AC – 6.8
Item No. – 28/6/2024

As Per NEP 2020

University of Mumbai

Bachelor of Engineering

First Year Engineering (Semester I & II), Revised Course

(NEP-2020 Scheme) from Academic Year 2024-25

(Common for All Branches of Engineering)

A- U.G. Certificate in **Major Discipline of Engineering/Technology**
B- U.G. Diploma in **Major Discipline of Engineering/Technology**
C- B.Voc/B.S.c. in **Major Discipline of Engineering/Technology**
D- B.E. in **Major Discipline of Engineering/Technology**
E- B.E. (Hons.) in **Major Discipline of Engineering/Technology**
F- B.E. (Hons. With Research) in **Major Discipline of Engineering/Technology**

Under

FACULTY OF SCIENCE & TECHNOLOGY

Ref: GR dated 20th April, 2023 for Credit Structure of UG

(As per AICTE & NEP 2020 Guidelines with effect from the Academic Year 2024-25 Progressively)

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.

Dr. Deven Shah
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Program Structure for First Year Engineering

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

Semester II

Course Code	Course Description	Teaching Scheme (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	Engineering Graphics	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	Engineering Graphics Lab	-	2	--	-	-	1	1
PCL201X	Program Core Lab	-	2	-	-	-	1	1
CC201	Social Science & Community Services	-	2*+2	-	-	-	2	2
IKS201	Indian knowledge System	-	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	Course Description	Examination scheme							
		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	Engineering Graphics	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	Engineering Graphics Lab	--	--	--	--	--	25	25	50
PCL201X	Program Core Lab	--	--	--	--	--	25	25	50
CC201	Social Science & Community Services	--	--	--	--	--	25	--	25
IKS201	Indian knowledge System	--	--	--	--	--	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
PCC2011	Computer Engineering, Information Technology, Computer Science & Engineering, Computer Science & Design, CSE (AI & ML), CSE(DS), CSE (IoT & CSBT), CS&E, AI &DS, AI &ML, Cyber Security, Internet of Things, Data Engineering	**Data Structure**
PCC2012	Civil Engineering, Civil and Infrastructure Engineering, Civil Engineering and Planning	**Elements of Civil Engineering**
PCC2013	Biomedical Engineering	**Elements of Biomedical Engineering**
PCC2014	Electronics Engineering & Electronics Engineering & Computer Science	**Digital Electronics**
PCC2015	Chemical Engineering	**Introduction to Chemical Engineering**
PCC2016	Electronics & Telecommunication-Engineering	**Elements of Telecommunication**
PCC2017	Electrical Engineering	**Elements of Electrical Systems**
PCC2018	Mechanical Engineering, Mechatronics, Automation & Robotics	**Elements of Mechanical Engineering**
PCC2019	Instrumentation Engineering	**Basics of Measurement and Sensors**

Program Core Lab

PCL201X	Name of Program as per Cluster	Name of Program Core Course
PCL2011	Computer Engineering, Information Technology, Computer Science & Engineering, Computer Science & Design, CSE (AI & ML), CSE(DS), CSE (IoT & CSBT), CS&E, AI &DS, AI &ML, Cyber Security, Internet of Things, Data Engineering	**Data Structure Lab**
PCL2012	Civil Engineering, Civil and Infrastructure Engineering, Civil Engineering and Planning	**Elements of Civil Engineering Lab**
PCL2013	Biomedical Engineering	**Elements of Biomedical Engineering Lab**
PCL2014	Electronics Engineering & Electronics Engineering & Computer Science	**Digital Electronics Lab**
PCL2015	Chemical Engineering	**Introduction to Chemical Engineering Lab**
PCL2016	Electronics & Telecommunication-Engineering	**Elements of Telecommunication Lab**
PCL2017	Electrical Engineering	**Elements of Electrical Systems Lab**
PCL2018	Mechanical Engineering, Mechatronics Engineering, Automation & Robotics	**Elements of Mechanical Engineering Lab**
PCL2019	Instrumentation Engineering	**Basics of Measurement and Sensors Lab**

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 and technology.
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 of engineering.
2. Apply the concepts of Higher Order Linear Differential equation to the engineering problems.
3. Apply concepts of Beta and Gamma function to solve improper integrals.
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	Detailed Contents	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 of parameters. **# Self learning topics:** Cauchy's homogeneous linear differential equation and Legendre's differential equation, Applications of Higher order differential equation.	**3** **1**	**CO2**
03	**Beta and Gamma Function, Differentiation under Integral sign** **3.1** Beta and Gamma functions and its properties. **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 polar coordinates	**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	**2** **2**	**CO5**

	Volume.		
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's method (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, Khanna Publication
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, McGraw Hill
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 as per 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 entire syllabus.
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 1/3rd Rule (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

		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)					
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**	Nanocomputer Introduction , 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

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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**

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
BSC2022	Semiconductor Physics	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 + 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, 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	**4**	**CO2**
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	**6**	**CO5**

		in Detail - MOSFET structure, Enhancement and depletion modes, Threshold voltage MOSFET Applications - MOSFET as a switch,		
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
8.	https://archive.nptel.ac.in/courses/108/108/108108122/
9.	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						
		Internal assessment (IAT)			End Sem. Exam	Term Work	Practical/ Oral	Total
		IAT-I	IAT-II	IAT-I + IAT-II (Total)				
BSL2012	Seminconductor 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**

		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** Various temperaturemeasurementtechniques ranges.
6. Learner will be able to **IMPLEMENT** knowledge learned here to nano 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,	**6**	**CO1**

		Population standard Deviation, Principles of least Squares		
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 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**	**CO3**
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	**4**	**CO6**

		Microscope (SEM), Transmission Electron Microscope (TEM), Atomic Force Microscope (AFM), Applications in sensing toxic gases, gas sensing capacitors, Introduction to lithography, water purification		

Text Books:

1.Engineering Metrology by R.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

		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-composites. B) Bio-composites – Definition, Classification and Applications.	**4**	**CO3**
IV	**Plastics and Elastomers**	A) Introduction to Plastics - Thermoplastic and Thermosetting plastics, compounding of plastics, Application of Plastics, Numerical based on Degree of polymerisation,	**5**	**CO4**

		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		
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	**4**	**CO1**

		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.		
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) 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	**4**	**CO2**
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)**	A) Need of non-conventional energy sources. B) Renewable Sources of Energy such as Hydro, Solar, Wind, Biomass, Tidal and	**4**	**CO4**

	energy sources	Geothermal - their availability and limitations.		
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. C) Natural Resource management & Environmental Ethics D) Importance of Responsible Consumption. E) Introduction to concept of Energy Audit	**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. "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				Term Work	Practical/ Oral	Total
		Internal assessment (IAT)			End Sem. Exam			
		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

		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 D) Density Functional Theory E) Molecular dynamics	**4**	**CO2**
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	**4**	**CO4**

		B) Potential energy surfaces and molecular modeling C) Applications of molecular mechanics in predicting molecular properties		
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 and discuss any changes in bond lengths or angles observed during optimization.	2
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, 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	Practical	Tutorial	Theory	Practical	Tutorial	Total
ESC201	Engineering Graphics	3	-	-	3	-	-	3

		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 Projections of Points** Projections of points in any quadrants as well as resting on planes. **2.2 Projections of Lines** Projections of lines inclined to both the reference planes (Excluding Traces of lines). Simple application based problems on projection of lines. **2.3 Projections of Planes** Projections of planes (Triangular, Square, Rectangular, Pentagonal, Hexagonal and Circular) inclined to both the Reference Planes. (Exclude composite planes).	**06**	**CO2**
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	**Sections of Solids and Development of Surfaces**	**4.1 Sections of Solids** Sections of Prism, Pyramid, Cylinder, & Cone cut by plane perpendicular to at least one reference plane (Exclude Curved Section Plane). Use change of position or Auxiliary plane method. **4.2 @Development of Surfaces** Development of lateral surface (only) of prism and pyramid only.	**08**	**CO4**
V	**Orthographic Projections**	**5.1 Orthographic Projections** Fundamentals of orthographic projections like concept of quadrants, observer position, horizontal, vertical and profile plane, symbol etc. Different orthographic views, First and Third angle method of projection.	**09**	**CO5**

		Views of a simple machine part as per the first angle projection method recommended by I.S. **5.2 Sectional Orthographic Projections** Fundamentals of 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 first angle projection.		
VI	**Isometric Views**	Basic concept of isometric projection like why it is called isometric, what does it represents, its need, isometric and non-isometric lines, isometric axes and isometric scale. Difference between isometric projection and isometric views. Conversion of orthographic views to isometric views (Excluding sphere).	**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
3.	https://archive.nptel.ac.in/courses/112/105/112105294/
4.	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**	1.1 Construction of plain and diagonal scales for simple applications.	**02**	**LO1**

	Curves	1.2 Construction of basic engineering curves like cycloid, involutes and helix (cylinder only).		
II	**Projections of Lines and Planes**	**2.1 Projections of Lines** Simple problems to apply the concept of projections of lines inclined to both the reference planes. **2.2 Projections of Planes** Problems on projections of planes inclined to both the 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 auxiliary plane method. **3.2 Sections of Solids** Problems on sections of solids cut by plane perpendicular to at least one reference plane. Use auxiliary plane method. **3.3 @Development of Surfaces** Development of lateral surface (only) of prism, pyramid and cylinder.	**04**	**LO3**
IV	**Orthographic Projections**	**4.1 Orthographic Projections** Construction of orthographic views from pictorial view of an object. Use of proper dimensioning technique for dimensioning the drawn views. **4.2 Sectional Orthographic Projections** Construction of orthographic views (with section) from pictorial view of an object. Location of section plane in concerned views.	**04**	**LO4**
V	**Isometric Views**	Conversion of orthographic views to isometric views.	**02**	**LO5**
VI	**Drafting Technique**	**6.1 Overview of Computer Graphics Covering:** Basic information about the drafting software (CAD). Demonstrating knowledge of the theory of CAD software such as: Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable),The Status Bar, Different methods of zoom as used in CAD, Select and erase objects. **6.2 Customization & CAD Drawing:** Consisting of set up of the drawing page and the printer including scale settings,setting up of units and drawing limits, ISO and ANSI standards for coordinate dimensioning. **6.3 Annotations, layering & other Functions Covering:** Applying dimensions to objects, applying annotations to drawings, setting up anduse of layers, layers to create drawings, Create, edit and use	**08**	**LO6**

		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:

5. Narayana, K.L. & P Kannaiah (2008), Textbook on Engineering Drawing, Scitech Publisher.

6. Prof. Sham Tickoo (Purdue University) & Gaurav Verma, "(CAD Soft Technologies).

7. Auto CAD 2012 (For engineers and Designers)", Dreamtech Press NewDelhi.

8. Dhananjay A Jolhe, "Engineering Drawing" Tata McGraw Hill.

Online Resources:

Sr. No.	Website Name
5.	https://archive.nptel.ac.in/courses/112/105/112105294/
6.	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 Engineering Curves *to be drawn on drawing sheet.*	02	LO1
02	Minimum four problems on Projection of Lines *to be drawn on drawing sheet.*	02	LO2
03	Minimum four problems on Projection of Planes *to be drawn on drawing sheet.*	02	LO2
04	Minimum of two problems on Projection of 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 Sections of 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 Orthographic Projections (without section) *using drafting software.*	02	LO4, LO6
08	Two problems on Orthographic Projections (with section) *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.
* All printouts to be taken in the CAD Laboratory. Preferably, use A3 size sheets for print out.

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.
* 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	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Tut.	Pract / Oral	Theory	Tut.	Pract/ Oral	Total
PCC2011	Data Structure	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)					
PCC2011	Data Structure	20	20	40	60	2	--	--	100

Course Objectives: The course aims to

1. Learn the purpose and significance of data structures, as well as their fundamentals.
2. Learn linear and nonlinear data structures, as well as how they are implemented.
3. Analyze the data structures, such as stacks, queues
4. Learn the terminologies, types and various operations in Linked list
5. Explore the fundamentals of Tree and learn about its operations and applications.
6. Explore the real time applications of various data structures

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

1. Classify and Apply the concepts of Linear and Non-Linear data structures in real life problem solving and apply the operations like insertion, deletion, and traversal operations on them.
2. Explore data structures such as Stacks, learn about their operations, and use them to solve problems in a variety of domains.
3. Examine Queue data structures and use them to address real-world problems.
4. Apply the concept of Linked list to evaluate the problems in a diverse applications
5. Analyze and apply the concepts of Trees and their applications in real life problem solving.
6. Demonstrate the ability to analyze, construct, implement, and use data structures to solve real-world problems and evaluate their effectiveness.

Prerequisite: Concepts in C Programming

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping

0	**Prerequisite**	Concepts of Functions, Recursion, Arrays, Pointers, Structures and C programming constructs.		
I	**Introduction**	Introduction to Data Structures, Concept of ADT, Types of Data Structures- Linear, Nonlinear, Static, Dynamic and operations on Data Structures.	**2**	**CO 1** **CO 2**
II	**Stack**	Introduction to Stack, Stack as ADT, ADT Operations on Stack, Array Implementation of Stack, Multiple Stacks, Evaluation of Arithmetic Expressions.	**4**	**CO 1** **CO3**
III	**Queue**	Introduction to Queue, ADT operations on Queue, Array Implementation of Queue, Types of Queues: Circular Queue, Priority Queue, Double Ended Queue and Multiple Queues	**5**	**CO 1** **CO 3**
IV	**Linked List**	Concept of Linked Lists, Linked List v/s Array, Types of Linked List- Singly linked lists, doubly linked lists and circular linked lists. Insertion, deletion, update and copying operations with Singly linked lists, doubly linked lists. Implementation of Stack and Queue using linked list. Reversing a singly linked list.	**6**	**CO 1** **CO 4**
V	**Tree**	Introduction to Trees, Tree Terminologies, Binary Tree, Binary Tree Representation, Types of Binary Tree, Binary Tree Traversals, Binary Search Tree, Insert, Delete, Search Operations on Binary Search Tree.	**5**	**CO 1** **CO 5**
VI	**Applications of Data Structures**	**Stacks:** Conversion of Arithmetic Expressions using Infix, Prefix and Postfix Notations, Reversing a String/List, Parentheses Checker. **Trees**: Representing expressions using of Expression tree and Huffman Encoding.	**4**	**CO 1** **CO 6**

Text Books:

1. Aaron M Tenenbaum, Yedidyah Langsam, Moshe J Augenstein, "Data Structures Using C", Pearson Publication.
2. Reema Thareja, " Data Structures using C", Oxford Press.
3. E. Balagurusamy, "Data Structure Using C", Tata McGraw-Hill Education India.
4. Richard F. Gilberg and Behrouz A. Forouzan, "Data Structures: A Pseudocode Approach with C", 2ndEdition, CENGAGE Learning.

References:

1. Sahni Horowitz, Fundamentals of data structures in C, computer science press, 2008.
2. Jean Paul Tremblay, P. G. Sorenson, "Introduction to Data Structure and Its Applications", McGraw-Hill Higher Education
3. Narasimha Karumanchi, Data Structures And Algorithms, 5th Edition,CareerMonk, 2016.
4. Robert Kruse, C. L. Tondo, Bruce Leung, "Data Structures and Program Design in C", Pearson Publication.

Online References:

Sr. No.	Website Name
7.	https://nptel.ac.in/courses/106/102/106102064/

8.	Data Structure using C Programming - Course (swayam2.ac.in)

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
PCL2011	Data Structure 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)					
PCL2011	Data Structure Lab	--	--	--	--	--	25	25	50

Lab Objectives: The course aims to

1. Learn about the purpose and importance of data structures, as well as their principles.
2. Understand linear and nonlinear data structures, as well as their implementation.
3. Analyze data structures, such as stacks and queues.
4. Study the terminologies, types, and various operations in linked lists.
5. Discover the principles of Tree, including its operations and uses.
6. Investigate the real-time uses of different data structures.

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

1. Classify and apply linear and non-linear data structure concepts to real-world problem solving, as well as performing operations such as insertion, deletion, and traversal.
2. Explore data structures like Stacks, learn about their operations, and apply them to solve issues in a variety of domains.
3. Examine queue data structures and apply them to use in diverse real-world applications.
4. Apply the concept of linked lists to evaluate problems in a variety of applications.
5. Analyze and apply the concepts of Trees and their applications in real life problem solving.
6. Demonstrate the ability to analyze, construct, implement, and use data structures to solve real-world problems and evaluate their effectiveness.

Prerequisite: Fundamentals of C programming and its concepts like Functions, Recursion, Arrays, Structures and Pointers.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Constructs of C like Functions, Recursion, Arrays, Structures and Pointers.		
I	Introduction	Overview of Data Structure, Elementary Data Structure Organization, Classification of Data Structures, Operations on Data Structures and Abstract Data Type, recursion.	**04**	**LO 1**
II	Stack	Introduction to Stacks, Array representation of Stacks, Operations on a Stack.	**04**	**LO 2**
III	Queue	Introduction to Queues, Array representation of Queues, Types of Queues, Operations on Queue, Applications of Queues.	**04**	**LO 3**
IV	Linked list	Basics of Linked list, ADT Operations Singly Linked Lists, Circular Linked Lists, Doubly Linked Lists, Linked representation of Stacks, and Linked representation of Queues.	**04**	**LO 4**
V	Tree	Basic Terminology, Types of Trees, Binary Tree traversal, Operations on Binary Search Trees.	**04**	**LO 5**
VI	Applications of Data Structures	**Stack:** Reversing a list/String, Implementing Parentheses Checker, Evaluation of Arithmetic Expressions, **Tree:** Evaluating the expressions using expression tree and implementation of Huffman Encoding.	**06**	**LO 6**

Text Books:

1. Reema Thareja, "Data Structures using C", Oxford Press.
2. Aaron M Tenenbaum, Yedidyah Langsam, Moshe J Augenstein, "Data Structures Using C", Pearson Publication.
3. Ellis Horowitz, Sartaj Sahni, Fundamentals of Data Structures, Galgotia Publications; 2010.
4. E. Balagurusamy, "Data Structure Using C", Tata McGraw-Hill Education India.

References:

1. Narasimha Karumanchi, Data Structures And Algorithms, 5th Edition,CareerMonk, 2016.
2. Jean Paul Tremblay, P. G. Sorenson, "Introduction to Data Structure and Its Applications", McGraw-Hill Higher Education.
3. Robert Kruse, C. L. Tondo, Bruce Leung, "Data Structures and Program Design in C", Pearson Edition.

Online Resources:

Sr. No.	Website Name
9.	https://nptel.ac.in/courses/106/102/106102064/
10.	Data Structure using C Programming - Course (swayam2.ac.in)

List of Experiments:

Note:

1. All the practical's must be performed in C programming language
2. Students are required to complete at least 10-12 experiments.
3. '*' marked experiments are compulsory while rest can be taken from the given list

Sr No	List of Experiments	Hrs
01. *	Implementation of Insertion and deletion in a specific position in an Array using Function.	2
02.	Implementation of recursive program.	2
03. *	Array Implementation of Stack.	2
04. *	Array Implementation of Linear Queue.	2
05.	Array Implementation of Circular Queue.	2
06. *	Implement Singly Linked List.	2
07.	Implement Doubly Linked List.	2
08. *	Implementation of Double Ended Queue using Linked List.	2
09.	Implementation of Stack using Linked list	2
10. *	Implementation of Binary Search Tree and its traversal methods.	2
11.	Program to count Number of leaf nodes, find the biggest and smallest and height of the tree.	2
12.	Implementation of Reversing a List using Stack.	2
13.	Convert an Infix expression to Postfix expression using stack ADT.	2
14. *	Program to Evaluate Postfix Expression using Stack ADT.	2

List of Assignments:

Sr No	List of Assignments / Tutorials	Hrs
01	Assignment covers the topics from first three units (Introduction, Stack and Queue) limited to three Questions	2
02	Assignment covers the topics from Last three units (Linked list, Tree and Application of Data Structures) limited to three Questions	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	Tut.	Pract / Oral	Theory	Tut.	Pract/ Oral	Total
PCC2012	Elements of Civil Engineering	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)					
PCC2012	Elements of Civil Engineering	20	20	40	60	2	--	--	100

Rationale:

This course is intended for gaining useful knowledge with respect to principles and procedures related to civil engineering with practical approaches. Civil Engineering structures are made using various engineering materials such as concrete, timber, metals, or their composites. Knowledge of surveying is very useful to all engineers to plan and execute any civil engineering project. The element of civil engineering is to address societal needs like water and shelter by creating safe, efficient, and sustainable infrastructure that also enhances quality of life and economic development.

Course Objectives:

1. To study the basic concepts of civil engineering.
2. To study various building material and their significance in the construction activity.
3. To introduce the concept of elements of building drawing.
4. To develop the concept of basic surveying.
5. To understand the concept of water resources engineering
6. To understand the concept of transportation engineering

Course Outcomes:

1. Compare and contrast different branches of civil engineering in terms of their focus areas and applications.
2. Analyse common building materials and their construction applications.
3. Interpret and sketch basic building drawings using standard symbols.
4. Apply basic surveying principles using instruments for simple measurements.
5. Describe the importance of water resources management
6. Understand the basics of transportation systems.

Prerequisite: A strong foundation of Mathematics, Physics, Chemistry and Spatial reasoning.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content		Hours	CO Mapping
0	Prerequisite	Spatial reasoning and basics of Mathematics			
I	Introduction to Civil Engineering	1.1	What is Civil Engineering/ Infrastructure? Basics of Engineering and Civil Engineering; Importance of Civil Engineering, Introduction to different disciplines of Civil Engineering; Possible scopes for a career	**02**	**CO1**
		1.2	Early constructions and developments over time; Ancient monuments & Modern marvels; Development of various materials of construction and methods of construction; Works of eminent civil engineers		
		1.3	Position of construction industry vis-à-vis other industries, five-year plan outlays for construction; current budgets for infrastructure works		
II	Building Materials	2.1	**Materials:** Introduction to construction materials like Stone, Bricks, Lime, Timber, Sand, Aggregates, Mortar, and bitumen.	**06**	**CO2**
		2.2	**Cement:** Chemical composition, Hydration of cement, Properties of Portland cement, OPC: PPC, Slag cement and other types of cement and their suitability, Different tests on Cement		
		2.3	**Concrete:** Introduction to Concrete, Grade of concrete. Manufacturing process of concrete, Introduction to RMC plant.		
III	Building drawing	3.1	Classification of buildings, Types of loads acting on buildings, building components and their functions and nominal dimensions, signs, and symbols used for different materials and elements of buildings	**05**	**CO3**
		3.2	Elements of building drawing, Methods of making line drawing and detailed drawing. Site plan, floor plan, FSI, elevation and section drawing of small residential building.		
IV	Basics of Surveying	4.1	Role of Civil Engineer in Surveying, Definition, Working Principles, Scale and Mapping, Classification of surveying, Linear measurement, Chain and tapes, field work	**08**	**CO4**

		4.2	Angular Measurement: Bearing and Direction, Types of compasses		
		4.3	Levelling: Principle of leveling, Instruments for leveling, Methods of reduction.		
V	Water supply and Sanitary Engineering	5.1	Sources of Water and quality standards, Water demands.	**03**	**CO5**
		5.2	Fundamentals of Sanitary Engineering collection and conveyance of refuse, waste water: Introduction to Air pollution, noise pollution.		
VI	Transportation Engineering	6.1	Role of transportation in national development, Introduction to mass transportation system.	**02**	**CO6**
		6.2	Introduction to transportation infrastructure in India, Highways, Railways, Airports and Ports		

Text Books:

1. Building Construction: *S.P. Arora, Dr. S.P. Bindra,* Dhanpat Rai Publication, New Delhi.
2. Planning and Designing Buildings: *Y. S. Sane* (Modern Publication House, Pune)
3. Surveying and Levelling: *Dr. B. C. Punmia,* Vol.-I, 16th Edition, Vol. -II 4th Edition, Laxmi Publications (ISBN9788170088530)
4. Irrigation and Water power Engineering: *Dr. B. C. Punmia, Dr. Pande Lal, Ashok Kumar Jain, Arun Kumar Jain*, 16th Edition, Laxmi Publication.
5. Principles of Transportation Engineering: *Chakrabory, Partha and Das, Animesh;* Prentice Hall India Learning Pvt. Ltd., New Delhi

References:

1. Introduction to Engineering Materials: B. K. Agrawal, Tata McGraw Hill, New Delhi.
2. Building Materials (Products, Properties and Systems): M.L. Gambhir and Neha Jamwal, McGraw Hill Publications.
3. IS 962: 1989 – Code of Practice for Architectural and Building Drawings.
4. Surveying and Levelling (Vol.-I): S.K. Duggal, Tata McGraw Hill
5. Principles and Practice of Highway Engineering: *Kadiyali, L. R.*; Khanna Publsihers, Delhi.

Online References:

Sr. No.	Website Name
1.	https://www.asce.org/about-civil-engineering
2.	https://gate.nptel.ac.in/video.php?branchID=5&cid=1
3.	http://www.nptel.iitm.ac.in/courses.php?branch=Civil
4.	http://www.nptel.iitm.ac.in/courses/Webcourse-contents/IIT

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
PCL2012	Elements of Civil 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)					
PCL2012	Elements of Civil Engineering Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1. To study the basic concepts of civil engineering.
2. To study various building material and their significance in the construction activity.
3. To introduce the concept of elements of building drawing.
4. To develop the concept of basic surveying.
5. To understand the concept of water resources engineering
6. To understand the concept of transportation engineering

Lab Outcomes:

1) Recall the fundamental role of civil engineering and list its core branches.
2) Explain the characteristics of common building materials and their typical applications in construction.
3) Use standard symbols to sketch basic building drawings based on given interpretations.
4) Compare and contrast basic surveying instruments and their principles for simple measurements.
5) Assess the importance of water resources management in relation to environmental and societal needs.
6) Understanding the basic of the transportation system considering various factors.

Prerequisite: Knowledge of physics and mathematics up to 12 science level.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Knowledge of physics and mathematics up to 12 science level.		
I	Introduction to Civil Engineering	Prepare a report on different branches of civil engineering in terms of their focus areas and applications	**02**	**LO1**
II	Building Materials	Prepare a report on different building materials with their properties	**02**	**LO2**
III	Building drawing	Each student shall prepare a plan, elevation, and section of a simple residential building from given data	**02**	**LO3**
IV	Basics of Surveying	Use of Chain Compass and Instruments for leveling	**02**	**LO4**
V	Open Ended Problem (Model Making):	Prepare a model of any one type from hydraulic structures like gravity dam, earthen dam, falls, canal structures	**02**	**LO5**
VI	Transportation Engineering	Prepare a poster related to transportation engineering	**02**	**LO6**

Text Books:

1. Building Construction: *S.P. Arora, Dr. S.P. Bindra,* Dhanpat Rai Publication, New Delhi.
2. Planning and Designing Buildings: *Y. S. Sane* (Modern Publication House, Pune)
3. Surveying and Levelling: *Dr. B. C. Punmia,* Vol.-I, 16th Edition, Vol. -II 4th Edition, Laxmi Publications (ISBN9788170088530)

References:

1. Introduction to Engineering Materials: B. K. Agrawal, Tata McGraw Hill, New Delhi.
2. Building Materials (Products, Properties and Systems): M.L. Gambhir and Neha Jamwal, McGraw Hill Publications.
3. IS 962: 1989 – Code of Practice for Architectural and Building Drawings.
4. Surveying and Levelling (Vol.-I): S.K. Duggal, Tata McGraw Hill
5. Principles and Practice of Highway Engineering: *Kadiyali, L. R.*; Khanna Publsihers, Delhi.

Online Resources:

Sr. No.	Website Name
1.	https://www.asce.org/about-civil-engineering
2.	https://gate.nptel.ac.in/video.php?branchID=5&cid=1
3.	http://www.nptel.iitm.ac.in/courses.php?branch=Civil
4.	http://www.nptel.iitm.ac.in/courses/Webcourse-contents/IIT

List of Experiments.

Sr No	List of Experiments	Hrs.	LO Mapping
01	Initial and Final setting time test on cement	**02**	**LO1**
02	Compressive strength of cement	**02**	**LO2**
03	Drawing plan of G+1 bungalow (Existing)	**02**	**LO3**
04	Ranging, chaining, and offsetting	**02**	**LO4**
05	Measurement of bearings using prismatic and surveyor's compass	**02**	**LO5**
06	Simple and compound levelling	**02**	**LO6**

Sr No	List of Assignments / Tutorials	Hrs.	LO Mapping
01	Enlist in detail scope of Civil Engineering based on different disciplines of Civil Engineering	**02**	**LO1, LO2, LO3, LO4, LO5, LO6**
02	Prepare detail report on three Civil Engineering projects of national repute		
03	Discuss on Hydrological cycle and water supply		
04	Comparison of different modes of transportation		

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	Tut.	Pract / Oral	Theory	Tut.	Pract/ Oral	Total
PCC2013	Elements of Biomedical Engineering	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)					
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
11.	*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*
12.	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 (Hrs/week)			Credits Assigned			
PCC2014	Digital Electronics	L	T	P	L	T	P	Total
		2	--	--	2	--		2
		Examination Scheme						
			IA1	IA2	ESE		Total	
		Theory	20	20	60		100	

Pre-requisite Course Codes	Binary number system and codes, binary arithmetic	
Course Outcomes	After the successful completion students should be able to	
	CO1	Compare TTL and CMOS families w.r.t. their characteristic parameters
	CO2	Construct combinational circuits using given MSI devices.
	CO3	Apply the knowledge of flip-flops and MSI devices to design sequential circuits.
	CO4	Analyze the given sequential circuits to identify the state transitions and race conditions.
	CO5	Implement the given logic function using programmable logic devices.

Module No.	Unit No.	Topics	Reference	Hrs.
1. Implementation of Logic functions	1.1	Logic gates, Implementation of functions using basic gates and using Universal gates	1,2, 3,4	4
	1.2	Formulating a logic function, Sum of Products (SOP), Product of Sums (POS), Minimization using Boolean Algebra, De Morgan's Theorems, Minimization using Karnaugh map (up to 4 variables), Quine-McClusky technique	1,2, 3,4	
2. Logic Families	2.1	Characteristic parameters of logic families: Voltage and Current parameters, Fan in, Fan out, Noise margin, Power Dissipation, Propagation Delay TTL NAND gate and its transfer characteristics, CMOS inverter and transfer characteristics, comparison of TTL and CMOS logic families	1,2, 3,4	3
3. Combinational Circuit Design	3.1	Full adders, ripple carry adders, Carry Look ahead Adders, Binary Subtractors	1,2, 3,4	5

	3.2	Multiplexer/ Demultiplexer, Encoders, Priority Encoders, Parity Generators, Code Converters, comparator, ALU		
	3.3	Static and dynamic hazards in combinational circuits		
4 . Elements of Sequential Circuit	**4.1**	Storage elements: Latches and Flip-flops (S-R, J-K, D, T Flip-flop), Master Slave Flip-flop	1,2, 3,4	5
	4.2	Synchronous and Asynchronous counters, Shift registers and their applications	1,2, 3,4	
5. Analysis of Sequential circuits	**5.1**	Analysis of Moore and Mealy type Finite State Machines (FSM), State Reduction	1,2, 3,4	5
	5.2	Introduction to Asynchronous Sequential circuits, Essential hazards in asynchronous sequential circuits	1,2, 3,4	
6. Programmable devices		Structure of Programmable Logic Devices (PLDs), Function implementation with PAL and PLAs, Introduction to CPLD and FPGA	1,2, 3,4	4
			Total	**26**

Recommended Books:

[1] John F. Wakerly, "Digital Design Principles and Practice"- Pearson Publications, 4th edition

[2] Morris Mano, Michael D. Ciletti, " Digital Design with introduction to Verilog HDL" Pearson, 5th edition

[3] John M. Yarbrough, "Digital Logic Applications and Design" – Thomson Publications

[4] Stephen Brown and ZvonkoVranesic, "Fundamentals of digital logic design with Verilog design", McGraw Hill, 3rd Edition

[5] Roth and Kinney, "Fundamentals of Logic Design", Cengage learning,7th edition

[6] J. Bhaskar, A Verilog HDL Primer, Third Edition, Star Galaxy Publishing

[8] Sameer Palnitkar, "Verilog HDL: A guide to digital design and synthesis"

[7] William I. Fletcher, "An Engineering Approach to Digital Design", PrenticeHall of India

Online References:

https://archive.nptel.ac.in/content/storage2/courses/106108099//Digital%20Systems.pdf

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 (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
PCL2014	Digital Electronics Lab	--	--	2	--	--	1	1
		Examination Scheme						
		Term work		Orals			Total	
		25		25			50	

Pre-requisite Course Codes	Binary number system and codes, binary arithmetic	
Laboratory Objectives	1.	Simplification of the real life functions with multiple variables
	2	Understand different Logic Families
	3.	Construct combinational and Sequential circuits using given MSI devices.
Laboratory Outcomes	After the successful completion students should be able to	
	LO 1	Apply the knowledge of combinational circuits and MSI devices to design circuits.
	LO 2	Analyze the given sequential circuits to identify the state transitions and race conditions.
	LO 3	Implement the given logic function using programmable logic devices.

Laboratory Experiments:

Sr. No.	Title of experiment	Module	Reference
1.	To implement the combinational logic for a given function using basic gates and Universal gates.	**1**	**1,2**

2.	To simulate a CMOS inverter and to plot the transfer characteristics (using SPICE)	**2**	**1,2**
3.	a. To verify the function of 8 bit binary adder IC7483 b. To implement a BCD adder using IC7483	**3**	**1,2**
4.	a. To implement the function of 8-bit Multiplexer using IC74151 b. To implement a given 4 variable Boolean function using Multiplexer IC 74151	**3**	**1,2**
5.	To implement an 8-bit binary comparator using IC 7485	**3**	**1,2**
6.	a. To implement a Mod n asynchronous counter using flip-flops b. To implement a Mod n counter using IC 74163	**4**	**1,2**
7.	Implementation of a combinational circuit using reconfigurable devices a. To write an HDL code for the parity generator and simulate verify the operation by simulation. b. To implement the HDL code on FPGA and verify the operation.	**6**	**6,7**
8.	Implementation of a sequential circuit using reconfigurable devices a. To write an HDL code for a 4-bit shift register and verify the operation by simulation. b. To implement the HDL code on FPGA and verify the operation.	**6**	**6,7**

Recommended Books:

[1] Morris Mano, Michael D. Ciletti, " Digital Design with introduction to Verilog HDL" Pearson, 5th edition

[2] Sameer Palnitkar, "Verilog HDL: A guide to digital design and synthesis"

[3] William I. Fletcher, "An Engineering Approach to Digital Design", PrenticeHall of India

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
PCC2015	Introduction to Chemical Engineering	2	-	-	2	-	-	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment (IAT)			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-II	IAT-I_TAT-II (Total)					
PCC2015	Introduction to Chemical Engineering	20	20	40	60	2	--	--	100

Rationale :

The course focuses on imparting a understanding of unit operations, unit processes, and key concepts like pH, solubility, specific gravity, and electrical conductivity essential for handling solutions and mixtures. Emphasis is placed on mastering these fundamentals to enhance operational efficiency and quality. Additionally, the course prioritizes safety awareness to prevent accidents and ensure workplace safety, equipping to mitigate risks in chemical processing environments.

Course Objectives:

1. To study chemical engineering principles, and essential chemical calculation.
2. To study fundamental principles and applications of various unit operations
3. To study chemical reactions and applications of essential unit processes.
4. To study chemical processes and interpretation of flow sheets and block diagrams
5. To study fundamental principles and techniques in chemical processes.
6. To study the various utilities in a Chemical plant.

Course Outcomes:

Gain knowledge of chemical engineering principles, industry applications, and essential chemical calculation.

1) Understand the fundamental principles and applications of various unit operations in chemical engineering, including mechanical, mass, and heat transfer processes.
2) Understand the key chemical reactions and applications of essential unit processes used in industrial chemical production.
3) To analyze chemical processes, understand key performance metrics, and interpret flow sheets and block diagrams
4) Understand fundamental principles and techniques for measuring parameters along with the importance and use of Personal Protective Equipment (PPE) in chemical processes.
5) Understand the use and management of utilities in a Chemical plant

Prerequisite:

HSC standard Physics , Chemistry and Maths

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite			
I	**INTRODUCTION**	Historical background, scope of chemical engineering, types of industries - nature and size of industries (large, medium, small scale). Units, dimensions, conversions and conversion factors. Basic concepts and basic chemical calculations: Concept of mole, weight percentage, mole percentage, normality, molarity, molality, vapour pressure, partial pressure. Dalton's law, Amagat's law	**04**	**CO1**
II	**UNIT OPERATIONS**	Definitions, purpose and principles of unit operations like Mechanical operation: Size reduction, Size separation, Filtration, Sedimentation, Mixing. Mass transfer: Gas absorption, Desorption. Mass and Heat transfer: Distillation, Drying. • Heat transfer: Modes of heat transfer. • Fluid flow: Fluid handling.	**04**	**CO2**
III	**UNIT PROCESSES**	Unit processes with simple examples like Sulphonation, Oxidation, Reduction, Hydrogenation, Hydration, Saponification, Esterification, Nitration, Chlorination and Cracking/Pyrolysis	**04**	**CO3**
IV	**BASIC CONCEPTS OF CHEMICAL PROCESSES**	Chemical Process, Definition of conversion, yield, reaction efficiency. Introduction to Process Flow sheets: block diagrams	**04**	**CO4**
V	**PROCESS INSTRUMENTATION AND SAFETY**	Temperature scales, measurement of temperatures using mercury thermometer. Pressure scales, units, measurement of pressure using manometers. Level measurement using direct methods like bob and tape, float and tape, sight glass. • Flow measurement using rotameter. • Measurement of viscosity by using Redwood viscometer and density by using specific gravity bottle. • Personal Protective Equipment (PPE).	**05**	**CO5**

VI	**PLANT UTILITIES**	List and use of various utilities in chemical plant, Use of Water, Steam, Air & Inert Gases as utilities Steam Generator : Classification , comparison , components. Construction and working of (a) Locomotive Fire tube boiler (b) Lancashire boiler Factors affecting selection of Boiler	**05**	**CO6**

Text Books:

1. S.N. Saha, Fundamental Of Chemical Engineering, Dhanpat Rai Publishing Company New Delhi

2. Bhatt B. I & Vora S.M., Stoichiometry; Tata Mc Graw Hill Publication, New Delhi

3. Ashoutosh Panday, Plant Utilities, Vipul Prakashan Mumbai

References:

1. Mc Cabe , W.L.Smith, Harriott, Unit Operation of Chemical Engineering , Mc Graw Hill International

2. Salil K.Ghosal, , Shyamal K. Sanyal, Siddhartha Datta, Introduction to Chemical Engineering, Tata Mc Graw Hill publication Education Pvt Limited

3. Walter L.Badger, Julius T Banchero, Unit Operation of Chemical Engineering, Mc Graw Hill International

Online References:

Sr. No.	Website Name
13.	www.thechemicalengineers.com/

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
PCL2015	Introduction to Chemical Engineering Lab		2	-		1	-	1

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)				
PCL2015	Introduction to Chemical Engineering Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To enable the students to understand the development of a process from its chemistry
2. Apply principles of basic sciences and chemical engineering for designing various size reduction and separation equipment
3. Learn reactant properties influence reaction pathways and product formation.
4. To demonstrate the application of chemical process principles through the analysis of reaction
5. To understand the primary mechanisms of sensors
6. To understand construction and working principles boilers.

Lab Outcomes:

1. Outline laboratory procedures for the preparation of industrially important chemicals and products
2. Acquire analytical skills for determination of particle size of solid mixture
3. Understand reactant properties to reaction Mechanism and product formation.
4. Analyze and optimize chemical reactions by calculating and interpreting conversion, yield, and reaction efficiency metrics.
5. The student will be able to calculate the output of various measuring schemes
6. **To** explore the role of utilities, study boilers and cooling towers, and conduct data collection and analysis for understanding industrial process efficiency and optimization.

Prerequisite:

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite			
I	**INTRODUCTION TO CHEMICAL ENGINEERING**	Volumetric Analysis: Types of Titration, Principle ,Procedure and and apparatus used for volumetric analysis. Gravimetric analysis: Principle and types	**02**	**L2,L3**
II	**UNIT OPERATIONS**	Size reduction and Seperation: Sieve analysis, Mesh Number, Dry and wet screening, Application of size distribution data	**02**	**L2,L3**
III	**UNIT PROCESSES**	Reactant, Mechanism of reaction, condition and importance of reaction	**02**	**L3**
IV	**BASIC CONCEPTS OF CHEMICAL PROCESSES**	Batch process, continuous process, separation, purification and formulation	3 **02** Effectiveness of screen	**L3**
V	**PROCESS INSTRUMENTATION AND SAFETY**	Introduction Standards and Calibration, Elements of Measuring Systems, Classification of Instruments, Performance Characteristics, Errors in Measurement.	**02**	**L2**
VI	**PLANT UTILITIES**	Role of utilities , study of Boiler and cooling Tower, data collection and analysis.	**02**	**L2**

Text Books:

1. S.N.Saha, Fundamental Of Chemical Engineering, Dhanpat Rai Publishing Company New Delhi

2. Bhatt B. I & Vora S.M. ,Stoichiometry; Tata Mc Graw Hill Publication ,New Delhi

3. Ashoutosh Panday , Plant Utilities, Vipul Prakashan Mumbai

References:

1. Mc Cabe , W.L.Smith, Harriott, Unit Operation of Chemical Engineering , Mc Graw Hill International

2. Salil K.Ghosal, , Shyamal K. Sanyal, Siddhartha Datta, Introduction to Chemical Engineering, Tata Mc Graw Hill publication Education Pvt Limited

3. Walter L.Badger, Julius T Banchero, Unit Operation of Chemical Engineering, Mc Graw Hill International

Online Resources:

Sr. No.	Website Name
1	www.thechemicalengineers.com/

List of Experiments.

Sr No	List of Experiments	Hrs
01	Preparation of standard solutions and to find normality and deviation factor.[Any two]	2
02	Gravimetric estimation of Barium as BaCl2, Tin as SnCl2	2
03	Sieve Analysis	2
04	Effectiveness of Screen	2
05	Saponification of Ethyl Acetate	2
06	Preparion of Biodisel	2
07	Preparation of Rubber latex ball	2
08	Gravimetric estimation	2
09	Chemical Process	2
10	Flow measurement	2
11	Pressure measurements	2
12	Level measurements	2
13	Temperature measurements	2
14	Hardness of water	2
15	Study of Boiler	2
16	Study of Cooling tower	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
PCC2016	**Elements of Telecommunication**	**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)					
PCC2016	**Elements of Telecommunication**	20	20	40	60	2	–	–	100

Course Objectives:

1 To provide students with a foundational understanding of wireless communication systems.
2 To understand the basic principles of fiber optic communication.
3 To learn computer network fundamentals
4 To understand the basics of analog
5. To digital communication system
6 To provide students with a foundational understanding of satellite

Course Outcomes : -Students will be able to :-

CO1 : Understand basics of analog communication system
CO2: Explain basics of digital communication system
CO3: Learn the fundamental key concepts of computer networks
CO4: Know the various elements of mobile communication systems.
CO5: Understand the fundamentals of Fiber Optical Communication System.
CO6: Describe t**he** fundamentals **of the satellite communication system.**

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite			
1	Analog Communication	Introduction to Communication Systems, Analog & Digital Signal, Need for Modulation and Demodulation. Amplitude and Frequency Modulation and Demodulation.	**4**	**CO1**
2	Digital Communication	Introduction to Digital Communication, Definition of sampling theorem, Pulse Code Modulation, Basics of ASK, FSK & PSK waveforms.	**4**	**CO2**
3	Computer Communication Network	Introduction to Computer Network, Network Topologies, TCP/IP and OSI Model, Data Communication and Transmission Media.	**4**	**CO3**
4	Mobile Communication	Introduction to wireless communication:Mobile Radio Telephony, Types of mobile wireless services/systems – Cellular, Standard, Introduction to 2G, 3G, 4G and 5G technologies.	**5**	**CO4**

5	Fiber Optical Communication	Introduction to Basics of Fiber Optic Communication, Historical Development, Reflection, Refraction, and Dispersion, structure of Optical Fibers, Advantages & Disadvantages, Applications of Fiber Optics Communication.	**5**	**CO5**
6	Satellite Communication	Introduction to Satellite Communication, types of satellites, Applications of satellite communication systems, Frequency bands used in satellite communication, such as C-band, Ku-band, and Ka-band. Components of satellite communication systems.	**4**	**CO6**

Text Books:

1. **"Electronics Communications System" by George Kennedy.**
2. **"Optical Fiber Communications" by Gerd Keiser, 5th Edition**
3. **"Data Communications and Networking" by Behrouz A. Forouzan, Fifth Edition TMH, 2013.**
4. **T. Pratt, C. Bostian, and J. Allnutt, *Satellite Communications*, 2nd ed., Wiley, 2002.**

References:

1. Simon Haykin, "Communication Systems", 4th Edition, John Wiley & Sons, 2004.
2. Optical Fiber Communication: Principles and Practice, John M. Senior, 3rd edition.
3. M. Richharia and L. K. T. S. Mhurchu, *Satellite Communications Systems: Systems, Techniques and Technology*, 6th ed., Wiley, 2020.

Online References:

Sr. No.	Website Name
1.	Analog Communication By Prof. Goutam Das (IIT Kharagpur); https://swayam.gov.in/nd1_noc20_ee69/preview
2.	https://nptel.ac.in/courses/108/101/108101113/
3	https://nptel.ac.in/courses/117/101/117101050/
4	http://nptel.ac.in/courses/117104099/ - (Advanced 3G and 4G Wireless Mobile communications)
5	**https://www.iitg.ac.in/psm/qip2015/material/Subir_Bandyopadhyay_Lecture1.pdf**
6	**https://archive.nptel.ac.in/courses/117/105/117105131/**

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
PCL2016	Elements of Telecommunication Lab	-	2	-	-	1	-	1

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)				
PCL2016	Elements of Telecommunication Lab	--	--	--	--	25	25	75

Lab Objectives: -

1. To demonstrate generation and detection of analog modulation techniques.
2. To demonstrate generation and detection of digital modulation techniques.
3. To illustrate the different computer network topology.
4. To illustrate the mobile various AT commands of GSM & to know about parameters of Wi-Fi.
5. To make use of modern tools for simulation of communication systems.
6. To provide practical experience in simulating satellite communication.

Lab Outcomes: Students will be able to

LO1: Demonstrate the concepts of AM and FM
LO2: Compare digital modulation techniques PCM, ASK, FSK
LO3: Simulate a computer network using various network components
LO4: Use of AT Commands in mobile device

LO5: Setting up of optical fiber link
LO6: Simulate satellite communication scenarios.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
I	Analog Communication	Modulation and Demodulation Techniques like AM and FM	2	LO1
II	Digital Communication	Digital Modulation technique like PCM, ASK, FSK	4	LO2
III	Computer Communication Network	Network topologies and devices. Implementation of above topologies using open source softwares. .	2	LO3
IV	Mobile Communication	AT commands for GSM. Demonstrate AT commands. To know and study various parameters of Wi-Fi / Access points	4	LO4
V	Fiber Optical Communication	Components of Fibre Optic Communication	2	LO5
VI	Satellite Communication	Components of Satellite Communication	2	LO6

Text Books:

1. **"Electronics Communications System" by George Kennedy.**
2. **"Optical Fiber Communications" by Gerd Keiser, 5th Edition**
3. **"Data Communications and Networking" by Behrouz A. Forouzan, Fifth Edition TMH, 2013.**
4. **T. Pratt, C. Bostian, and J. Allnutt, *Satellite Communications*, 2nd ed., Wiley, 2002.**

References:

1. Simon Haykin, "Communication Systems", 4th Edition, John Wiley & Sons, 2004.
2. Optical Fiber Communication: Principles and Practice, John M. Senior, 3rd edition.
3. M. Richharia and L. K. T. S. Mhurchu, *Satellite Communications Systems: Systems, Techniques and Technology*, 6th ed., Wiley, 2020.

Online Resources:

Sr. No.	Website Name
1.	Analog Communication By Prof. Goutam Das (IIT Kharagpur); https://swayam.gov.in/nd1_noc20_ee69/preview
2.	https://nptel.ac.in/courses/108/101/108101113/
3.	https://nptel.ac.in/courses/117/101/117101050/
4	http://nptel.ac.in/courses/117104099/ - (Advanced 3G and 4G Wireless Mobile communications)
5	**https://www.iitg.ac.in/psm/qip2015/material/Subir_Bandyopadhyay_Lecture1.pdf**
6	**https://archive.nptel.ac.in/courses/117/105/117105131/**

List of Experiments:

Sr No	List of Experiments	Hrs
01	Simulation /Hands on modulation techniques AM	2
02	Simulation /Hands on modulation techniques FM.	2
03	Simulation /Hands on digital techniques PCM.	2
04	Simulation /Hands on digital techniques ASK.	2
05	Simulation /Hands on digital techniques FSK.	2
06	Simulation/Setting up of star topology using packet tracer (Open Source Softwares).	2
07	Simulation/Setting up of ring topology using packet tracer (Open Source Softwares).	2
08	Simulation/Setting up of mesh/tree topology using packet tracer (Open Source Softwares).	2
09	Simulation/Setting up of bus topology using packet tracer (Open Source Softwares).	2
10	Test the AT commands on mobile devices using open softwares.	2
11	To study parameters of Wi-Fi (IEEE 802.11)	2
12	Simulation of Satellite Communication System.	2
13	Setting up/ Simulate Analog fiber optic communication System using open source software	2
14	Setting up/ Simulate Digital fiber optic communication System using open source software	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
PCC2017	Elements of Electrical Systems	2	2	-	2	-	-	2

Course Code	Course Name	Theory							Total
		Internal Assessment (IAT)			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)					
PCC2017	Elements of Electrical Systems	20	20	40	60	2			100

Course Objectives:

1. To list & describe the different methods of Power generation
2. To elaborate the various types of transmission lines
3. To discuss the various types of electrical loads
4. To understand and calculate the power consumption in electrical system
5. To explain the various types of electrical energy storage system
6. To discuss the various types of electrical meters

Course Outcomes:

1. Understand the different methods of Power generation
2. Evaluate the sending end and receiving end voltage of transmission line
3. Study the various types of electrical loads
4. Understand the ratings and calculate the electrical energy consumption
5. Study the various types of electrical storage
6. Illustrate the working of different types of meters in electrical system

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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Generation of Electrical Power	Overview of different methods of Power generation: thermal (fossil fuels, nuclear), renewable (solar, wind, hydro, geothermal), nuclear and emerging technologies (tidal, wave, biomass). Layout of hydroelectric power station, thermal power plant, solar generation, nuclear power plant	06	CO1

		with their advantages and disadvantages. Cost of generation, peak load and base load plant.		
II	Transmission	Short, medium and long transmission lines, Types of conductors used, Single phase transmission line, 3 phase transmission line (single circuit and double circuit). Application of KVL, KCL to find sending end and receiving end voltage. Calculations of Power transmitted	**04**	**CO2**
III	Utilization of Electrical Energy	Electric Power Distribution: Generation, Transmission and distribution systems: grid structure, voltage levels. Types of loads: Residential: lighting load, refrigeration and air conditioning, washing machine. Agricultural load: pumps. Industrial load: Electrical Drives- AC-DC, furnace, Electric heating & welding, Machines (Motors and generators: AC vs. DC)	**07**	**CO3**
IV	Ratings & Calculation of Energy Consumption	Power rating of household appliances such as tube light, fan, air conditioners, PCs, laptops, printers, etc. Definition of "unit" used for consumption of electrical energy, understand the calculation of electricity bill for LT & HT consumers.	**03**	**CO4**
V	Energy Storage	Battery Technologies: Chemistry basics: lead-acid, lithium-ion, sodium-ion, solid-state batteries. Charging and discharging characteristics. Battery management systems (BMS). Battery storage: types (lead-acid, lithium-ion, flow batteries), applications.	**03**	**CO5**
VI	Measurement in Electrical Energy Systems	Importance of measurement in electrical energy systems. Basic principles of electrical measurements: instruments and techniques. Moving coil and Moving iron Ammeters & Voltmeters, Power measurement by wattmeter in single phase circuit	**03**	**CO6**

Text Books:

1. Mahesh Verma, Power Plant Engineering, Metrolitan Book Co Pvt Ltd
2. RK Rajput, A Text Book of Power System engineering, Laxmi Publication
3. D. P. Kothari, I. J. Nagrath, Power System Engineering, 3 Edition, Mc GrawHill
4. B.R. Gupta, Power System Analysis And Design, S.Chand
5. Mehta V.K., Principles of Power System, S Chand

6. AK Sawhney, Electrical & Electronic Measurements and Instrumentation, Dhanpat Rai & Sons
7. Dincer I., and Rosen M. A. (2011); Thermal Energy Storage: Systems and Applications,Wiley

References:

1. W. D. Stevenson, Elements of Power System, 4 Edition TMH
2. Trevor M. Letcher, Storing Energy with Special Reference to Renewable Energy Source, Elsevier, 2016.
3. RS Sirohi & Radhakrisnan, Electrical Measurement & Instrumentation, New Age International

Online References:

Sr. No.	Website Name
1	https://www.energy.gov/eere/renewable-energy

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
PCL2017	Elements of Electrical Systems Lab	-	2	-	-	1	-	1

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)				
PCL2017	Elements of Electrical Systems Lab	--	--	--	--	25	25	50

Lab Objectives:

1. Evaluate the performance of transmission lines.
2. Understand the performance parameters of a generator.
3. Evaluate the characteristics of batteries.
4 Study the operation and performance of an electric motor.
5 Analyze the performance of renewable energy sources.
6.Familiarize with electrical measurement techniques.

Lab Outcomes:

1) To study various aspects of performance of different renewable energy sources.

2) To analyze the operational behavior of batteries and energy storage.

3) To evaluate the efficiency and performance of DC machines (motor and generator) under varying speed and load conditions.
4) To demonstrate the effective use of various meters to perform voltage, current and power measurements of single and three phase circuits.
5) To study the nature of V-I characteristics for single phase and three phase loads.
6) To analyze the behavior of a transmission line under varying load conditions

Online Resources:

Sr. No.	Website Name
1.	https://www.vlab.co.in/broad-area-electrical-engineering
2.	https://www.vlab.co.in/broad-area-electronics-and-communications

List of Experiments.

Sr No	List of Experiments
01	Measure and plot the no load magnetization (open circuit) characteristic (V-I curve) of a DC generator.
02	Calculate efficiency and voltage regulation of DC generator using external characteristics.
03	Case study to get the current-voltage (I-V) characteristics of a solar PV panel under different light intensities (simulated using lamps).
04	Calculate the MPPT of a solar PV panel under different light intensities (simulation using lamps).
05	Measure speed-torque characteristics of a DC motor under different load conditions.
06	Calculate efficiency and analyze the starting and running performance of a DC motor under different load conditions.
07	Measure charge-discharge characteristics of different types of batteries (e.g., lead-acid, lithium-ion).
08	To analyze efficiency, capacity, and voltage profiles of different types of batteries (e.g., lead-acid, lithium-ion) (simulation based or hands on).
09	Perform voltage, current and power measurements in single phase circuit using analog meters and verify Ohm's law.
10	Perform voltage, current and power measurements in single phase circuit using digital meters and verify Ohm's law.
11	Perform voltage, current and power measurements in three phase circuit using analog meters and verify Ohm's law.
12	Perform voltage, current and power measurements in three phase circuit using digital meters and verify Ohm's law.
13	To perform load test using 1- phase and 3 phase sources and loads using MATLAB Simulink
14	To deduce the transmission line performance i.e. sending end voltage and receiving end voltage for long, medium and short transmission lines using MATLAB Simulink.
15	Generation of sinusoidal voltage waveform using MATLAB Simulink.
16	Simulation of transmission line model using MATLAB Simulink
17	To perform speed control of DC motor using MATLAB Simulink
18	To perform practical using breadboard to extract the charging and discharging characteristics of capacitor.
19	Case Study to compare efficiency and reliability of different renewable energy sources
20	Case Study to analyze the effectiveness of energy storage in balancing supply and demand in distribution networks.

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
PCC2018	Elements of Mechanical Engineering	2	2	-	2	-	-	2

Course Code	Course Name	Theory							Total
		Internal Assessment (IAT)			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)					
PCC2018	Elements of Mechanical Engineering	20	20	40	60	2			100

Course Objectives:

1. To familiarize with various Mechanical Engineering domains.
2. To provide insights on fundamental concepts in mechanical engineering.
3. To familiarize with latest technological developments in Mobility and Manufacturing domains.

Outcomes: Learner will be able to…

1. Understand the role of mechanical engineering in industry, society and concept of thermodynamics.
2. Illustrate working of gas power cycles and components used in I.C.Engines.
3. Compare and evaluate various types of coupling, clutches, brakes and belt and gear drives.
4. Comprehend various types of Refrigerants and concept of Air conditioning along with modern manufacturing processes
5. Identify and describe various advancements in Mobility domain.
6. Compare and classify various Engineering Materials and their properties.

Module	Details	Hrs.
1.	**Introduction to Mechanical Engineering Domain:** Role of Mechanical Engineering in Industry and Society, Application of Mechanical Engineering in various domains such as Automobile, Aerospace,	**04**

	Energy, Manufacturing etc **Fundamentals of Mechanical Engineering:** Concept of Prime Mover, Sources of Energy, Force and Mass, Pressure, Work, Power, Energy, Temperature, Heat. **Basic Concept of Thermodynamics:** Definition, Microscopic and Macroscopic approach, System, Boundary and Surrounding, Thermodynamic properties Zeroth Law of Thermodynamics First law of thermodynamics, Internal Energy, Concept of Enthalpy and Entropy	
2.	**Gas Power Cycles:** Definition of Cycle, Air standard efficiency, Carnot cycle, Otto cycle, Diesel cycle, Dual combustion cycle, Atkinson cycle, and Brayton cycle(Gas turbine cycle) **Internal Combustion Engines:** Heat Engine, Classification of IC Engine, Components of IC Engine, Terms associated with IC Engine, Indicator diagram, Two stroke cycle engine, Four stroke cycle engine, Comparison between S.I and C.I engine.	**06**
3.	**Couplings, Clutches and Brakes** Types of Coupling-Rigid and flexible Types of clutch-Friction and positive contact clutches Classification of brakes and mechanical brakes **Mechanical Power transmission:** Belt drives-Components of belt drive and types of velocity ratio, Types of belt drives (Flat belt, V-belt etc) and its applications, Concept of rope and chain drives. Gear Drives-Types of gears and velocity ratio, Simple and Compound gear trains	**05**
4.	**Refrigeration and Air conditioning:** Application of refrigeration, Principle of refrigeration, Refrigeration system and Refrigerants. Air conditioning: Temperature, Humidity of air, Purity of air, Air circulation, Noise level **Introduction to Modern manufacturing tools and techniques** Components of CNC, Advantages of CNC, CNC machining centers and turning centers, Concept of Smart Manufacturing and Industrial IOT.	**05**
5.	**Insights into future of mobility:** Hybrid Electric Vehicle-Components, Series and parallel hybrids Electric Vehicle- PHEV,EREV,BEV and drives based on Battery and Motor locations Autonomous vehicles- SAE Taxonomy of Autonomous vehicles	**04**
6.	**Engineering Materials:** Classification of materials- Biomaterials, Advanced materials, Smarts Materials, Nanotechnology and Nanomaterials. Mechanical Properties of Metals, Ferrous Metals and Alloys, Non ferrous metals and alloys, Polymers and plastics, Ceramic materials and Composite materials	**06**

#- Laboratory component of two hours

TEXT/REFERENCE BOOKS:-

1. Elements of Mechanical Engineering,V.K.Manglik
2. Elements of Mechanical Engineering, R.K.Rajput
3. Basic and Applied Thermodynamics, P.K.Nag, Tata McGraw Hill 2nd Ed., 2002
4. Internal Combustion Engine, V Ganesan, TMH

5. Electric Vehicle Technology Explained, James Larminie, John Lowry, Wiley

List of Experiments: (Minimum 6 experiments to be submitted as a part of Teamwork)

1. Study Visit to any Industry in either Automobile/Aerospace/Energy/Manufacturing engineering unit.
2. Dismantling and Assembly of S.I or C.I Engine.
3. Demonstration of any machine consisting gear train.
4. Demonstration of working of Coupling, clutch and brakes.
5. Demonstrate Components and Working principles of Domestic Refrigerator.
6. Study/visit any commercial centralized Air-Conditioning unit, understand various components and operations, and prepare a comprehensive report.
7. Study/Visit an Industry using CNC/ modern techniques and submit a report.
8. Demonstrate working of CNC machine with an appropriate application.
9. Prepare a case study/Report on any working HEV/EV/FCEV.
10. Prepare a case study on various materials used/selected for any industrial application (Gears /A.C. Unit/Solar panel/Automobile/Rocket/Airplane etc.) and its importance.

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
PCL2018	Elements of Mechanical Engineering Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)				
PCL2018	Elements of Mechanical Engineering Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To study the basic concepts of Mechanical Engineering
2. To study operation of various mechanical components
3. To understand how a mechanical industry operates.
4. To introduce the concept of various boilers and steam generators
5. To understand the concept of mechanical power transmission
6. To corelate theory with practical working in industry

Lab Outcomes:

1. Recall the fundamental role of mechanical engineering and lists its application areas.
2. Explain various ways in which energy is generated.
3. Compare different types of steam generators and boilers.
4. Understand basic working principles of different prime movers
5. Describe various tools used for Engine service.
6. Identify and describe various types of robots and its end effectors.

Prerequisite: Knowledge of physics and mathematics up to 12 science level.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Knowledge of physics and mathematics up to 12 science level.		
I	Introduction to Mechanical Engineering	Visit to any Workshop/Industry in either automobile/Aerospace/Energy	**02**	**LO1**

		/Manufacturing engineering unit and prepare a report.		
II	Energy Resources	Prepare a comparative report on various Energy sources (Solid, Liquid, Gaseous fuels, Biofuels, Solar, Wind, Hydro, Nuclear etc).	**02**	**LO2**
III	Steam Generation and Boilers	Prepare a report on Steam generation process and different types of boilers used in Mechanical Industry	**02**	**LO3**
IV	Prime Movers	Prepare a report on different types of Turbines (Steam, Gas, Water)	**02**	**LO4**
V	Engines	Visit to any local workshop and prepare a report on its functioning.	**02**	**LO5**
VI	Robotics	Visit to any Workshop/ Industry in Robotics and understand various variety of robots and its operation	**02**	**LO6**

Text Books:

1. K.P.Roy, S.K.Hajra Choudhury, Nirjhar Roy, "Elements of Mechanical Engineering", Media Promoters & Publishers Pvt Ltd,Mumbai,7th Edition,2012
2. K.R.Gopalkrishna, "A text Book of Elements of Mechanical Engineering"-Subhash Publishers, Bangalore.
3. Pravin Kumar, "Basic Mechanical Engineering", 2013 Edition, Pearson.

References:

1. Mikell P.Groover, "Automation, Production Systems & CIM", 3rd Edition, PHI
2. S.TrymbakaMurthy, "A Text Book of Elements of Mechanical Engineering", 4th Edition 2006, Universities Press (India) Pvt Ltd, Hyderabad.

Online Resources:

Sr. No.	Website Name
1	https://www.youtube.com/watch?v=h0nRjn12jag&list=PLcM_rr2NOZ5fKCSbvx1fNIe95LeFt1HZh

List of Experiments.

Sr No	List of Experiments	Hrs
01	Dismantling and Assembly of Petrol/Diesel Engine	02
02	Determine the actual valve timing for a 4-stroke diesel engine and hence draw the diagram	02
03	Determine the actual PORT timing for a 2-stroke Petrol engine and hence draw the diagram.	02
04	Engine Performance test on 2/4 stroke Petrol engine	02
05	Engine Performance test on 2/4 stroke Diesel engine	02
06	Performance test on Francis Turbine	02
07	Performance test on Pelton wheel Turbine	02
08	https://mr-iitkgp.vlabs.ac.in/exp/forward-kinematics/ Should be conducted by V-labs	02

09	https://mr-iitkgp.vlabs.ac.in/exp/inverse-kinematics/ Should be conducted by V-labs	02
10	https://fab-coep.vlabs.ac.in/exp/computer-controlled-cutting/ Should be conducted by V-labs	02
11	Navigation of drone	02
12	Study experiment on types of boilers	02

Sr No	List of Assignments / Tutorials	Hrs
01	Compare Renewable and Nonrenewable energy resources	1
02	Show the enthalpy of steam is equal to total heat supplied in its generation.	1
03	Will the pressure indicated by pressure gauge be greater or less than atmospheric pressure? If so why? How the gauge pressure to be corrected to obtain the absolute pressure.	1
04	Why are safety valves required in boilers?	1
05	What are biofuels? Explain briefly common types of biofuels.	1
06	Draw temperature-enthalpy diagram for constant pressure heating process to represent on it the following: Sensible heat region Latent heat region Superheated region Dryness fraction 0.75	1
07	Define following terms with help of simple diagram a) Manipulator b) Joint c) Link d) Degree of freedom e) End effector f) Base	1
08	State the application of composite materials in Automobile and aircraft.	1

Assessment :
Term Work: Term Work shall consist of at least 8 to 10 practical's based on the above list. Also, Term work Journal must include at least 2 assignments.
Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)
Practical& Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

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: 50 Marks (Total marks) = 25 Marks (Capstone Project) + 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	Tut.	Pract / Oral	Theory	Tut.	Pract/ Oral	Total
PCC2019	Basics of Measurement and Sensors	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)					
PCC2019	Basics of Measurement and Sensors	20	20	40	60	2	--	--	100

Course Objectives: The course aims to

1. Learn the list different types of sensor/measuring instruments used for displacement, velocity, acceleration, force and torque.
2. Define and describe working principles and characteristics of the sensors and Measuring Instruments.
3. Implement and sketch the electronic signal processing for the sensors
4. Select and defend suitable sensor/measuring system for a specific application

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. List different types of sensor/measuring instruments used for displacement, velocity, acceleration, force and torque.
2. Define and describe working principles and characteristics of the sensors and Measuring Instruments.
3. Implement and sketch the electronic signal processing for the sensors
4. Select and defend suitable sensor/measuring system for a specific application

Prerequisite:

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**			
I		Introduction of measuring Systems:Concepts and terminology of measurement system, transducer, sensor, range and span, classification of transducers, static and dynamic characteristics, selection criteria, sources of errors and their statistical analysis, standards and calibration. Introduction to Mesh analysis, nodal analysis and One port and two port networks	**7**	**CO1**
II		Resistance, Inductance & Capacitance Measurement: Wheatstone bridge, design, arrangement of ratio arms, sensitivity, errors, null type and deflection type, calibration adjustment, Kelvin bridge, Kelvin double bridge, series ohmmeter, shunt ohmmeter, DMM. Maxwell's bridge: design and applications, Hay's bridge: design and applications, Schering bridge: design and applications, LCR Q-meter	**7**	**CO2**
III		Displacement Measurement:Resistive: Potentiometer, Linear and rotary, Loading Effect types of strain gauges. Inductive: LVDT and Eddy current type Transducers. Capacitive:Capacitance pickups, Differential capacitive cells. Piezoelectric, Ultrasonic transducers and Hall effect transducers Optical transducers. Precision measuring instrument (gauges), Angular measurement: Combination protractor, universal bevel protractor, sine bar, clinometers, optical prism method	**7**	**CO 3**
IV		Velocity and Acceleration measurement:Standards, working principle, types,	**7**	**CO 4**

		materials, design criterion: Moving magnet and moving coil, Electromagnetic tachometer, Photoelectric tachometer, Toothed rotor variable reluctance tachometer. Magnetic pickups,Encoders, Photoelectric pickups, stroboscopes and stroboscopic method, Shaft speed measurement. Standards, working principle, types, materials, design criterion: Eddy current type, piezoelectric type, Seismic Transducer, Accelerometer: Potentiometric type, LVDT type, Piezo-electric type		
V		Force and torque measurement:Basic methods of force measurement, elastic force traducers, strain gauge, load cells, shear web, piezoelectric force transducers, vibrating wire force transducers, Strain gauge torque meter, Inductive torque meter, Magneto-strictive transducers, torsion bar dynamometer, etc. Dynamometer (servo control and absorption) instantaneous power measurement	**5**	**CO 5** **CO 6**
VI				

Textbooks:

***** A. K. Sawhney, "Electrical and Electronic Measurements and Instrumentation", DhanpatRai and Sons, 12th ed., 2005

* B. C. Nakra and K. K. Choudhari, "Instrumentation Measurements and Analysis" by, Tata McGraw Hill Education, 4th ed., 2016 References:

Reference Books:

***** E.O. Doebelin, "Measurement Systems", McGraw Hill, 6th ed., 2017

* D. Patranabis, "Principle of Industrial Instrumentation", Tata McGraw Hill, 2nd ed., 1999

* A. J. Bouwens, "Digital Instrumentation", McGraw-Hill, 6th reprint, 2008

* H S Kalsi, "Electronic Instrumentation", Tata McGraw-Hill, 4th ed., 2017

* Albert D. Helfrick, William David Cooper, "Modern electronic Instrumentation and Measurement Techniques" Prentice Hall, Second ed., 1990

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
PCL2019	Basics of Measurement and Sensors 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)					
PCL2019	Basics of Measurement and Sensors Lab	--	--	--	--	--	25	25	50

List of Experiments:

1. Determination of admittance and impedance of one port network.
2. Design and implementation of resistance measurement such as Wheatstone bridge, LCR meter, V-I Method.
3. Design, implementation of series and shunt ohmmeters. Evaluate its performance characteristics.
4. Characterization and calibration of potentiometer as displacement sensor. Study of loading effect on potentiometer (linear and rotary).
5. Characterization and calibration of LVDT based displacement measurement system.
6. Characterization of strain gauge using cantilever beam.

7. Characterization and calibration of piezoelectric measurement system.
8. Measurement using proximity sensors (inductive/Capacitive) for an application

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*	-	--

		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**	• Baudhayan, Aryabhatta, Brahmgupta, Bhaskaracharya, Varahamihira, Nagarjuna, Susruta, Kanada & Charak	**5**	**CO5**

	Laureates	• Rabindranath Tagore, C.V. Raman, Har Gobind Khorana, Mother Teresa, Subrahmanyan Chandrasekhar, Amartya Sen, V.S. Naipaul, Venkatraman Ramakrishnan, Kailash Satyarthi and Abhijit Banerjee		
V I	**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 Munshiram Manoharlal 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 Itihas evam Parichay, 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. Apply communication & 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, Nilakantha Somayaji
- 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 Hajra Choudhury,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	**4**	**L3**

		3.2 Creating Python Packages, Modules and 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,Alan Gauld, 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.

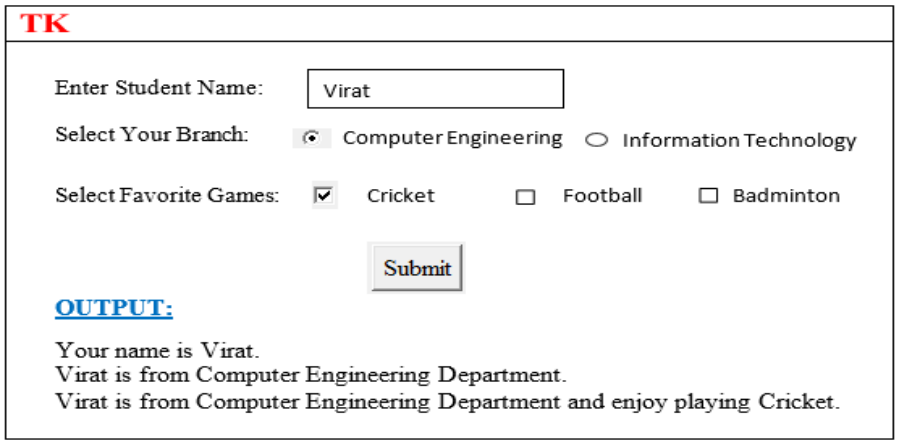
List of Experiments.

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 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.	02

	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 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.	02

	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 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	02

	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. iii. 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. iii. 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.