a) Program to demonstrate Operators Data Input and Output – getchar( ), putchar( ), scanf( ), printf( ), gets( ), puts( ) b) Program to demonstrate Operators-Arithmetic, Relational and logical, Assignment, Unary, Conditional, Bitwise, Comma, other operators.	**02**
02	a) Program to demonstrate Branching - If statement, If-else Statement, Multiway decision. b) Program to demonstrate Looping – while, do-while	**02**
03	a) Program to demonstrate Nested control structure- Switch statement, Continue statement, Break statement, Goto statement	**02**
04	a) Program to demonstrate Function, Passing Arguments to a Function (call by value and call by reference	**02**
05	a) Implement an iterative function for factorial/ Fibonacci etc. b) Implement a recursive function for factorial/ Fibonacci etc.	**02**
06	a) Program to demonstrate Storage Classes –Auto, Extern, Static, Register	**02**
07	c) Program to demonstrate Array 1D, d) Program to demonstrate Array 2D	**02**
08	e) Program to demonstrate String f) Program to demonstrate String arrays of string	**02**
09	Program to demonstrate Structure Write a program to store and display information of a student/employee etc. using structures. a) Define a structure. b) Read and store details. c) Display the stored information.	**02**
10	Program to demonstrate pointers a) Define a node structure. b) Implement functions to insert, delete, and display nodes.	**02**

11	Program to demonstrate files Write a program to maintain a simple student/employee etc. database using file handling. a) Open a file to store student records. b) Implement functions to add, update, and display records. c) Ensure data persistence by saving changes to the file.	**02**
12	Implement one small application using Function, Files, Structure and Pointers concepts you have learnt in C (eg. : Simple Library Management System 1.Functions: Add, display, and search books. 2. Files: Store and retrieve book data. 3. Structures: Represent a book. 4. Pointers: Manage the list of books dynamically	**02**

Sr No	List of Assignments / Tutorials	Hrs
01	Flowcharts for programs	**02**
02	Functions and Parameter	
03	Control Structures	
04	Functions and Parameter	
05	Arrays, String Structure and Union	
06	Pointer and Files	

Assessment :

Term Work: Term Work shall consist of at least 10 to 12 practicals' 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.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CC101	Induction cum Universal Human Values	2#	-	-	-	-	-	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment Test (IAT)			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)					
CC101	Induction cum Universal Human Values	--	--	--	--	--	--	--	--

Rationale:

"The purpose of the education system is to develop good human beings capable of rational thought and action, possessing compassion and empathy…, with sound ethical moorings and values. It aims

at producing engaged, productive, and contributing citizens for building an equitable, inclusive, and plural society as envisaged by our Constitution. Education must develop not only cognitive capacities... but also social, ethical, and emotional capacities and dispositions…. Education is fundamental for achieving full human potential, developing an equitable and just society, and promoting national development… A holistic and multidisciplinary education would aim to develop all capacities of human beings – intellectual, aesthetic, social, physical, emotional, and moral in an integrated manner" [NEP 2020, p 4].

UHV courses are intended to help students to develop a holistic, humane world vision. A self-reflective, explorational methodology is adopted. All content discussed is universal, rational, and verifiable, and leads to harmony.

Holistic education inculcates the following three aspects in the student:

1. **Holistic, Humane Vision of Life** – harmonious individual to cosmos
2. **Human Values**– human feelings, participation based on holistic vision
3. **Skills**– required to live with these values in mutual relationship at all levels of human existence

Course Objectives:

The objective of the course is :

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.
5. Prepare learner for achieving full human potential who can be contribute for developing an equitable and just society, and promoting national development
6. developing clarity of these fundamental universal human values to help the learner in understanding and living by the various specific expressions. E.g., National values enshrined in the Constitution, aspirations articulated in NEP 2020, UN MDGs and SDGs...

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

1. Identify basic human aspirations and programme for its fulfilment.
2. Express existing reality of Human being
3. Explain the values in human-human relationship and program for its fulfilment to ensure mutual happiness.
4. Describe harmony in surroundings family and society.
5. Explain harmony nature, existence as coexistence and become more responsible in life, in handling problems with sustainable solutions.
6. Apply what they have learnt to their own self in day-to-day life and utilize the professional competence for augmenting universal human order, develop holistic technologies, management models and production systems.

Prerequisite: There is no prerequisite for this course.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	No prerequisite		

I	**Introduction - Need, Basic Guidelines, Content and Process for Value Education**	Purpose and motivation for the course, Self-Exploration, Continuous Happiness and Prosperity- the basic Human Aspirations, Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfil the above human aspirations.	**05**	**CO1**
II	**Understanding Harmony in the Human Being**	Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. the Body as an instrument of 'I', characteristics and activities of 'I' and harmony in 'I', harmony of I with the Body: Self-regulation and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Self-regulation and Health.	**04**	**CO2**
III	**Understanding Harmony in the Family**	Understanding values in human-human relationship and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, the other salient values in relationship	**07**	**CO3**
IV	**Understanding Harmony in the Society**	Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.	**03**	**CO4**
V	**Understanding Harmony in the Nature and Existence - Whole existence as Coexistence**	Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature, cyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all pervasive space, Holistic perception of harmony at all levels of existence.	**04**	**CO5**
VI	**Implications of the Holistic Understanding of Harmony on Professional Ethics**	Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic. Universal Order, Competence in professional ethics: Ability to utilize the professional competence for augmenting universal human order and identify the scope and characteristics of people friendly and eco-friendly production systems. Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic	**03**	**CO6**

		technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order. Sum up.		

(In every module one lecture can be used for students sharing and discussion)

Text Books:

1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 3rd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. The Teacher's Manual Teachers" Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2
3. A Foundation Course in Holistic Human Health – Its Philosophy and Practice, Sharmila Asthana, Akhilesh Shukla, T Sundara Raj Perumall, 1st Edition, October 2023, Published by UHV Publications, , Kanpur, UP.7

A References:

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya
2. Prakashan, Amarkantak, 1999.
3. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
4. The Story of Stuff (Book).
5. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
6. Small is Beautiful - E. F Schumacher.
7. Slow is Beautiful - Cecile Andrews
8. Economy of Permanence - J C Kumarappa
9. Bharat Mein Angreji Raj – Pandit Sunderlal
10. Rediscovering India - by Dharampal
11. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
12. India Wins Freedom - Maulana Abdul Kalam Azad
13. Vivekananda - Romain Rolland (English)
14. Gandhi - Romain Rolland (English)

Online References:

Sr. No.	Website Name
3.	https://uhv.org.in

Note:

1. This is an **audit course.**
2. This course is to be taught by faculty from every teaching department
3. Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.
4. In the discussions, the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration
5. One or two periods from each module may be used for tutorials. These are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life.
6. Depending on the nature of topics, worksheets, home assignment and/or activity can be included. The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut.	Theory	TW/Pract	Tut.	Total
BSC201	Applied Mathematics-II	02	--	01	02	--	01	03

Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract	Oral	Total
		Internal Assessment Test (IAT)			End Sem Exam				
		IAT-I	IAT-II	IAT-I + IAT-II (Total)					

BSC201	**Applied Mathematics-II**	20	20	40	60	25	--	--	125

Course Objectives

1. The course is aimed to develop the basic Mathematical skills of engineering students that are imperative for effective understanding of engineering subjects. The topics introduced will serve as basic tools for specialized studies in many fields of engineering andtechnology.
2. To provide hands on experience in using SCILAB software to handle applications to real life problems.

Course Outcomes: Students will be able to…

1. Apply the concepts of First Order and first degree Differential equation to the problems in the field ofengineering.
2. Apply the concepts of Higher Order Linear Differential equation to the engineering problems.
3. Apply concepts of Beta and Gamma function to solve improperintegrals.
4. Apply concepts of Double integral of different coordinate systems to the engineering problems.
5. Apply concepts of triple integral of different coordinate systems to the engineering problems and its application.
6. Solve differential equations and integrations numerically using SCILAB software to experimental aspect of applied mathematics.

DETAILED SYLLABUS

Module	DetailedContents	Hrs.	CO Mapping
01	**Differential Equations of First Order and First Degree** **1.1** Exact differential Equations, Equations reducible to exact form by using integrating factors. **1.2** Linear differential equations (Review), equation reducible to linear form, Bernoulli's equation. **# Self learning topics:** Simple application of differential equation of first order and first degree to electrical and Mechanical Engineering problem	**3** **2**	**CO1**
02	**Linear Differential Equations With Constant Coefficients of Higher Order** **2.1** Linear Differential Equation with constant coefficient-complementary function, particular integrals of differential equation of the type f(D)y = X where X is e^{ax}, sin(ax + b),cos(ax +b),x^m,$e^{ax}V$ 2.2 Method of variation ofparameters. **# Self learning topics:** Cauchy's homogeneous linear differential equation and Legendre's differential equation, Applications of Higher	**3** **1**	**CO2**

	order differential equation.		
03	**Beta and Gamma Function, Differentiation under Integral sign** **3.1** Beta and Gamma functions and itsproperties. **3.2** Differentiation under integral sign with constant limits of integration. **# Self learning topics:** Rectification of curves.(Cartesian, Polar and Parametric)	**2** **2**	**CO3**
04	**Multiple Integration- I** **Pre-requisite: Tracing of curves** **4.1** Double integration-definition, Evaluation of Double Integrals.(Cartesian & Polar) **4.2** Change the order of integration.(No Evaluation) **4.3** Evaluation of double integrals by changing to polarcoordinates	**2** **1** **2**	**CO4**
05	**Multiple Integration- II** **5.1** Triple integration definition and evaluation (Cartesian, cylindrical and spherical polar coordinates). **5.2** Application of double integrals to compute Area, Mass. **# Self learning topics:** Application of triple integrals to compute Volume.	**2** **2**	**CO5**
06	**Numerical solution of ordinary differential equations of first order and first degree, and , Numerical Integration** **6.1** Numerical solution of ordinary differential equation using (a) Euler'smethod (b) Modified Euler method, (c) Runge-Kutta fourth order method **6.2** Numerical integration-by (a) Trapezoidal (b) Simpson's 1/3rd (c) Simpson's 3/8th rule (all without proof)	**3** **1**	**CO6**

References:

1. Higher Engineering Mathematics, Dr.B.S.Grewal, KhannaPublication
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley EasternLimited,9th Ed.
3. Engineering Mathematics by Srimanta Pal and SubodhBhunia, Oxford University Press
4. Applied Numerical Methods with MATLAB for Engineers and Scientists by Steven Chapra, McGrawHill
5. Elementary Linear Algebra with Application by Howard Anton and Christ Rorres. 6th edition. John Wiley &Sons,INC.

Term Work:

General Instructions:

1. Batch wise tutorials are to be conducted. The number of students per batch should be asper University pattern for practical.

2. Students must be encouraged to write SCILAB Programs in tutorial class only.Each Student has to write at least 4 SCILAB tutorials (including print out) and at least 6 class tutorials on entiresyllabus.

3. SCILAB Tutorials will be based on (i) Euler Method, (ii) Modified Euler Method, (iii) Runge-Kutta Method of fourth order , (iv) Trapezoidal Rule , (v) Simpson's 1/3rdRule

(vi) Simpson's 3/8th rule

The distribution of Term Work marks will be as follows –

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

Assessment:

Internal Assessment (IA) for 20 marks each:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

End Semester Theory Examination:

- **Question paper format**

  - Question Paper will comprise a total of **six questions each carrying 15 marks Q.1** will be **compulsory** and should **cover the 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	Pract.	Tut.	Theory	Pract.	Tut.	Total
BSC2021	Physics for Emerging Fields	2	--	-	2	--	-	2

Course Code	Course Name	Theory			Term work	Pract / Oral	Total
		Internal Assessment Test (IAT)	End Sem	Exam Duratio			

		IAT-I	IAT-II	IAT-I + IAT-II (Total)	Exam	n (in Hrs)			
BSC2021	**Physics for Emerging Fields**	15	15	30	45	2		--	75

Rationale :

This course discusses basic aspects and working principles of frontier technologies which are in trend and in frontier research . Modules are designed to provide conceptual clarity of technologies of the 21st century ranging from Imaging to Energy Harvesting where AI and Data analytic are going to play an important role. Creative young minds have larger scope to explore in these areas with the skill sets they are going to acquire in having specific training in their selected Branch of engineering .

Course Objectives:

1. To demonstrate the use of Solar Power system and basic designing of solar power stations .
2. To explain basic working principle of Image sensors and their use and fundamentals of image processing.
3. To explain MEMS technology and sensor construction
4. To describe various types of fuel cell and its selection
5. To provide fundamentals of Energy harvesting
6. To discuss nanotechnology applications in Nano computing

Course Outcomes:

1. Learners will be able to MEASURE solar Power and CONSTRUCT basic solar power system .[BT 3]
2. Learners will be able to MEASURE Chromaticity and ILLUSTRATE colour matching concept..[BT3]
3. Learners will be able to ILLUSTRATE use of MEMS sensors {BT2]
4. Learners will be able to DESCRIBE various Fuel cells and its components [BT2]
5. Learner will be able to ASSIMILATE concept of Energy harvesting and its role in emerging innovative eco friendly applications. [BT2]
6. Learner will be able to EXPLAIN AI integration in various nanotechnology applications.[BT2]

DETAILED SYLLABUS:

	Name of Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**	P-n- junction, working principle of optical fibre, Basics of sound, electric field, magnetic field, conductivity, mobility, Basics of Crystal Physics (Unit cell, Space lattice, Crystal systems), X-rays, Frequency ranges in electromagnetic spectrum, classification of sound, Electrostatic focusing, magneto-static focusing.		
I	**solar Energy**	Conversion of solar Energy in to Electricity ,PhotovoltaicEffect and Solar Cells working principle , Types of Solar Cells , Series & parallel solar cell connections . Applications of Solar system .	**4**	**CO1**
II	**OPTICAL Imaging**	Imaging sensors CCD , CMOS construction and working , Image formation .(Monochrome and Colour) Chromaticity diagram , Chromaticity coordinates, Colour Measurement &colour matching	**4**	**CO2**
III	**Micro Electro - Mechanical Systems**	Overview of MEMS , Intrinsic Characteristics of MEMS , Microsensors and microactuators , Materials for MEMS (Silicon , polymer , Metal) , Packaging and encapsulation of MEMS .	**4**	**CO3**

IV	**Fuel Cell**	Introduction , Classification of Fuel cell Construction & working of Alkaline Fuel cell,Molten carbonate fuel cell , Polymer electrolyte membrane Cell , Solid OXide fuel cell .	**4**	**CO4**
V	**Energy harvesting**	Piezoelectric Effect , Materials and models for Piezoelectric effect ,Piezoelectric Electricity generator , energy harvesting application , human power	**4**	**CO5**
VI	**Nanocomputing**	NanocomputerIntroduction , Nano computer Building block , DNA Carbon nanotubes and nanowires,CHEMICALLY ASSEMBLED ELECTRONIC NANOTECHNOLOGY (CAEN)	**6**	**CO6**

Text Books:

1. Terrestrial Solar Photovoltaics :Tapan Bhattacharya : Narosa Publication House
2. Essential Principles of Image Sensors: by Takao Kuroda : oreilly Publication
3. Fuel cells from fundamentals to Applications By S Srinivasan , L. Krishnana, C Marozzi, Springer
4. Piezo electric Energy Harvesting Willey
5 Designing Nano computer
https://rguir.inflibnet.ac.in/bitstream/123456789/16635/1/9781984664167.pdf
6. Digital Image Processing - Rafael C. Gonzalez, Richard E. Woods, Pearson Prentice Hall
7. Designing Nano computer
https://rguir.inflibnet.ac.in/bitstream/123456789/16635/1/9781984664167.pdf
8. Instrumentation & Measurement Techniques by Albert D. Helfrick& William D. Cooper (PHI) Edition

9. A Textbook of Nanoscience and Nanotechnology, T. Pradeep Tata McGraw Hill Education Pvt. Ltd., 2012

References:

1. Handbook of Modern Sensors Physics design and application- Jacob Fraden, Springer, AIP press.
2. Fundamentals of Physics, Halliday and Resnick, Wiley publication
3. Textbook of and Nanoscience Nanotechnology - B S Murty, S Shankar, Springer Universities Press

Online References:

Sr. No.	Website Name
1.	https://onlinecourses.nptel.ac.in/noc23_ee95/preview
2.	https://repositorio.uam.es/bitstream/handle/10486/665596/artificial_sacha_NT_2013_ps.pdf
3.	https://biogenericpublishers.com/pdf/JBGSR.MS.ID.00147.pdf
4	https://archive.nptel.ac.in/courses/117/105/117105082/
5	https://www.bharathuniv.ac.in/page_images/pdf/courseware_eee/Notes/NE3/BEE026%20MEMS.pdf

Assessment:

Internal Assessment Test (IAT) for 20 marks each:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

End Semester Theory Examination:

Question paper format

- Question Paper will comprise a total of **five questions each carrying 15 marks Q.1** will be **compulsory** and should **cover the 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 **three questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BSL2011	Physics for Emerging Fields Lab		1	-		0.5	-	0.5

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment (IAT)			End Sem. Exam			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)				

BSL2011	**Physics for Emerging Fields Lab**	--	--	--	--	25		25

Lab Objectives:

1. To develop scientific understanding of the physics concepts.
2. To develop the ability to explain the processes and applications related to science subjects.
3. To apply skills and knowledge in real life situations.
4. To improve the knowledge about the theory concepts of Physics learned in the class.
5. To improve ability to analyze experimental result and write laboratory report.
6. To develop understanding about inferring and predicting.

Lab Outcomes:

Learners will be able to

1. Learn Characteristics and use of Photovoltaic Cell
2. Learn Characteristics and use of MEMS sensors
3. Learn to use color sensors and Color measurement
4. Learn to Calibrate RGB LED
5. Learn to use CMOS image sensor
6. Learn use of virtual lab and simulation Experiments

.

List of Experiments. (Minimum five experiments required)

Sr No	List of Experiments	**Hrs**	**LO**
01	Measurements of V-I characteristics (Load) Photovoltaic Cell	**01**	**LO1**
02	Study of power out of series and parallel combinations of Photovoltaic cells	**01**	**LO1**
03	Study of MEMS pressure Sensor	**01**	**LO2**
04	study of colour sensor	**01**	**LO3**
05	Study of Chromaticity diagram with RGB led	**01**	**LO4**
06	Study of directivity and frequency response of MEMS microphone	**01**	**LO2**
07	Study of CMOS image sensor and Colour calibration	**01**	**LO3**
08	Study of a piezoelectric electric transducer as energy source	**01**	**LO2**
09	Study of a Chromaticity &colour matching using Chromatic Vision simulator	**01**	**LO3**
10	Simulation experiments based on nanotechnology using open source simulation	**02**	**LO6**

11	Any other experiment based on syllabus may be included, which would help the learner to understand concept. ,after defining a suitable LO	**02**	**LO6**

Course Code	**Course Name**	**Teaching Scheme (Contact Hours)**			**Credits Assigned**			
		Theory	**Pract.**	**Tut.**	**Theory**	**Pract.**	**Tut.**	**Total**
BSC2022	**Semiconductor Physics**	**2**		**-**	**2**		**-**	**2**

Term Work Marks: 25 Marks (Total marks) = 10 Marks (Experiment) + 10 Marks Project + 5 Marks (Attendance)

Project work : Execution of project as per the plan submitted in semester-I , A working model or a simulation model or a study report leading to a conclusion as anticipated in semester –I is required to be used for awarding marks. A proper rubric should be framed.

Course Code	**Course Name**	**Theory**					**Term work**	**Pract / Oral**	**Total**
		Internal Assessment (IAT)			**End Sem Exam**	**Exam Duration (in Hrs)**			
		IAT-I	**IAT-II**	**IAT-I + ITA-II (Total)**					
BSC2022	**Semiconductor Physics**	15	15	30	45	2		--	75

Rationale:

Most of the engineering branches are being off-spring of basic sciences where physics is playing a pivotal role in concept and understanding of foundation of core engineering branches. This syllabus is developed by keeping in mind, needs of all branches that we offer in University of Mumbai. In the distribution of modules, core physics and its applied form are given priority. Further, it is ensured that these modules will cover prerequisites needed and will remain aligned to the requirements for a certain group of engineering courses to be introduced in higher semesters as core subjects or as interdisciplinary subjects.

Course Objectives:

1. To provide students with a basic understanding of Semiconductors in the field of Basic Engineering.
2. To explain basic importance of p-n junction diodes.
3. To learn about few special diode important for semiconductor industry.

4. To understand the basics of transistors and their applications in the field of electronics.
5. To build foundation of Field effect transistors and their applications.
6. To give exposure to the upcoming field of Nano technology in the field of solid state physics.

Course Outcomes:

1. Learners will be able to **USE** and **DEMOSTRATE** his/ her ability earned here to **apply it to calculate Hall voltage**
2. Learners will be able to **CALCULATE** barrier potential and **PLOT I-V** characteristics of p-n junction diode.
3. Learners will be able to **PLOT** I - V characteristics and understand their applications of some special diodes
4. Learners will be able to **CALCULATE** current gain and **PLOT I-V** characteristics for CB-CE configurations.
5. Learner will be able to **PLOT** I-V characteristics and understand applications of FETs
6. Learner will be able to **APPLY** the knowledge of Nano Technology to certain emerging areas of technology.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
	Prerequisite	Band theory of solids Fermi Dirac Distribution function Density of states and	-	-
1	**Basics of Semiconductors**	Types of semiconductors, Carrier Concentration in Intrinsic Semiconductors, Fermi level of Intrinsic Semiconductors, Variation of Fermi level of Intrinsic Semiconductors, wrttemperature. Extrinsic Semiconductors, Fermi level of Extrinsic Semiconductors, Variation of Fermi level of Extrinsic Semiconductors, wrt temperature and Impurity Concentration, Equation of conductivity with current flow, Hall Effect, Calculation of Hall Voltage**.**	**4**	**CO1**
2	**Junction diode**	Formation of p-n junction,	**4**	**CO2**

		calculation of barrier potential Diode equation, p-n junction in forward Bias, p-n junction in Reverse bias, Current- voltage curve for p-n junction diode, LED and its working		
3	**Important Diodes**	Working of: Photo diode, solar cell, Zenerdiode ,Varactor diode , Gunn diode and their applications.	**4**	**CO3**
4	**Bipolar Junction Transistors**	BJT Structure and Operation - BJT structure, Modes of operation,CB, CE I-V characteristics BJT Amplification and Switching - Current gain, BJT as a switch,	**4**	**CO4**
5	**Field Effect Transistors**	Field-Effect Transistors (FETs) - FET types: JFET, MOSFET, Structure and operation MOSFETs in Detail - MOSFET structure, Enhancement and depletion modes, Threshold voltage MOSFET Applications - MOSFET as a switch,	**6**	**CO5**
6	**NanoTechnology**	Introduction to Nanotechnology , Properties (optical, Electrical, Structural, Mechanical) Importance of surface to Volume ratio, Bonding in solids (Vander walls interactions) , Application: Lithography, Single Electron Transfer (SET), Spin Valves.	**4**	**CO6**

Text Books:

1. Engineering Physics by D.K Bhttacharya, PoonamTandon - Oxford University Press
2. Solid State Electronic Devices – B. G. Streetman – Pearson
3. Electronic Devices and Circuits – Homas Floyd – Pearson
4. Electronic Devices and Circuits – David A. Bell – Oxford University Press

References:

1. Semiconductor Physics and Devices – Basic Principles – Donald Neamen – McGraw Hill
2. Physics of Semiconductor Devices - S.M. Sze, Kwok K. Ng - John Wiley & Sons
3. Electronic Devices and Circuit Theory - R. Boylestad, L Nashelsky - Pearson

Online References:

Sr. No.	Website Name
4.	https://archive.nptel.ac.in/courses/108/108/108108122/
5.	https://onlinecourses.nptel.ac.in/noc22_ee97/preview
3.	https://www.optima.ufam.edu.br/SemPhys/Downloads/Neamen.pdf

Assessment:

Internal Assessment Test (IAT) for 20 marks each:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

End Semester Theory Examination:

Question paper format

- Question Paper will comprise a total of **five questions each carrying 15 marks Q.1** will be **compulsory** and should **cover the 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 **three questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BSL2012	Semiconductor Physics Lab		1	-		0.5	-	0.5

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment (IAT)			End Sem. Exam			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)				
BSL2012	Semiconductor Physics Lab	--	--	--	--	25		25

Lab Objectives:

1. To develop scientific understanding of the physics concepts.
2. To develop the ability to explain the processes and applications related to science subjects.

3. To apply skills and knowledge in real life situations.
4. To improve the knowledge about the theory concepts of Physics learned in the class.
5. To improve ability to analyze experimental result and write laboratory report.
6. To develop understanding about inferring and predicting.

Lab Outcomes:

Learners will be able to..

1. Understand the concepts of Hall effect.
2. Experimentally obtain I-V Characteristics of various junction diodes.
3. Experimentally obtain I-V Characteristics of transistors in various configurations.
4. Experimentally obtain I-V Characteristics of FET in configurations
5. Experimentally obtain I-V characteristics of special purpose diodes.
6. Use virtual lab effectively to perform experiments

List of Experiments. (Minimum five experiments required)

Sr No	List of Experiments	**Hrs**	**LO**
01	Measurement of Hall Voltage	**01**	**LO1**
02	Input –out put characteristics of CE configuration	**01**	**LO3**
03	Input –out put characteristics of CB configuration	**01**	**LO3**
04	I-V Characteristics of p-n junction diode	**01**	**LO2**
05	I-V Characteristics of Zener diode (RB)	**01**	**LO5**
06	I-V Characteristics of photo diode	**01**	**LO5**
07	Carrier concentration using Hall Effect	**01**	**LO1**
08	I-V characteristics of JFET	**01**	**LO4**
09	Carrier concentration using Hall Effect	**01**	**LO1**
10	Simulation experiments based on nanotechnology using open source simulation .	**02**	**LO6**
11	Any other experiment based on syllabus may be included, which would help the learner to understand concept. ,after defining a suitable LO	**02**	**LO6**

Term Work Marks: 25 Marks (Total marks) = 10 Marks (Experiment) + 10 Marks Project + 5 Marks (Attendance)

Project work: Execution of project as per the plan submitted in semester-I , A working model or a simulation model or a study report leading to a conclusion as anticipated in semester –I is required to be used for awarding marks. A proper rubric should be framed.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BSC2023	Physics of Measurements and Sensors	2		-	2		-	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment (IAT)			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)					
BSC2023	Physics of Measurements and Sensors	15	15	30	45	2		--	75

Rationale:

Most of the engineering branches are being off-spring of basic sciences where physics is playing a pivotal role in concept and understanding of foundation of core engineering branches. This syllabus is developed by keeping in mind, needs of all branches that we offer in University of Mumbai. In the distribution of modules, core physics and its applied form are given priority. Further, it is ensured that these modules will cover prerequisites needed and will remain aligned to the requirements for a certain group of engineering courses to be introduced in higher semesters as core subjects or as interdisciplinary subjects.

Course Objectives:

1. To provide students with a basic understanding of Measurements in the field of Basic Engineering.
2. To explain basic importance of Interference in the field of measurements.
3. To learn foundation of Transducers in the area of measurements..
4. To describe the significance of solid state sensors.
5. To build foundation of temperature measurements required in the field of technology..
6. To give exposure to upcoming field of Nano technology in the field of Measurements.

Course Outcomes:

1. Learners will be able to **USE** and **DEMOSTRATE** his ability earned here to **EXAMINE** the erroneous results of measurement systems.
2. Learners will be able to **EXECUTE** the flatness testusing Light waves
3. Learners will be able to**EXAMINE** the use of appropriate transducers for application.
4. Learners will be able to**EXAMINE** the use of appropriate sensors for application
5. Learner will be able to **IMPLEMENT** and**ORGANISE**Varioustemperaturemeasurementtechniques ranges.
6. Learner will be able to **IMPLEMENT** knowledge learned here tonano measurements

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
	Prerequisite	Unit and Dimensions , Wave optics, Piezo electric effect, Wheatstone bridge, Potentiometer, Wave particle duality.	-	-
1	**Introduction**	Preliminary Idea of Physical Measurements: Principle of Measurement, Error of Measurement, Correction, Correctness of Measurement Reliability of Measurements, Verification, Calibration, Measuring Instruments : Measuring range, Sensitivity, Scale Intervals, Response time, repeatability, Inaccuracy, Precision ,Accuracy. Sources of error: Static error, Environmental error, Characteristic error dynamic error Statistical Treatment of errors : Sample mean, Sample Standard deviation, Population Mean, Population standard Deviation, Principles of least Squares	**6**	**CO1**
2	**Measurements by light – Wave Interference**	Significance of monochromatic light in interference, Interferometry applied to flatness testing , surface contour test	**4**	**CO2**
3	**Transducers**	Transducers: Classification by function, classification by performance, classification by	**4**	**CO3**

		output. Developments in transducer technology :Solid state transducer, Optical transducers , Piezoelectric Transducers Resistive Transducers: Potentiometer , Strain Gauges, Resistive Temperature Transducers Inductive Transducers : LVDT Optical measurements system: Thermal photo detectors		
4	**Solid state sensors**	Hall Effect, Measurement of Hall voltage , Piezo electric effect and its use as source in Ultrasonic system, Its application in flow measurements, Ultrasonic distance meter	**4**	**CO4**
5	**Temperature and its measurements**	Concept of Heat , Temperature and its measurements, Bimetallic thermometers, Platinum Resistance thermometers, Thermoelectric thermometers Negative Temperature Coefficient (NTC) Thermistors, Factors for the selection of a thermometer for a particular use, Temperature Range and Comparison of various thermometers. Calibration of PT-100 for temperature measurement.	**4**	**CO5**
6	**Nanotechnology**	Introduction to Nanotechnology , Properties (optical, Electrical, Structural, Mechanical) Importance of surface to Volume ratio, Bonding in solids (Vander walls interactions),Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Atomic Force Microscope (AFM), Applications in sensing toxic gases, gas sensing capacitors, Introduction to lithography, water purification	**4**	**CO6**

Text Books:

1.Engineering Metrology byR.K.Jain (Khanna Publication)

2.Mechatronics byD.A.Bradley et al CRC press Boca Raton London
3. Engineering Physics byDattu R. Joshi Mcgraw Hill Publication (India) Pvt Limited

References:
1.:Transducers and Interfacing by Banister B.R. and Whitehead DC
2 Sensors and Transducers by D Patranabis PHI
3. Transducers and Instrumentation byMurty DVS , (Second Edition) PHI

Online References:

Sr. No.	Website Name
1.	https://onlinecourses.nptel.ac.in/noc21_ee32/preview
2.	https://onlinecourses.nptel.ac.in/noc23_ee95/preview
3.	https://nptel.ac.in/courses/118102003

Assessment:

Internal Assessment Test (IAT) for 20 marks each:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

End Semester Theory Examination:

Question paper format

- Question Paper will comprise a total of **five questions each carrying 15 marks Q.1** will be **compulsory** and should **cover the 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 **three questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BSL2013	Physics of Measurements and Sensors Lab		1	-		0.5	-	0.5

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment (IAT)			End Sem. Exam			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)				

BSL2013	**Physics of Measurements and Sensors Lab**	--	--	--	--	25		25

Lab Objectives:

1. To develop scientific understanding of the physics concepts.
2. To develop the ability to explain the processes and applications related to science subjects.
3. To apply skills and knowledge in real life situations.
4. To improve the knowledge about the theory concepts of Physics learned in the class.
5. To improve ability to analyze experimental result and write laboratory report.
6. To develop understanding about inferring and predicting.

Lab Outcomes:

Learners will be able to:

1. Measure certain physical parameters like R.I.,
2. Understand function of Solid state sensors.
3. Calibrate thermocouple
4. Measure physical parameters using ultra sound sensors.
5. Use virtual lab effectively to perform experiments

List of Experiments.

Sr No	List of Experiments	**Hrs**	**LO**
01	Measurements of R.I of a suitable liquid using Newton's ring Experiment	**1**	**LO1**
02	Measurement of Hall Voltage	**1**	**LO2**
03	Carrier concentration using Hall Effect	**1**	**LO2**
04	Measuring distance using ultrasonic distance meter flow	**1**	**LO4**
05	Calibration of PT100	**1**	**LO3**
06	Calibration of J /K type thermocouple	**1**	**LO3**
07	Simulation experiments based on nanotechnology using open source simulation	**1**	**LO5**
08	Study and use of pressure transducer	**1**	**LO2**
09	V-I characteristic of photo diode	**1**	**LO2**
10	Characteristics of LDR	**2**	**LO2**
11	Any other experiment based on syllabus may be included, which would help the learner to understand concept. ,after defining a suitable LO	**2**	**LO6**

Term Work Marks: 25 Marks (Total marks) = 10 Marks (Experiment) + 10 Marks Project + 5 Marks (Attendance)

Project work: Execution of project as per the plan submitted in semester-I , A working model or a simulation model or a study report leading to a conclusion as anticipated in semester –I is required to be used for awarding marks. A proper rubric should be framed.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BSC2031	Engineering Materials	2		-	2		-	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment (IAT)			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)					
BSC2031	Engineering Materials	15	15	30	45	2		--	75

Rationale:

Chemical science has contributed in many ways to most of the Engineering branches where "Engineering Materials" such as alloys, ceramics, composites can be prerequisites to many subjects of all core groups. Polymeric materials can be learnt from the perspective of applications as Polymer semiconductor, Polymer batteries which are common in technology.

Course Objectives:

1. To study the composition, properties and functions of various alloys
2. To learn the types, properties and uses of various Ceramics
3. To learn the composition, properties and functions of various Composite materials
4. To learn important types, synthesis and uses of plastics and elastomers.
5. To study the different types of advanced polymers with their applications.
6. To study the types, properties and uses of various Nanomaterials

Course Outcomes:

Student will be able to –

1. Identify different types of alloys and use them for specific engineering applications
2. Familiar with different types of ceramics and apply them for different engineering purposes

3. Identify different types of composite materials for the industrial uses
4. Utilize different plastics and elastomers in industries
5. Recognize different advanced polymers for specific engineering applications
6. Find different nanomaterials for the scientific applications

Prerequisite:

1. Knowledge about purpose of making alloys
2. Knowledge about Constituents of Composites and their functions.
3. Knowledge of basic properties of polymers.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Alloys**	A) Ferrous alloys – Plain-carbon steels, Heat and Shock resisting steels, Stainless steels. Effect of the alloying element- Ni, Cr, Co, Mn, Mo, W and V. B) Aluminium alloys – Composition, properties and uses of i) Duralumin, ii) Magnalium. C) Copper alloys – Composition, properties and uses of i) Brass – Dutch Metal and German Silver and ii) Bronze – Gun metal and Nickel bronze. D) Alloys of Pb – Composition, properties and Uses of i) Wood's metal ii) Tinman's solder. E) Numerical based on Composition, density and weight of an alloy	**4**	**CO1**
II	**Ceramics**	A) Introduction of Ceramics – Definition, types, properties and uses. B) Glass – Definition, Properties, Types with uses. C) Abrasives – Natural and Artificial Abrasives – Examples, Properties and Uses. D) Optical fibres – Definition, Components of optical transmission system, Advantages of optical fibre communication, Applications of glass-based fibre - optical fibres.	**4**	**CO2**
III	**Composites**	A) Types of Composites, sub-types and Applications: - i) Fibre- reinforced composites, ii) Layered-composites (Laminates), iii) Particulate-	**4**	**CO3**

		composites. B) Bio-composites – Definition, Classification and Applications.		
IV	**Plastics and Elastomers**	A) Introduction to Plastics - Thermoplastic and Thermosetting plastics, compounding of plastics, Application of Plastics, Numerical based on Degree of polymerisation, Density and mass, tensile strength of polymer B) Introduction to elastomers - structural requirement of elastomer, natural rubber, processing of natural rubber, drawbacks, compounding of rubber C) Synthesis of commercial polymers: i) Plastics: Preparation, properties and uses of Polymethyl Methacrylate (PMMA), polytetrafluoroethylene (PTFE) ii) Elastomers: Preparation, properties and uses of Polyurethane Rubber, Silicone rubber	**5**	**CO4**
V	**Advanced Polymers**	A) Conducting polymers, B) Bio- polymers, C) Liquid crystal polymers, D) Intelligent (smart) polymers	**3**	**CO5**
VI	**Nano materials**	A) Definition, Types of Nanostructured materials, Applications of Nanomaterials. B) Graphene, C) Types of Carbon Nanotubes (SWCNTs and MWCNTs) – Properties and Uses.	**4**	**CO6**

Recommended Books:

1. Engineering Chemistry, Jain and Jain, Dhanpat Rai Publication
2. A textbook of Engineering Chemistry, S. S. Dara, S. Chand and Company
3. Polymer Science: Vasant Gowarikar, Wiley Estern Ltd, new Delhi
4. Textbook of Polymer science : F.W. Billmeyer

5. Fundamentals of Polymer science & Engineering- Anilkumar& S K Gupta, Tata McGraw Hill, New Delhi

Online References:

Sr. No.	Website Name
1.	https://www.researchgate.net/
2.	https://www.sciencedirect.com/topics/engineering/polymer-material
3.	https://www.sciencedirect.com/topics/chemistry/nanomaterial

Assessment:

Internal Assessment Test (IAT) for 20 marks each:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

End Semester Theory Examination:

Question paper format

- Question Paper will comprise a total of **five questions each carrying 15 marks Q.1** will be **compulsory** and should **cover the 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 **three questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BSL2021	Engineering Materials Lab	--	1	-	--	0.5	-	0.5

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment (IAT)			End Sem. Exam			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)				
BSL2021	Engineering Materials Lab	--	--	--	--	25	--	25

Lab Objectives:

1. To apply knowledge acquired during the theory class in carrying out the experiments for qualitative and quantitative determination.
2. To analyse experimental results and write laboratory reports.

Lab Outcomes:

After completion of experiment, the learners will be able to:

1. Learn various quantitative analytical techniques to determine % of elements from alloy samples
2. Synthesize UF/PF resin at laboratory level

Prerequisite:

1. Knowledge of basic safety practices in Chemistry Laboratory
2. Knowledge of volumetric analysis

List of Experiments.

Sr No	List of Experiments	Hrs
01	Determination of Sn from solders volumetrically	**01**
02	Determination of Cu by colorimetry	**01**
03	Determination of Fe by colorimetry	**01**
04	Determination of % purity of iron	**01**
05	Synthesis of Urea formaldehyde resin	**01**
06	Synthesis of Phenol formaldehyde resin	**01**
07	Determination of viscosity average molecular weight of polymer	**01**
08	Determination of glass transition temperature of polymer0	**01**

Sr No	List of Assignments / Tutorials	Hrs
01	Composition, Properties of any 4 alloys	1
02	Advantages and applications of Ceramics	1
03	Note on FRPs	1
04	Synthesis, properties and uses of any two plastics/elastomers	1
05	Note on Liquid Crystal polymers	0.5
06	Note on CNTs	0.5

Assessment :
Term Work: Term Work shall consist of at least 5 to 6 practicals based on the above list. Also, Term work Journal must include at least 4 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BSC2032	Environmental Chemistry and Non-conventional energy sources	2		-	2		-	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment (IAT)			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)					
BSC2032	Environmental Chemistry and non-conventional energy sources	15	15	30	45	2		--	75

Rationale:

Chemical science has contributed in many ways to most of the Engineering branches where "Environmental Chemistry" is the modern approach to learn impact of Technology on habitat and can be common to all Core Groups. "Non-Conventional Energy Study" is the matter of general approach to all Core groups as Energy issue is the most recent concern even for designing computational engines (Include hardware & software energy efficient).

Course Objectives:

1. To gain the knowledge of different air pollutants and their control methods.
2. To identify water pollutants of different sources and suggest methods for the treatments.

3. To study the solid and hazardous waste management methods
4. To identify different types of non-conventional energy sources.
5. To gain knowledge of biomass energy and processes.
6. To demonstrate sustainable practices to make the environment clean

Course Outcomes:
Student will be able to –

1. Apply the knowledge of air pollution control to save the environment.
2. Analyze the quality of waste water to clean the water bodies
3. Identify methods for solid and hazardous waste treatment to protect the health and environment.
4. Compare the availability and efficiency of performance and environmental impact of non-conventional energy sources.
5. Determine the sources and applications of biomass to save the environment
6. Apply the knowledge of sustainable practices in different parts of world to protect the environment

Prerequisite:

1. Knowledge of different types of pollution.
2. Knowledge of basics of pollution control
3. Knowledge of demerits of conventional energy sources.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Air Pollution and Atmospheric Chemistry**	A) Chemistry and mechanism of some global effects of air pollution – Acid rain, Ozone hole, Photochemical smog B) Gaseous Pollutants: i) Measurement of gaseous pollutants; ii) Methods to control emissions of sulphur oxides, nitrogen oxides, carbon monoxide and gaseous hydrocarbons. C) Automotive emission controls: Measurement and control, catalytic convertors.	**4**	**CO1**
II	**Water & Waste water Treatment and Management**	A) Classification of water pollutants – Organic, Inorganic, Suspended, Radioactive, Heat. B) Monitoring Techniques and methodology for following parameters: Hardness, pH, Dissolved oxygen, Chloride (Numerical)	**4**	**CO2**

		C) Point and nonpoint sources of water pollution D) Characteristics of waste water, Acidification, Eutrophication and thermal stratification of lake water. E) Wastewater treatment: Primary treatment, Secondary Treatment – Activated Sludge Process, Tertiary Treatment F) Relevance of determining Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) with reference to waste water treatment process, numerical		
III	**Solid and Hazardous Waste Management**	A) Integrated solid waste management; Waste hierarchy; Rules and regulations for solid waste management in India. Definition and Composition Hazardous waste. B) Hazardous waste management: Control Methods: - i) Physical Methods – Sedimentation, Adsorption, Ion exchange methods, Electrodialysis, Reverse Osmosis ii) Chemical Methods – Neutralization, Chemical precipitation, chemical oxidation-reduction, biological treatment, incineration	**4**	**CO3**
IV	**Introduction to non-conventional (Renewable) energy sources**	A) Need of non-conventional energy sources. B) Renewable Sources of Energy such as Hydro, Solar, Wind, Biomass, Tidal and Geothermal - their availability and limitations.	**4**	**CO4**
V	**Non-conventional Energy sources**	A) Biomass Energy: - i) Definition, ii) Sources of Biomass – Wood, Agricultural crop, Animal waste, Algae, Sewage waste iii) Advantages and disadvantages of Biomass, iv) Important Biomass processes – Pyrolysis, Gasification, Anaerobic decomposition, v) Uses of biomass – (Direct) for heat generation and (Indirect) for conversion to biofuel B) Hydrogen fuel cell	**4**	**CO5**
VI	**Sustainable Practices**	A) Energy Resources available B) Consumption practices in different parts of the world.	**4**	**CO6**

		C) Natural Resource management & Environmental Ethics D) Importance of Responsible Consumption. E) Introduction to concept of Energy Audit		

Recommended Books:

1. Engineering Chemistry, Jain and Jain, Dhanpat Rai Publication
2. A textbook of Engineering Chemistry, S. S. Dara, S. Chand and Company
3. "Energy Resources: Conventional & Non-Conventional" by R. K. Rajput
4. Engineering Chemistry, O. G. Palana, Tata McGraw Hill Publication
5. Environmental Chemistry, A. K. De, Tenth edition, New Age International,

Online References:

Sr. No.	Website Name
1.	https://www.sciencedirect.com/topics/earth-and-planetary-sciences/wastewater-management
2.	https://www.researchgate.net/publication/355204245_Biomass_Energy
3.	https://nelda.org.in/sustainable-living-practices/

Assessment:

Internal Assessment Test (IAT) for 20 marks each:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

End Semester Theory Examination:

Question paper format

- Question Paper will comprise a total of **five questions each carrying 15 marks Q.1** will be **compulsory** and should **cover the 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 **three questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BSL2022	Environmental Chemistry and Non-conventional Energy sources Lab	--	1	-	--	0.5	-	0.5

Course Code	Course Name	Examination Scheme						
		Theory Marks						
		Internal assessment (IAT)			End Sem. Exam	Term Work	Practical/ Oral	Total
		IAT-I	IAT-II	IAT-I + IAT-II (Total)				
BSL2022	Environmental Chemistry and Non-conventional Energy sources Lab	--	--	--	--	25	--	25

Lab Objectives:

1. To apply knowledge acquired during the theory class in carrying out the experiments for qualitative and quantitative determination.
2. To analyze experimental results and write laboratory reports.

Lab Outcomes:

After completion of experiment, the learners will be able to:

1. Apply knowledge of various quantitative analytical techniques to determine the hardness and other impurities in water.
2. Use pH meter for determination of pH of water samples
3. Interpret results of COD to assess pollution level of wastewater.

Prerequisite:

1. Knowledge of basic safety practices in Chemistry Laboratory
2. Knowledge of volumetric analysis
3. Knowledge of BOD & COD of waste water

List of Experiments.

Sr No	List of Experiments	Hrs	LO Mapping
01	Determination of Total, Temporary and Permanent hardness of water by EDTA method	**2**	**LO1**
02	Determination of Chloride content of water	**2**	**LO2**
03	Determination of pH of various water samples	**2**	**LO3**
04	Determination of COD of waste water	**2**	**LO4**
05	Making report on energy saving appliances	**2**	**LO5**
06	Case study based on sustainable development practices	**2**	**LO6**

Sr No	List of Assignments / Tutorials	Hrs
01	Note on methods to control emissions of various air pollutants	**01**
02	Numerical on determination of hardness of water	
03	Note on Activated sludge treatment	
04	Note on limitations of Renewable sources of energy	
05	Note on Hydrogen fuel cell	
06	Note on Environmental Ethics	

Assessment :

Term Work: Term Work shall consist of at least 5 to 6 practicals based on the above list. Also, Term work Journal must include at least 4 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BSC2033	Introduction to Computational Chemistry	2		-	2		-	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment (IAT)			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)					
BSC2033	Introduction to Computational Chemistry	15	15	30	45	2	25	--	100

Rationale:

This subject is a Common to All Core Groups as this involves basic simulation Design Techniques to understand real world phenomena. It links real world to correlated simulation essential to understand how simulation works with reliability. Generation of data and data analysis with experimentation is the core theme of this subject and can be a choice of all core Groups.

Course Objectives:

1. To know the fundamental principles of Computational Chemistry required to solve engineering problems
2. Practical implementation of fundamental theory concepts
3. To enable the students to understand the role of computers in chemistry
4. To study the applications of chemistry in various engineering and technological processes

Course Outcomes:
Student will be able to –

1. Understand computational chemistry, distinguishing it from experimental chemistry, and articulate its role within the broader field of chemical sciences.
2. Apply mathematical concepts and theories that underpin computational chemistry techniques, such as quantum mechanics and statistical mechanics
3. Utilize computers to understand role of computer simulations to understand and solve basic problems in chemistry
4. Develop the basic understanding of scientific simulation and modeling
5. Apply computational and theoretical chemistry concepts to understand chemistry behind every day and industrial processes
6. Apply the computational tools and methodology to represent chemical systems

Prerequisite:

1. Basic understanding of chemical principles, including atomic structure, chemical bonding, stoichiometry, and thermodynamics.
2. Knowledge of differential and integral calculus, including concepts of limits, derivatives, and integrals.
3. Understanding of basic numerical techniques for solving mathematical problems, such as root-finding, numerical integration, and differential equations.
4. Familiarity with general scientific software and tools, such as MATLAB and basic knowledge of operating systems (Linux, Windows).

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Computational Chemistry	A) Definition and scope B) Importance in modern chemical research C) Computational investigations	**4**	**CO1**
II	Tools of Computational Chemistry	A) Molecular Mechanics B) Ab initio Calculations C) Semi Empirical methods	**4**	**CO2**

		D) Density Functional Theory E) Molecular dynamics		
III	Basics of Quantum mechanics	A) Fundamental concepts: particles, waves, and quantization B) Schrödinger equation and its significance C) Simple systems: particle in a box, hydrogen atom	**4**	**CO3**
IV	Molecular mechanics	A) Force fields: definition and components B) Potential energy surfaces and molecular modeling C) Applications of molecular mechanics in predicting molecular properties	**4**	**CO4**
V	Molecular Structure and Bonding	A) Atomic orbitals and electron configuration B) Molecular orbitals: formation and significance C) Bonding theories: Valence Bond Theory (VBT) and Molecular Orbital Theory (MOT)	**4**	**CO5**
VI	Computational Methods in Quantum Chemistry	A) Introduction to Hartree-Fock method B) Basis sets and their importance	**4**	**CO6**

Recommended Books:

1. "Introduction to Computational Chemistry" by Frank Jensen, John Wiley & Sons, Ltd
2. "Essentials of Computational Chemistry: Theories and Models" by Christopher J. Cramer, John Wiley & Sons, Ltd
3. Computational Chemistry, David C. Young, John Wiley & Sons, Inc, Publication

Online References:

Sr. No.	Website Name
1.	MIT OpenCourseWare: Computational Chemistry
2.	Khan Academy: Basic Quantum Mechanics
3.	https://www.sciencedirect.com/topics/chemistry/computational-chemistry#:~:text=Computational%20chemistry%20is%20a%20branch,properties%20of%20 molecules%20%5B43%5D

Assessment:

Internal Assessment Test (IAT) for 20 marks each:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

End Semester Theory Examination:

Question paper format

- Question Paper will comprise a total of **five questions each carrying 15 marks Q.1** will be **compulsory** and should **cover the 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 **three questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BSL2023	Introduction to Computational Chemistry Lab	--	1	-	--	0.5	-	0.5

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment (IAT)			End Sem. Exam			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)				
BSL2023	Introduction to Computational Chemistry Lab	--	--	--	--	25	--	25

Lab Objectives:

1. To study applications of computational chemistry
2. To learn to simulate and predict molecular structures and properties using different kinds of calculations based on quantum and classical physics

Lab Outcomes:

After completion of experiment, the learners will be able to:

1. Attain proficiency in using major computational chemistry software packages (e.g., Gaussian, GAMESS) to conduct simulations and analyze chemical systems.
2. Apply principles of Computational Chemistry
3. Simulate and predict molecular structures and properties using different kinds of calculations.
4. Understand the complementarity of computational and experimental approaches in chemistry.
5. Develop research skills and problem-solving abilities using computational chemistry techniques.
6. Adhere to ethical standards and practices in computational chemistry research.

List of Experiments.

Sr No	List of Experiments	Hrs	LO Mapping
01	Introduction to key software packages (e.g., Gaussian, GAMESS)	**1**	**LO1**
02	Setting up and running basic calculations	**1**	**LO2**
03	Interpreting output files	**1**	**LO3**
04	Fundamentals of Molecular interaction	**1**	**LO4**
05	Fundamentals of Chemical reaction	**1**	**LO5**
06	Prediction of molecular structure	**1**	**LO6**

Sr No	List of Assignments / Tutorials	Hrs
01	Research and summarize three key applications of computational chemistry in different fields (e.g., drug design, material science, environmental chemistry).	2
02	Derive and explain the significance of the Schrödinger equation.	1
03	Define force fields and list their main components (bond stretching, angle bending, torsional interactions, non-bonded interactions).	1
04	Draw a simple PES for a diatomic molecule by hand or using a graphing software. Label the critical points (minima, maxima, saddle points).	1
05	Download and install a molecular visualization software (e.g., Avogadro, VMD). Use the software to build and optimize the geometry of a small organic molecule (e.g., ethanol).Take screenshots of the optimized structure and include them in a report. Describe the process you followed	2

	and discuss any changes in bond lengths or angles observed during optimization.	
06	Follow a tutorial to perform a simple MD simulation of a water box using online resources or an introductory MD software package.	2

Assessment :

Term Work: Term Work shall consist of at least 5 to 6 practicals based on the above list. Also,

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ESC201	Engineering Graphics	3	-	-	3	-	-	3

Term work Journal must include at least 4 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Course Code	Course Name	Theory					Term work	Practical / Oral	Total
		Internal Assessment (IAT)			End Semester Exam	Exam Duration (in Hrs.)			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)					
ESC201	Engineering Graphics	20	20	40	60	3	--	--	100

Rationale:

Engineering Graphics is an essential subject across all engineering disciplines, as it develops crucial visualization skills, enabling students to comprehend and design complex structures and systems in three dimensions. It facilitates precise technical communication, allowing engineers to convey design ideas, concepts and specifications effectively, which is vital for collaboration in multidisciplinary

teams. It is a language engineers, designers, and architects use to convey their ideas to manufacturers, constructors, and stakeholders. This subject enhances problem-solving abilities of students to create and interpret detailed technical drawings, helping to identify and resolve design issues early. Furthermore, it emphasizes accuracy and precision, which are critical in producing exact drawings for fabrication and assembly across all branches of engineering.

Course Objectives:

1. To impart and inculcate proper understanding of the theory of projection.
2. To impart the knowledge to read and interpret a drawing
3. To improve the visualization skill.
4. To enable students to represent three-dimensional objects on a two-dimensional surface in a way that accurately conveys their shape, size, and orientation.
5. To acquaint students with representing internal features of a three-dimensional object by way of section that accurately conveys their internal orientation.

Course Outcomes: Learners will be able to …

1. Apply basic concepts of geometrical constructions to create engineering curves.
2. Apply the basic principles of projections in Projection of Lines and Planes
3. Apply the basic principles of projections in Projection of Solids.
4. Apply the basic principles of sectional views in Section of solids.
5. Apply the basic principles of projections in converting pictorial views into orthographic Views.
6. Apply the basic principles of projections in converting orthographic Views into isometric drawing.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	1.To draw basic geometric shapes like pentagon, hexagon and square (in different orientation). 2. Divide a line into equal number of parts. 3. Divide a circle into equal number of parts. **Comment** (Prerequisite syllabus should not be considered for paper setting)	**01**	
I	**Introduction to Engineering Drawing**	1.1 Introduction to Engineering Graphics and its significance in Engineering domain. Types of Lines, Dimensioning Systems as per IS conventions. 1.2 Introduction to plain and diagonal scales. 1.3 Engineering Curves: Basic construction of Cycloid, Involutes and Helix (cylinder only).	**03**	**CO1**
II	**Projections of Points, Lines and Planes**	**2.1 ProjectionsofPoints** Projections of points in any quadrants as well as resting on planes. **2.2 ProjectionsofLines** Projections of linesinclinedto boththe reference planes(Excluding Tracesof lines).	**06**	**CO2**

		Simpleapplicationbasedproblemsonprojectionoflines. **2.3 ProjectionsofPlanes** Projections of planes (Triangular,Square,Rectangular,Pentagonal,Hexagonaland Circular) inclinedto boththe Reference Planes. (Excludecompositeplanes).		
III	**Projections of Solids**	Projections of solids with the axis inclined to one and both reference planes. (prism, pyramid, cylinder and cone only). Triangular to hexagonal prism and pyramids to be considered. Exclude Spheres, Composite, hollow solids and frustum of solids). Use change of position or Auxiliary plane method.	**06**	**CO3**
IV	**SectionsofSolids and Development of Surfaces**	**4.1 SectionsofSolids** Sections of Prism, Pyramid, Cylinder, & Cone cut by plane perpendicular to atleast one reference plane (Exclude Curved Section Plane). Use change ofpositionorAuxiliaryplanemethod. **4.2 @Development of Surfaces** Development of lateral surface (only) of prism and pyramid only.	**08**	**CO4**
V	**Orthographic Projections**	**5.1 OrthographicProjections** Fundamentalsoforthographic projections like concept of quadrants, observer position, horizontal, vertical and profile plane, symbol etc. Different orthographic views, First and Third angle method of projection. Views of a simple machine part as per the firstangle projection method recommended by I.S. **5.2 SectionalOrthographicProjections** Fundamentalsof sectional projections like concept of section plane, its representation, section lines and its features, need of sectional views, rib and web in section. Types of section and its representation. Different views of a simple machine part as per the firstangle projection.	**09**	**CO5**
VI	**IsometricViews**	Basic concept of isometricprojection like why it is called isometric, what does it represents, its need, isometric and non-isometric lines, isometric axes and isometricscale. Difference between isometric projection and isometric views. Conversionof orthographicviewstoisometricviews (Excludingsphere).	**07**	**CO6**
@ only in Term Work and to be considered for lab course (i.e.; Questions will not be asked in any examination).				

Textbooks:

1. N.D. Bhatt, "Engineering Drawing (Plane and solid geometry)", Charotar Publishing House Pvt. Ltd.

2. N.D. Bhatt & V.M. Panchal, "Machine Drawing", Charotar Publishing House Pvt. Ltd.

References:

1. Narayana, K.L. & P Kannaiah (2008), Textbook on Engineering Drawing, Scitech Publisher.
2. Prof. Sham Tickoo (Purdue University) & Gaurav Verma, "(CAD Soft Technologies).
3. Auto CAD 2012 (For engineers and Designers)", Dreamtech Press New Delhi.
4. Dhananjay A Jolhe, "Engineering Drawing" Tata McGraw Hill.

Online References:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/112/105/112105294/
2.	https://nptel.ac.in/courses/112103019
3.	https://archive.nptel.ac.in/courses/112/102/112102304/

Assessment:

Internal Assessment (IA) for 20 marks each:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

End Semester Theory Examination:

- **Question paper format**

  - Question Paper will comprise a total of **six questions each carrying 15 marks Q.1** will be **compulsory** and should **cover the 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	Tutorial	Total
ESL201	Engineering Graphics Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks						
		Internal assessment (IAT)			End Semester Exam	Term Work	Practical/ Oral	Total
		IAT-I	IAT -II	IAT-I + IAT-II (Total)				
ESL201	Engineering Graphics Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To impart and inculcate proper understanding of the theory of projection.
2. To impart the knowledge to read and interpret a drawing
3. To improve the visualization skill.
4. To enable students to represent three-dimensional objects on a two-dimensional surface in a way that accurately conveys their shape, size, and orientation.
5. To acquaint students with representing internal features of a three-dimensional object by way of section that accurately conveys their internal orientation.
6. To impart basic AutoCAD skills.

Lab Outcomes: Learners will be able to …

1. Apply basic concepts of geometrical constructions to create engineering curves.

2. Apply the basic principles of projections in projection of basic geometric objects.
3. Apply the basic principles of projections in projection of regular solid objects.
4. Apply the basic principles of projections in converting pictorial views into orthographic Views.
5. Apply the basic principles of projections in converting orthographic views into isometric drawing.
6. Apply basic AutoCAD skills in construction of views and objects.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
I	**Basic Engineering Curves**	1.1 Construction of plain and diagonal scales for simple applications. 1.2 Construction of basic engineering curves like cycloid, involutes and helix (cylinder only).	**02**	**LO1**
II	**Projections of Lines and Planes**	**2.1 ProjectionsofLines** Simple problems to apply the concept of projections of linesinclinedto boththe reference planes. **2.2 ProjectionsofPlanes** Problems on projections of planesinclinedto boththe reference planes.	**04**	**LO2**
III	**Operations on Solids**	**3.1 Projections of Solids** Problems on projections of solids with the axis inclined to one and both reference planes. Use auxiliaryplanemethod. **3.2 SectionsofSolids** Problems on sections of solids cut by plane perpendicular to atleast one reference plane. Use auxiliaryplanemethod. **3.3 @Development of Surfaces** Development of lateral surface (only) of prism, pyramid and cylinder.	**04**	**LO3**
IV	**Orthographic Projections**	**4.1 OrthographicProjections** Construction of orthographic views from pictorial view of an object. Use of proper dimensioning technique for dimensioning the drawn views. **4.2 SectionalOrthographicProjections** Construction of orthographic views (with section) from pictorial view of an object. Location of section plane in concerned views.	**04**	**LO4**
V	**IsometricViews**	Conversionof orthographicviewstoisometricviews.	**02**	**LO5**
VI	**Drafting Technique**	**6.1 OverviewofComputerGraphicsCovering:** Basic information about the drafting software (CAD). Demonstrating knowledge of the theory of CAD software such as: MenuSystem, Toolbars	**08**	**LO6**

		(Standard, Object Properties, Draw, Modify and Dimension),Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes andwindows,Shortcutmenus(ButtonBars),TheCommandLine(whereapplicable),The Status Bar, Different methods of zoom as used in CAD, Select and eraseobjects. **6.2 Customization&CADDrawing:** Consistingofsetupofthedrawingpageandtheprinterincludingscalesettings,settingupofunitsanddrawing limits,ISOandANSIstandardsforcoordinate dimensioning. **6.3 Annotations,layering&otherFunctionsCovering:** Applyingdimensionstoobjects,applyingannotations todrawings,settingupanduse of layers, layers to create drawings, Create, edit and use customized layers,changing line lengths through modifying existing lines (extend/lengthen).		

Textbooks:

1. N.D. Bhatt, "Engineering Drawing (Plane and solid geometry)", Charotar Publishing House Pvt. Ltd.

2. N.D. Bhatt & V.M. Panchal, "Machine Drawing", Charotar Publishing House Pvt. Ltd.

References:

1. Narayana, K.L. & P Kannaiah (2008), Textbook on Engineering Drawing, Scitech Publisher.
2. Prof. Sham Tickoo (Purdue University) & Gaurav Verma, "(CAD Soft Technologies).
3. Auto CAD 2012 (For engineers and Designers)", Dreamtech Press NewDelhi.
4. Dhananjay A Jolhe, "Engineering Drawing" Tata McGraw Hill.

Online Resources:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/112/105/112105294/
2.	https://nptel.ac.in/courses/112103019
3.	https://archive.nptel.ac.in/courses/112/102/112102304/

List of Experiments

Sr No	List of Experiments	Hrs	CO Mapping
01	Two problems on Scale and two problems on EngineeringCurves *to be drawn on drawing sheet.*	02	LO1
02	Minimum four problems on ProjectionofLines*to be drawn on*	02	LO2

	drawing sheet.		
03	Minimum four problems on Projectionof Planes*to be drawn on drawing sheet.*	02	LO2
04	Minimum of two problems on Projectionof Solids *to be drawn on drawing sheet.* Out of two problems one should be on the prism category (includes cylinder) and other should be on the pyramid category (includes cone).	02	LO3
05	Minimum of two problems on Sectionsof Solids *to be drawn on drawing sheet.* Out of two problems one should be on the prism category (includes cylinder) and other should be on the pyramid category (includes cone).	02	LO3
06	Minimum two problems on Development of Surfaces *to be drawn on drawing sheet.* Out of two problems one should be on the prism category (includes cylinder) and other should be on the pyramid category (includes cone).	02	LO3
07	Two problems on OrthographicProjections(withoutsection)*using drafting software.*	02	LO4, LO6
08	Two problems on OrthographicProjections(withsection)*using drafting software.*	02	LO4. LO6
09	Minimum of two problems on Isometric Projections *to be drawn on drawing sheet.* Out of the two problems, one should include a circular portion and one problem should have a sloping surface. Also, one problem should be solved by natural scale and another problem should be solved by isometric scale.	02	LO5
10	Minimum two problems on Isometric Projections *using drafting software.*	02	LO5, LO6

* Out of four problems from practical numbers 4 and 5 at least one problem should be on cone and cylinder each.

*****Allprintoutstobe taken intheCADLaboratory.Preferably,useA3sizesheetsforprintout.

Assessment

a) Term Work: Term Work shall consist of all the above mentioned practical. Term work will also include the A3 size sketch book. Problems taught in theory class in A3 size sketch book may be considered for term work. Alternatively subject teacher may give problems on each topic to be solved by students as home assignments in the same A3 size sketch book.

Term Work Marks: 25 Marks

a) Drawing Sheets + CAD printout = 15 Marks
b) Theory Class A3 size Sketch Book = 5 Marks
c) Attendance = 5 Marks

b) Practical Exam: (2 hours/ 25 Marks)

End semester Practical exam will be held using CAD software only. This exam will be based on the following syllabus.

1. Isometric projections. (One problem, compulsory)
2. Orthographic Projection (without section)
3. Orthographic Projection (with section)

* The examiners may decide the weightage of the questions asked in the practical exam.

* Printout of the answers have to be taken preferably in A3 size sheets and should be assessed by external examiner only.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Tut.	Pract / Oral	Theory	Tut.	Pract/ Oral	Total
PCC2013	Elements of Biomedical Engineering	2	--	-	2	-	-	2

* Knowledge of AutoCAD software, concepts of Engineering Graphics related to specified problem and accuracy of drawing should be considered during evaluation.

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment Test (IAT)			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)					
PCC2013	Elements of Biomedical Engineering	20	20	40	60	2	--	--	100

Rationale:

An introductory course of the branch is necessary in first year to give an overall view and develop interest.

Course Objectives:

1 To understand the anatomical structures and physiological processes of the human body.

2 To understand bio-electric signals and their recording.

3 To understand need for patient monitoring and continuous recording of vitals.

4 To understand need for life saving equipment's and get acquainted with their construction and working.
5 To understand basics of imaging equipment.
6 To understand basic concepts and theory related to statistics.

Course Outcomes:

1. Learners will be able to explain the anatomical parts and physiological processes of important systems of human body.
2. Learners will be able to record bio-electric signal from the human body.
3. Learners will be able to acquire human vitals from patient in ICU.

4.Learners will be able to demonstrate working of the lifesaving instruments.
5.Learners will be able to explain construction and working of X-ray and Ultrasound.
6.The learner will be able to perform preliminary analysis of the medical data.

Prerequisite: Knowledge of living organisms, Basics of electrical and electronics circuits, Physics of sensors and measurements.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**	Knowledge of living organisms, Basics of electrical and electronics circuits, Physics of sensors and measurements	**0**	**---**
I	**Introduction to the Human Body**	Cardiovascular system, Respiratory system, Nervous system, Special senses, Action potential	**05**	**CO1**
II	**Bio-electric Signals**	ECG, EMG and EEG signals, Lead configurations, Sensors and amplifiers, Patient safety	**05**	**CO2**
III	**Patient monitoring instruments**	ECG, spO2, Respiratory, Blood pressure, Temperature monitoring during intensive care.	**04**	**CO3**
IV	**Lifesaving instruments**	Principle and working of cardiac pace maker and de-fibrillator	**04**	**CO4**
V	**Basics of imaging**	Principle and working of X-ray and ultarsound imaging	**04**	**CO5**
VI	**Data analysis**	Descriptive statistics, probability and sampling distributions, Differentiate between two populations	**04**	**CO6**

Text Books:

1. Introduction to Biomedical Equipment Technology: Carr –Brown. (PH Pub)
2. Medical Instrumentation, Application and Design: J G. Webster. (John Wiley)
3. Biostatistics by Wayne W. Daniel, Seventh edition, Wiley India

References:

1. Principles of Applied Biomedical Instrumentation, Geddes & Baker, John Wiley
2. Christensen's Physics of Diagnostic Radiology, Thomas S. Curry, James E. Dowdey, Robert C. Murry. Wolters Kluwer, Fourth Edition
3. Physics of Diagnostic Imaging, David Dowsett, Patrick A Kenny, R Eugene Johnston. CRC Press, Second Edition.

Online References:

Sr. No.	Website Name
1.	*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*
2.	Medical Image Analysis, Dr. Debdoot Sheet, Indian Institute of Technology, Kharagpur Course Link: https://nptel.ac.in/courses/108/105/108105091/
3.	***Course 1:*** *Introduction to Biomedical Imaging* *https://www.edx.org/course/introduction-to-biomedical-imaging* ***Course 2:*** *Fundamentals of Biomedical Imaging: Ultrasounds, X-ray, positron emission tomography (PET) and applications* *https://www.edx.org/course/fundamentals-of-biomedical-imaging-ultrasounds-x-r*
4.	Introduction to Data Analytics by Prof. Nandan Sundarsanam – IIT-M and Prof. B. Ravindran – IIT-M https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-mg06/

Assessment:

Internal Assessment (IA) for 20 marks each:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

End Semester Theory Examination:

- **Question paper format**

  - Question Paper will comprise a total of **six questions each carrying 15 marks Q.1** will be **compulsory** and should **cover the 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	Tut.	Pract / Oral	Theory	Tut.	Pract/ Oral	Total
PCL2013	Elements of Biomedical Engineering Lab	--	--	2	--	-	1	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment Test (IAT)			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)					
PCL2013	Elements of Biomedical Engineering Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1 To understand test and measuring instruments.
2 To understand bio-electric signals and their recording.
3 To understand need for patient monitoring and continuous recording of vitals.

4 To understand need for life saving equipment's and get acquainted with their construction and working.
5 To understand basics of imaging equipment's.
6 To understand basic concepts and theory related to statistics

Lab Outcomes:

1 Learner will be able to make measurements using common tools.
2 Learners will be able to record bio-electric signal from the human body.
3 Learners will be able to acquire human vitals from patient in ICU.
4 Learners will be able to demonstrate working of the lifesaving instruments.
5 Learners will be able to explain construction and working of X-ray and Ultrasound.
6 The learner will be able to perform preliminary analysis of the medical data.

Prerequisite: Knowledge of living organisms, Basics of electrical and electronics circuits, Physics of sensors and measurements.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	**Prerequisite**	Knowledge of living organisms, Basics of electrical and electronics circuits, Physics of sensors and measurements	**0**	**---**
I	**Introduction to the Human Body**	Cardiovascular system, Respiratory system, Nervous system, Special senses, Action potential	**5**	**LO1**
II	**Bio-electric Signals**	ECG, EMG and EEG signals, Lead configurations, Sensors and amplifiers, Patient safety	**5**	**LO2**
III	**Patient monitoring instruments**	ECG, spO2, Respiratory, Blood pressure, Temperature monitoring during intensive care.	**4**	**LO3**
IV	**Lifesaving instruments**	Principle and working of cardiac pace maker and de-fibrillator	**4**	**LO4**
V	**Basics of imaging**	Principle and working of X-ray and ultarsound imaging	**4**	**LO5**
VI	**Data analysis**	Descriptive statistics, probability and sampling distributions, Differentiate between two populations	**4**	**LO6**

Text Books:

1. Introduction to Biomedical Equipment Technology: Carr –Brown. (PH Pub)
2. Medical Instrumentation, Application and Design: J G. Webster. (John Wiley)

3. Biostatistics by Wayne W. Daniel, Seventh edition, Wiley India

References:

1. Principles of Applied Biomedical Instrumentation, Geddes & Baker, John Wiley
2. Christensen's Physics of Diagnostic Radiology, Thomas S. Curry, James E. Dowdey, Robert C. Murry. Wolters Kluwer, Fourth Edition
3. Physics of Diagnostic Imaging, David Dowsett, Patrick A Kenny, R Eugene Johnston. CRC Press, Second Edition.

Online Resources:

Sr. No.	Website Name
3.	*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*
4.	Medical Image Analysis, Dr. Debdoot Sheet, Indian Institute of Technology, Kharagpur Course Link: https://nptel.ac.in/courses/108/105/108105091/
3.	***Course 1:*** *Introduction to Biomedical Imaging* *https://www.edx.org/course/introduction-to-biomedical-imaging* ***Course 2:*** *Fundamentals of Biomedical Imaging: Ultrasounds, X-ray, positron emission tomography (PET) and applications* *https://www.edx.org/course/fundamentals-of-biomedical-imaging-ultrasounds-x-r*
4.	Introduction to Data Analytics by Prof. Nandan Sundarsanam – IIT-M and Prof. B. Ravindran – IIT-M https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-mg06/

List of Experiments.

Sr No	List of Experiments	Hrs
01	Test and measuring instruments usage	2
02	DC Power supplies and measurements with multimeters and digital storage oscilloscope	2
03	To measure blood pressure using sphygmomanometer	2
04	Design of instrumentation amplifier	2
05	To study the twelve lead electrode scheme and operation of the ECG Machine.	2
06	To record ECG and measure its various parameters (amplitude, intervals/segment).	2
07	Measurement of temperature and oxygen saturation	2
08	Demonstration of defibrillator	2
09	Demonstration of pacemaker	2
10	Plotting histogram of given data and inference	2
11	Chi square distribution and analysis of frequency	2
12	Analysis of variance	2

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practicals' 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.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CC201	Social Science and Community Services		2*+2	-		2	-	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment (IAT)			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)					
CC201	Social Science and Community Services	_	__	-__	__	_	25	--	25

Rationale : This group of activities is to support Individual Interest , Skill utilization and desire to contribute towards social welfare and discharge a duty of good citizen.Activities offered are based on based on diverse scope, ranging from social activities and services, training as a volunteer at the time of National Emergencies,Training volunteer take part at National level campaign in the field of science and technology.

Course Objectives:

- Understanding knowledge from a range of disciplines
- Connecting knowledge to other knowledge, ideas, and experiences
- Constructing knowledge
- Relating knowledge to daily life
- Critical thinking
- Reflective thinking
- Effective reasoning
- Creativity

Course Outcomes:

1) Communicate effectively verbally and in writing by selecting proper content, tone, and demeanor for the situation

2) Demonstration effective use of technology for personal and professional activities, including electronic communication and information resources

3) Develop and actively pursue personal, academic and professional goals

4) Seek guidance and assistance as needed to achieve academic success, maintain good academic standing and progress toward a degree

5) Manage personal affairs by demonstrating empathy toward others, caring for one's self and seeking assistance as needed

6) Demonstrate professionalism toward peers, faculty, staff, employers and other members of the College community through social etiquette, effective communication and restraint

Available Choice (Any One)	**Available at**	**Guided By**	**Evaluation at**
NSS	**College / Cluster**	**University NSS Coordinator**	**Institute ***
NCC	**College/Cluster**	**University/State level NCC core**	**Institute ***
Civil Defense	**College/Cluster**	**State/ local Governance Civil defense Unit**	**Institute ***
Amateur radio	**College / Cluster /Coordinated**	**Local /Cluster / University level Coordinator**	**Institute ***

- **By Coordinator / program officer assigned at institute level**

DETAILED GUIDELINE :

1) For NSS /NCC

The students shall earn marks for all relevant activities, which include Sports and Games, NCC, NSS etc. Every student opted for NSS is expected

to participate in the program for a minimum of 120 hours in a semester to become eligible for the credit. Every time the student participates / completes a task, the same is entered in the attendance register meant for the purpose and to be certified by the concerned Head and the Academic Coordinator, at the end of the semester, the student shall be awarded marks for participation as devised for the respective program.

Assessment: (Towards termwork)
Evaluation Pattern for Participation

Sr No	Particulars	Max marks
1	Attendance & Routine Activities	05
2	Participation in Camps / Field Activity	10
3	Brief Report	10
	Total	25

2) For Civil Defense

Civil Defence offers members the opportunity to train in a variety of skills and to learn new techniques that will not only assist your local community in the event of an emergency but will also enhance your own personal development. All training is given by experienced instructors and is certified to national standards. Casualty Service – training for First Aid, Rescue Service – training for Rescue. Fire Fighting Service – training in certain areas of fire fighting. Pumping floodwaters and supplying water and emergency services for support to the community.

The activity can be started at college level/ Cluster level by coordinating with the local Civil defense center . Training will be arranged by theLocal civil defense center set up by the Directorate of civil defense ,Maharashtra state in the region of College/ Cluster. a Civil Defense unit can be established by a Coordinator assigned amongst the desiring faculty member at college / cluster level .

OBJECTIVES OF CIVIL DEFENCE UNIT

To enable students to identify social issues and their solutions.

To develop self discipline and a helping attitude among the students.

To make students responsible citizens For protection of the environment.

To implement government programs and policies among people.

To prepare students to give scientific aid in natural and manmade disaster

Online References:

Sr. No.	Website Name
1.	https://www.maharashtracdhg.gov.in/cde/index.php
2.	https://dgfscdhg.gov.in/training-0
3.	https://dgcd.assam.gov.in/sites/default/files/swf_utility_folder/departments/cdhg_webcomindia_org_oid_5/menu/information_and_services/eligibility_criteria_to_apply_for_civil_defence_0_5.pdf

Assessment: (Towards termwork)
Evaluation Pattern for Participation

Sr No	Particulars	Max marks
1	**Attendance & Routine Activities**	**05**
2	**Participation in Training**	**10**
3	**field demonstration /presentation**	**10**
	Total	**25**

3) **For Amateur Radio**

Amateur Radio is a scientific activity popularly known as “Ham Radio”. Amateur radio operators use two way radio stations and communicate with others similarly authorized using various modes of communication like voice, morse code, computers, internet etc. The things that amateur radio operators do with their radios are as diverse as the people themselves. The advanced amateur radio communication techniques include Automatic Position Reporting Systems using GPS information, Internet linking of Repeater stations, Interface with internet for exchange of emails, images etc as well as visual communication modes.

Amateur (HAM) Radio is both a Hobby activity and Service. It is an activity of self learning, inter-communication & technical investigation carried on the duly authorized persons (i.e. Amateur Radio Operators) for a personal aim and without pecuniary interest. A wireless communication network through Amateur Radio is one of the most effective and alternate medium of communication and can play a significant role in providing reliable communications when other normal communications fail.

The skills of the trained amateur radio operator can be used for public service in times of need and national emergencies.

For participation in ISRO programs for student satellites and to act as a volunteer for radio monitoring of space missions, owning an Amateur (HAM) Radio operators certification is a legal and technical essential condition .

The Activity can be started at college level or at University inducted Nodal Centers. Interested faculties can be assigned a role of coordinator and enroll students for becoming Radio enthusiasts.

Online References:

Sr. No.	**Website Name**
1	https://vigyanprasar.gov.in/science-communication-programs/ham-radio/
2	https://www.isro.gov.in/HAMSAT.htmlhttps://www.isro.gov.in/HAMSAT.html
3.	https://amsatindia.org/

Assessment: (Towards termwork)
Evaluation Pattern for Participation

Sr No	**Particulars**	**Max marks**
1	**Attendance & Routine Activities**	**05**
2	**Participation in Training sessions & progress**	**15**
3	**Technical report / field activity**	**05**
	Total	**25**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
IKS201	Indian Knowledge System	2*	--	-	-	2*	-	--

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment (IAT)			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)					
IKS201	Indian Knowledge System	-	-	-	-	-	--	--	--

Rationale:

The Indian Knowledge System (IKS) is vital for preserving India's rich cultural heritage, fostering holistic and sustainable practices, and integrating ancient wisdom with modern science to address contemporary challenges and enrich global knowledge.

Course Objectives:

1. To explore and understand the evolution of Indian scientific thought
2. To evaluate the historical and modern educational systems in our country
3. To analyse sustainable practices in in ancient India
4. To know the richness of Indian Arts and Culture
5. To understand the contributions of Indian Scientists and Nobel Laureates
6. To understand the principles of good governance

Course Outcomes:

1. Recognize the sources and concepts of the Indian knowledge system
2. Learn about our history of Indian ancient knowledge and its significance in the current scenario.
3. Demonstrate sustainable development in various fields like Science, Technology, agriculture, industry, architecture performing arts, etc.
4. Understand and appreciate the rich heritage that resides in literature
5. Learn about the ancient Bhartiya education system in comparison with the modern era
6. Showcase the multi-dimensional nature of IKS and its importance in modern society

Prerequisite:

1. Students should have the foundational knowledge and skills necessary for a comprehensive understanding of IKS

2. Students should be familiar with the Indian Culture, Language, and History of Science and Technology in India.

DETAILED SYLLABUS:

Sr. No.	**Name of Module**	**Detailed Content**	**Hours**	**CO Mapping**
I	**Introduction to the Indian Knowledge System (I.K.S.)**	• Basic knowledge and scope of IKS • IKS in ancient India and modern India, • Bhartiya education system – ancient to modern era, • Sources of Education, Aim of Education, Curriculum, methods of learning, • Educational Institutes, Higher Educational Institutions, • Advantages and Disadvantages of the Gurukul System, • Distinguish between the Gurukul system And the Modern Education System	**3**	**CO2**

II	**Development of Scientific Thoughts in Ancient India**	• Development in Science, Technology, Astronomy, Mathematics, and Life Sciences – Life Science, Physiology, Ayurveda, etc.	**4**	**CO1**
III	**Development of Arts & Culture in India**	• Introduction to Ancient Architecture (Arts, Forts, Paintings, Sculpture, Temple architecture, etc) • Development in performing arts & culture: Music, Art of singing, Art of dancing, Natyakala Cultural traditions and Folk arts	**5**	**CO4**
IV	**Good Governance in Ancient India**	• Introduction to Indian religions • Moral and Ethical Governance • Vishva Kalyan through Vasudhaiva Kutumbkam • Principles of Good Governance about Ramayana, Mahabharat, Artha Sastra and Kauṭilyan State	**5**	**CO6**
V	**Contribution of Indian Scientist & Nobel Laureates**	• Baudhayan, Aryabhatta, Brahmgupta, Bhaskaracharya, Varahamihira, Nagarjuna, Susruta, Kanada&Charak • Rabindranath Tagore, C.V. Raman, Har Gobind Khorana, Mother Teresa, Subrahmanyan Chandrasekhar, Amartya Sen, V.S. Naipaul, Venkatraman Ramakrishnan, Kailash Satyarthi and Abhijit Banerjee	**5**	**CO5**
VI	**Sustainable Practices in Ancient India**	• Agriculture, waste management, water conservation, forest conservation, architecture, urban planning, biodiversity preservation, etc • Yoga, pranayama, and meditation for health and well-being	**4**	**CO3**

Text Books:

1. **1.** A.K Bag, History of technology in India (Set 3 vol), Indian Nation Science Academy, 1997.
2. An Introduction to Indian Knowledge Systems: Concepts and Applications, B Mahadevan, V R Bhat, and Nagendra Pavana R N; 2022 (Prentice Hall of India).
3. Ancient Indian Knowledge: Implications To Education System, Boski Singh; 2019
4. India's Glorious Scientific Tradition by Suresh Soni; 2010 (Ocean Books Pvt. Ltd.)
5. Indian Art: Forms, Concerns, and Development in Historical Perspective (History of Science, Philosophy and Culture in Indian Civilization), General Editor: D.P. Chattopadhyaya, Ed. By. B.N. Goswamy; 1999 MunshiramManoharlal Publishers Pvt. Ltd.

6. Indian Knowledge Systems: Vol I and II, Kapil Kapoor and A K Singh; 2005 (D.K. Print World Ltd).
7. Pandey, K.K. Kriya Sarira Comprehensive Human Physiology, Chaukhambha Sanskrit series, Varanasi, 2018
8. Shukla Vidyadhar& Tripathi Ravidatt, Aayurved ka ItihasevamParichay, Chaukhambha Sanskrit Sansthaan, New Delhi, 2017
9. Textbook on The Knowledge System of Bharata by Bhag Chand Chauhan; 2023 (Garuda Prakashan) 6. Pride of India- A Glimpse of India's Scientific Heritage edited by Pradeep Kohle et al. Samskrit Bharati; 2006
10. Traditional Knowledge System in India, Amit Jha

Online References:

Sr. No.	Website Name
1.	https://swayam.gov.in/explorer?searchText=iks
2.	https://iksindia.org/book-list.php
3.	https://iksindia.org/index.php

Assessment:

Suggested Pedagogy and assessment criteria for Teachers:

1. Project-based activities.
2. Presentation, Group Discussions, and Case studies.
3. Visit historical places.
4. Flip class mode/ Roleplay
5. Quiz MCQ
6. Assignment as per the modules: 06
7. Internal Assessment through flipped class and PowerPoint presentation along with documentation

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
IKS201	Indian Knowledge System	-	2*+2	-	-	2*+2	-	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment (IAT)			End Sem. Exam			
		IAT-I	IAT-II	IAT-I + ITA-II (Total)				

IKS201	**Indian Knowledge System**	--	--	--	--	25	-	25

Objectives:

To provide practice in ….

1. Understanding Traditional Indian Knowledge Systems that have evolved in India over centuries
2. Learn practical applications of traditional Indian techniques in various fields
3. Promote the cultural heritage in Indian knowledge systems,
4. Develop skills to critically analyze Indian knowledge systems in contemporary contexts, assessing their relevance, strengths, and limitations.
5. Analyze interdisciplinary connections between Indian knowledge systems and modern scientific & technological advancements.
6. Applycommunication & collaborative abilities through group discussions or presentations focusing on specific aspects of Indian knowledge systems.

Outcomes:

Learners will be able to

1. Learn about the evolution and practices of major Indian religions
2. Gain insight into the cultural diversity of India through its art, literature, music, dance, and architecture.
3. Recognize India's historical contributions to fields such as mathematics astronomy, medicine, and technology.
4. Develop critical ability to evaluate different interpretations of Indian knowledge systems in academics, literature, media, and popular culture.
5. Analyze how Indian philosophical and spiritual ideas have influenced global thought
6. Understand the relevance of Indian knowledge systems in contemporary contexts, including their role in shaping social values, ethics, and sustainable practices.

Sr No	Details of Activities	Hrs
01	Project-based activities	02
02	Presentation	02
03	Case studies	02

04	Visit historical places and write a report	02
05	Flip class mode	02
06	Quiz with MCQ	02
07	Comparative Study of IKS & other philosophical & scientific systems around the world	02
08	Group Discussions	02
09	Roleplay	02
10	Self-study activities	02

(The faculty can choose any of these activities for continuous assessment)

Assessment:

Suggested Pedagogy and assessment criteria for Teachers:

1. Total Assignments as per the modules: 06
2. Internal Assessment through flipped class and PowerPoint Presentation along with documentation

- **Sample Case Studies:**
- Mathematics of Madhava, NilakanthaSomayaji
- Astronomical models of Aryabhata
- Wootz steel, Aranumula Mirrors, and lost wax process for bronze castings
- Foundational aspects of Ayurveda
- Foundational aspects of Ashtanga yoga
- Foundational aspects of Sangeeta and Natya-shastra

Term Work:

- Assignments: 10 Marks
- Presentation/Group Discussion:10 Marks
- Attendance: 05 Marks

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total
VSEC201	Engineering Workshop-II	--	2	--	--	--	1	1

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment (IAT)			End Sem. Exam.	Exam. Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)					
VSEC201	Engineering Workshop-II	--	--	--	--	--	25	--	25

Lab Objectives

1. To impart training to help the students develop engineering skill sets.
2. To inculcate respect for physical work and hard labor.
3. To get exposure to interdisciplinary engineering domain.

Lab Outcomes: Learner will be able to…

1. Develop the necessary skill required to handle/use different carpentry tools.
2. Identify and understand the safe practices to adopt in electrical environment.
3. Demonstrate the wiring practices for the connection of simple electrical load/ equipment.
4. Design, fabricate and assemble pcb.
5. Develop the necessary skill required to handle/use different masons tools.
6. Develop the necessary skill required to use different sheet metal and brazing tools.
7. Able to demonstrate the operation, forging with the help of a simple job.

DETAILED SYLLABUS

	Detailed Content	**Hrs.**
Note: Trade 1 and 2 are compulsory. Select any ONE trade topics out of the topic trade 3 to 5. Demonstrations and hands on experience to be provided during the periods allotted for the same. Report on the demonstration including suitable sketches is also to be included in the term work CO-1 is related to Trade-1 CO-2 to CO-4 is related to Trade-2 CO-5 is related to Trade-3 CO-6 is related to Trade-4 CO-7 is related to Trade-5 CO evaluation is to be done according to the opted Trades in addition to Compulsory Trades.		
Trade-1	**Carpentry(Compulsory)** 1. Use and setting of hand tools like hacksaws, jack planes, chisels and gauges for construction of various joints, wood tuning and modern wood turning methods. 2. Term work to include one carpentry job involving a joint and report on demonstration of a job involving wood turning	**10**

Trade-2	**Basic Electrical work shop:(Compulsory):** 3. Single phase and three phase wiring. Familiarization. of protection switchgears and their ratings (fuse, MCB, ELCB). Wiring standards, Electrical safety in the work place safe work practices. Protective equipment, measures and tools. 4. Layout drawing, layout transfer to PCB, etching and drilling and soldering technique	**08**
Trade-3	**Masonry:** 5. Use of masons tools like trowels, hammer, spirit level, square, plumb line and pins etc. demonstration of mortar making, single and one and half brick masonry , English and Flemish bonds, block masonry, pointing and plastering.	**06**
Trade 4	**Sheet metal working and Brazing:** 6. Use of sheet metal, working hand tools, cutting , bending , spot welding	**06**
Trade-5	**Forging (Smithy):** 7. At least one forging job to be demonstrated and a simple job to be made for Term Work in a group of 4 students.	**06**

Text Books:

1. Workshop Technology, Volume-I, P.N.Rao, McGrrawHill Publication
2. Elements of Workshop Technology, Vol-I, S.K. Hajra Choudhury, A K HajraChoudhury,Nirjar Roy, Media Promoters &Publishers Pvt Ltd

References:

1. Workshop Technology, Part-II, W A J Chapman, VIVA Books Pvt Ltd
2. A Course in Workshop Technology, B.S. Raghuvanshi, Dhanpat Rai and Co Ltd.

Assessment:
Term Work: Term Work shall consist of at least 3 practicals' based on the above list
Term Work Marks:25 Marks (Total marks) = 20 Marks (Experiment) + 5 Marks (Attendance)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
VSEC202	Python Programming	-	2*+2	-	-	2	-	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment (IAT)			End Sem. Exam			
		IAT I	IAT-II	IAT-I + IAT-II (Total)				
VSEC202	Python Programming	--	--	--	--	25	25	50

Lab Objectives:

1. To familiarize learners with Python's basic syntax, variables, data types, operators, and input/output functions.
2. To reinforce the understanding and application of conditional statements, loops, and functions in Python programming.
3. To instill learners on file handling, exception management, and Python packaging.
4. To Introduce object-oriented programming principles and their application in Python.
5. To explore advanced topics such as regular expressions, pattern matching, and GUI development.
6. To introduce and demonstrate the use of popular Python libraries for data handling.

Lab Outcomes: Learner will be able to

1. Demonstrate the proficiency in basic python programming or Create and perform various operations on data structures like list, tuple dictionaries and strings.
2. Apply Control Flow and Functions for efficient coding to solve problems.
3. Demonstrate proficiency in handling file operations, managing exceptions, and developing Python packages and executable files for modular programming.
4. Illustrate the concept of Object-Oriented Programming used in python.
5. Design Graphical User Interface (GUI) applications, utilizing appropriate Python libraries to create user-friendly interfaces.
6. Investigate and apply popular python libraries to conduct efficient data handling tasks.

Prerequisite: VSEC 102 C Programming

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hrs	LO Mapping
0	**Prerequisite**	Introduction to Programming**:** Understanding basic concepts like algorithms, flowcharts, and pseudocode. Problem-Solving Skills**:** Ability to approach problems methodically and apply logical thinking to develop solutions.	1	--
1	**Introduction to Python**	1. Basic Syntax and Data Types - Variables and data types, Operators, Input and output, 2. Data Structures- list, tuple, set and dictionary 3. Understanding the Syntax Transition: From C to Python	**4**	**L1**
2	**Control Flow and Functions**	2.1 Conditional Statements: if, else, elif 2.2 Loops: for and while loop 2.3 Functions- Defining functions, Parameters and return values, Scope and lifetime of variables	**4**	**L2**
3	**File Handling, Packaging, and Debugging**	3.1 File Handling- Reading and writing files, Exception handling 3.2 Creating Python Packages, Modules and	**4**	**L3**

		executable files 3.3 Dealing with Syntax Errors, Runtime Errors and Scientific Debugging		
4	**Object-Oriented Programming (OOP) in Python**	4.1 Introduction to OOP: Classes and objects, Encapsulation, inheritance, and polymorphism 4.2 Creating Classes and Objects: Class attributes and methods Constructor and destructor. 4.3 Type of Inheritance: Single, multiple and multilevel inheritance	**4**	**L4**
5	**Advanced Python Concepts**	5.1 Regular Expressions, Pattern matching, Regex functions in Python 5.2 GUI Development using any Python GUI framework	**5**	**L5**
6	**Python Libraries**	6.1 Introduction to Popular Libraries 6.2 NumPy for numerical computing, 6.3 Pandas for data manipulation 6.4 Matplotlib for data visualization	**4**	**L6**

Text Books:

1. Core Python Programming, Dr. R. Nageswara Rao, Second Edition, Dreamtech Press.
2. Beginning Python: Using Python 2.6 and Python 3.1. James Payne, Wrox Publication.
3. Python Programming, Anurag Gupta and G. P. Biswas, First Edition,McGraw-Hill Education.

References:

1. Learn Python the Hard Way, Zed Shaw, Third Edition, Addison-Wesley.
2. Python Projects, Laura Cassell,AlanGauld, First Edition, Wrox Publication.
3. Introduction to computing and problem-solving using python, Balagurusamy, First Edition, McGraw Hill Education.

Online Resources:

Sr. No.	Website Name
1.	Python Tutorial: http://docs.python.org/release/3.0.1/tutorial/
2.	Python for everybody specialization: https://www.coursera.org/specializations/python.

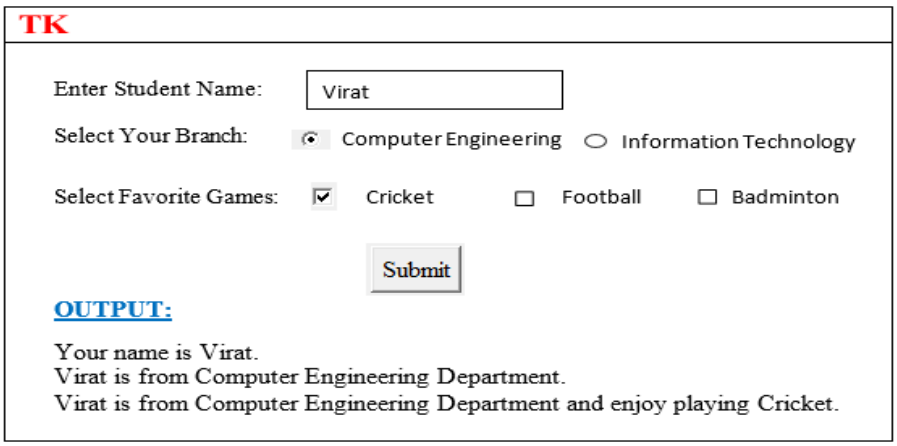
List of Experiments.

The following experiments serve as samples to illustrate the application of concepts covered in each unit. Instructors are encouraged to modify and adapt these experiments to meet the specific needs of the course and

the learning objectives. It is essential to ensure that the fundamental concepts and skills outlined in each unit are adequately covered, even with modifications.

Week No	List of Experiments	Hrs
01	**Objective:** To enable learners to transition their understanding of basic programming constructs from C to Python by focusing on Python's syntax, variables, data types, operators, and input/output functions, and comparing these elements with their equivalents in C 1. **Personalized Greeting Generator* -** Write a python code to generate Personalized Greeting. 2. **Calculating Areas of Geometric Figures* -** Write a python program to calculate areas of any geometric figures like circle, rectangle and triangle. **3. Developing Conversion Utilities:** Develop any converter such as Rupees to dollar, temperature convertor, inch to feet etc. 4. **Calculating Gross Salary of an Employee*:** Write a Python program to calculate the gross salary of an employee. The program should prompt the user for the basic salary (BS) and then compute the dearness allowance (DA) as 70% of BS, the travel allowance (TA) as 30% of BS, and the house rent allowance (HRA) as 10% of BS. Finally, it should calculate the gross salary as the sum of BS, DA, TA, and HRA and display the result. 5. **Calculating Simple Interest:** Write a Python program to calculate the simple interest based on user input. The program should prompt the user to enter the principal amount, the rate of interest, and the time period in years. It should then compute the simple interest using the formula **Simple Interest=(Principal×Rate×Time) /100** and display the result. **6. Exploring Basic Arithmetic Operations in Python*:** Write a Python program to explore basic arithmetic operations. The program should prompt the user to enter two numbers and then perform addition, subtraction, multiplication, division, and modulus operations on those numbers. The results of each operation should be displayed to the user.	02
02	**Objective:** Mastering Python New Data Structures for Practical Applications **Task List Manager*:** Develop a Python program to manage a task list using lists and tuples, including adding, removing, updating, and sorting tasks. **Student Enrollment Manager *:** Create a Python code to demonstrate the use of sets and perform set operations (union, intersection, difference) to manage student enrollments in multiple courses / appearing for multiple entrance exams like CET, JEE, NEET etc. **Student Record Keeper *:** Write a Python program to create, update, and manipulate a dictionary of student records, including their grades and attendance.	02
03	**Objective:** To enable students to transition their understanding of control statements and loops from C to Python, emphasizing the adoption of Python syntax while reinforcing logical structures already learned. 1. **Triangle Pattern Generator Using Loops:**Write a Python program to print a triangle pattern (give any), emphasizing the transition from C to Python syntax. **2. Number Type Identifier*:** Develop a Python program that takes a numerical input and identifies whether it is even or odd, utilizing conditional statements and loops. **3. Character Type Identifier:** Create a Python program to check whether the given input is a digit, lowercase character, uppercase character, or a special character using an 'if-else-if' ladder. **4. Multiplication Table Generator:** Write a Python program to take a numerical input from	02

	the user and generate its multiplication table using loops. 5. **Fibonacci Sequence Generator:** Develop a Python program to print the Fibonacci sequence using a while loop. 6. **Factorial Generator*:** Design a Python program to compute the factorial of a given integer N. 7. **Prime Number Analyzer*: U**sing function, write a Python program to analyze the input number is prime or not. 8. **Simple Calculator Using Functions*:** Implement a simple Python calculator that takes user input and performs basic arithmetic operations (addition, subtraction, multiplication, division) using functions. 9. **Interactive Guessing Game:** Develop a number guessing game where the program generates a random number, and the user has to guess it. Implement loops and conditional statements for user interaction.	
04	**Objective:** To enable learners to proficiently handle file operations, manage exceptions, and create Python packages and executable files. *1.* **Extracting Words from Text File *:** Develop a Python program that reads a text file and prints words of specified lengths (e.g., three, four, five, etc.) found within the file. 2. **Finding Closest Points in 3D Coordinates from CSV**: Write a python code to take a csv file as input with coordinates of points in three dimensions. Find out the two closest points. 3. **Sorting City Names from File:** Write a python code to take a file which contains city names on each line. Alphabetically sort the city names and write it in another file. **4. Building an Executable File*:** Create a executable file for any program developed in earlier practical.	02
05	**Objective:** To enable learners to proficiently handle errors and exceptions in Python programs, ensuring robust and fault-tolerant code. Learners will also develop debugging skills to identify, diagnose, and fix issues efficiently using scientific debugging methods. 1. **Basic Exception Handling***: Write a Python program that takes two numbers as input and performs division. Implement exception handling to manage division by zero and invalid input errors gracefully. 2. **Custom Exceptions**: Develop a Python program that simulates a banking system with a function to withdraw money. Raise custom exceptions for scenarios such as insufficient funds and invalid account numbers 3. **Logging for Debugging:** Enhance a Python program by adding logging statements to record the flow of execution and error messages. Use the logging module to configure different logging levels (INFO, DEBUG, ERROR). 4. **Using a Debugger*:** Demonstrate the use of a Python debugger (e.g., pdb or an IDE with debugging capabilities) on a sample program with intentional errors. Guide students on setting breakpoints, stepping through code, and examining variable values. 5. **Scientific Debugging Techniques:** Provide a Python program with multiple logic and runtime errors. Instruct students to apply scientific debugging techniques, such as binary search debugging, to identify and resolve the issues methodically	02
06	**Objective:** To apply object-oriented programming (OOP) principles in Python to model real-world scenarios and systems, fostering the development of modular, reusable, and efficient solutions. Fostering the ability to design and implement solutions for real-world problems. Choose any one real world scenario. Ask student to apply OOP principles such as encapsulation, inheritance, and polymorphism in practical scenarios. The sample real world scenarios are as follows. 1. **Event Management System:** Implement an event management system using OOP concepts to organize and manage various aspects of college festivals or events. Design	02

	classes for events, organizers, participants, and activities. Include methods for event registration, scheduling, participant management, and activity coordination. 2. O**nline Shopping System:** Develop classes for products, customers, and shopping carts. Include methods for adding items to the cart, calculating total costs, processing orders, and managing inventory. 3. **Vehicle Rental System:** Design a system using classes for vehicles, rental agencies, and rental transactions. Implement methods to handle vehicle availability, rental periods, pricing, and customer bookings.	
07	**Objective:** To develop a graphical user interface (GUI) application for any use case. Choose any use case from below. 1. **GUI for Developing Conversion Utilities:** Develop a Python GUI application that performs various unit conversions such as currency (Rupees to Dollars), temperature (Celsius to Fahrenheit), and length (Inches to Feet). The application should include input fields for the values, dropdown menus or buttons to select the type of conversion, and labels to display the results. 2. **GUI for Calculating Areas of Geometric Figures:** Develop a Python GUI application that calculates the areas of different geometric figures such as circles, rectangles, and triangles. Allows users to input the necessary dimensions for various geometric figures and calculate their respective areas. The application should include input fields for the dimensions, buttons to perform the calculations, and labels to display the results. 3. **College Admission Registration Form:** The college admission registration form collects essential personal, educational, and contact information from prospective students. Create a GUI as shown in Figure-1 that allows the user to input his/her name, branch and favorite game. When the user clicks the Submit button, it should display the output as illustrated.  Figure-1: A basic GUI featuring text field and various buttons.	02
08	**Objective:** To enable learners to effectively utilize regular expressions in Python for pattern matching, validation, and data extraction tasks, enhancing their ability to process textual data efficiently and accurately. 1. **Script to Validate Phone Number and Email ID *:** Write a Python script that prompts the user to enter their phone number and email ID. It then employs Regular Expressions to verify if these inputs adhere to standard phone number and email address formats 2. **Password Strength Checker:** Write a Python script that prompts the user to enter a password. Use regular expressions to validate the password based on these criteria: At least 8 characters long, Contains at least one uppercase letter, one lowercase letter, one digit, and one special character. 3. **URL Validator:** Develop a script that verifies if a given string is a valid URL. Use regular expressions to check for standard URL formats, including protocols (http, https), domain names, and optional path segments. Test with various URLs and ensure the validation	02

	covers common cases. 4. **Extracting Data from Text ***: Create a program that reads a text file containing various data (e.g., names, emails, phone numbers). Use regular expressions to extract specific types of data, such as email addresses, phone numbers, dates (e.g., MM/DD/YYYY format).	
09	**Objective:** To equip learners with the skills to utilize the NumPy libraries for efficient numerical computing. 1. **Creating and Manipulating Arrays*:** Write a Python program to create a 1D, 2D, and 3D NumPy array. Perform basic operations like reshaping, slicing, and indexing. 2. **Array Mathematics*:** Develop a Python script to create two arrays of the same shape and perform element-wise addition, subtraction, multiplication, and division. Calculate the dot product and cross product of two vectors. 3. **Statistical Operations*:** Write a Python program to calculate mean, median, standard deviation, variance, and correlation coefficients of a given array.	02
10	**Objective:** To provide learners with the knowledge and skills necessary to effectively use the Pandas library for data manipulation and the Matplotlib library for data visualization. Learners will engage in tasks that involve analyzing real-world datasets, creating meaningful visualizations, and drawing insights from data. Following task should be performing on a real-world dataset: **Task1- Loading and Inspecting Data:** Load a CSV file containing information on global COVID-19 cases into a DataFrame. Display the first few rows, check the data types, and summarize basic statistics. **Task 2-Data Cleaning:** Identify and handle missing values in the dataset. Remove any duplicate rows and ensure data consistency. **Task 3-Data Aggregation:** Perform aggregation operations to summarize data. *Task 4- Plotting graphs: Generate a line plot showing the trend / bar plot to compare data/ histogram to show distribution/ scatter plot to examine relationships between variables.* Instructors can choose other datasets relevant to the course objectives. Sample datasets and task list are as follows. **1. Using the Iris Data** (https://www.kaggle.com/datasets/saurabh00007/iriscsv), perform the following tasks: i. Read the first 8 rows of the dataset. ii. Display the column names of the Iris dataset. ii. Fill any missing data with the mean value of the respective column. iv. Remove rows that contain any missing values. v. Group the data by the species of the flower. vi. Calculate and display the mean, minimum, and maximum values of the Sepal length column. **2.Using the Cars Data** (https://www.kaggle.com/datasets/nameeerafatima/toyotacsv) perform the following tasks: i. Create a scatter plot between the Age and Price of the cars to illustrate how the price decreases as the age of the car increases. ii. Generate a histogram to show the frequency distribution of kilometers driven by the cars. ii. Produce a bar plot to display the distribution of cars by fuel type. iv. Create a pie chart to represent the percentage distribution of cars based on fuel types. v. Draw a box plot to visualize the distribution of car prices across different fuel types.	02

Note: * Marks indicate the minimum required programs to be taken. Additional programs should be covered based on the student's learning pace.

The goal of these experiments is to provide a structured approach to learning Python programming concepts. Instructors are encouraged to use these samples as a foundation and customize them to create engaging and effective learning experiences for the students.

Assessment:

Term Work: Term Work shall consist of at least 15 to 18 practicals based on the above list. Since the initial Python programs are small and straightforward, this allows for more practicals to be conducted, providing essential practice needed for mastering any programming language.

Internal Practical Exam: Conduct an internal practical exam after completing the first three modules of the Python course to assess and ensure the learner's understanding.

Term Work Marks: 25 Marks (Total marks) = 10 Marks (Experiment) + 10 Marks (Internal Practical Exam) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

Justification for B.E. (Biomedical Engineering)

1.	Necessity for starting the course:	**Engineering is an innovative field, the origin of ideas leading to everything from automobile to aerospace, skyscrapers to sonar. Biomedical Engineering focuses on the advances that improve human health and health care at all levels. Biomedical engineering is an interdisciplinary field with application of the principles of Basic Sciences, Mathematics, Engineering fundamentals and Biology for problem-solving.**
2.	Whether the UGC has recommended the course:	**Yes**
3.	Whether all the courses have commenced from the academic year 2023-24	**Yes, the Program started from A.Y 2024-25 as per NEP 2020 Policy.**
4.	The courses started by the University are self-financed, whether adequate number of eligible permanent faculties are available?:	**Self-financed Yes. Some experts are called as adjunct or visiting faculties.**
5.	To give details regarding the duration of the Course and is it possible to compress the course?:	**4 years. Not possible to compress the program.**
6.	The intake capacity of each course and no. of admissions given in the current academic year:	**30 seats for one division. Admissions have beenstarted from academic year 2024-2025. Admissions given in current year are 25.**
7.	Opportunities of Employability / Employment available after undertaking these courses:	**B.E. in Biomedical Engineering can open up various opportunities and employment prospects across various private industries in health sector, medical colleges & hospitals, engineering education and research & development in government sectors. Technology is continuously evolvingleading to new roles and specialties as envisaged during management of Covid19.Recent advances in Machine Learning, Artificial Intelligence, Data Analytics and other emerging technologies have paved way in health care, which has provided an impetus to employability of biomedical engineers in these sectors.**

Sd/-
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BoS-Chairman-Biomedical Engineering
Faculty of Technology

Sd/-
Dr. Deven Shah
Associate Dean
Faculty of Science & Technology

Sd/-
Prof. Shivram S. Garje
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