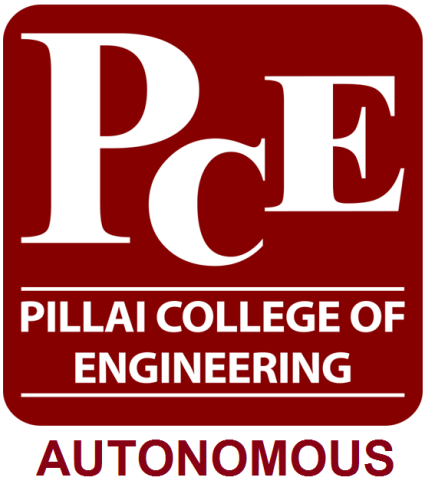
Mahatma Education Society's

Pillai College of Engineering

(Autonomous)

Affiliated to University of Mumbai

Dr. K. M. Vasudevan Pillai's Campus, Sector 16, New Panvel – 410 206.



Department of Automobile Engineering

Syllabus

of

B.Tech. in Automobile Engineering

for

The Admission Batch of AY 2024-25

First Year - Effective from Academic Year **2024-25**

Second Year - Effective from Academic Year **2025-26**

Third Year - Effective from Academic Year **2026-27**

Fourth Year - Effective from Academic Year **2027-28**

as per

NEP-2020

Mahatma Education Society's

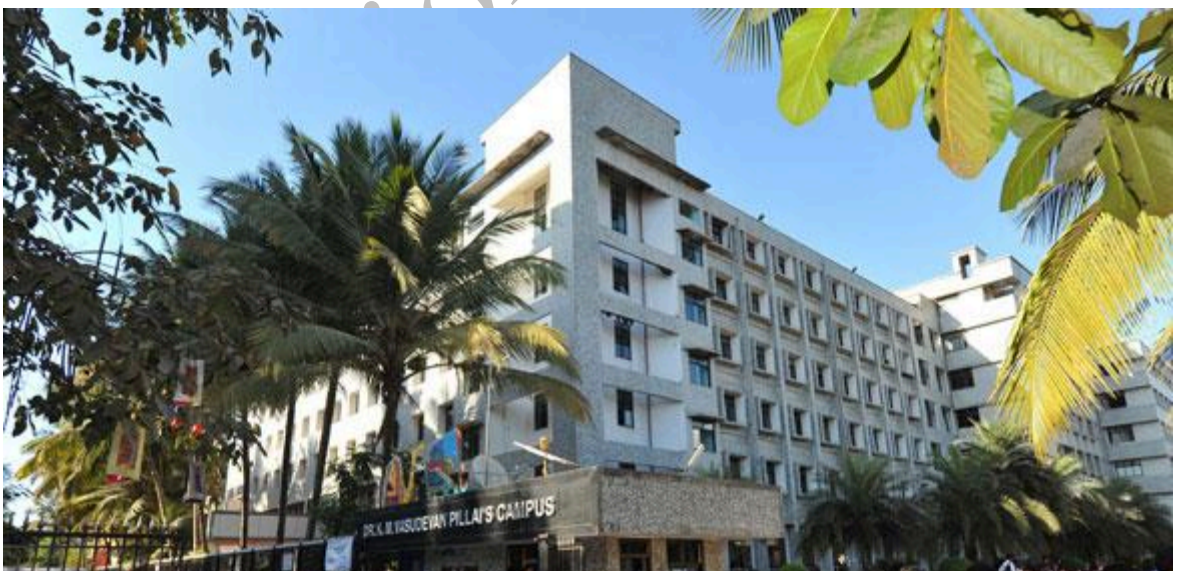
Pillai College of Engineering

Vision

Pillai College of Engineering (PCE) will admit, educate and train a diverse population of students who are academically prepared to benefit from the Institute's infrastructure and faculty experience, to become responsible professionals or entrepreneurs in a technical arena. It will further attract, develop and retain, dedicated, excellent teachers, scholars and professionals from diverse backgrounds whose work gives them knowledge beyond the classroom and who are committed to making a significant difference in the lives of their students and the community.

Mission

To develop professional engineers with respect for the environment and make them responsible citizens in technological development both from an Indian and global perspective. This objective is fulfilled through quality education, practical training and interaction with industries and social organizations.



Dr. K. M. Vasudevan Pillai's Campus, Sector - 16, New Panvel – 410 206

Department of Automobile Engineering

Vision

To develop an established institution of Automobile Engineering which will become a centre of quality standardization, research and academics through innovation, high quality teaching, projects and world class technology.

Mission

To provide quality education and knowledge that is well-grounded in the fundamental principles of engineering, which fosters innovation, and prepares students for leadership positions and successful careers in industry, academia or entrepreneurial ventures.

Program Educational Objectives (PEOs):

I. Students should develop sound fundamental knowledge in mathematics, science and automobile engineering.

II. Students would acquire the ability to function productively as an individual as well as in a team and are well versed in using modern technology and equipment to solve real world problems.

III. Students would be provided with opportunities to develop an instinct for innovation and skills as researchers through industry collaboration, practical training, laboratory experience, projects and the various courses offered to them.

IV. Students would inculcate a professional and ethical attitude, good leadership qualities and commitment to social responsibilities in their thought process.

V. Students will be encouraged to understand the importance of lifelong learning, working on contemporary global issues and to become a successful entrepreneur.

Program Outcomes:

Engineering Graduates will be able to:

1. **PO1: Engineering Knowledge:** Apply knowledge of mathematics, natural science,computing, engineering fundamentals and an engineering specialization as

specified in WK1 to WK4 respectively to develop the solution of complex engineering problems.

2. **PO2: Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
3. **PO3: Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
4. **PO4: Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
5. **PO5: Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
6. **PO6: The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
7. **PO7: Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
8. **PO8: Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
9. **PO9: Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.
10. **PO10: Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to

one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

11. **PO11: Life-Long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8).

Program Specific Outcomes (PSOs):

1. Students should be able to generate and develop ideas that can result in self-employment (e.g. Start–ups) and create more jobs.

2. Students should be updated with the latest trends in automobile engineering, beyond curriculum by way of doing internships and research projects.

The Autonomous status of the institute has given an opportunity to design and frame the curriculum in such a way that it incorporates all the needs and requirements of recent developments in all fields within the scope of the technical education. This curriculum will help graduates to attain excellence in their respective field. The curriculum has a blend of basic and advanced courses along with provision of imparting practical knowledge to students through minor and major projects. The syllabus has been approved and passed by the Board of Studies.

Outcome based education is implemented in the academics and every necessary step is undertaken to attain the requirements. Every course has its objectives and outcomes defined in the syllabus which are met through continuous assessment and end semester examinations. Evaluation is done on the basis of Choice Based Credit and Grading System (CBCGS). Optional courses are offered at department and institute level. Selection of electives from the same specialization makes the student eligible to attain a B. Tech. degree with respective specialization.

Every learner/student will be assessed for each course through (i) an Internal/Continuous assessment during the semester in the form of either Practical Performance, Presentation, Demonstration or written examination and (ii) End Semester Examination (ESE), in the form of either theory or viva voce or practical, as prescribed by the respective Board Studies and mentioned in the assessment scheme of the course content/syllabus. This system involves the Continuous Evaluation of students' progress Semester wise. The number of credits assigned with a course is based on the number of contact hours of instruction per week for the course. The credit allocation is available in the syllabus scheme of each semester.

The performance of a learner in a semester is indicated by a number called Semester Grade Performance Index (SGPI). The SGPI is the weighted average of the grade points obtained in all the courses by the learner during the semester. For example, if a learner passes five courses

(Theory/labs./Projects/ Seminar etc.) in a semester with credits C1, C2, C3, C4 and C5 and learners grade points in these courses are G1, G2, G3, G4 and G5 respectively, then learners SGPI is equal to:

$$SGPI = \frac{C_1G_1 + C_2G_2 + C_3G_3 + C_4G_4 + C_5G_5}{C_1 + C_2 + C_3 + C_4 + C_5}$$

The learner's up to date assessment of the overall performance from the time s/he entered for the programme is obtained by calculating a number called the Cumulative Grade Performance Index (CGPI), in a manner similar to the calculation of SGPI. The CGPI therefore considers all the courses mentioned in the scheme of instructions and examinations, towards the minimum requirement of the degree learners have enrolled for. The CGPI at the end of this semester is calculated as,

$$CGPI = \frac{C_1G_1 + C_2G_2 + C_3G_3 + \ldots + C_i * G_i + \ldots + C_nG_n}{C_1 + C_2 + C_3 + \cdots + C_i + \ldots + C_n}$$

The Department of Automobile Engineering offers a B. Tech. programme in Automobile Engineering. This is an eight-semester course. The complete course is of 168 credits which comprises basic sciences and mathematics, core courses, projects, internship, MOOC course and elective courses. The elective courses are distributed over 8 specializations. The specializations are:

1. Electric Vehicles
2. Additive Manufacturing
3. MotorSports Engineering
4. Computer Aided Engineering
5. Transportation & Mobility
6. Supply Chain Management and Logistics
7. Automotive Designing
8. Autonomous Vehicles

The students also have a choice of opting for 15 different Institute level specializations. These are

1. IP Management and Digital Business
2. Business Management
3. Bio Engineering
4. Bio Instrumentation
5. Engineering Design
6. Sustainable Technologies
7. Contemporary Studies
8. Art and Journalism
9. Applied Science
10. Green Technologies

11. Maintenance Engineering
12. Life Skills
13. Environment and Safety
14. Safety
15. Quantum Computing and Technologies

As minimum requirements for the credits to be earned for the B.Tech in Automobile Engineering program, a student will have to complete a minimum of three specializations of which two are to be chosen from the Department list and one has to be from the Institute level specialization list. In order to complete each specialization, a minimum of three courses under that specialization has to be completed.

- ***At least One MOOC course is highly recommended to be completed with certification in the four years of study.***

The credit requirement for the B.Tech. in Automobile Engineering course is tabulated in Table 1.

Table 1. Credit Requirement for B.Tech in Automobile Engineering

Category	Credits
Humanities and Social Sciences including Management courses	10
Basic Science courses	18
Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc	16
Professional core courses	58
Professional Elective courses relevant to chosen specialization/branch	19
Open subjects – Electives from other technical and /or emerging subjects	14
Project work, seminar and internship in industry or elsewhere	21
Mandatory Courses - Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge	10
Human Values	2
Total Credits	**168**

Program Structure for
Bachelor of Technology in Automobile Engineering
W.E.F. A.Y.2024-25
Semester I

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract.	Theory	Pract.	Total
MATH 101	Engineering Mathematics I	BSC	3	2	3	1	4
PHY 101	Engineering Physics I	BSC	2	1	2	0.5	2.5
CHEM 101	Engineering Chemistry I	BSC	2	1	2	0.5	2.5
ENGG 102	Basic Electrical Engineering	ESC	3	-	3	-	3
MECH 101	Engineering Mechanics	ESC	3	2	3	1	4
ENGG 103	Basic Electrical Engineering Lab	Skill	-	2	-	1	1
ENGG 104	Engineering Workshop-I	Skill	-	2	-	2	1
HUM 103	Ancient Indian Engineering(IKS)	HSSM	-	2+2#	-	2	2
ENGG 108	Co-curricular course-I	Liberal Learning	-	4	-	2	2
Total			13	18	13	10	**22**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg.					
MATH 101	Engineering Mathematics I	40	40	40	60	2	25	-	125
PHY 101	Engineering Physics I	30	30	30	45	2	25	-	100
CHEM 101	Engineering Chemistry I	30	30	30	45	2	25	-	100
ENGG 102	Basic Electrical Engineering	40	40	40	60	2	-	-	100
MECH 101	Engineering Mechanics	40	40	40	60	2	25	25	150
ENGG 103	Basic Electrical Engineering Lab	-	-	-	-	-	25	25	50
ENGG 104	Engineering Workshop-I	-	-	-	-	-	50	-	50
HUM 103	Indian Knowledge Systems	-	-	-	-	-	50	-	50
ENGG 108	Co-curricular course-I	-	-	-	-	-	50	-	50
Total									**775**

Program Structure for
Bachelor of Technology in Automobile Engineering
W.E.F. A.Y.2024-25
Semester II

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract.	Theory	Pract.	Total
MATH 102	Engineering Mathematics II	BSC	3	2	3	1	4
PHY 102	Engineering Physics II	BSC	2	1	2	0.5	2.5
CHEM 102	Engineering Chemistry II	BSC	2	1	2	0.5	2.5
MECH 102	Engineering Drawing	ESC	2	4	2	2	4
CE 106	Python Programming	ESC	3	-	3	-	3
COMM 104	Professional Communication and Ethics-I	HSSM	1	2	1	1	2
CE 107	Python Programming Lab	Skill	-	2	-	1	1
ENGG 105	Engineering Workshop-II	Skill	-	2	-	1	1
ENGG 109	Co-curricular Course-II	Liberal learning	-	4	-	4	2
Total			**14**	**16**	**14**	**10**	**22**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract./ Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs.)			
		1	2	Avg.					
MATH 102	Engineering Mathematics II	40	40	40	60	2	25	-	125
PHY 102	Engineering Physics II	30	30	30	45	2	25	-	100
CHEM 102	Engineering Chemistry II	30	30	30	45	2	25	-	100
MECH 102	Engineering Drawing	40	40	40	60	3	25	25	150
CE 106	Python Programming	40	40	40	60	2	-		100
COMM 104	Professional Communication and Ethics-I	20	20	20	30	1	25	-	75
CE 107	Python Programming Lab	-	-	-	-	-	25	25	50
ENGG 105	Engineering Workshop-II	-	-	-	-	-	50	-	50
ENGG 109	Co-curricular Course-II	-	-	-	-	-	50	-	50
Total									**800**

Program Structure for Second-Year
Bachelor of Technology in Automobile Engineering
W.E.F. A.Y. 2025-26
Semester III

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract.	Theory	Pract.	Total
MECH 201	Manufacturing Processes and Technology*	PCC	3	2	3	1	4
MATH 202A	Mathematics for Mechanical and Automobile Engineers*	PCC	3	-	3	-	3
MECH 203	Strength of Materials*	PCC	3	2	3	1	4
MECH 204	Thermodynamics*	PCC	3	-	3	-	3
AUTO 201	Engineering Metallurgy and Automotive Materials	PCC	3	2	3	1	4
MECH 206	Computer Aided Drafting*	VSEC	-	2	-	1	1
HUM 201	Human Values and Social Ethics	HSSM	2	-	2	-	2
AUTO 293	Minor Project I	CEP	-	2	-	1	1
Total			**17**	**10**	**17**	**5**	**22**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs.)			
		1	2	Avg.					
MECH 201	Manufacturing Processes & Technology*	40	40	40	60	2	25	25	150
MATH 202A	Mathematics for Mechanical and Automobile Engineers*	40	40	40	60	2	-	-	100
MECH 203	Strength of Materials*	40	40	40	60	2	25	25	150
MECH 204	Thermodynamics*	40	40	40	60	2	-	-	100
AUTO 201	Engineering Metallurgy and Automotive Materials	40	40	40	60	2	25	-	125
MECH 206	Computer Aided Drafting*	-	-	-	-	-	25	50	75
HUM 201	Human Values and Social Ethics	-	-	-	-	-	50	-	50
AUTO 293	Minor Project I	25(Mid Sem assessment)					25	25	75
Total									**825**

*** - Common with B.Tech in Mechanical Engineering**

Program Structure for
Bachelor of Technology in Automobile Engineering
W.E.F. A.Y. 2025-26
Semester IV

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract.	Theory	Pract	Total
AE 208	I.C.Engines & Alternate Fuels	PCC	3	2	3	1	4
AE 209	Theory of Machines & Mechanisms*	PCC	3	2	3	1	4
AE 210	Fluid Mechanics	PCC	3	2	3	1	4
AE 211	Finite Element Analysis	PCC	3	2	3	1	4
AE 212	Data Science	AEC	-	2	-	1	1
AE 213	Personal Finance Management	HSSM	2	-	2	-	2
AE 214	Innovation and Entrepreneurship	HSSM	2	-	2	-	2
AE 292	Minor Project II	CEP	-	2	-	1	1
Total			**16**	**12**	**16**	**6**	**22**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs.)			
		1	2	Avg.					
AE 208	I.C.Engines & Alternate Fuels	40	40	40	60	2	25	25	150
AE 209	Theory of Machines & Mechanisms*	40	40	40	60	2	25	25	150
AE 210	Fluid Mechanics	40	40	40	60	2	25	25	150
AE 211	Finite Element Analysis	40	40	40	60	2	25	25	150
AE 212	Data Science	30	30	30	45	2	-	-	75
AE 213	Personal Finance Management	20	20	20	40	2	-	-	60
AE 214	Innovation and Entrepreneurship	20	20	20	40	2	-	-	60
AE 292	Minor Project II	25 (Mid Sem assessment)					25	25	75
Total									**870**

*** - Common with B.Tech in Mechanical Engineering**

Program Structure for
Bachelor of Technology in Automobile Engineering
W.E.F. A.Y. 2026-27
Semester V

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract.	Theory	Pract.	Total
AE 301	Automotive Systems & Design	PCC	3	2	3	1	4
AE 302	Vehicle Body Engineering & Safety	PCC	3	2	3	1	4
AE 303	Measurement and Control System	PCC	3	2	3	1	4
AE 304	Professional Communication and Ethics-II	AEC	1	2	1	1	2
AE 3xx	Department Elective I	PEC	3	2	3	1	4
IL 3xx	Institute Elective I	OE	3	-	3	-	3
AE 391	Minor Project III	CEP	-	2	-	1	1
Total			**16**	**12**	**16**	**6**	**22**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract./Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg.					
AE 301	Automotive Systems & Design	40	40	40	60	2	25	25	150
AE 302	Vehicle Body Engineering & Safety	40	40	40	60	2	25	25	150
AE 303	Measurement and Control System	40	40	40	60	2	25	25	150
AE 304	Professional Communication and Ethics-II	-	-	-	-	2	50	-	50
AE 3xx	Department Elective I	40	40	40	60	2	25	25	150
IL 3xx	Institute Elective I	40	40	40	60	2	-	-	100
AE 391	Minor Project III	25 (Mid Sem assessment)					25	25	75
Total									**825**

*** - Common with B.Tech in Mechanical Engineering**

Department Level Elective-I

Group	Department Specialization	Course Code	DLOC I
1	Electric Vehicles	AE 305	Electric Vehicle Drives and Control
2	Additive Manufacturing	AE 306	Automotive Product Design and Development
3	Motorsports Engineering	AE 307	Material Selection and Manufacturing
4	Computer Aided Engineering	AE 308	Automotive Sheet Metals

Institute Level Elective-I

SN	Specialization	Course 1 (Semester V) 26-27	
1	IP Management and Digital Business	ENGG 380	IPR and Patenting
2	Business Management	MGMT 380	E- Commerce and E-Business
3	Bio Engineering	ENGG 381	Introduction to Bioengineering
4	Bio Instrumentation	ENGG 382	Biomedical Instrumentation
5	Engineering Design	DES 380	Design of Experiments
6	Sustainable Technologies	DES 381	Design for Sustainability
7	Contemporary Studies	ECON 380	Political Science
8	Art and Journalism	VART 380	Visual Arts
9	Applied Science	PHY 380	Modern Day Sensor Physics
10	Green Technologies	ENGG 383	Energy Audit and Management
11	Maintenance Engineering	ENGG 384	Maintenance of Electronics Equipment
12	Life Skills	HMC 380	Cooking and Nutrition
13	Environment and Safety	EVS 380	Environmental Management
14	Safety	ENGG 385	Vehicle Safety
15	Quantum Computing and Technologies	ENGG 394	Quantum Computing and Technologies - Part 1

Program Structure for
Bachelor of Technology in Automobile Engineering
Semester VI
W.E.F A.Y 2026-27

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract.	Theory	Pract.	Total
AE 309	Automotive Electronics and Diagnostics	MD M	3	2	3	1	4
AE 310	Automotive Vibrations	PCC	3	2	3	1	4
AE 311	Research Methodology	ELC	2	-	2	-	2
AE 3xx	Department Elective II	PEC	3	-	3	-	3
AE 3xx	Department Elective III	PEC	3	-	3	-	3
IL 3xx	Institute Elective II	OE	3	-	3	-	3
AE 392	Major Project I	CEP	-	6	-	3	3
Total			**17**	**10**	**17**	**5**	**22**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract./Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
AE 309	Automotive Electronics and Diagnostics	40	40	40	60	2	25	25	150
AE 310	Automotive Vibrations	40	40	40	60	2	25	25	150
AE 311	Research Methodology	20	20	20	40	2	-	-	60
AE 3xx	Department Elective II	40	40	40	60	2	-	-	100
AE 3xx	Department Elective III	40	40	40	60	2	-	-	100
IL 3xx	Institute Elective II	40	40	40	60	2	-	-	100
AE 392	Major Project I						25	50	75
Total									**735**

For an elective which has a laboratory associated, the examination scheme will have additional 25 marks of termwork and that would be a continuous evaluation.

Semester VI

Group	Department Specialization	Course Code	DLOC II
1	Electric Vehicles	AE 312	Automotive Embedded Systems
2	Additive Manufacturing	AE 313	CAD for Additive Manufacturing
3	Motor Sports Engineering	AE 314	Race Car Designing
4	Computer Aided Engineering	AE 315	Automotive BIW and Fixture Design

Group	Department Specialization	Course Code	DLOC III
5	Supply Chain Management and Logistics	AE 316	Supply Chain and Operations Management
6	Automotive Designing	AE 317	Concept Sketching, Rendering and Modelling
7	Transportation & Mobility	AE 318	Multimodal Transportation and Aerial Vehicles
8	Autonomous Vehicles	AE 319	Introduction to Self-Driving Cars

Institute Level Elective-I

SN	Specialization	Course 2 (Semester VI) 26-27	
1	IP Management and Digital Business	MKT 380	Digital Business Management and Digital Marketing
2	Business Management	ENGG 386	Business Analytics
3	Bio Engineering	ENGG 387	Bio Mechanics
4	Bio Instrumentation	ENGG 388	Medical Image Processing
5	Engineering Design	DES 382	Product Design
6	Sustainable Technologies	DES 383	Technologies for Rural Development
7	Contemporary Studies	ECON 381	Economics
8	Art and Journalism	MMC 380	Journalism, Media and Communication studies
9	Applied Science	ENGG 389	Operation Research
10	Green Technologies	ENGG 390	Climate Informatics
11	Maintenance Engineering	ENGG 391	Maintenance of Mechanical Equipment
12	Life Skills	PE 380	Physical Education
13	Environment and Safety	ENGG 392	Industrial Regulations and Laws
14	Safety	ENGG 393	Industrial and high voltage Safety
15	Quantum Computing and Technologies	ENGG 395	Quantum Computing and Technologies - Part 2

Program Structure for
Bachelor of Technology in Automobile Engineering
Semester VII
W.E.F A.Y 2027-28

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract.	Theory	Pract.	Total
AE 401	Hybrid and Electric Vehicles	PCC	3	2	3	1	4
AE 402	Vehicle Dynamics	PCC	3	2	3	1	4
AE 403	Connected and Autonomous Vehicles	MD M	3	2	3	1	4
AE 4xx	Department Elective IV	PEC	3	-	3	-	3
AE 4xx	Department Elective V	PEC	3	-	3	-	3
AE 491	Major Project II	CEP	-	8	-	4	4
Total			**15**	**14**	**15**	**7**	**22**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs.)			
		1	2	Avg.					
AE 401	Hybrid and Electric Vehicles	40	40	40	60	2	25	25	150
AE 402	Vehicle Dynamics	40	40	40	60	2	25	25	150
AE 403	Connected and Autonomous Vehicles	40	40	40	60	2	25	25	150
AE 4xx	Department Elective III	40	40	40	60	2	-	-	100
AE 4xx	Department Elective IV	40	40	40	60	2	-	-	100
AE 491	Major Project II	-					50	50	100
Total									**750**

For an elective which has a laboratory associated, the examination scheme will have additional 25 marks of term work and that would be a continuous evaluation.

Semester VII

Group	Department Specialization	Course Code	DLOC IV
1	Electric Vehicles	AE 404	Automotive Testing and Certification
2	Additive Manufacturing	AE 405	Additive Manufacturing for Engineering applications
3	Motor Sports Engineering	AE 406	Simulation of Racing Cars
4	Computer Aided Engineering	AE 407	Automotive Plastics/Trims and Crashworthiness

Group	Department Specialization	Course Code	DLOC V
5	Supply Chain Management & Logistics	AE 408	Logistics and Materials Management
6	Automotive Designing	AE 409	AR/VR in Automobiles
7	Transportation & Mobility	AE 410	Transportation for Smart Cities
8	Autonomous Vehicles	AE 411	Multi Object Tracking in Self-Driving Cars (T)

Program Structure for
Bachelor of Technology in Automobile Engineering
Semester VIII
W.E.F A.Y 2027-28

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract.	Theory	Pract.	Total
AE 4xx	Department Elective VI	PEC	3	-	3	-	3
AE 492	Major Project III	CEP	-	6	-	3	3
AE 493	Internship*	AEC	-	16	-	8	8
Total			**3**	**22**	**3**	**11**	**14**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract./ Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs.)			
		1	2	Avg.					
AE 4xx	Department Elective VI	40	40	40	60	2	-	-	100
AE 492	Major Project III	-	-	-	-	-	25	-	25
AE 493	Internship	-	-	-	-	-	200	-	200
Total									**325**

*** - Six months internship to be undertaken by the student during the semester**

Semester VIII

Group	Department Specialization	Course Code	DLOC VI
5	Supply Chain Management & Logistics	AE 412	Quality Management
6	Automotive Designing	AE 413	Aesthetics and Ergonomics
7	Transportation & Mobility	AE 414	Autonomous Aerial Vehicles
8	Autonomous Vehicles	AE 415	Decision making in Self Driving Cars

Semester	I	II	III	IV	V	VI	VII	VIII	Total Credits
Credits	22	22	22	22	22	22	22	14	**168**
Grand Total of Credits									**168**

Department Specializations at a glance:

Minimum **Two specializations** to be completed.

Department Specializations							
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Electric Vehicles	***Additive Manufacturing***	***MotorSports Engineering***	***Computer Aided Engineering***	***Transportation & Mobility***	***Supply Chain Management and Logistics***	***Automotive Designing***	***Autonomous Vehicles***
Electric Vehicles Drives and Control	Automotive Product Design and Development	Material Selection and Manufacturing	Automotive Sheet Metals	Multimodal Transportation & Aerial Vehicles	Supply Chain Management	Concept Sketching, Rendering and Modelling	Introduction to Self-Driving Cars
Automotive Embedded Systems	CAD for Additive Manufacturing	Race Car Designing	Automotive BIW and Fixture Design	Transportation for Smart Cities	Logistics and Material Management	ARVR in Automobiles	Multi Object Tracking in self-driving cars
Automotive Testing & Certification	AM for Engineering applications	Simulation of Racing Cars	Automotive Plastic/Trims & Crashworthiness	Autonomous Aerial Vehicles	Quality Management	Aesthetics and Ergonomics	Decision making in Self Driving Cars

Institute Specializations at a glance:
Minimum **One** to be completed (Minimum **Two** subjects from each.)

SN	Specialization	Course 1 (Semester V) 26-27		Course 2 (Semester VI) 26-27	
1	IP Management and Digital Business	ENGG 380	IPR and Patenting	MKT 380	Digital Business Management and Digital Marketing
2	Business Management	MGMT 380	E- Commerce and E-Business	ENGG 386	Business Analytics
3	Bio Engineering	ENGG 381	Introduction to Bioengineering	ENGG 387	Bio Mechanics
4	Bio Instrumentation	ENGG 382	Biomedical Instrumentation	ENGG 388	Medical Image Processing
5	Engineering Design	DES 380	Design of Experiments	DES 382	Product Design
6	Sustainable Technologies	DES 381	Design for Sustainability	DES 383	Technologies for Rural Development
7	Contemporary Studies	ECON 380	Political Science	ECON 381	Economics
8	Art and Journalism	VART 380	Visual Arts	MMC 380	Journalism, Media and Communication studies
9	Applied Science	PHY 380	Modern Day Sensor Physics	ENGG 389	Operation Research
10	Green Technologies	ENGG 383	Energy Audit and Management	ENGG 390	Climate Informatics
11	Maintenance Engineering	ENGG 384	Maintenance of Electronics Equipment	ENGG 391	Maintenance of Mechanical Equipment
12	Life Skills	HMC 380	Cooking and Nutrition	PE 380	Physical Education
13	Environment and Safety	EVS 380	Environmental Management	ENGG 392	Industrial Regulations and Laws
14	Safety	ENGG 385	Vehicle Safety	ENGG 393	Industrial and high voltage Safety
15	Quantum Computing and Technologies	ENGG 394	Quantum Computing and Technologies - Part 1	ENGG 395	Quantum Computing and Technologies - Part 2

Multiple Exit & Re-Entry Criteria as per NEP 2020

As per the Maharashtra Government G.R.dated 04th July 2023 and referring to Mumbai University NEP curriculum, the following Exit and Entry criteria are suggested for Pillai College of Engineering students admitted from A.Y. 2023-24 under NEP 2020 curriculum.

Multiple Exits: Students will have the flexibility to enter a programme in odd semesters and exit a programme after the successful completion of even semesters as per their future career needs.

1. Students exiting the First Year programme after securing **44 credits** will be awarded a UG Certificate in the relevant Discipline /Subject. In case the first year credits are a **minimum of 40**, the candidate needs to secure 8 credits in work-based vocational courses or internship / Apprenticeship offered during summer vacation, in addition to 4 credits from skill-based courses earned during the first and second semester.
2. Students exiting the Second Year Programme after securing **88 credits** will be awarded a UG Diploma in the relevant Discipline /Subject. In case the total number of credits is a **minimum of 80**, the candidate needs to secure an additional 8 credits in skill-based vocational courses (skill-based courses, internship, mini projects, etc) offered during summer vacation after the second year.
3. Students exiting the 3-year UG program will be awarded B.Voc. in the relevant Discipline /Subject upon securing a **minimum of 120 credits** with an additional 8 credits in skill-based vocational courses (skill-based courses, internship, mini projects, etc.) offered during summer vacation after the sixth semester.
4. Exit options shall be provided with Certification, Diploma, and B. Vocational degrees to the students at the end of the second, fourth, and sixth semesters, respectively, in the four-year degree programme. Students will receive a Bachelor's degree with a single minor on successfully completing all eight semesters of the UG Programmes either at a stretch or with opted exits and re-entries. In addition to this, students will receive a Bachelor's degree with a Double Minor/Honours/ Research subject to earning an additional 18 credits.

Re-entry or Lateral Entry: Students, opting for exits at any level, will have the option to re-enter the programme from where they had left off, in the same or a different higher education institution within four years of exit and complete the degree programme within the stipulated maximum period of eight years from the date of admission to first year UG. Re-entry at various levels for lateral entrants in academic programmes shall be based on the earned and valid credits as deposited and accumulated in the Academic Bank of Credits (ABC) through Registered Higher & Technical Education Institutions (RHTEI) and proficiency test records. Lateral entry into the programme of study leading to the UG Diploma/ B. Vocational/ UG Bachelor's Degree with single minor/ UG Bachelor's Degree with Double Minor/ Honours /Research will be based on the validation of prior learning outcomes achieved and subject to availability based on intake capacity.

Course Code	Course Name	Credits
MATH101	**Engineering Mathematics I**	**3+1**

Course Code	Course Name	Theory	Practical	Tutorial	Total contact hours	Theory	Practical /Oral	Tutorial	Total credits
MATH 101	Engineering Mathematics - I	3	2	-	05	3	1	-	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg.					
MATH101	Engineering Mathematics-I	40	40	40	60	25	-	-	125

Course Objectives:

1.To develop the basic Mathematical skills of engineering students that are imperative for effective understanding of complex numbers, hyperbolic, and logarithmic functions in engineering subjects.
2.To understand differentiation and expansions of functions. which will serve as basic tools for specialised studies in many fields of engineering and technology.
3.To learn the partial differentiation techniques and its applications used in engineering problems.
4.To learn the applications of Matrices useful in engineering.
5.To understand the concept of complex variables, C-R equations with applications.
6.To provide hands-on experience using Matlab Software to handle Mathematical modeling.

Course Outcomes:

On successful completion of course learner/student will be able to:
1. Apply the basic concept of complex numbers and use it to solve problems in engineering.
2. Apply the concept of expansion of functions and successive differentiation in optimization problems.
3. Use the basic concepts of partial differentiation in finding the Maxima and Minima required in engineering problems.

4.Use the concept of matrices in solving the system of equations used in mathematical modeling.
5.Apply the concept of complex variables and C-R equations in many areas of research.
6.Apply the concept of numerical Methods for solving the engineering problems with the help of Matlab software.

CO/PO Mapping

CO-PO Mapping (3 High , 2 Medium , 1 Low)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	1			1	1		1	1
CO2	3	2	1	1				1	1		1	1
CO3	3	2	1	1				1	1		1	1
CO4	3	2	1	1	1			1	1		1	1
CO5	3	2	1	1	2			1	1		1	1
CO6	3	2	1	1	2			1	1		1	1

Syllabus :

Module	Detailed Contents	Hrs.
1	**Complex Numbers** **Pre-requisite:** Review of Complex Numbers-Algebra of Complex Number, Cartesian, polar and exponential form of complex number.De Moivre's Theorem. 1.1. Roots of complex number 1.2. Introduction to Hyperbolic functions, Inverse Hyperbolic Functions. 1.3.. Logarithmic of Complex Number, Separation of real and Imaginary parts.	6
2	**Successive Differentiation and Expansion of Function** **Pre-requisite :-** Derivative of standard functions and Rules of derivative. 2.1 Successive differentiation: nth derivative of standard functions. Leibnitz's Theorem (without proof) and problems 2.2 Taylor's Theorem (Statement only) and Taylor's series, Maclaurin's series (Statement only). Expansion of $e^{\wedge}$ (x), sin(x), cos(x), tan(x), sinh(x), cosh(x), tanh(x),log(1+x), $\sin^{-1}(x)$, $\cos^{-1}(x)$,$\tan^{-1}(x)$.	5
3	**Partial Differentiation and Applications of Partial Differentiation.** 3.1 Partial Differentiation: Function of several variables, Partial derivatives of first and higher order. Differentiation of composite function. 3.2.Euler's Theorem on Homogeneous functions with two independent variables (without proof). Deductions from Euler's Theorem. 3.3 Maxima and Minima of a function of two independent variables, Lagrange's method of undetermined multipliers with one constraint. Jacobian of two independent variables.	7

4	**Matrices :-** **Pre-requisite:** Inverse of a matrix, addition, multiplication and transpose of a matrix ,Elementary row and column transformation 5.1. Symmetric, Skew- Symmetric, Hermitian, Skew Hermitian,Unitary, Orthogonal Matrices and properties of Matrices (Without Proof). 5.2 Rank of a Matrix using Echelon forms, reduction to normal form and PAQ form. 5.3.System of homogeneous and non –homogeneous equations, their consistency and solutions.	6
5	**Complex Variables** 4.1 Function f(z)of complex variable, Analytic function: Necessary and sufficient conditions for f(z) to be analytic, Cauchy-Riemann equations in Cartesian and Polar coordinates. 4.2 Milne-Thomson method: Determine analytic function f(z)when real part(u), imaginary part(v) is given. 4.3 Introduction to Conformal mapping, Linear and Bilinear mappings, cross ratio.	7
6	**Numerical Methods** 6.1 **Solution of system of linear algebraic equations**, (1)Gauss Jacobi Iteration Method (2) Gauss Seidel Iteration Method, 6.2 **Solutions of Transcendental equations** (1) Bisection Method (2) Secant Method (3) Newton Raphson Method.	5

Assessment

I. Internal Assessment Test:

Assessment consists of two class tests of 40 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class test when an additional 35% syllabus is completed. Duration of each test shall be 90 minutes.

II. End Semester Theory Examination:

1.Question paper will comprise of a total 05 questions, each carrying 20 marks.
2.Total 03 questions need to be solved.
3.Question No: 01 will be compulsory and based on the entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4.Remaining questions will be randomly selected from all the modules.
5.Weightage of each module will be proportional to number of respective lecture mentioned in the syllabus.

References:

1.Higher Engineering Mathematics, Dr.B.S.Grewal, Khanna Publication
2.Advanced Engineering Mathematics, Erwin Kreyszig, Wiley EasternLimited, 9thEd.
3.Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication,
4.Matrices, Shanti Narayan, S. Chand publication.
5.Applied Numerical Methods with MATLAB for Engineers and Scientists by Steven Chapra, McGraw Hill .

Engineering Mathematics I Laboratory

General Instructions: Each student has to perform at least 6 MATLAB practical's and at least 6 assignments on the entire syllabus.

List of Matlab Programing

1. Complex Number
2. Gauss Seidel Iteration method
3. Gauss Jacobi Iteration Method
4. Bisection method
5. Secant Method
6. Newton Raphson
7. Matrices
8. Maxima and Minima
9. Taylor's series
10. Differentiation

Term Work:

The distribution of Term Work marks–

1. Attendance (Theory, Practicals) : 05 marks
2. Assignments on entire syllabus : 10 marks
3. MATLAB Practicals : 10 marks

Course Code	Course Name	Credits
MATH115	**Engineering Mathematics II**	3+1

Course Code	Course Name	Theory	Practical	Tutorial	Total contact hours	Theory	Practical /Oral	Tutorial	Total credits
MATH 115	Engineering Mathematics - II	3	2	-	05	3	1	-	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
MATH 115	Engineering Mathematics- II	40	40	40	60	25	-	-	125

Course Objectives:

1. To develop the basic mathematical skills of differential equations of engineering students.
2. To understand the linear differential equation with constant coefficients used in mathematical modeling.
3. To acquaint the students with the Beta and Gamma functions
4. To learn different techniques to solve double integrations.
5. To learn the applications of integration in solving complex engineering problems.
6. To provide knowledge of numerical techniques using MATLAB software to handle Mathematical modeling.

Course Outcomes:-

On successful completion of course learner/student will be able to:

1. Apply the basic concept of linear differential equations to solve problems in engineering.
2. Apply the basic concept of applications of LDE with constant coefficient in mathematical modeling to solve real life problems.
3. Apply the basic concepts of beta and gamma functions to solve engineering problems.
4. Apply the concept of double integration in solving problems of engineering and technology.
5. Apply the concept of double integrations to find areas.
6. Apply the concept of differentiation and integration numerically for solving the engineering problems with the help of MATLAB software.

CO/PO Mapping

CO-PO Mapping (3 High , 2 Medium , 1 Low)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO1	3	2	1	1	2			1	1		1	1
CO2	3	2	1	1	2			1	1		1	1
CO3	3	2	1	1				1	1		1	1
CO4	3	2	1	1				1	1		1	1
CO5	3	2	1	1	1			1	1		1	1
CO6	3	2	1	1	2			1	1		1	1

Syllabus:

Module	Detailed Contents	Hrs.
1	**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, Equations reducible to linear form.	6
2	**Linear Differential Equations With Constant Coefficients and Variable 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^n, e ^axV. 2.2. Cauchy Differential equation, 2.3 Method of variation of parameters two variables	8
3	**Beta and Gamma Function,** 3.1 Gamma Functions and its properties. 3.2 Beta Functions and its properties.	4
4	**Double Integration:** 4.1. Tracing of curves, Double integration- Evaluation of Double Integrals.(Cartesian & Polar),Change of order of Integration and evaluation 4.2. Evaluation of integrals over the given region.(Cartesian & Polar) 4.3. Evaluation of double integrals by changing to polar coordinates.	8
5	**Applications of integration** :- 5.1. Application of double integrals to compute Area 5.2. Triple integration**:** Evaluation only (Cartesian, cylindrical and spherical polar coordinates)	4
6	**Numerical Techniques:-** 6.1. **Numerical solution of ordinary differential equation** (a) Euler's method (b) Modified Euler method, (c)Runge-Kutta fourth order method 6.2. **Numerical integration-** (a) Trapezoidal (b) Simpson's 1/3rd (c) Simpson's 3/8th rule	6

Assessment

I. Internal Assessment Test:

Assessment consists of two class tests of 40 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class test when an additional 35% syllabus is completed. Duration of each test shall be 90 minutes.

II. End Semester Theory Examination:

1. Question paper will comprise of a total 05 questions, each carrying 20 marks.
2. Total 03 questions need to be solved.
3. Question No: 01 will be compulsory and based on the entire syllabus wherein 4sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture mentioned in the syllabus.

References:

1. Higher Engineering Mathematics, Dr.B.S.Grewal, Khanna Publication
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley EasternLimited, 9thEd.
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication,
4. Applied Numerical Methods with MATLAB for Engineers and Scientists by Steven Chapra, McGraw Hill .

Engineering Mathematics II Laboratory

General Instructions: Each student has to perform at least 6 MATLAB practical's and at least 6 assignments on the entire syllabus.

List of Matlab Programing

1. Euler's Method
2. Euler's Modified Method
3. Runge Kutta Fourth Order
4. Trapezoidal Rule
5. Simpson's 1/3rd Rule
6. Simpson's 3/8th Rule
7. Differential Equations
8. Integration.
9. Graphical representation of Functions
10. Graphical representation of intersection of two curves

Term Work:

The distribution of Term Work marks–

1. Attendance (Theory, Practicals) : 05 marks
2. Assignments on entire syllabus : 10 marks
3. MATLAB Practicals : 10 marks

Course Code	Course Name	Credits
PHY102	Engineering Physics-I	**2 + 0.5**

Course Code	Course Name	Theory	Practical	Tutorial	Total contact hours	Theory	Practical /Oral	Tutorial	Total credits
PHY 102	Engineering Physics-I	2	1	-	03	2	1	-	2.5

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
PHY 102	Engineering Physics-I	30	30	30	45	25	-	-	100

Course Objectives:

1. To impart knowledge of basic concepts in applied physics and founding principles of technology..
2. To provide the knowledge and methodology necessary for solving problems in the field of engineering.
3. To develop scientific temperament for scientific observations, recording, and inference drawing essential for technology studies.

Course Outcomes:

Upon successful completion of this course, the learner will be able to:

1. Explain the functioning of lasers and their various applications.
2. Explain the working principle of optical fibres and their applications especially in the field of communication
3. Understand fundamental concepts of classical optics to study Interference of light in thin films
4. Apply the knowledge of Interference of light in various applications.
5. Explain the limits of Classical Physics and apply the fundamentals of quantum mechanics to study the one dimensional motion of microscopic particles.
6. Apply the knowledge of superconductivity to Magnetic levitation.

CO/PO Mapping

CO/PO Mapping (3 High , 2 Medium , 1 Low)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2						3		1		1
CO2	3	2	2	1				3		1		1
CO3	2	2						3		1		1
CO4	2	2						3		1		1
CO5	2	2			1			3		1		1
CO6	2	2						3		1		1

Syllabus:

Module	Details	Hours.
1.	**Lasers**: 1.1 Basic Definitions and explanation of terms: Spontaneous emission and stimulated emission; metastable state, population inversion, types of pumping, resonant cavity, Einstein's Coefficients and their derivation. 1.2. 3-level and 4-level lasing system and need for at least a 3-level system for lasing action. 1.3. Helium Neon laser: Construction, working and Energy level Diagram. 1.4. Nd: YAG laser: Construction, working and Energy level Diagram. 1.5.Various applications of Lasers	4
2.	**Optical Fibres**: 2.1. Working Principle and Structure 2.2. Derivation of expression for Numerical Aperture for step index fibre. Expression for Critical angle; angle of acceptance for a step Index Fibre, Fractional Index difference. 2.3. Classification of optical fibres.(SMF and MMF, SIF and GIF) 2.4. Expression for V-number and modes of propagation for a step index fibre. 2.5. Applications : Fibre optic communication system	**3**
3.	**Interference in Thin Films:** 3.1. Interference by division of amplitude and by division of wave front. 3.2.Interference in thin films of constant thickness due to reflected light: Conditions for maxima and minima 3.3. Study of Wedge Shaped Film: No derivations. Only conditions for maxima and minima.	4

	3.5.Newton's Rings: Diameter of dark and bright rings	
4.	**Applications of Interference of light:** 4.1: Thin Films of constant thickness: Origin of colours and estimation of absent colours in interference pattern, Conditions for refractive index and thickness for Highly reflecting and Anti-reflecting thin films on glass. 4.2: Wedge Shaped Thin Film: Relation between fringe width and wedge angle, Estimation of film thickness of a thin foil or wire. 4.8: Newton's Rings: Testing of Surface smoothness and finding wavelength of monochromatic liquid.	**3**
5.	**Quantum Mechanics**: 5.1. De Broglie wave hypothesis, properties of matter waves: wave packet, Concept of phase velocity and group velocity and their relationship. 5.2. Wave Function, its physical interpretation and salient features. 5.3. Heisenberg's Uncertainty principle and its significance (statements only) and their interpretation: momentum and position/ Numerical. 5.4.Derivation of Schrodinger's Time Dependent Wave equation and Schrodinger's Time Independent Wave Equation 5.5. Particle in a 1-D box (Expression for Energy EigenValues)	**7**
6.	**Superconductivity**: 6.1. Critical temperature, critical magnetic field of a superconductor. 6.2. Meissner Effect, Type I and Type II and high Tc superconductors 6.3. Applications of superconductors: MAGLEV	**3**

Assessment

I. Internal Assessment Test

Assessment consists of two class tests of 30 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class test when an additional 35% syllabus is completed. Duration of each test shall be one hour.

II.End Semester Examination

In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

1. Question paper will comprises of 3 questions, each carrying 15 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module then part (b) will be from other than module (3)
4. Total three questions need to be solved.

References:

1. A text book of Engineering Physics-Avadhanulu & Kshirsagar, S. Chand
2. A textbook of Optics - N. Subramanyam and Brijlal, S.Chand
3. Fundamentals of optics by Jenkins and White, McGrawHill
4. Modern Engineering Physics – Vasudeva, S.Chand
5. Concepts of Modern Physics- Arther Beiser, Tata McGraw Hill
6. A TextBook of Engineering Physics, S. O. Pillai, New Age International Publishers.
7. Optics - Ajay Ghatak, Tata McGraw Hill8. Introduction to Electrodynamics- D. J. Griffiths, Pearson publication .
8. Physics for Engineers, M.R. Srinivasan, New Age International Publishers.

Engineering Physics-I Laboratory

List of Experiments:

1. Determination of angular divergence of laser beam.
2. Determination of wavelength of laser light using Diffraction grating. (Laser source)
3. Determination of Numerical Aperture of an optical fibre.
4. Study of a Fibre Optic Communication system (Demonstration only)
5. Determination of Thickness of thin paper sheet using Wedge Shaped film
6. Determination of wavelength of monochromatic source using Newton's Rings
7. Determination of Planck's constant 'h' using LEDs of different colours.
8. Determination of 'h' using KE vs. frequency plot (Simulation).
9. Determination of l of laser light using diffraction grating (Simulation).
10. Determination of R of a plano-convex lens using Newton's rings method (Simulation).
11. Determination of thickness of a thin foil using interference in a wedge shaped film (Simulation).

Term work:

Term Work shall consist of a minimum eight experiments. The distribution of marks rubric for term work shall be as follows:

1. Laboratory work (Experiments and Journal): 10/20 marks
2. Group Project or Topic Presentation (Optional): 10 marks
3. Attendance (Theory and Practical): 05 marks

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

Course Code	Course Name	Credits
PHY116	**Engineering Physics-II**	**2+0.5**

Course Code	Course Name	Theory	Practical	Tutorial	Total contact hours	Theory	Practical /Oral	Tutorial	Total credits
PHY 116	Engineering Physics-II	2	1	-	03	2	1	-	2.5

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
PHY 116	Engineering Physics-II	30	30	30	45	25	-	-	100

Course Objectives:

1. To impart knowledge of basic concepts in applied physics and founding principles of technology.
2. To provide the knowledge and methodology necessary for solving problems in the field of engineering.
3. To develop scientific temperament for scientific observations, recording, and inference drawing essential for technology studies.

Course Outcomes:

Upon successful completion of this course, the learner will be able to:

1. Comprehend the basic concepts of semiconductor physics.
2. Apply the knowledge of semiconductor concepts towards the study of electronic semiconductor devices.
3. Interpret and explore basic sensing techniques for physical measurements in modern instrumentations.
4. Comprehend the concepts of electrodynamics and Maxwell's equations and their use in telecommunication systems.
5. Comprehend the various material characterisation techniques.
6. Comprehend the knowledge of Piezoelectric and Magnetostriction effect for production of ultrasonic waves and its application in various fields.

CO/PO Mapping

CO/PO Mapping (3 High , 2 Medium , 1 Low)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2						1		1		1
CO2	3	2	2	1			1	1		1		1
CO3	2	2				1		1	1	1		1
CO4	2	2						1		1		1
CO5	2	2			1	1		1	1	1		1
CO6	2	2				1	1	1	1	1		1

Syllabus:

Module	Details	Hours.
1.	**1.Semiconductors**: 1.1 Relation between Conductivity, Mobility, Current density; relation between conductivity, charge concentration, and mobility for metals and semiconductors 1.2 Splitting of energy levels for band formation in semiconductors; classification of semiconductors(doping): Intrinsic and Extrinsic; classification of semiconductors(band gap): Direct and Indirect band gap, Classification of semiconductors (composition):elemental and compound 1.3 Fermi Dirac distribution function: Calculation of energy from probability of occupancy, Fermi level in intrinsic and extrinsic semiconductors; Qualitative discussion on effect of temperature and charge concentration on the fermi levels of n-type and p-type semiconductors, Proof of position of Fermi level in midway of bandgap for an intrinsic semiconductors.	5
2.	**Semiconductor Devices and Applications** 2.1 Hall Effect: Derivation of expression for Hall Voltage, Hall coefficient and Hall Angle. 2.2 Applications of Hall effect. 2.3 Semiconductor Devices: I-V curves and mechanism of operation for Solar Cell, LED and Zener Diode	**3**
3.	**Physics of Sensors**: 3.1.Temperature Sensor 3.2.Pressure Transducer: Capacitive and Inductive types 3.3.Photodiode: IV characteristics and use in measurement of light intensity	4

	3.4.Moisture sensor	
4.	**Electrodynamics:** 4.1.Scalar and Vector fields, gradient, curl and divergence 4.2.Determination of Maxwell's equations for static and varying fields 4.3.Significance of Maxwell's equations and their application in Antenna design and waveguide. 4.4.Numerical Problems	**5**
5.	**Material Characterisation Techniques** 5.1 X-Ray Diffraction: Bragg's law and its application in measuring crystal lattice parameter. 5.2 SEM and TEM: Principle of operation and working using schematic diagram.	**4**
6.	**Ultrasonics** : 6.1. Ultrasonic Wave generation; Magnetostriction Oscillator; Piezoelectric Oscillator; 6.2. Applications of ultrasonic: Echo sounding; NDT; ultrasonic cleaning(cavitation); ultrasonic sensors; 6.3.Industrial applications of ultrasonic(soldering, welding, cutting, drilling)	**3**

Assessment

I. Internal Assessment Test

Assessment consists of two class tests of 30 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class test when an additional 35% syllabus is completed. Duration of each test shall be one hour.

II. End Semester Examination

In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

1. Question paper will comprises of 3 questions, each carrying 15 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module then part (b) will be from other than module (3)

4. Total three questions need to be solved.

References:

1. A text book of Engineering Physics-Avadhanulu & Kshirsagar, S. Chand
2. A textbook of Optics - N. Subramanyam and Brijlal, S.Chand
3. Fundamentals of optics by Jenkins and White, McGrawHill
4. Modern Engineering Physics – Vasudeva, S.Chand
5. Concepts of Modern Physics- Arther Beiser, Tata McGraw Hill
6. A TextBook of Engineering Physics, S. O. Pillai, New Age International Publishers.
7. Optics - Ajay Ghatak, Tata McGraw Hill8. Introduction to Electrodynamics- D. J. Griffiths, Pearson publication.
8. Physics for Engineers, M.R. Srinivasan, New Age International Publishers.

Engineering Physics-II Laboratory

List of Experiments:

1. I-V characteristics of a solar cell and calculation of efficiency.
2. I-V characteristics of a Zener diode and its use as a voltage regulator
3. Demonstration of Hall Apparatus.
4. Use of CRO to determine: DC voltage, frequency and amplitude of AC signals.
5. I-V curves of a photodiode at various light intensities and verification of Inverse Square Law for Light Intensity.
6. Voltage vs. Temperature characteristics of a Temperature Sensor.
7. Use of Ultrasonic distance meter for determination of distance.
8. Study of characteristics of solar cell (simulation).
9. Determination of Hall Voltage and Hall Coefficient in Hall Effect (Simulation).
10. Non-destructive testing using Ultrasonic.
11. To find Fermi level of a metal (copper) and a semiconductor(thermistor)
12. To study the I-V characteristics of a solar cell and obtain the efficiency.

Term work:

Term Work shall consist of a minimum of eight experiments.

Overall Rubric for the distribution of term work marks:

1. Laboratory work (Experiments and Journal): 10/20 marks
2. Group Project or Topic Presentation (Optional): 10 marks
3. Attendance (Theory and Practical): 05 marks

The final certification and acceptance of Term Work includes the satisfactory performance of laboratory work and minimum passing marks in the Term Work.

Course Code	Course Name	Credits
CHEM103	**Engineering Chemistry I**	**2+0.5**

Course Code	Course Name	Theory	Practical	Tutorial	Total contact hours	Theory	Practical /Oral	Tutorial	Total credits
CHEM 103	Engineering Chemistry I	2	1	-	03	2	1	-	2.5

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
CHEM 103	Engineering Chemistry I	30	30	30	45	25	-	-	100

Course objectives:

1. To appreciate the need and importance of engineering chemistry in the industry and Engineering field.

2. To include the importance of water in industrial usage.

3. To provide the knowledge of lubrication aspects of machine components.

4. To enable the understanding of the role of engineering polymeric materials.

5. To introduce advanced engineering materials and their applications.

6. To provide an understanding of the fundamental chemical processes that cause environmental problems.

Course outcomes:
Students will be able to:

1. To analyse the quality of water for application in industries and to suggest methods to improve it.

2. To acquire knowledge on physical / chemical / biological characteristics of water and the treatment technique for sewage.

3. To select various lubricants for different industrial applications.

4. To identify various polymeric materials and understand their properties and applications in engineering.

5. To introduce and understand the basics of advanced engineering materials and their applications.

6. To develop an understanding of the environmental challenges and suggest methods for their minimisation based on green chemistry principles.

CO-PO Mapping

CO-PO Mapping (3 High , 2 Medium , 1 Low)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2				3		1	1	2		
CO2	2	2				1	2	3	2			
CO3	3	1				2	1	2		2		3
CO4	2	1	3	1	2	1	2	1			2	3
CO5	1	2	2	2	1	2	2				2	2
CO6	1	1	2	1	2	1	3	2			3	3

Syllabus:

Module	Detailed Contents	Hrs.
1	**Module 1 - Hardness of water** **Pre - requisites** : Knowledge of sources of water, Possible impurities in water, Characteristics imparted by impurities in water. Hardness in water – Types & its units, Determination of hardness by EDTA method, numerical problems. Effects of Hard water in Industries - Boiler corrosion, Scales and Sludges, (Causes, methods of prevention) Softening of water- Ion exchange process.	5
2	**Module 2 - Water Treatment** Specifications for drinking water, BIS standards Domestic water treatment : Steps involved in domestic water treatment - screening, sedimentation, filtration, disinfection - chlorination, treatment with ozone.	3

	Membrane Technology for water treatment - Reverse Osmosis, Electro dialysis Sewage water treatment **:** BOD and COD, determination and numerical problems, Activated sludge process	
3	**Module 3 - Lubricants** **Pre - requisites** : Definition of Lubricants and Lubrication, Functions of lubricants, Mechanisms of lubrication – Thick film, Thin film and Extreme pressure Classification of lubricants - Solid (MoS_2, graphite), Semi solid (greases), Liquid (animal/vegetable oils, mineral oils, Blended oils) Lubricants for special applications- Synthetic oils Properties of lubricants and their significance - Viscosity and Viscosity Index, Flash and Fire Points, Cloud and Pour Points, Acid Number, Saponification Number, and related numerical problems. .	3
4	**Module 4 - Engineering Polymeric materials** **Prerequisite** : Polymer, Monomer, Polymerization, Degree of polymerisation, Classification of polymers, Mechanism of polymerisation. Molecular weight of polymers: Average molecular weight (weight average and number average) of a polymer, Polydispersity Index, Numerical problems. Polymer crystallinity - Glass transition temperature and factors affecting Tg, Viscoelasticity. Properties of Polymers (Mechanical, Electrical and Optical) Commercially important polymers - Polyethylene, Polyvinyl acetate, Polydimethyl Siloxane , Polylactic acid Conducting polymers - Mechanism of conduction in polymers, Examples and applications.	6
5	**Module 5: Advanced Engineering Materials** **Prerequisite** :Definition and basic understanding of composite materials. Composite Materials Constitution of composite materials- Matrix and Dispersed phase Classification of composite materials - Particle reinforced composites, Fibre reinforced composites, structural composites .	4

	Advantages and Applications of composite materials Smart Materials Introduction to Smart Materials, Shape Memory Effect, Shape Memory Polymers.	
6	**Module 6 - Environmental Chemistry** **Pre- requisites:** Definition of Environment and Primary concept of environmental pollution**.** Pollution Management:- Causes, Effects and control measures on: Space Pollution, E-Pollution and Nuclear Pollution. Solid Waste Management. Concept of 12 principles of Green chemistry, discussion with examples (synthesis of indigo, adipic acid), numericals on atom economy.	3

Assessment

I.Internal Assessment Test

Assessment consists of two class tests of 30 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 35% syllabus is completed. Duration of each test shall be 75 minutes.

II.End Semester Examination

In the question paper, the weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.
1. Question paper will comprise 4 questions, each carrying 15 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be random in nature (for example, if Q.2 has part (a) from module 3, then part (b) will be from other than module)
4. Total three questions need to be solved.

References:

1. Engineering Chemistry – P.C.Jain and Monika Jain, Dhanpat Rai Publications
2. A Textbook of Engineering Chemistry, - Shashi Chawla (DhanpatRai publications)
3. A textbook of Engineering Chemistry - S.S. Dara, S. Chand Publishing House
4. Environmental Pollution Control Engineering - C.S.Rao (New Age International)
5. Environmental Chemistry – A.K.De, New Age International

Engineering Chemistry-I Laboratory

List of Experiments:

1. Determination of Hardness in water by complexometric titration.
2. Determination of Chloride content in water Argentometric titration.
3. Determination of Acid value of lubricating oil by Acid-Base titration.
4. Determination of Viscosity Index by Redwood Viscometer.

5. Determination of Dissolved oxygen in water by Winkler's method.
6. Determination of Chemical Oxygen Demand by simulation.
7. To determine the Viscoelasticity of Silly putty by creep test.
8. Synthesis of conducting polyaniline from aniline by chemical oxidative polymerization.

Term work:

Each student has to perform a minimum of five experiments and four assignments based on the entire syllabus.

The distribution of marks for term work shall be as follows:
Laboratory work (Experiments and Journal) : 10 marks
Assignments and Viva on modules : 10 marks
Attendance (Theory and Practical) : 05 marks

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

Course Code	Course Name	Credits
CHEM117	**Engineering Chemistry II**	**2+0.5**

Course Code	Course Name	Theory	Practical	Tutorial	Total contact hours	Theory	Practical /Oral	Tutorial	Total credits
CHEM 117	Engineering Chemistry II	2	1	-	03	2	1	-	2.5

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
CHEM 117	Engineering Chemistry II	30	30	30	45	25	-	-	100

Course objectives:

1. To familiarize the students with the basic concepts of chemistry in the industry and Engineering field.
2. To understand the chemistry of various fuels and their combustion mechanism.
3. To acquire knowledge of electrochemical energy systems.
4. To introduce the underlying science of corrosion and the significance of corrosion control to protect the structures.
5. To educate the theory and applications of spectroscopic techniques.
6. To provide an introduction to and an overview over nanomaterials.

Course outcomes

Students will be able to:

1.To understand and analyze the combustion mechanisms of various fuels and introduce alternate fuels.

2. To develop knowledge on electrochemical energy systems considering the operation.

3. To acquire knowledge of the different battery technologies and understanding the basic mechanisms allowing electrochemical energy storage in batteries

4. To become familiarized with corrosion forms and their effects and to recognize and use the method of corrosion protection.

5. To describe the theoretical background of spectroscopic techniques such as NMR, IR, spectroscopy to apply them for the various fields.

6. To acquire basic knowledge of types of nanomaterials and their synthesis and specific applications.

CO-PO Mapping

CO-PO Mapping (3 High , 2 Medium , 1 Low)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	1	3	2	1	1	2	1	2	2		2
CO 2			2	1								1
CO 3	1	2	2	2		1		2				2
CO 4	1	1	2	2				1		2		2
CO 5	1	2				1	1	1				1
CO 6	2	1				2	1	2	1		1	1

Syllabus:

Module	Detailed Contents	Hrs.
1	**Module -1 - Fuels and combustion** **Pre- requisites** : What are fuels, Types of fuels, Characteristics of fuels. Calorific value of a fuel - HCV and LCV, Units of Calorific value, Theoretical determination of calorific value of fuel by Dulong's formula, Numerical problems Coal - Definition and Ranking, Analysis of coal - Proximate and Ultimate analysis, Numerical problem Crude oil - Classification, Fuels for Internal Combustion Engines - Knocking, Octane number, Anti Knocking agents, Cetane number. Alternative Fuels: Biodiesel and Power Alcohol	6

	Combustion of fuels – Numerical problems for calculating the amount of air needed for the complete combustion of solid and gaseous fuels. Propellants.	
2	**Module 2- Engineering Electrochemistry** **Prerequisite :** redox reaction, cell reaction, electrode and its type, salt bridge Electrode potential, electrode reactions. Electrochemical cells, derivation of Nernst equation for cell potential, numerical problems. Reference electrodes -Types of reference electrodes, Construction, working of Glass electrode and Calomel electrode.	3
3	**Module 3- Battery Technology** Battery- classification – primary, secondary and reserve batteries. Characteristics – Capacity, Electricity storage density, energy efficiency, cycle life and shelf life. Construction, working, applications and limitations of Lead acid storage battery, Modern Batteries - Lithium and Lithium ion batteries and its applications. Fuel Cells: Introduction, classification of fuel cells, limitations & advantages of fuel cells, Construction of Hydrogen oxygen alkaline fuel cells.	3
4	**Module -4- Corrosion and its Control** **Pre- requisites** : corrosion , corrosion product, corrosive and non corrosive metals. Galvanic series and electrochemical series. Mechanism of corrosion - Chemical and Electrochemical corrosion. Types of corrosion : Galvanic corrosion, Differential aeration corrosion, Pitting corrosion, Intergranular corrosion, Waterline corrosion, Stress corrosion. Factors Affecting Corrosion Rate : - (i) Nature of metal (ii) Nature of environment. Methods of Corrosion Control : Material selection, Design, Cathodic protection Corrosion Inhibitors Protective Coatings: Metallic coatings - anodic coating (galvanizing) and cathodic coating (Tinning)	6

	Methods of Applying Metallic Coatings - Hot dipping, Metal Spraying, Electroplating and Diffusion coating	
5	**Module 5- Spectroscopic techniques** **Pre-requisites :** Electromagnetic radiation, characteristics of electromagnetic radiation, electromagnetic spectrum. Spectroscopy - Principle, Interaction of radiation with matter, Selection rules. Classification of spectroscopy - Based on atomic or molecular level, absorption or emission, electronic or magnetic level Types of spectroscopy - IR and NMR Spectroscopy and its applications.	3
6	**Module 6 -Nanomaterials** **Prerequisites:** Concept of nano scale, definition of nanoparticles Types of nanomaterials - Fullerenes, Carbon Nanotubes Properties of nanomaterials – Optical properties, magnetic properties, electrical properties Preparation of Nanomaterials - Top down and Bottom up approach Synthesis of Nanomaterials -Chemical vapour deposition (CVD) method and Laser Ablation Method Examples and applications of nanomaterials(Electronics, Energy, Biomedicine,Environment ,Food , Textile).	3

Assessment

I.Internal Assessment Test

Assessment consists of two class tests of 30 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 35% syllabus is completed. Duration of each test shall be 75 minutes.

II.End Semester Examination

In the question paper, the weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

1. Question paper will comprise 4 questions, each carrying 15 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be random in nature (for example, if Q.2 has part (a) from module 3, then part (b) will be from other than module)
4. Total three questions need to be solved

References:

1. Engineering Chemistry – P.C.Jain and Monika Jain, Dhanpat Rai Publications
2. A Textbook of Engineering Chemistry, - Shashi Chawla (DhanpatRai publications)
3. A textbook of Engineering Chemistry - S.S. Dara, S. Chand Publishing House
4. Instrumental methods of Chemical Analysis - B.K.Sharma, Goel Publishing House

5. Fundamentals of Molecular Spectroscopy - C.N. Banwell, Tata Mc Graw Hill.

Engineering Chemistry-II Laboratory

List of Experiments:
1. Determination of moisture content and ash content in coal sample by proximate analysis.
2. Preparation of bio- diesel by trans-esterification process.
3. Preparation of Fe2O3 nanoparticles.
4. Cu-Zn electrochemical cell- Effect of conc.on cell potential.
5. Determination of strength of a strong acid by pH meter
6. Determination of strength of a strong acid by conductivity meter
7. EMF measurement (Simulation Expt)
8. To study the rate of corrosion of metal in acidic and basic medium.

Term work:

Each student has to perform a minimum of five experiments and four assignments based on the entire syllabus.

The distribution of marks for term work shall be as follows:
Laboratory work (Experiments and Journal) : 10 marks
Assignments and Viva on modules : 10 marks
Attendance (Theory and Practical) : 05 marks

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

Course Code	Course Name	Credits
ENGG105	**Basic Electrical Engineering**	**4**

Course Code	Course Name	Theory	Practical	Tutorial	Total contact hours	Theory	Practical /Oral	Tutorial	Total credits
ENGG 105	Basic Electrical Engineering	3	2	-	5	3	1	-	4

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ENGG 105	Basic Electrical Engineering	40	40	40	60	25	-	25	150

Prerequisite: Resistance, inductance, capacitance, series and parallel connection of resistance, concept of voltage, current, power and energy and its units.

Course Objectives:

1. To provide knowledge on fundamentals of D.C. circuits.
2. To provide knowledge of D.C network theorems and its applications.
3. To impart knowledge on fundamentals of A.C. circuits
4. To impart knowledge on fundamentals of single phase A.C circuits and its applications.
5. To impart knowledge on fundamentals of 3-Φ A.C. circuits and its applications.
6. To impart knowledge on basic operation and applications of electrical machines.

Course Outcomes:

On successful completion of course learner/student will be able to

1. Apply basic concepts to analyse D.C circuits.
2. Apply various D.C network theorems to determine the circuit response/ behavior.
3. Apply basic concepts to analyse A.C waveforms.
4. Evaluate and analyse single phase A.C circuits.
5. Evaluate and analyse three phase A.C circuits.
6. Understand the constructional features and operation of electrical machines.

CO/PO Mapping

CO-PO Mapping (3 High , 2 Medium , 1 Low)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO1	3	2	1	1	1	1	-	1	1	1	-	1
CO2	3	2	1	1	2	1	-	1	1	1	-	1
CO3	3	2	1	1	2	1	-	1	1	1	-	1
CO4	3	2	1	1	2	1	-	1	1	1	-	1
CO5	3	1	1	1	2	1	-	1	1	1	-	1
CO6	3	1	1	1	1	1	-	1	1	1	-	1

Syllabus

Module	Detailed Contents	Hrs.
1	**DC Circuits** Series and Parallel circuits, Concept of short and open circuits, Star-delta transformation, Ideal and practical voltage and current source, Kirchhoff's laws, Mesh and Nodal analysis (super node and super mesh included), Source transformation.	6
2	**DC Theorems** Linear and Nonlinear Circuit, Active and passive network, Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, (Source transformation not allowed for Superposition theorem).	8
3	**AC fundamentals** Generation of alternating voltages, A.C terminology, RMS and Average value, form factor, crest factor, Phasor representation of alternating quantities, addition and subtraction of alternating quantities using phasors.	3
4	**Single Phase AC Circuits** AC through pure resistor, inductor and capacitor. AC through R-L , R-C and R-L-C series and parallel circuits, phasor diagrams, power and power factor, series and parallel resonance, Q-factor**.**	10
5	**Three Phase AC Circuits** Three phase voltage and current generation, star and delta connections (balanced load only), relationship between phase and line currents and voltages, Phasor diagrams, Basic principle of wattmeter, measurement of power by two wattmeter method .	6
6	**Electrical Machines** Working principle of single-phase transformer, EMF equation of a transformer, Transformation Ratio, Transformer Rating. Losses in transformer.	3

Assessment:

I. Internal Assessment Test:

Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.

II. End Semester Examination:

1. Question paper will consist of 5 questions, each carrying 20 marks.
2. Total 3 questions need to be solved.
3. Q.1 will be compulsory, based on the entire syllabus.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of marks should be proportional to number of hours assigned to each module

References:

1. "Basic Electrical Engineering", by Prof. B. R. Patil, Oxford Higher Education
2. "Basic Electrical Engineering (BEE)", by Prof.Ravish Singh", McGraw Hill Education
3. B.L.Theraja "Electrical Technology" Vol-I and II, S. Chand Publications, 23 rd ed. 2003.
4. Joseph A Edminister, "Schaum‟s outline of theory and problems of electric circuits" Tata McGraw Hill, 2 nd edition
5. D P Kothari and I J Nagrath "Theory and Problems of Basic Electrical Engineering", PHI 13th edition 2011.

Basic Electrical Engineering Laboratory

Hardware/Software Requirements: Hardware kits, MATLAB Simulink, TINA software and V-Lab.

List of Experiments:

1. To learn and verify Mesh analysis using hardware kits.
2. To understand and verify Nodal analysis using hardware kits.
3. To study Superposition theorem and its Implementation using MATLAB Simulink.
4. To verify Thevenin's theorem by using TINA software.
5. To verify Norton's theorem by using TINA software.
6. To understand the operation of Series R-L circuit using TINA software
7. To understand the operation of a series R-L-C resonant circuit using TINA software.
8. Power measurement in three phase system by two wattmeter method using V-Labs

Lab Assessment:

I.Term work Assessment:

Term work consists of performing minimum 08 practical's. Final certification and acceptance of the term work ensures satisfactory performance of laboratory work.

The distribution of Term Work marks will be as follows:

Attendance (Theory, Practicals) : 5 marks

Assignment on entire syllabus : 10 marks

Practicals : 10 marks

II. Oral/Viva Assessment:

The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus

Course Code	Course Name	Credits
MECH107	**Engineering Mechanics and Graphics**	**3+1**

Course Code	Course Name	Theory	Practical	Tutorial	Total Contact Hours	Theory	Practical/ Oral	Tutorial	Total Credit
MECH 107	Engineering Mechanics and Graphics	3	2	-	5	3	1	-	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of 2 Tests					
MECH107	Engineering Mechanics and Graphics	40	40	40	60	25	25	-	150

Course Objectives:

The course is aimed

1. To develop the capacity to predict the effects of force and motion and to acquaint the concept of static and dynamic equilibrium.
2. Ability to visualise physical configurations in terms of actual systems and its constraints, and able to formulate the mathematical function of the system.
3. To study, analyse and formulate the motion of moving particles/bodies.
4. To impart and inculcate proper understanding of the theory of projection.
5. To impart the knowledge of reading a drawing and to improve the visualisation skill.
6. To teach basic utility of computer aided drafting (CAD) tools.

Course Outcomes:

On successful completion of course learner/student will be able to:

1. Illustrate the concept and M-Lab program of force, moment and apply for two dimensional systems with the help of FBD.
2. Illustrate the concept and M-Lab program of concept of equilibrium in two and three dimensional systems with the help of FBD.
3. Illustrate and M-Lab program of different types of motions and establish Kinematic relations for a particle & rigid body.
4. Analyse particles in motion using force-acceleration, work-energy and impulse momentum principles.

5. Apply the basic principles of projections in reading, visualising and converting 3D view to 2D drawing and vice versa.
6. Create, Annotate, Edit and Plot drawings using basic AutoCAD commands and features.

CO PO Mapping:

CO-PO Mapping (3 High , 2 Medium , 1 Low)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO1	3	3		1	1			1	1			1
CO2	3	3		1	1			1	1			1
CO3	3	3		1	1			1	1			1
CO4	3	3		1				1	1			1
CO5	3	3	2	1				1	1	1		1
CO6	3	3	2	1				1	1	1		1

Syllabus:

Module	Detailed Contents	Hrs.
1	Basics of Calculus, Basic Trigonometric Functions and Units of physical entities. Properties of Triangle. Newton's Law of Motions, Equations of Motions and its applications. **Coplanar and Non-Coplanar Force System and Resultant:** **1.1 System of Coplanar Forces:** Classification of force systems, Principle of transmissibility, composition and resolution of forces. **1.2 Resultant:** Resultant of coplanar and non-coplanar force system (Concurrent forces, parallel forces and non-concurrent non-parallel system of forces). Moment of force about a point, Couples, Varignon's Theorem. Force couple system. Distributed Forces in plane.	**06**
2	**2.1 Equilibrium of System of Coplanar Forces:** Conditions of equilibrium for concurrent forces, parallel forces and non-concurrent non- parallel general forces and Couples. Equilibrium of rigid bodies' free body diagrams. **2.2 Equilibrium of Beams:** Types of beams, simple and compound beams, type of supports and reaction. Determination of reactions at supports for various types of loads on beams. (Excluding problems on internal hinges)	**06**
3	Basics of Calculus, Basic Trigonometric Functions and Units of physical entities. Area of Geometries. Newton's Law of Motions, Equations of Motions and its applications. **Kinematics of Particle and Rigid Body:** **3.1 Kinematics of Particles:** Motion of particles with variable acceleration. General curvilinear motion. Tangential and Normal component of acceleration, Motion curves (a-t, v-t, s-t curves). **3.2 Kinematics of Rigid Body:** Translation, Rotation & General Plane motion of Rigid body. The concept of Instantaneous center of rotation (ICR). Location of ICR of mechanism. Velocity analysis of rigid bodies using ICR.	**06**
4	**Kinetics of a Particle:**	**06**

	4.1 Force and Acceleration: - Introduction to basic concepts, D'Alemberts Principle, concept of Inertia force, Equations of dynamic equilibrium, Newton's second law of motion. (Analysis limited to simple systems only.) **4.2 Work and Energy:** Work Energy principle for a particle in motion. Application of Work–Energy principle to a system consists of connected masses and Springs. **4.3 Impulse and Momentum:** Principle of linear impulse and momentum. Impact and collision: Law of conservation of momentum, Coefficient of Restitution. Direct Central Impact and Oblique Central Impact. Loss of Kinetic Energy in collision of inelastic bodies.	
5	**5.1 *Introduction to Engineering Graphics** Principles of Engineering Graphics and their significance, usage of Drawing instruments, Types of Lines, Dimensioning Systems as per IS conventions. Introduction to plain and diagonal scales. **5.2 @Introduction to Auto CAD:-** Basic Drawing and Editing Commands. Knowledge of setting up layers, Dimensioning, Hatching, plotting and Printing. **5.3 *Orthographic and Sectional Orthographic Projections: -** Fundamentals of orthographic projections. Different views of a simple machine part as per the first angle projection method recommended by I.S. Full or Half Sectional views of the Simple Machine parts. **5.4 @Drawing of orthographic projections using Autocad.**	**06**
6	**6.1 *Isometric Projection:** Principles of Isometric projection – Isometric Scale, Isometric Views, Conversion of Orthographic Views to Isometric Views (Excluding Sphere). **6.2 @ Drawing of Isometric projections using Autocad.**	**06**

*Will be covered during practical hours. @ Will be covered during Autocad practical hours.

Assessment:

I.Internal Assessment Test (Entirely on Engineering Mechanics):
Assessment consists of two class tests of 40 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class test when an additional 35% syllabus is completed. Duration of each test shall be 90 minutes.

II.End Semester Theory Examination (Entirely on Engineering Mechanics):

1. Question paper will comprise of a total 05 questions, each carrying 20 marks.
2. Total 03 questions need to be solved.
3. Question No: 01 will be compulsory and based on the entire syllabus **(Module 1-4)** wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules **(Module 1-4)**.
5. Weightage of each module will be proportional to the number of respective lectures mentioned in the syllabus.

References:

1. Engineering Mechanics by Beer &Johnston, Tata McGrawHill
2. Engineering Mechanics (Statics) by Meriam and Kraige, Wiley Books
3. Engineering Mechanics (Dynamics) by Meriam and Kraige, Wiley Books
4. Engineering Mechanics by F. L. Singer, Harper & Raw Publication
5. Engineering Mechanics by Shaum Series
6. N.D. Bhatt, "Engineering Drawing (Plane and solid geometry)", Charotar Publishing HousePvt. Ltd.
7. N.D. Bhatt & V.M. Panchal, "Machine Drawing", Charotar Publishing House Pvt. Ltd.
8. M.B Shah & B.C Rana, "Engineering Drawing", Pearson Publications.

9. P.J. Shah, “Engineering Graphics”, S Chand Publications.
10. Dhananjay A Jolhe, “Engineering Drawing” Tata McGraw Hill.
11. Prof. Sham Tickoo (Purdue University) & Gaurav Verma, “(CAD Soft Technologies) : AutoCAD 2012 (For engineers and Designers)”, Dreamtech Press NewDelhi.

Engineering Mechanics & Graphics Laboratory

Term Work:

Component-1 Engineering Mechanics Practical (Any Four)

1. Verification of Polygon law of coplanar forces
2. Verification of Principle of Moments (Bell crank lever)
3. Determination of support reactions of a Simply Supported Beam
4. Kinematics of particles. (Projectile motion)
5. Matlab Programming – Coplanar Force System, Equilibrium and Motion Curves. (Total 6 Programme)

Component-2 AutoCAD Practical

Printouts of each from:

1. Orthographic Projections – 2 problems.
2. Orthographic Projections with Section – 2 problems.
3. Isometric projections – 2 problems.

Note:- 2 hrs /week Auto CAD Practical is essential for completing the Auto CAD Drawings and taking required printouts.

End Semester Practical Examination (Auto CAD) (2 hours/ 25 Marks.)

1. Isometric drawing. (1 problem) (10 Marks)
2. Orthographic Projection (With Section) (1 problem). (15 Marks)

Course Code	Course Name	Credits
MECH106	Engineering Mechanics	3+1

Course Code	Course Name	Teaching Scheme (Total Contact Hours 05)			Credit Assigned (Total Credit 04)		
		Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial
MECH106	Engineering Mechanics	3	2	-	3	1	-

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical/ Oral	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs.)			
		IA-I	IA-II	Avg. of 2 IA					
MECH 106	Engineering Mechanics	40	40	40	60		25	25	150

Course Objectives:
The course is aimed

1. To develop the capacity to predict the effects of force and motion and to acquaint the concept of static and dynamic equilibrium.
2. Ability to visualize physical configurations in terms of actual systems and its constraints, and able to formulate the mathematical function of the system.
3. To study, analyze and formulate the motion of moving particles/bodies.

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

1. Illustrate the concept of force, moment and apply the same along with the concept of equilibrium in two- and three-dimensional systems with the help of FBD.
2. Demonstrate the understanding of Centroid and its significance and locate the same.
3. Correlate real life application to specific type of friction and estimate required force to overcome friction.
4. Establish relation between velocity and acceleration of a particle and analyze the motion by plotting the relation.
5. Illustrate different types of motions and establish Kinematic relations for a rigid body.
6. Analyze particles in motion using force & acceleration, and impulse momentum principles.

CO-PO Mapping :

CO-PO Mapping (3 High , 2 Medium , 1 Low)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	-	-	1	1	1	-	3
CO2	3	3	2	1	1	-	-	1	1	1	-	3
CO3	3	3	2	1	1	-	-	1	1	1	-	3
CO4	3	3	2	1	1	-	-	1	1	1	-	3
CO5	3	3	2	1	1	-	-	1	1	1	-	3
CO6	3	3	2	1	1	-	-	1	1	1	-	3

Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
1.	**Coplanar and Non-Coplanar Force System**	**Basic Concepts:** System of Units-Conversion of Units, Use of Trigonometry Functions, Resolution of a force, The Fundamental Concepts and Principles of Mechanics, Concepts of Vector Algebra, Functions of a Scientific Calculator **1.1 System of Coplanar Forces:** Classification of force systems, Principle of transmissibility, composition and resolution of forces. **1.2 Resultant:** Resultant coplanar force system (Concurrent forces, parallel forces and non-concurrent non-parallel system of forces). Moment of force about a point, Couples, Varignon's Theorem. **1.3 Forces in Space:** Resultant of Non-Coplanar (Space Force)	08	CO1
2.	**Equilibrium of Force system**	**2.1 Equilibrium:** Conditions of equilibrium for concurrent forces, parallel forces and general forces, Couples. Equilibrium of rigid bodies, free body diagrams. **2.2 Equilibrium of Beams:** Types of beams, simple and compound beams, type of supports and reaction: Determination of reactions at supports for various types of loads on beams. (Excluding problems on internal hinges)	06	CO1
3.	**Centroid**	**3.1 Centroids of plane laminas:** Plane lamina consisting of primitive geometrical shapes.	04	CO2
4.	**Friction**	**4.1 Friction:**	04	CO3

		Laws of friction. Cone of friction, Angle of repose, Angle of friction, Equilibrium of bodies on a horizontal and inclined plane.		
5.	**Kinematics of Particle and Rigid Body**	**5.1 Kinematics of Particles:** Motion of particles with variable acceleration. General curvilinear motion. Tangential & Normal component of acceleration, Motion curves (a-t, v-t, s-t curves). **5.2 Kinematics of Rigid Body:** Translation, Rotation and General Plane motion of Rigid body. The concept of Instantaneous center of rotation (ICR) for the velocity. Location of ICR of mechanism. Velocity analysis of rigid body using ICR	07	CO4 & CO5
6.	**Kinetics of Particle**	**6.1 Force and Acceleration:** - D'Alemberts Principle, concept of Inertia force, Equations of dynamic equilibrium, Newton's second law of motion. (Analysis limited to simple systems only.) **6.2 Impulse and Momentum:** Principle of linear impulse and momentum. Impact and collision: Law of conservation of momentum, Coefficient of Restitution. Direct Central Impact and Oblique Central Impact. Loss of Kinetic Energy in collision of inelastic bodies.	07	CO6

References:

1. Engineering Mechanics by Beer &Johnston, Tata McGrawHill
2. Engineering Mechanics (Statics) by Meriam and Kraige, WileyBools
3. Engineering Mechanics (Dynamics) by Meriam and Kraige, WileyBools
4. Engineering Mechanics by F. L. Singer, Harper & Raw Publication
5. Engineering Mechanics by ShaumSeries

Theory Assessment:

Internal Assessment (IA) for 40 marks each:

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

End Semester Theory Examination for 60 marks:

1. Question Paper will comprise a total of 05 questions each carrying 20 marks.
2. A total of 03 questions need to be answered.
3. Q.1 will be compulsory and should cover the maximum contents of the syllabus.
4. Any 02 questions need to be solved from the remaining 04 questions. There won't be any compulsory Question
5. Questions will be mixed in nature. (E.g. Suppose Q.2 has part (a) from module3 then part (b) will be from any module other than module 3).
6. In question paper weightage of each module will be proportional to the number of respective lecture hrs. as mentioned in the syllabus.

Engineering Mechanics Laboratory:

List of Experiments:

Minimum six experiments from the following list of which at least one should be from dynamics.

Sr. No.	List of Experiments	CO Mapping
1.	Verification of Polygon law of coplanar forces	**CO1**
2.	Verification of Principle of Moments (Bell crank lever.)	**CO1**
3.	Determination of support reactions of a Simply Supported Beam.	**CO1**
4.	Determination of coefficient of friction using inclined plane	**CO3**
5.	Collision of elastic bodies (Law of conservation of momentum).	**CO5**
6.	Kinematics of particles. (Uniform motion of a particle, Projectile motion, motion under gravity)	**CO6**
7.	Kinetics of particles. (collision of bodies)	**CO6**

Term Work:

It comprises Laboratory Experiments and Assignments. The distribution of marks for term work shall be as follows:

Components	Marks
Practical Work and Journal	10
Assignment	10
Attendance	05
Total	**25**

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

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

Course Code	Course Name	Credits
MECH120	Engineering Drawing	2+2

Course Code	Course Name	Teaching Scheme (Total Contact Hours 06)			Credit Assigned (Total Credit 04)		
		Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial
MECH120	Engineering Drawing	2	4	-	2	2	-

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical/ Oral	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs.)			
		IA-I	IA-II	Avg. of 2 IA					
MECH 120	Engineering Drawing	40	40	40	60	3	25	25	150

Prerequisite:

1. To draw basic geometric shapes like circle, triangle, pentagon, hexagon, square (in different orientation).
2. Divide a line into equal number of parts.
3. Divide a circle into equal number of parts.

Course Objectives:

The course is aimed

1. To develop graphic skills for communication of concepts, ideas and design of engineering products.
2. To impart and inculcate proper understanding of the theory of projection.
3. To impart the knowledge of reading a drawing
4. To improve the visualization skill.
5. To teach basic utility of Computer Aided drafting (CAD) tools.

Course Outcomes:

On successful completion of course learner/student 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 and development of surfaces.

5. Apply the basic principles of projections in converting pictorial views into orthographic Views (3D view to 2D Drawing) and converting orthographic views into isometric drawing (2D view to 3D Drawing)
6. Create, Annotate, Edit and Plot drawings using basic AutoCAD commands and features.

CO-PO Mapping:

CO-PO Mapping (3 High , 2 Medium , 1 Low)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**3**	**1**	**1**	**1**	**1**	**1**	**1**		**1**	
CO2	**3**	**2**	**2**	**1**	**1**			**1**	**1**		**1**	
CO3	**3**	**3**	**3**	**1**	**1**	**1**	**1**	**1**	**1**		**1**	
CO4	**3**	**3**	**3**	**1**	**1**	**1**	**1**	**1**	**1**		**1**	
CO5	**3**	**3**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**3**
CO6	**3**	**3**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**1**	**3**

Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
1.	**Introduction to Engineering Drawing**	**1.1 Introduction to Engineering Graphics:** Principles of Engineering Graphics and their significance, usage of Drawing instruments, Types of Lines, Dimensioning Systems as per IS conventions. Introduction to plain and diagonal scales. **1.2 Engineering Curves:** Basic construction of Cycloid, Involutes and Helix (cylinder only).	**03**	**CO1**
2.	**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. (1st and 3rd Quadrant only) **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**

3.	**Projections of Solids**	**3.1 Projections of Solids:** Projections of solids with the axis inclined to one and both reference planes. (Prism, Pyramid, Cylinder and Cone only). (Exclude Spheres, Composite, hollow solids and frustum of solids). Use change of position or Auxiliary plane method.	**07**	**CO3**
4.	**Sections of Solids and Development of Surfaces**	**4.1 Section of Solids:** Section 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 Lateral Surfaces:** Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids, cylinders and cones.	**06**	**CO4**
5.	**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 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. Different views of a simple machine part as per the first angle projection.	**08**	**CO5**
6.	**Isometric Views**	**6.1 Isometric View:** Basic concept of isometric projection - what does Isometric represents, its need, Isometric axes and Isometric scale. Conversion of orthographic views to isometric views (Excluding sphere).	**06**	**CO5**

References:

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

Theory Assessment:

Internal Assessment (IA) for 40 marks each:

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

End Semester Theory Examination for 60 marks:

1. Question Paper will comprise a total of 06 questions each carrying 15 marks.
2. A total of 04 questions need to be answered.
3. Q.1 will be compulsory and should cover the maximum contents of the syllabus.
4. Any 03 questions need to be solved from the remaining 05 questions. There won't be any compulsory Question
5. Questions will be mixed in nature. (E.g. Suppose Q.2 has part (a) from module3 then part (b) will be from any module other than module 3).
6. In question paper weightage of each module will be proportional to the number of respective lecture hrs. as mentioned in the syllabus.

Engineering Drawing Lab:

Drawing Book: (Drawing Book Problems will be taught in the Drawing Hall)

Sr. No.	Drawing Book Problems	CO Mapping
1.	Three Problems on Engineering Curves.	CO1
2.	Five Problems on Projections of Points.	CO2
3.	Four Problems on Projection of Planes.	CO2
3.	Four Problems on Projection of Solids.	CO3
4.	Four Problems on Section of Solids & Development of Surfaces.	CO4

Drawing Sheet: (Drawing Sheet Problems will be taught in the ED Lab T-201)

Sr. No.	Drawing Sheet Problems	CO Mapping
1.	Two Problems on Orthographic Projections (without section).	CO5
2.	Two Problems on Orthographic Projections (with section).	CO5
3.	Two Problems on Isometric Projections	CO5

AutoCAD Sheet: (AutoCAD Sheet Problems will be taught in the Computer Lab J-201)

Sr. No.	AutoCAD Sheet Problems	CO Mapping
1.	Two Problems on Orthographic Projections (without section).	CO5 & CO6
2.	Two Problems on Orthographic Projections (with section).	CO5 & CO6
3.	Two Problems on Isometric Projections	CO5 & CO6

Term Work:
Satisfactory submission of all 3 components is mandatory to fulfill the Term work.
The distribution of marks for term work shall be as follows:

Components	Marks
Drawing Book	07

Drawing Sheet	07
AutoCAD Sheet	06
Attendance	05
Total	**25**

End Semester Practical Examination:

Software	Duration in Hours	Marks
AUTOCAD	2 Hrs.	25

The Practical Exam will be based on the following syllabus:

1. Isometric drawing (1 Problem) (10 Marks)
2. Sectional Orthographic Projection (1 Problem). (15 Marks)

Course Code	Course Name	Credits
CE104	**C Programming**	**3+1**

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
CE104	C Programming	Contact Hours	3	2	-	5
		Credits	3	1	-	4

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
CE104	C Programming	40	40	40	60	25	25	-	150

Course Objectives:

The course is aimed to:
1.To provide exposure to problem-solving by developing algorithms and designing flowchart.
2.Implement the logic to solve real world problems using the C programming language.
3.To develop solutions using different programming concepts.
4.To decompose solutions into smaller units using functions.
5.To create different types of data-structure using structure and arrays.
6.Describe the dynamics of memory using a pointer.

Course Outcomes:

On successful completion of course learner/student will be able to:
1.Understand the basic terminology and use different data types, operators and keywords in computer programming.
2.Able to logically code using control statements and loops.
3.Design programs involving functions and recursive function.
4.Utilize the concept of arrays and strings to develop computer programs.
5.Use the concepts Structures and nested structure to design complex programs.
6.Use of pointers to access different user defined data types like arrays, Strings and Structures

CO-PO Mapping (3 High , 2 Medium , 1 Low												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1			2			1	1	2		2
CO2	3	2			2			1	1	2		2
CO3	3	3			2	1		1	1	2		2
CO4	3	3		1	2			1	1	2		2
CO5	3	3	2	1	2			1	1	2		2
CO6	3	3	2	1	2	1		1	1	2	-	2

Syllabus:

Module	Module	Detailed Content	Hrs.
1	Fundamentals of C Programming	History of C programming language and its features 1.1 Algorithm & Flowchart : Three construct of Algorithm and flowchart: Sequence, Decision (Selection) and Repetition 1.2 Character Set, Identifiers and keywords, Data types, Constants, Variables. 1.3 Operators-Arithmetic, Relational and logical, Assignment, Unary, Conditional, Bitwise, Comma, other operators. Expression, statements, Preprocessor, Structure of basic C program.	4
2	Control Flow Statements	2.1 Decision making statements- if statement, if-else statement , if-else-if ladder, nested if-else, switch statement 2.2 Looping – while , do-while, for 2.3 Jump Statements- break, continue, goto, return, exit	10
3	Functions	3.1 Introduction to Functions, declaring and defining function, calling function, passing arguments to a function, recursion and its application. 3.2 Library functions – getchar( ), putchar( ), gets( ), puts( ), Math function, Ctype functions 3.3 Storage classes in C-auto, extern, static, register.	5
4	Arrays and Strings	4.1 Array Introduction, Declaration, Initialization, Accessing array element, One and Two-dimensional array. 4.2 Strings Introduction, String using char array, String handling functions	7
5	Structures	5.1 Structure Introduction, Declaration, Initialization, operations on structure. 5.2 Nested structure, Array of Structure.	3

6	Pointers	6.1 Pointer :Introduction, Definition, Pointer Variables, Referencing and Dereferencing operator, Pointer Arithmetic, Pointers to Pointers, void Pointer, 6.2 Pointers to Array and Strings, Passing Arrays to Function, Accessing structure using pointers, Array of Pointers, call by value and call by reference. 6.3 Dynamic Memory Allocation using malloc, calloc, realloc, free	7

Assessment:

I.Internal Assessment :

Two class tests of 40 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class test when an additional 35% syllabus is completed. Duration of each test shall be one and half hour.

II.End Semester Theory Examination:

In question, paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

1.Question paper will consist of 3 questions, each carrying 20 marks.
2.Question number 1 will be compulsory and based on maximum contents of the syllabus
3.Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4.Total three questions need to be solved.

References:

1. "Programming in ANSI C", by E. Balaguruswamy, Tata McGraw-Hill Education
2. "A Computer Science –Structure Programming Approaches using C ", by BehrouzForouzan , Cengage Learning
3. "Let Us C", by Yashwant Kanetkar, BPB Publication
4. "MASTERING C" by K.R.Venugopal and SudeepR.Prasad , Tata McGraw-Hill Publications.
5. "Programming Techniques through C", by M. G. Venkateshmurthy, Pearson Publication.
6. "Programming in C", by Pradeep Dey and Manas Gosh, Oxford University Press.
7. Schaum's outlines "Programming with C", by Byron S. Gottfried, Tata McGraw-Hill Publications.
8. "Basics of Computer Science", by BehrouzForouzan , Cengage Learning .

C Programming-Laboratory

List of Experiments:

1.Write a program to Input Radius and Height of Cylinder and output Volume.

2.Write a program to find the greatest among three integers using ternary operator.

3. An electric power distribution company charges its domestic customer as follows : Consumption Units Rate of charge:

Consumption Units	Rate of charge
0 - 200	0.50 per unit
201 - 400	Rs. 100 plus 0.65 per unit excess of 200 units.
401 - 600	Rs. 230 plus 0.85 per unit excess of 400 units.
601 above	Rs. 390 plus 1.00 per unit excess of 600 units.

Program should read units consumed for a customer and calculate the total bill

4. Write a program to print S = 1/1! – 1/3! + 1/5! – 1/7! .....n terms

5. Write a program to print the following pattern : (Take input for the no. of lines 'N').

```
* * * * *          A
*       *          A B
*       *          A B C
* * * * *          A B C D
```

6. Write a Menu Driven Program to Perform Addition, Subtraction, Multiplication, and Division of any two numbers.

7. Write a program to check whether a number is an Armstrong number or not.

8. Write a Program to find factorial of number using Recursive Function.

9. Write a program to shift each element of an array to left or right as per user's choice (Known as cyclic rotation of array elements)
e.g.: Given array: 10 20 30 40 50
After rotating left: 20 30 40 50 10
After rotating right: 50 10 20 30 40"

10. WAP to find the transpose of a given square matrix of order n without using an additional matrix.
NOTE: swap a[i][j] and a[j][i]

11. Write a program to find the reverse of a string using another string (Define a user defined function to find the length of the string).

12. Write a program using Structure to accept employee name, emp_id, date_of_joining and salary. Display the result in descending order of salary. Store data for 'N' employees.

13. Write a Program to swap two integers using call by value and call by reference method.

14. Write a program to dynamically allocate memory for the user entered size ‘N’ of an array, accept ‘N’ integers from user and find the average of these integers using function and pointer (Pass array to the function using pointer).

Practical Assessment:

A Practical / Oral exam will be held based on the above syllabus. The final certification and acceptance of TW ensures the satisfactory performance of laboratory work and minimum passing in the TW.

A.Term Work: Term Work shall consist of practical’s based on the above list. Also, Term work Journal must include at least 2 assignments based on the topics mentioned in the syllabus.

B.Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiments) + 5 Marks (Assignments) + 5 Marks (Attendance)

Course Code	Course Name	Credits
CE119	**Python Programming**	**3+1**

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
CE119	Python Programming	Contact Hours	3	2	-	5
		Credits	3	1	-	4

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
CE119	Python Programming	40	40	40	60	25	25	-	150

Course Objectives:

1. Basics of python including data types, operator, conditional statements, looping statements, input and output functions in Python.
2. List, tuple, set, dictionary, string, array and functions
3. Object Oriented Programming concepts in python
4. Concepts of modules, packages, multithreading and exception handling
5. File handling

Course Outcomes:

Upon completion of the course students will be able

1. To understand the structure, syntax of the Python language.
2. To interpret varied data types in python.
3. To implement arrays and functions.
4. To illustrate the concepts of object-oriented programming as used in Python.
5. To create Python applications using modules, packages, multithreading and exception handling.
6. To gain proficiency in writing File Handling programs.

CO-PO Mapping (3 High , 2 Medium , 1 Low												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	2	-	-	1	1	2	-	2
CO2	3	3	3	2	2	-	-	1	1	2	-	2
CO3	3	3	3		2	-	-	1	1	2	-	2
CO4	3	3	3	2	2	2	-	1	1	2	-	2
CO5	3	3	3	-	2	2	1	1	1	2	-	2
CO6	3	3	3	-	2	2	1	1	1	2	-	2

Syllabus:

	Module	Description	hrs
	Prerequisite	Python IDE installation and environment setup.	
	Basics of Python	Introduction, Features, Python building blocks – Identifiers, Keywords, Indention, Variables and Comments, Basic data types (Numeric, Boolean, Compound) Operators: Arithmetic, comparison, relational, assignment, logical, bitwise, membership, identity operators, operator precedence Control flow statements: Conditional statements (if, if…else, nested if) Looping in Python (while loop, for loop, nested loops) Loop manipulation using continue, pass, break. Input/output Functions, Iterators.	06
	Advanced data types & Functions	Lists: a) Defining lists, accessing values in list, deleting values in list, updating lists b) Basic list operations c) Built-in list functions Tuples: a) Accessing values in Tuples, deleting values in Tuples, and updating Tuples b) Basic Tuple operations c) Built-in Tuple functions Dictionaries: a) Accessing values in Dictionary, deleting values in Dictionary, and updating Dictionary b) Basic Dictionary operations c) Built-in Dictionary functions Sets: a) Accessing values in Set, deleting values in Set, updating Sets b) Basic Set operations, c) Built-in Set functions Strings: a) String initialization, Indexing, Slicing, Concatenation, Membership & Immutability b) Built-in String functions.	08

	Array and Functions	Arrays: a) Working with Single dimensional Arrays: Creating, importing, Indexing, Slicing, copying and processing array arrays. b) Working with Multi-dimensional Arrays using NumPy: Mathematical operations, Matrix operations, aggregate and other Built-in functions Functions: a) Built-in functions in python b) Defining function, calling function, returning values, passing parameters c) Nested and Recursive functions d) Anonymous Functions (Lambda, Map, Reduce, Filter)	08
	Object Oriented Programming	Overview of Object-oriented programming, Creating Classes and Objects, Self-Variable, Constructors, Inner class, Static method. Inheritance: Types of Inheritance (Single, Multiple, Multi-level, Hierarchical), super() method, Constructors in inheritance, Method overloading, Method overriding, Abstract class, Abstract method	06
	Modules and Packages	Modules: Writing modules, importing objects from modules. Python Packages: creating user defined packages and importing packages. Exception handling: Compile time errors, Runtime errors, exceptions, types of exception, try statement, except block, raise statement, Assert statement, User-Defined Exceptions.	04
	File handling	File Handling: Opening file in different modes, closing a file, Writing to a file, accessing file contents using standard library functions , Reading from a file – read( ), readline( ), readlines(), Renaming and Deleting a file, File Exceptions.	04

Assessment:

I.Internal Assessment Test:

Assessment consists of two class tests of 40 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class test when an additional 35% syllabus is completed.

II.End Semester Theory Examination:

1. Question paper will comprise of total 05 questions, each carrying 20 marks.
2. Total 03 questions need to be solved.
3. Question No: 01 will be compulsory and based on the entire syllabus wherein 4/5 sub-questions of 5/4 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to the number of respective lectures mentioned in the syllabus.

References:

1. Dr. R. Nageswara Rao, "Core Python Programming" , Dreamtech Press, Wiley Publication
2. M. T. Savaliya , R. K. Maurya, "Programming through Python", StarEdu Solutions.
3. E Balagurusamy, "Introduction to computing and problem solving using python", McGraw Hill Publication.
4. Zed A. Shaw, "Learn Python 3 the Hard Way", Zed Shaw's Hard Way Series.
5. Martin C. Brown," Python: The Complete Reference", McGraw-Hill Publication.
6. Paul Barry," Head First Python", 2nd Edition, O'Reilly Media, Inc.

Web resources:

1. https://docs.scipy.org/doc/numpy/user/quickstart.html
2. https://matplotlib.org/tutorials/
3. https://pandas.pydata.org/docs/getting_started/
4. https://www.geeksforgeeks.org/python-build-a-rest-api-using-flask/ Back to Scheme

Python Programming Laboratory

Minimum Hardware Requirements	Software Requirements	Other Requirements
PC With following Configuration 1. Intel Dual core Processor or higher 2. Minimum 2 GB RAM 3. Minimum 40 GB Hard disk 4. Network interface card	1. Windows or Linux Desktop OS 2. Python 3.6 or higher 3. Notepad ++ 4. Python IDEs like IDLE, Pycharm, Pydev, Netbeans or Eclipse 5. Mysql	1.Internet Connection for installing additional packages

List of suggested Experiments:

1. Write python programs to understand
   a) Basic data types, Operators, expressions and Input Output Statements
   b) Control flow statements: Conditional statements (if, if…else, nested if)
   c) Looping in Python (while loop, for loop, nested loops)
2. Write python programs to understand
   a) Different List and Tuple operations using Built-in functions
   b) Built-in Set and String functions
3. Write python programs to understand
   c) Basic Array operations on 1-D and Multidimensional arrays
   d) Implementing User defined and Anonymous Functions
4. Write python programs to understand
   a) Classes, Objects, Constructors and Static method
   b) Different types of Inheritance
   c) Method overloading, Method overriding, Abstract class and Abstract method
5. Write python programs to understand
   a) Creating User-defined modules/packages and import them in a program
   b) Creating user defined multithreaded application to demonstrate simultaneous execution of multiple threads
   c) Creating a menu driven applications which should cover the built-in exceptions in python
6. Write python programs to understand
   a) Different File Handling operations in Python

Lab Assessments:

1. Term work Assessment:

The Term work shall consist of at least 15 practical's based on the above list. The term work Journal must include at least 2 Programming assignments. The Programming assignments should be based on real world applications which cover concepts from more than one module of syllabus.

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

2. Oral/Viva Assessment:

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

Course Code	Course Name	Credits
CE118	**Java Programming**	**4**

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
CE118	Java Programming	Contact Hours	3	2	-	5
		Credits	3	1	-	4

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
CE118	Java Programming	40	40	40	60	25	25	-	150

Course Objectives:

The course is aimed to:

1. To learn the basic concepts of object-oriented programming
2. To understand the importance of Classes & objects along with constructors
3. To study and understand Arrays, Strings and vectors
4. To study various concepts of JAVA programming like multithreading, exception Handling, packages, etc.
5. To explain components of GUI based programming.

Course Outcomes:

On successful completion of course learner/student will be able to:

1. To apply fundamental programming constructs
2. To illustrate the concept of packages, classes and objects.
3. To elaborate the concept of strings, arrays and vectors
4. To implement the concept of inheritance and interfaces
5. To implement the concept of exception handling and multithreading
6. To develop GUI based applications.

CO-PO Mapping (3 High , 2 Medium , 1 Low												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1		2			1	1	2		2
CO2	3	2	2		2			1	1	2		2
CO3	3	3	2	1	2	1		1	1	2		2
CO4	3	3	2	1	2	1		1	1	2		3
CO5	3	3	2	2	2	1		1	1	2		3
CO6	3	3	3	2	2	1		1	2	2		3

Syllabus:

Prerequisite: Basics of Computer Programming

Module No	Module	Detailed Contents of Module	Hrs.
1	Introduction to Object Oriented Programming	**Overview of procedure and object oriented Programming, Introduction to the principles of object oriented programming**: Classes, Objects, Abstraction, Encapsulation, Inheritance, Polymorphism, Message passing Features of Java Language , JDK, JRE , keywords, Data types, Variables, Operators, Expressions, Types of variables and methods. **Control Statements**: If Statement, If-else, Nested if, switch Statement, break, continue. **Iteration Statements:** for loop, while loop, and do- while loop	06
2	Class, Object, Packages and Input/output	**Classes & Objects:** Reference Variables, Passing parameters to Methods and Returning parameters from the methods, Static members, Non-Static members, Method overloading, Recursive method **Constructors:** Types of Constructors, chaining of constructor, finalize() Method, Constructors Overloading. **Packages** in java, types, user defined packages Defining packages, creating packages and Importing and accessing packages **Input and output functions** in Java, Command Line Arguments, Scanner class	08
3	Array, String and Vector	Array, Strings, String Buffer class, Wrapper classes, Vectors.	04
4	Inheritance, Abstract Class and Interfaces	**Inheritance:** Inheritance Basics, Types of Inheritance in Java, member access, using Super- to call superclass Constructor, to access member of super class(variables and methods), creating multilevel hierarchy, Constructors in inheritance, method overriding, **Abstract classes** and methods,final keyword. **Interfaces:** Defining, implementing and extending interfaces, variables in interfaces, Default Method in Interface, Static Method in interface, Abstract Classes vs Interfaces.	08
5	Exception handling and Multithreading	**Exception Handling:** Exception Handling Fundamentals, Exception Types, Exception class Hierarchy, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions, Creating Your Own Exception Subclasses **Multithreaded Programming:** The Java Thread Model and Thread Life Cycle, Thread Priorities, creating a Thread, Implementing Runnable, Extending Thread, Creating Multiple Threads.	04
6	GUI programming in JAVA	**Designing Graphical User Interfaces in Java:** Components and Containers, Basics of Components, Using Containers, Layout Managers, AWT Components, Event-Handling, Introduction to Swings.	06

Assessment:

I.Internal Assessment :

Two class tests of 40 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class test when an additional 35% syllabus is completed. Duration of each test shall be one and a half hours.

II.End Semester Theory Examination:
In question, paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.
1.Question paper will consist of 3 questions, each carrying 20 marks.
2.Question number 1 will be compulsory and based on maximum contents of the syllabus
3.Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4.Total three questions need to be solved.

References:

1. Herbert Schildt, "Java-The Complete Reference", Tenth Edition, Oracle Press, Tata McGraw Hill Education.
2. E. Balguruswamy, "Programming with Java A primer", Fifth edition, Tata McGraw Hill Publication
3. Anita Seth, B.L.Juneja, " Java One Step Ahead", Oxford university press.
4. D.T. Editorial Services, "Java 8 Programming Black Book", Dreamtech Press.
5. Learn to Master Java by Star EDU Solutions
6. Yashvant Kanetkar, "Let Us Java" ,4th Edition ,BPB Publication

Java Programming- Laboratory
List of Experiments:

Hardware & Software Requirements:

Hardware Requirements	Software Requirements	Other Requirements
PC With Following Configuration: 1. Intel PIV Processor 2. 2 GB RAM 3. 500 GB Hard disk 4. Network interface card	1. Windows or Linux Desktop OS 2. JDK 1.8 or higher 3. Notepad ++ 4.JAVA IDEs like Netbeans or Eclipse 5.VSCode	1. Internet Connection for installing additional packages if required

1. Write a program which will read a number and should implement the following methods.

1.factorial()

2.testArmstrong()

3.testPalindrome()

4.testPrime()

2. Implement java program to calculate gross salary and net salary taking the following data through command line arguments

Input:empno,empname,basic salary

Process:

DA=70% of basic

HRA=30% of basic

CCA=Rs240/-

PF=10% of basic

PT=Rs.100/-

3.Write a java program to demonstrate default constructors, Parameterized Constructors and Constructor Overloading.

4. Write a program using recursive function 'power' to compute x^n, power(x,n) = 1 if n=0, power(x,n) = x if n=1, power(x,n) = x*power(x, n-1) otherwise

5.Write a program to take input for 'N' integers in an array and display only those integers that are greater than the average of all integers.

6.Write a program to create Vector objects with Student names. Program should perform following operations based on choice:

●Add Student name - to add new student name in the Vector

●Remove Student Name - Removes student name if already exists else display appropriate message

●Search a student by index

●Display - Display contents of vector

7.Consider the class network given below for multilevel inheritance. Write a program to display 'Results' objects.

8. Write a java program to create a user defined package.

9. Define interface for Area and Volume, and implement the required interfaces in Circle class and Sphere class.

10. Write a program to accept and display the month number. Throw an exception if an improper month number is entered. Make your own exception class to handle this exception.

11. Create a threads such that one thread will print even number and another will print odd number in an ordered fashion.

12. Case Study on module six.

Practical Assessment: An Practical / Oral exam will be held based on the above syllabus. The final certification and acceptance of TW ensures the satisfactory performance of laboratory work and minimum passing in the TW.

A. **Term Work:** Term Work shall consist of practical's based on the above list. Also Term work Journal must include at least 2 assignments based on the topics mentioned in the syllabus.
B. **Term Work Marks:** 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Course Code	Course Name	Credits
COMM121	**Professional Communication and Ethics-I**	**3**

Subject Code	Subject Name	Theory (Hrs)	Practical (Hrs)	Tutorial (Hrs)	Theory (Credits)	Practical/Oral (Credits)	Tutorial (Credits)	Total (Credits)
COMM 121	Professional Communication and Ethics-I	2	02	--	2	01	--	03

Subject Code	Subject Name	Examination Scheme (tentative)							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
COMM 121	Professional Communication and Ethics-I	-20-	-20-	-20-	30--	25	--		75

Course Objectives:

The course is aimed

1. To understand, compare and demonstrate the importance and relevance of communication with specific emphasis on listening skill.
2. To promote practice in speaking skill and encourage learners to compose on the spot speeches for the purpose of developing and generating ideas.
3. To train learners in reading strategies that will enhance their global understanding of the text and help them to comprehend academic and business correspondence.
4. To illustrate effective writing skills in business, academic and technical areas.
5. To inculcate confident personality traits with grooming and social etiquette.
6. To train learners in producing words on the basis of contextual cues and reflect on errors in sentences.

Course Outcomes:

On successful completion of course learner/student will be able to:

1. Listen, comprehend and identify potential barriers in spoken discourse with ease and accuracy.
2. Develop confidence and fluency in speaking at social,academic and business situations as well as make effective professional presentations.
3. Implement reading strategies for systematic, logical understanding, that will enhance the skill of comprehension, summarisation and evaluation of texts.
4. Understand and demonstrate effective writing skills in drafting academic, business and technical documents.

5. Communicate effectively in academic as well as business settings, displaying refined grooming and social skills.
6.Anticipate the meaning of unfamiliar words with the help of contextual cues and construct grammatically correct sentences.

Syllabus:

Module	Detailed Contents	Hrs.
1	**The Importance and Strategies of Effective Listening** **Prerequisite: Able to listen, read, speak, write and comprehend the target language** Introduction to communication 1.1 Importance and relevance of communication 1.2 Listening skill -ability to discriminate stress and intonation -Comprehend meaning of audio text-graded on the basis of vocabulary, sentence construction and theme. -potential barriers	**5 Hrs**
2	**Developing Speaking Skills** 2.1 Intensive Speaking- on the spot topics 2.2 Responsive speaking-answering a question 2.3 Interactive speaking-conversations 2.4 Extensive speaking-speech, oral presentations-specific emphasis on plagiarism check and generating the report	**6 Hrs**
3	**Strategies and Techniques to build Reading Skil** 3.1 Develop the process of reading- a) predicting content from the given title, b) anticipating content from the given sentence, c) skimming for understanding the theme of the passage, d) scanning for specific information, e) guessing the meaning of unfamiliar words from the context, that is, the careful analysis of structural words f) inferring from the content- conclusion reached on the basis of evidence and reasoning g) deduction- logical conclusions based on the information given in a text Special emphasis on reading comprehension exercises and summarisation	**5 Hrs**
4	**Developing Professional Writing Skills** 4.1 Effective introduction with emphasis on general statement, opposing statement and thesis statement 4.2 Critical response to a text with special reference to purpose, evaluation of the content, theme and style of a text 4.3 Organization of ideas, sentence construction and word choice, grammar and usage 4.4 Explanation and support of ideas (special reference to writing paragraphs and business letters- Sales and Claim letters}	**6 Hrs**

5	**Etiquette and Grooming for Personality Development** 5.1 Social Etiquette 5.2 Corporate etiquette 5.3 Confidence building and Personality development	**1 Hr**
6	**Vocabulary and Grammar** 6.1 Contextual vocabulary Development- Word Maps 6.2 Identifying errors in a sentence.	**1 Hr**

Assessment:

I.Internal Assessment Test:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class test when an additional 35% syllabus is completed. Duration of each test shall be 60 minutes**.(Note: Summarization should be a compulsory question in Test II and not in the End Semester Theory Examination)**

II. End Semester Theory Examination:
Total marks 30, duration 1 and half hours.

1. Question paper will consist of 5 questions, each carrying 10 marks.
2. Total 3 questions need to be solved.
3. Q.1 will be compulsory, based on the entire syllabus.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of marks should be proportional to the number of hours assigned to each module.

References:

1.Raman Meenakshi & Sharma Sangeeta, *Communication Skills,* Oxford University Press
2.Kumar Sanjay & Lata Pushp, *Communication Skills*, Oxford University Press
3.Locker, Kitty O. Kaczmarek, Stephen Kyo. (2019). Business Communication: Building Critical Skills. Place of publication not identified: Mcgraw-hill.
4.Murphy, H. (1999). Effective Business Communication. Place of publication not identified: Mcgraw-Hill.
5.Lewis, N. (2014). Word power made easy. Random House USA.

Professional Communication and Ethics-I Laboratory

Lab Prerequisite: Basic language skills

Syllabus:

Sr. No.	Level 1. Basic 2. Design 3. Advanced 4. Project/Case Study/Seminar	Detailed Lab/Tutorial Description	LO Mapping
1	Assignment 1	Written record of listening activities-Listening practice tasks of 3 types (through audio recordings of (1) Monologues (2) Dialogues (3) Formal/Expert Talk or Lecture)	LO1

2	Assignment 2	Transcription of the public speech along with a plagiarism report-Practice public speech	LO2
3	Assignment 3	Summarization through graphic organisers (1. Text to graphic organizer 2. Graphic organizer to text)	LO3
4	Assignment 4	1. Case studies on critical thinking 2. 2 business letters in complete block format.	LO4
5	Assignment 5	Documentation of case studies/Role play based on Module 5	LO5
6	Assignment 6	1. Contextual Vocabulary Development 2. Aptitude Test	LO6

Term work:

Term Work shall consist of 6 Assignments .

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

1.Assignments : **10 marks**

2.Oral Exam/ Public Speaking : **10 marks**

3.Attendance (Theory and Tutorial) : **05 marks**

Course Code	Course Name	Credits
ENGG112	**Engineering Workshop I**	**1.5**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total
ENGG112	Engineering Workshop I	--	3	--	--	--	1.5	1.5

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)	Term Work	Pract./ oral	Total
		Test1	Test 2	Avg.				
ENGG112	Engineering Workshop I	--	--	--	--	--	50	--	50

Course 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.

Course Outcomes: Learners will be able to…

1. Develop the necessary skill required to handle/use different fitting tools.
2. Develop skills required for hardware maintenance.
3. Able to install an operating system and system drives.
4. Able to identify the network components and perform basic networking and crimping.
5. Able to prepare the edges of jobs and do simple arc welding.
6. Develop the necessary skill required to handle/use different plumbing tools.
7. Demonstrate the turning operation with the help of a simple job.

Trade	Detailed Content	Hrs.

Note: Trade 1 and 2 are compulsory. Select any two trade topics out of the topic at 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.**Can select Any two trade topics out of the topic at trade 3 to 5. Demonstrations and hands on experience to be provided during the periods allotted for the same.

Trade-1	**Fitting (Compulsory):** Use and setting of fitting tools for chipping, cutting, filing, marking, center punching, drilling, tapping. Term work to include one job involving following operations : filing to size, one simple male- female joint, drilling and tapping		**10**
Trade-2	**Hardware and Networking: (Compulsory)** Dismantling of a Personal Computer (PC), Identification of Components of a PC such as power supply, motherboard, processor, hard disk, memory (RAM, ROM), CMOS battery, CD drive, monitor, keyboard, mouse, printer, scanner, pen drives, disk drives etc. · Assembling of PC, Installation of Operating System (Any one) and Device drivers, Boot-up sequence. Installation of application software (at least one) · Basic troubleshooting and maintenance · Identification of network components: LAN card, wireless card, switch, hub, router, different types of network cables (straight cables, crossover cables, rollover cables) Basic networking and crimping. NOTE: Hands on experience to be given in a group of not more than four students		**08**
Trade-3	**Welding:*** Edge preparation for welding jobs. Arc welding for different jobs like, Lap welding of two plates, butt welding of plates with simple cover, arc welding to join plates at right angles.		**06**
Trade 4	**Plumbing*:** Use of plumbing tools, spanners, wrenches, threading dies, demonstration of preparation of a domestic line involving fixing of a water tap and use of coupling, elbow, tee, and union etc.		**06**
Trade-5	**Machine Shop*** At least one turning job is to be demonstrated and simple job to be made for Term Work in a group of 4 students.		**06**

* Optional trade can choose Two trade out of 3,4 and 5

Workshop Assessment
InternalAssessment:
50mark
Term Work:
1. All the jobs mentioned above.

2 Complete Work-Shop Book giving details of drawing of the job and time sheet The distribution of marks for Term work shall be as follows:
JobWork:30Marks
Workshopbook :10 marks
Attendance: 10 marks

References:

1. Workshop Technology by H K Hajara Choudhary
2. Manufacturing Technology by R C Jain
3. Workshop Technology by R S Khurmi and J S Gupta

Course Code	Course Name	Credits
ENGG124	**Engineering Workshop II**	**1**

Course Code	Course Name	Teaching Scheme (Contact Hours)			**Credits Assigned**			
		Theory	Pract.	Tut.	**Theory**		**Pract.**	**Total**
ENGG124	Engineering Workshop II		3				**1**	**1**

Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Practical	Total
		Internal Assessment			Exam. Duration (in Hrs)			
ENGG124	Engineering Workshop II					50		50

Course 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.

Course 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 the 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.

Trade	Detailed Content	Hrs.
Note: Trade 1 and 2 are compulsory. Select any two trade topics out of the topic trade 3 to 5. Demonstrationsandhandsonexperiencetobeprovidedduringtheperiodsallottedforthesame.Reporton the demonstration including suitable sketches is also to be included in the term work Trade evaluation is to be done according to the opted Trades in addition to Compulsory Trades.		
Trade-1	**Carpentry (Compulsory)** 6. 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. 7.Termworktoincludeonecarpentryjobinvolvingajointandreportondemonstrationofajob involving wood turning	**10**
Trade-2	**Basic Electrical workshop:(Compulsory):** 8. Single phase and three phase wiring. Familiarization. Of protection switch-gears and their ratings (fuse, MCB, ELCB). Wiring standards, Electrical safety in the workplace, safe work practices. Protective equipment. 9. Layout: drawing, layout transfer to pcb, etching and drilling and soldering technique	**08**
Trade-3	**Measurement*** 10. Vernier Height gauge, wire gauge, Dial gauge. Use of the listed gauges and precaution.	**06**
Trade 4	**Sheet metal working*** 11.Use of sheet metal, working hand tools, cutting, bending, spot welding operation	**06**
Trade-5	**Forging (Smithy):*** 12. 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**

* Students can choose Two trades out of Trades 3,4 &5.

Total hours= 10+8+6+6=30 hours

2. Complete Work-Shop Book giving details of drawing of the job and time sheet The distribution of marks for Term work shall be as follows:

2. Job Work: 30 Marks
3. Workshop book 10 marks
4. Attendance : 10 marks

References:

4. Workshop Technology by H K Hajara Choudhary
5. Manufacturing Technology by R C Jain
6. Workshop Technology by R S Khurmi and J S Gupta

Course Code	Course Name	Credits
ENGG111	**Basic Workshop Practice I**	**1.5**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total
ENGG111	Basic Workshop Practice-I	--	2	--	--	--	1.5	1.5

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract./oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
ENGG111	Basic Workshop Practice-I	--	--	--	--	--	50	--	50

Course 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.

Course Outcomes: Learners will be able to…

1. Develop the necessary skill required to handle/use different fitting tools.
2. Develop skills required for hardware maintenance.
3. Able to install an operating system and system drives.
4. Able to identify the network components and perform basic networking and crimping.
5. Able to prepare the edges of jobs and do simple arc welding.
6. Develop the necessary skill required to handle/use different plumbing tools.
7. Demonstrate the turning operation with the help of a simple job.

Trade	Detailed Content	Hrs.

Note: Trade 1 and 2 are compulsory. Select any one trade topic out of the topic at 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. Students Can** select any one trade topics out of the topic at trade 3 to 5. Demonstrations and hands on experience to be provided during the periods allotted for the same.

Trade-1	**Fitting (Compulsory):** Use and setting of fitting tools for chipping, cutting, filing, marking, center punching, drilling. Term work to include one job involving following operations : filing to size, one simple male- female joint & drilling.	**08**
Trade-2	**Hardware and Networking: (Compulsory)** Dismantling of a Personal Computer (PC), Identification of Components of a PC such as power supply, motherboard, processor, hard disk, memory (RAM, ROM), CMOS battery, CD drive, monitor, keyboard, mouse, printer, scanner, pen drives, disk drives etc. · Installation of Operating System (Any one) and Device drivers, Boot-up sequence. Installation of application software (at least one) · Identification of network components: LAN card, wireless card, switch, hub, router, different types of network cables (straight cables, crossover cables, rollover cables) Basic networking and crimping. NOTE: Hands on experience to be given in a group of not more than four students.	**08**
Trade-3	***Welding:** Edge preparation for welding jobs. Arc welding for different jobs like, Lap welding of two plates, butt welding of plates with simple cover, arc welding to join plates at right angles.	**04**
Trade- 4	***Plumbing:** Use of plumbing tools, spanners, wrenches, threading dies, demonstration of preparation of a domestic line involving fixing of a water tap and use of coupling, elbow, tee, and union etc.	**04**
Trade-5	***Machine Shop:** At least one turning job is to be demonstrated and a simple job to be made for Term Work in a group of 4 students.	**04**

Total Hours = 8+8+4=20.* One Optional trade can be chosen out of 3,4 and 5

Workshop Assessment

Internal Assessment: 50

Marks Term Work:

1. All the jobs mentioned above.

2. Complete Work-Shop Book giving details of drawing of the job and time sheet.

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

Job Work: 30 Marks
Workshop book: 10 marks
Attendance: 10 marks

Course Code	Course Name	Credits
ENGG123	**Basic Workshop Practice II**	**1**

Course Code	Course Name	Teaching Scheme(Contact Hours)			CreditsAssigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total
ENGG123	Basic Workshop Practice-II	--	2	--	--	--	1	1

Course Code	CourseName	ExaminationScheme							
		Theory					TermWork	Pract./ oral	Total
		InternalAssessment			End SemExam.	Exam.Duration(in Hrs)			
		Test 1	Test 2	Avg.					
ENGG 123	BasicWork Workshop Practice-II	--	--	--	--	--	50	--	50

Course Objectives

1. To Impart Training Help the students develop engineering skills sets.
2. Toinculcaterespectforphysicalworkandhard labor.
3. To Get Exposure To Interdisciplinary Engineering Domain.

Course 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 the electrical environment.
3. Demonstrate Thewiringpracticesforthe connectionof simpleelectricalload/equipment.
4. Design, fabricateandassemblePCB.
5. Develop Thenecessaryskill Required to handle/use different measuring tools.
6. Develop The Necessary Skill required to use different sheet metal tools.
7. Able To demonstrate the operation,forgingwiththehelpof asimplejob.

Trade	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. Report on the demonstration including suitable sketches is also to be included in the term work Trade evaluation is to be done according to the opted Trades in addition to Compulsory Trades.		
Trade-1	**Carpentry (Compulsory)** 6. 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. 7.Termworktoincludeonecarpentryjobinvolvingajointandreportondemonstrationofa job involving wood turning	**08**
Trade-2	**Basic Electrical workshop:(Compulsory):** 8. Single phase and three phase wiring. Familiarization. of protection switch-gears and their ratings (fuse, MCB, ELCB). Wiring standards, Electrical safety in the workplace, safe work practices. Protective equipment. 9. Layout drawing, layout transfer to PCB, etching and drilling and soldering technique	**08**
Trade-3	**Measurement*** 10. Vernier Height gauge, wire gauge, Dial gauge. Use of the listed gauges and precaution.	**04**
Trade 4	**Sheet metal working*** 11.Use of sheet metal, working hand tools, cutting, bending, spot welding operation.	**04**
Trade-5	**Forging (Smithy):*** 12.AtleastoneforgingjobtobedemonstratedandasimplejobtobemadeforTerm Work in a group of 4 students.	**04**

* Students can choose one trade out of Trades 3,4 & 5.

Total hours= 8+8+4=20 hours

2. Complete Work-Shop Book giving details of drawing of the job and time sheet The distribution of marks for Term work shall be as follows:

5. Job Work: 30 Marks
6. Workshop book 10 marks
7. Attendance : 10 marks

References:

7. Workshop Technology by H K Hajara Choudhary
8. Manufacturing Technology by R C Jain
9. Workshop Technology by R S Khurmi and J S Gupta

Course Code	Course Name	Credits
HUM113	Indian Knowledge System	2

Course Code	Course Name	Theory	Practical	Tutorial	Total contact hours	Theory	Practical/ Oral	Tutorial	Total credits
FY113	Indian Knowledge Systems	01	02	-	03	01	01	-	02

Course Code	Course Name	Examination Scheme				
		Theory Marks	Term Work and Project	Practical	Oral	Total
		End Semester . Exam				
FY113	Indian Knowledge Systems	20	30	-	-	50

Course Objectives:

1. Creating awareness amongst the youths about the true history and rich culture of the country;
2. Understanding the scientific value of the traditional knowledge of Bhārata;
3. Promoting the youths to do research in the various fields of the Bhāratīya knowledge system;
4. Converting the Bhāratīya wisdom into the applied aspect of the modern scientific paradigm;
5. Adding career, professional, and business opportunities to the youths.

Course Outcomes: Having completed this course, the learner will be able to

1.Understand the importance of ancient Indian knowledge and its historical background.

2.Become familiar with Yoga and Ayurveda as a pathway to self-knowledge and transformation

3.Learn to appreciate the origin and development of science and technology and maths practices from ancient to current times

4.Awareness of the strong foundation of foreign policy, dharmashastra based on Arthashastra.

5.Enable the student to appreciate the ancient architecture and knowledge of construction

CO/PO Mapping

CO-PO Mapping (3 High , 2 Medium , 1 Low)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO1	2	1	1	1				1	2	2	1	2
CO2		1				1	1	2	2	2	1	2
CO3	1	1	1	1		1	1	1	2	2	1	1
CO4		1				1	1	1	2	2	1	2
CO5	1	1	1			1	1	1	2	2	1	2

Syllabus :

Module	Detailed Contents	Hrs.
1	**Indian Knowledge Systems: An Overview** **1.1 Introduction to IKS:** Characteristic Features of Indian Knowledge System **1.2 The Purpose of IKS:** Macaulay's Education Policy and its impact, Need of revisiting Ancient Indian traditions **1.3 Scope of IKS**: Development from Earliest times to 18th Century CE **1.4 Tradition of IKS** - Ancient Indian Education System: Home, Gurukul, Pathashala and ancient Education centres	4
2	**Indian Health Science** **2.1 Basic Concepts of Ayurveda and holistic health care:** Concept of ayurveda, six pillars of ayurveda, food system and ayurveda **2.2 Definition, origin and types of yoga**	2+2
3	**Science and Technology, Mathematics** **3.1** Vedic references to different branches of science, metallurgy in ancient India, role of science and technology for development of a country **3.2** Ancient practices for sustainable development **3.3** Indian Astronomy and Weather Science **3.4Indian Mathematics:** Introduction and Overview,Mathematics in Vedas, Sulva Sutras and Jain texts	6

4.	**Art of Governance (Arthashastra)-** Administration, Foreign Policy, Finance /Tax, King's Qualities	02+02+02
5	**Indian architecture and Town planning** **5.1 The importance of Sthapatya-Veda** **5.2The ancient cities of the Indus -Saraswati region** **5.3 Architecture:**Town Planning and drainage systems, Temple Architecture	4

Assessment

End Semester Examination:

1. Written Examination for 20 marks

2. Weightage of each module will be proportional to the number of respective lectures mentioned in the syllabus.

Term Work and Project:

Project and Presentation for 30 marks based on the syllabus

References:

1. Pride of India- A Glimpse of India's Scientific Heritage edited by Pradeep Kohle et al. Samskrit Bharati (2006).

2. Vedic Physics by Keshav Dev Verma, Motilal Banarsidass Publishers (2012).

3. India's Glorious Scientific Tradition by Suresh Soni, Ocean Books Pvt. Ltd. (2010).

4. An Introduction to Indian Knowledge Systems: Concepts and Applications, B Mahadevan, V R Bhat, and Nagendra Pavana R N; 2022 (Prentice Hall of India).

5. Indian Knowledge Systems: Vol I and II, Kapil Kapoor and A K Singh; 2005 (D.K. Print World Ltd).

Course Code	Course Name	Credits
MECH 201	**Manufacturing Processes & Technology***	3+1

Course Objectives:

1. To familiarize with the various production processes used on shop floors
2. To study appropriate production processes for a specific application.
3. To introduce to the learner various machine tools used for manufacturing
4. To familiarize with the principle and working of Non-traditional Manufacturing
5. To familiarize with subtractive manufacturing processes in particular CNC systems.
6. To familiarize with various additive manufacturing processes

Course Outcomes:

1. Demonstrate an understanding of casting and forming process
2. Demonstrate applications of various types of welding processes.
3. Explain and classify metalworking processes, including hot and cold working techniques, will also be able to analyze bulk forming and sheet metal operations, understanding press types, dies, and punch-die setups.
4. Illustrate principles and working of non-traditional manufacturing and select the proper process for the purpose of manufacturing.
5. Generate, develop and execute CNC part programs for various machining operations.
6. Identify the additive manufacturing process for development of a component.

Module	Details	Hours
1	**Introduction to Manufacturing Processes and Metal Casting** Classification of Manufacturing Processes and applications areas, Pattern making materials, Types of pattern and allowances, Machine moulding, Special casting processes : CO2 and shell moulding, Investment casting,Die casting, Vacuum casting, Inspection & casting defects and remedies. Introduction to Jigs and Fixtures and types, P3-2-1 principle of location and principles of clamping and guiding.	6
2	**Joining Processes-** Classification of various joining processes; Applicability, advantages and limitations of Adhesive bonding, Mechanical Fastening; Welding and allied processes, Hybrid joining processes. Classification and Working of various welding methods: Gas, Arc, Chemical, Radiant, Solid State etc. Welding Joints, Welding Positions, Welding defects and their remedies.	6
3	**Forming processes** Introduction and classification of metalworking processes, hot and cold working processes**.** Introduction, classification and analysis of Different Bulk Forming Processes. Classification of Sheet metal operations, types of Presses used in sheet metal operations, types of dies, metal cutting in a punch and die set up, die details	7
4	**Non-traditional Manufacturing processes** – Introduction, Construction, Working principle, Types, Process parameters, problems, merits, demerits and applications of : Ultrasonic Machining, Abrasive Jet Machining, Water Jet machining, Electro-Chemical Machining, Electric Discharge Machining, Electron Beam Machining, Laser beam Machining	8

5	**Computer aided Manufacturing:** Introduction, NC/CNC/DNC machines, Machining Centers, Coordinate system. CNC machining practices and programming: Manual part programming method, Canned Cycles for milling, turning.	**8**
6	**Additive Manufacturing:** Product development cycle and importance of prototyping, types of prototypes-principles and advantages, different types of generative manufacturing process viz. Vat Photopolymerisation, Material extrusion, Material Jetting, Binder Jetting, Powder bed Fusion, Direct energy deposition, Sheet Lamination.	**5**

Laboratory Syllabus:

Module	Details	Hrs.
	Part A	
1.	Rack and Pinion for Gear Manufacturing	4
2.	Lathe Machine maintenance activity, like apron overhauling, tailstock overhaul etc.	2
	Part B	
3.	Part programming and part fabrication on CNC Turning trainer (Involving processes like Step turning, facing, Taper turning, threading, etc.)	2
4.	Part programming and part fabrication on CNC Milling trainer (Involving processes like contouring, drilling, facing, pocketing etc.)	2
5.	Tool-path generation by translation of part geometry from computer aided design (CAD) to computer aided manufacturing (CAM) systems.	4
6.	Development of physical 3D mechanical structure using any one of additive manufacturing processes. https://3dp-dei.vlabs.ac.in/	4
7.	Demonstration/Part Programming Simulation for any Unconventional Machining Process (Electric Discharge Machining, laser cutting Machining, Plasma Cutting Machining etc.) https://mm-coep.vlabs.ac.in/exp/electrochemical-machining-process/	4
	Part C	
9.	Case Study: Report on a visit conducted to any Commercial Advance Manufacturing Facility	4

Theory Assessment:
Internal Assessment for 40 marks:

1. Consisting of One Compulsory Class Tests **-** 40 Marks
2. Continuous evaluation- Class Test/Assignments /Quiz/Case studies/Seminar presentation - 40 Marks

End Semester Examination: 60 Marks
Weightage of each module in end semester examination will be proportional to the number of respective lecture hours mentioned in the curriculum.

Laboratory Assessment:

Internal Assessment: 25 marks

1. All exercises mentioned above
2. The distribution of marks for Term work shall be as follows:
   Part A …….**15 marks**
   Part B …….**10 marks**
3. Practical/Oral examination based on the laboratory curriculum for **25 marks**

Books/References:

1. Welding technology by O P Khanna
2. Foundry technology by O P Khanna
3. Elements of workshop technology. Vol. 1 & II by S K Hajra Choudhury
4. Tool Design by Cyril Donaldson, George H. LeCain, and V. C. Goold
5. Jigs and Fixtures by P H Joshi, Tata McGraw Hill
6. Manufacturing Science by Ghosh and Malik
7. Rapid Manufacturing –An Industrial revolution for the digital age by N.Hopkinson, R.J.M.Hauge, P M, Dickens, Wiley
8. Rapid Manufacturing by Pham D T and Dimov, Springer Verlag
9. Production Technology by WAJ Chapman Vol I, II, III
10. Production Technology by P C Sharma.
11. Production Technology by Raghuvanshi.
12. Industry 4.0: The Industrial Internet of Things by Alasdair Gilchrist, 2016, Apress.
13. Cyber-Physical Systems: From Theory to Practice by Danda B. Rawat, Joel Rodrigues, Ivan Stojmenovic, 2015, C.R.C. Press.
14. Optimization of Manufacturing Systems using Internet of Things by Yingfeng Zhang, Fei Tao, 2017, Academic Press (AP), Elsevier.
15. CNC Programming for Machining, Kaushik Kumar, Chikesh Ranjan, J. Paulo Davim, Springer Publication.
16. CNC Technology and Programming, Krar, S., and Gill, A., McGraw Hill Publishers.
17. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, I. Gibson l D. W. Rosen l B. Stucker, Springer Publication.
18. Nontraditional Manufacturing Processes", G.F.Benedict, Marcel Dekker, Inc. New York (ISBN 0-8247-7352-7)
19. Materials and Processes in Manufacturing" (8th Edition), E.P. DeGarmo, J. T Black, R.A.Kohser,Prentice Hall of India, New Delhi (ISBN 0-02-978760).

Recommended NPTEL Courses :

1. NPTEL :: Mechanical Engineering - Advanced Manufacturing Processes

COs - POs & PSOs Mapping (Level 0 to 3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	0	1	2	0	0	0	0	0	0	0	1
CO2	3	2	2	0	2	1	0	0	0	0	0	0	1
C03	3	2	2	2	3	0	0	0	0	0	0	0	1
C04	3	2	0	2	3	0	1	0	0	0	0	0	2
C05	2	1	0	0	3	0	0	0	0	1	2	2	2
C06	2	0	1	0	3	0	0	0	0	0	0	3	2

(Level 3: Strong Mapping, Level 2: Moderate Mapping, Level 1: Weak Mapping, Level 0: No Mapping

Course Code	Course Name	Credits
MATH 202A	**Mathematics for Mechanical and Automobile Engineers***	**3**

Course Objectives:

1. To learn the Laplace Transform & Inverse Laplace Transform of various functions, and its applications.
2. To learn the concept of Fourier Series, complex form of Fourier series and Fourier Transform and enhance problem-solving skills
3. To Learn the concepts of probability distribution & expectation.
4. To Learn the various probability distributions..
5. To Learn the regression analysis, interpolation methods, correlation & matrices's eigen values and eigen vectors & its applications..
6. To learn the partial differential equations and Analytical methods to solve it which are used in engineering problems & To learn numerical methods to solve the partial differential equations which are used in engineering problems.

Course Outcomes

1. Able to solve examples of Laplace transform, Inverse Laplace transform & apply the concept of Laplace transform and its application to solve the real integrals.
2. Able to solve examples of Fourier Series, complex form of Fourier series and Fourier Transform and apply the knowledge to enhance problem-solving skills .
3. Able to solve examples of probability distribution and expectation for decision making & apply the concepts of probability distribution and expectation for decision making.
4. Able to solve examples of various probability distributions & apply various probability distributions in data science.
5. Able to solve examples of eigen values and eigen vectors of matrices & apply concept of eigen values and eigen vectors of matrices in diagonalization of matrix & engineering problems.
6. Able to solve examples of regression, correlation, rank correlation, interpolation and fitting of curves & Apply the concept of regression, correlation, rank correlation, interpolation and fitting of curves in engineering problems.

Module	Details	Hours
1	**Laplace Transform** 1.1 Definition, Laplace Transforms of Standard Functions, Linearity properties of Laplace Transform, First Shifting theorem 1.2 Change of scale Property, Effect of multiplication by t, Effect of Division by t. 1.3 Use of standard formulae of Inverse Laplace Transform, First shift property, 1.4 Convolution theorem (without proof, examples of upto polynomials of degree 2 in denominator) , Partial fractions method.	6

	Topics for Self Learning/Home learning: Laplace transform of derivative of a function & integral, Evaluation of Integral using Laplace Transform, Solution of Differential Equation using Laplace transform & Inverse Laplace Transform, Solving examples of Laplace transform using MATLAB, MATLAB SIMULINK.	6
2	**Fourier Series, Fourier Transform** 2.1 Orthogonal and orthonormal set of functions, Fourier series of periodic function with period 2π , 2.2 Fourier series of even and odd functions with period 2π, Half range Sine and Cosine Series with period π, Half range Sine and Cosine Series with period L, where (Definition only for $L \neq \pi$). 2.3 Complex form of Fourier Series with period 2π , Fourier Integrals (Definition only). 2.4 Fourier transform of constant and exponential function, Fourier cosine and sine transform of constant and exponential function.	6
	Topics for Self Learning/Home learning: Fourier series, Complex form of Fourier series, Half range Fourier series in (0,2L), (-L,L), Inverse Fourier Transform, , Solving examples of Fourier series & Fourier transform using MATLAB, MATLAB SIMULINK.	6
3	**Probability Theory** **Prerequisites -** Probability, Conditional probability, Total Probability , Baye's Theorem. 3.1 Discrete and Continuous random variables, 3.2 Probability mass and density function, 3.3 Probability distribution for random variables, 3.4 Mean of probability distribution, also as Expectation.	6
	Topics for Self Learning/Home learning: Variance, as expectation, Moments - Skewness and Kurtosis, Moment generating function , Covariance, Solving examples of Probability Theory using MATLAB, MATLAB SIMULINK.	6
4	**Probability Distribution** 4.1 Binomial distribution, 4.2 Poisson distribution, 4.3 Normal distribution .	7
	Topics for Self Learning/Home learning: Applications of various distributions in engineering problems & real life, Solving examples of Probability distribution using MATLAB, MATLAB SIMULINK.	7

5	**Prerequisite:** Inverse of a matrix, addition, multiplication and transpose of a matrix , Elementary row and column transformation, System of homogeneous and non –homogeneous equations, their consistency and solutions **Interpolation, Regression , Correlation , Fitting of Curves, Linear Algebra- Eigen values , Eigen vectors of Matrices** 5.1 Interpolation - Lagrange's Linear and Quadratic, Linear Regression, Lines of regression, Fitting of Curves : Fitting of straight line and Second degree curve by Method of least squares. 5.2 Karl Pearson's Coefficient of correlation (r) , Spearman's Rank correlation coefficient (R) (Repeated & non repeated ranks problems) 5.3 Eigenvalues and Eigenvectors of Matrices, Properties of Eigenvalues (Without proof). 5.4 Cayley Hamilton theorem(Without Proof): Verification of Cayley Hamilton theorem (CHT), Application of CHT to find inverse of a matrix .	7
	Topics for Self Learning/Home learning: Derogatory matrix, Functions of matrices, Diagonalization of a matrix, Applications of Interpolation, Regression , Correlation , Fitting of Curves, Linear Algebra- Eigen values , Eigen vectors of Matrices in engineering problems, Solving examples of Interpolation, Regression , Correlation , Fitting of Curves, Linear Algebra- Eigen values, Eigen vectors of Matrices using MATLAB, MATLAB SIMULINK, Linear Algebra Machine Learning.	7
6	**Partial Differential Equations - Numerical methods** 6.1 Introduction of Partial Differential equations(PDE) & it's Classification. 6.2 1-D Heat Equation (Without Derivation), 1-D Wave Equation (Without Derivation) 6.3 Numerical methods to solve PDE -Bender Schmidt scheme , Simplified Crank Nicholson scheme.	7
	Topics for Self Learning/Home learning: Analytical methods to solve PDE, 2-D Heat equation, Solving examples of Partial Differential Equations - Numerical methods using MATLAB, MATLAB SIMULINK.	7

Theory Assessment:

Internal Assessment(IA): 40 Marks

IA1. Consisting of One Compulsory Class Test- approx. 40% syllabus should be completed - 40 Marks.

Questions from **Topics for Self Learning/Home learning** should not be asked.

IA2. Continuous Evaluation- Average of at least 8-Tutorials of 40 marks each with at least one on each of the six modules along with MATLAB experiments/commands execution during each Tutorial / NPTEL course Certification / Test on 40% syllabus - 40 Marks

Questions from **Topics for Self Learning/Home learning** should not be asked.

The final IA marks will be average of IA1 & IA2

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

1. Question paper will comprise of four questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only three questions need to be solved.
5. Questions from **Topics for Self Learning/Home learning** should not be asked.

Duration of test will be two hours and would be for 60 marks

Tutorial Assessment: The final certification and acceptance of Term Work(TW) ensures the satisfactory performance of assigned work and minimum passing in the TW.

Term Work:
Term Work shall consist of at least 6 tutorials, at least one tutorial on each of the six modules separately, based on the above syllabus .
Also Term work Journal/File must include at least 6 assignments, at least one assignment on each of the six modules separately, based on the above syllabus.
Questions from **Topics for Self Learning/Home learning** should not be asked.

Term Work Marks: 25 Marks
The distribution of marks for term work shall be as follows:
Tutorials : 15 marks
Assignments : 05 marks
Attendance : 05 marks

References:
1. Higher Engineering Mathematics, Dr.B.S.Grewal, Khanna Publication
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley EasternLimited, 9thEd.
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication,
4. Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill education
5. Advanced Engineering Mathematics H.K. Das, S. Chand, Publications
6. Matrices, Shanti Narayan, S. Chand publication.
7. Introductory Methods of Numerical Analysis, S. S. Sastry, Prentice-Hall of India Private Limited.
8. Statistics for Machine Learning, Pratap Dangeti, Packt Publishing Ltd.
9. Deep Learning, Yoshua Bengio, Ian J. Goodfellow, Aaron Courville, MIT Press (2016).
10. Introduction to Machine Learning, Ethem Alpaydin, The MIT Press (2004).

Recommended NPTEL Courses :
1. Advanced Engineering Mathematics By Prof. P. N. Agarwal | IIT Roorkee
https://onlinecourses.nptel.ac.in/noc25_ma85/preview
https://onlinecourses.nptel.ac.in/noc24_ma68/preview
https://nptel.ac.in/courses/111107119
2. Mathematics for Machine Learning By Prof. Debjani Chakraborty, Prof. Debashree Guha Adhya | IIT Kharagpur
https://onlinecourses.nptel.ac.in/noc25_ma61/preview
https://onlinecourses.nptel.ac.in/noc24_ma61/preview
https://nptel.ac.in/courses/111105489

COs - POs & PSOs Mapping (Level 0 to 3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	0	0	0	0	0	1	0	0	1	1	1
CO2	3	2	0	0	0	0	0	1	0	0	1	1	1
C03	3	2	0	0	0	0	0	1	0	0	1	1	1
C04	3	2	0	0	0	0	0	1	0	0	1	1	1
C05	3	2	0	0	0	0	0	1	0	0	1	1	1
C06	3	2	0	0	0	0	0	1	0	0	1	1	1

(Level 3: Strong Mapping, Level 2: Moderate Mapping, Level 1: Weak Mapping, Level 0: No Mapping

Back to Scheme

Course Code	Course Name	Credits
MECH 203	Strength of Materials*	3+1

Prerequisites:
1.Fundamentals of engineering mechanics
2.Concept of centroid, Analysis of forces and moments
3.Algebra and trigonometry, Elementary Calculus

Course Objectives:

1. To understand the mechanical behavior of the body by determining the stresses, strains and deformations produced by the loads up to the elastic limit.
2. To understand the fundamental concepts related to shear force and bending moments, torsional moments, strain energy.
3. To understand the fundamental concepts related to deflection of beams, columns, and thin cylindrical and spherical shells.

Course Outcomes:
Upon successful completion of this course, learner will be able to:

1. Apply principles of statics to analyze the reactions & internal forces in bodies subjected to static loads.
2. Evaluate the different types of stresses and strains developed in the members subjected to axial, bending, shear & torsional loads.
3. Compute slope and deflection at various cross-sections along a beam's length.
4. Determine and compare the maximum stress and deformation in structures under gradual, sudden and impact loads.
5. Determine the stability and load carrying capacity of columns with various end conditions under compressive loads.
6. Conduct various tests on standard testing machines to determine the failure limits of materials under various loadings, and comprehend the behavior and properties of engineering materials.

Theory Syllabus:

Module	Details	Hours
1	**Simple stresses and strains:** Stress, strain, Stress-strain diagram for ductile and brittle materials, factor of safety. Hooke's law, Poisson's ratio, Modulus of Elasticity, Modulus of Rigidity, Bulk Modulus. Interrelation between elastic constants. Thermal stresses and strains. Principal stresses and Principal planes, Mohr's circle. Moment of Inertia and Polar moment of Inertia.	06
2	**Shear Force and Bending Moment in Beams:** Definition of bending moment and shear force, Sign conventions, Relationship between load intensity, bending moment and shear force. Shear force and bending moment diagrams for statically determinate beam due to concentrated load, uniformly distributed load, uniformly varying load and couple, Point of Contraflexure. Beams with Internal Hinges/Moment Release (limited to two per beam).	07

3	**Stresses in Beams:** **Flexural stresses –** Theory of simple bending, Assumptions, derivation of equation of bending, neutral axis, determination of bending stresses, section modulus. **Shear stresses –** Derivation of formula, shear stress distribution across various beam sections like rectangular, circular, I, T sections **Direct and Bending stresses-** Introduction, eccentric loading, columns with eccentric loading, Limit of eccentricity,	07
4	**Torsion of Shafts:** Introduction to Torsion, Torsion formula – stresses and deformations in circular and hollow shafts, Stepped shafts, Design of shafts according to theories of failure. **Strain Energy:** Strain energy due to axial load (gradual, sudden and impact), Strain energy due to bending and torsion.	06
5	**Deflection of Beams:** Double integration method and its limitations. Macaulay's method of singularity or half-range functions to calculate slope and deflection at a cross-section along the beam's length.	07
6	**Columns and Struts:** Concept of buckling of columns, derivation of Euler's formula for buckling load for columns with various end conditions, concept of equivalent length, limitations of Euler's formula, Rankine's formula, safe load on columns. **Thin Cylinders and Spheres:** Cylinders and Spheres due to internal pressure, Cylindrical shell with hemispherical ends.	07

Lab Syllabus:

Module	Details	Hours
1.	Tension Test on Mild Steel Bar and other ductile materials using UTM (Universal Testing Machine), for specimens having diameter between 6 - 12 mm. Use of graph plotting software like MS Excel or similar to plot the Load vs. Deformation plot and Stress vs. Strain plot.	2
2.	Compression Test on Concrete or Wooden Block using UTM.	2
3.	Flexure (Bending) Test on Simply Supported Beam (3 Point Bending) using UTM.	2
4.	Shear Test on rods of various materials using Shear Attachment on UTM.	2
5.	Hardness Tests using Hardness Testing Machine: (a). Rockwell Hardness Test (b). Brinell Hardness Test	2
6.	Impact Tests on Impact Testing Machine: (a). Izod Impact Test (b). Charpy Impact Test	2
7.	Torsion Test on Tor-steel rod using Torsion Testing Machine. Use of graph plotting software like MS Excel or similar to plot the Torque vs. Angular Deformation (Twist) plot.	2

8.	Tensile Test on thin cross-section (rectangular/circular) specimens using Tensile Testing Machine. Use of graph plotting software like MS Excel or similar to plot the Load vs. Deformation plot and Stress vs. Strain plot.	2
9	Simulation Tests on the above experiments using Virtual Laboratory.	10

Theory Assessment:
Internal Assessment:
1.Consisting of One Compulsory Class Tests - 40 Marks
2.Continuous evaluation- Test/Assignments /Quiz/Case studies/Seminar presentation - 40 Marks

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

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

Duration of test will be two hours and would be for 60 marks

Laboratory Assessment:
Term Work: 25 marks.
Term Work consists of an ample number of assignments and experiments as decided by the Instructor. Mini-project based on this subject may be undertaken for which the number of assignments may be suitably reduced. Students can also avail NPTEL Certification for this course, which shall be considered in place of the assignment work.
Viva-você / Practical: 25 marks.
Viva-você (on the entire syllabus) or Practical exam (on at least one experiment) shall be conducted at the end of the course. In case both viva-voce and practical exams are conducted, 15 marks shall be allotted to viva-voce and 10 marks to the practical exam.

Books/References:

1. S. S. Rattan, Strength of Materials, TMH Publications
2. R.K. Bansal, Strength of Materials, Laxmi Publications, India
3. Beer and Johnston - Strength of materials - CBS Publication
4. Ramamrutham - Strength of material - Dhanpat Rai Publication
5. W. A. Nash and M. C. Potter, Strength of Materials, Schaum's Outline Series, McGraw-Hill
6. Singer and Pytel - Strength of materials - Harper and Row Publication
7. Strength of Materials - Lab Manual, by Anand Jayakumar Arumugham, Notion Press.
8. Experiments in Strength of Materials and Cement Laboratory, by Earl B. Smith, Leopold Classic Library.
9. Laboratory Strength of Materials, by Murad, Hassan, Abdulrahman

COs - POs & PSOs Mapping (Level 0 to 3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	3	2	0	2	1	0	3	3	2
CO2	3	3	3	3	3	2	0	2	1	0	3	3	2
C03	3	3	3	3	3	2	0	2	1	0	3	2	2
C04	3	3	3	3	3	2	0	2	1	0	3	2	2
C05	3	3	3	3	3	2	0	2	1	0	3	3	2
C06	3	3	3	3	3	2	2	3	3	0	3	3	2

(Level 3: Strong Mapping, Level 2: Moderate Mapping, Level 1: Weak Mapping, Level 0: No Mapping

Back to Scheme

Course Code	Course Name	Credits
MECH 204	**Thermodynamics***	**3**

Course Objectives:

1. To explore ideas about energy into forms suitable for engineering analysis.
2. To introduce entropy and show its use for thermodynamic analysis.
3. To study power systems utilizing working fluids like vapor and gas.
4. To demonstrate the procedures for determining thermodynamic properties of pure substances from tables of property data.
5. To introduce the first law of thermodynamics, energy balances, and energy transfer mechanisms to or from a system.

Course Outcomes:

Upon successful completion of this course, the learner will be able to

1. Describe basic concepts of thermodynamics.
2. Apply the first law of thermodynamics for closed and open systems and construct conservation of mass and energy equations.
3. Calculate thermal efficiency and coefficient of performance for heat engine, refrigerators and heat pumps.
4. Explain the available and unavailable energy.
5. Calculate the properties of the steam and analyse the vapour power cycle.
6. Analyse the gas power cycles.

Module	Detail Content	Hrs.
1	**1.1 Fundamentals** Applications of Thermodynamics, macroscopic and microscopic approach, Thermodynamic systems, properties of a system, state, path, process and cycle, point function & path function, thermodynamic equilibrium, temperature & zeroth law of thermodynamics, temperature scale, ideal gas equation of state. **1.2 Energy & Energy Transfer** Energy – a property of the system, Sources of energy, Forms of energy, internal energy, enthalpy, heat transfer, sign convention for heat transfer, Thermodynamic definition of work transfer, sign convention for work transfer, similarities & dissimilarities between heat and work transfer, Exact & inexact differentials.	7
2	**2.1 First Law of thermodynamics applied to closed system:** Statement, first law applied to the closed system undergoing a process and for a cyclic process (Joule's Experiment), PMM1. Concept of moving boundary work, Ideal gas processes, **2.2 First Law of thermodynamics applied to steady flow system:** Flow process and flow energy, steady flow process, derivation of steady flow energy equation (SFEE). Application of SFEE to the steady flow devices such as nozzle, turbine, compressor, pump, throttling process, boiler, heat exchanger, Limitations of the First Law of thermodynamics.	7

3	**3.1 Second Law of Thermodynamics:** Thermal reservoir, Concept of heat engine, Heat pump and Refrigerator, Statements of the second law of thermodynamics, equivalence between Kelvin-Planck and Clausius statement, PMM2, Reversible and irreversible Process, condition for a reversible process, Carnot cycle, Carnot theorem, **3.2 Entropy:** Clausius Inequality theorem, Entropy – a property of the system, Temperature-Entropy diagram, increase of entropy principle, Tds relations, entropy change for an ideal gas.	7
4	**4.1 Availability:** Concept of high- and low-grade energy, available and unavailable energy, dead state, useful work, availability, irreversibility. **4.2 Thermodynamic Relations** Helmholtz and Gibbs functions, Maxwell equation (without derivation), Joule Thomson coefficient – porous plug experiment.	6
5	**5.1 Properties of Pure Substance:** Pure substance, phase change phenomenon of pure substance, saturation pressure and saturation temperature, terminology of pure substance, P-V-T surfaces, p-v, p-T, T-s & h-s (Mollier diagram) diagrams, Steam diagram, critical point and triple point, Quality of steam, Calculation of various properties of steam, advantages of steam & applications of steam, **5.2 Vapour Power Cycle:** Carnot cycle, Limitations of Carnot vapour cycle, Simple Rankine cycle, mean temperature of heat addition.	7
6	**6.1 Gas Power Cycle:** Nomenclature of a reciprocating engine, Mean effective pressure, Assumptions of air Standard Cycle, Otto cycle, Diesel Cycle and Dual cycle, Comparison of these cycles.	5

Assessment:

Internal Assessment: 40 marks

1. Consisting of One Compulsory Class Tests of 40 Marks
2. Continuous evaluation: Class Test/ Assignments / Quiz/ Case studies/ Seminar presentation of 40 Marks

End Semester Examination: 60 Marks

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

Books/References:

1. Fundamentals of engineering thermodynamics by Michael J. Moran &Howard N. Shapiro, John wiley and Sons, Fifth edition,
2. Applied thermodynamics by B K Ventanna, PHI publications.
3. Thermodynamics: An Engineering Approach by Yunus A. Cengel and Michael A. Boles, 9th edition, TMH
4. Basic Engineering Thermodynamics by Rayner Joel, 5th edition, Longman Publishers

5. Engineering Thermodynamics by P Chattopadhyay, 2nd edition, Oxford University Press India
6. Thermodynamics by P K Nag, 6thEdition,TMH
7. Thermodynamics by Onkar Singh, 4th Edition New AgeInternational
8. Thermodynamics by C P Arora,1st EditionTMH
9. Thermal Engineering By Ajoy Kumar, G. N. Sah, 2nd Edition, Narosa Publishing house
10. Engineering Thermodynamics Through Examples by Y V C Rao, Universities Press (India) PvtLtd
11. Fundamentals of Thermodynamics by Moran &Shapiro, Eighth Edition, Wiley
12. Fundamentals of Classical Thermodynamics by Van Wylen G.H. & Sonntag R.E., 9th Edition John Wiley & Sons
13. Thermodynamics by W.C. Reynolds, McGraw-Hill &Co
14. Thermodynamics by J P Holman, 4th Edition McGraw-Hill & Co.

E-Books / Web References

1. Engineering Thermodynamics, Achuthan, 2nd Edition, Phi Learning, 2009
2. Fundamentals of Engineering Thermodynamics, Rathakrishnan, 2nd Edition, Phi Learning, 2005
3. http://nptel.ac.in/courses/112104113/
4. http://nptel.ac.in/courses/112108148/
5. http://nptel.ac.in/courses/112105123/

MOOCS

1. https://www.coursera.org/course/introthermodynamics
2. https://www.iitbombayx.in/courses/IITBombayX/ME209xA15/2015_T1/about
3. https://legacy.saylor.org/me103/Intro/

COs - POs & PSOs Mapping (Level 0 to 3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11		PSO1	PSO2
CO1	3	3	1	0	0	0	1	0	3	0	3		1	1
CO2	3	3	3	3	3	2	2	2	2	1	3		2	2
C03	3	3	3	3	3	2	2	1	2	1	3		2	2
C04	3	3	1	0	0	0	1	0	3	0	3		1	1
C05	3	3	3	3	3	2	2	2	2	1	3		2	2
C06	3	3	3	3	3	3	2	2	2	1	3		2	2

(Level 3: Strong Mapping, Level 2: Moderate Mapping, Level 1: Weak Mapping, Level 0: No Mapping)

Course Code	Course Name	Credits
AUTO 205	Engineering Metallurgy and Automotive Materials	3+1

Course Objectives:

1. To help students know about the different types of materials
2. To enable students to make a good selection of materials
3. To be able to understand the significance of structure property relationship
4. To understand the role of materials in automotive developments

Course Outcomes: On completion of this course, a learner will be able to

1. Identify the different classes of materials
2. Suggest ways to improve the strength of materials
3. Differentiate between steels and cast irons wrt composition and property development
4. Analyze the phase transformations and apply appropriate heat treatment
5. Suggest lightweight alternatives for automotive parts
6. Evaluate the reasons of failure in components and take corrective actions

Theory Syllabus:

Module	Details	Hours
1.	Stress-strain curve, Deformability and Strengthening Mechanisms-Hot and Cold working, Recrystallisation-its effects and factors affecting it.	6
2.	Concepts of solidification,difference in solidification of metals and alloys, Phases, Phase diagrams, Alloying - Fe-Fe3C diagram and cooling of steels and cast irons.	8
3.	Austenite transformation-equilibrium and non equilibrium,Hardenability and its importance, Hardenability tests, Alloy Steels-stainless steels, tool steels.	8
4.	Heat treatments: Thorough and Surface heat treatment, Isothermal treatments-Patenting, Austempering and martempering, Ausforming and Maraging.	6
5.	Developments in automotive materials with the aim of lightweighting-Shift to composite materials for bodies, interiors and engines.	6
6.	Failure by fracture-micromechanisms-fatigue and creep. Non destructive evaluation to prevent failures.	5

Lab Syllabus:

Experiment	Details	Hours
1	Metallographic sample preparation and etching	2
2	Comparison of hardness before and after Annealing, Normalizing and Hardening in medium carbon steel	2
3	Study of tempering characteristics of hardened steel	2
4	Determination of hardenability of steel using Jominy end Quench Test	2
5	Tension test on mild steel bar (stress-strain behaviour, determination of yield strength and modulus of elasticity)	2
6	Impact test on metal specimen (Izod/Charpy Impact test)	2
7	Hardness test on metals – (Brinell/ Rockwell Hardness	2

	Number	
8	Basics of Scanning electron Microscopy. https://emb-iitk.vlabs.ac.in/exp/sem-basics/	2
9	Basic operations of transmissions electron microscopy https://emb-iitk.vlabs.ac.in/exp/transmission-electron-microscope/	2
10	Sample preparation for TEM Analysis (bulk metal, powder sample,brittle)https://emb-iitk.vlabs.ac.in/exp/tem-analysis/	2
11	Electron diffraction of various materials https://emb-iitk.vlabs.ac.in/exp/electron-diffraction/	2
12	Feature size measurement porosity, grain and reinforcement https://emb-iitk.vlabs.ac.in/exp/feature-size-measurement/	2
13	Virtual Labs (virtual-labs.github.io)-Fatigue test	2

At Least 10 experiments from the above list to be performed.

Theory Assessment:

Internal Assessment:

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

End Semester Examination:

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

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

Duration of test will be two hours and would be for 60 marks.

Lab Assessment:

Term Work:

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

1. Experiment write ups : 20 Marks
2. Attendance : 05 marks

Books/References:

1. Materials Science and Engineering: An Introduction: William Callister Jr. and David G. Rethwisch, Wiley Publication
2. Introduction to Physical Metallurgy, Sidney H. Avner, Tata McGraw Hill
3. Introduction to Engineering Materials,BK Agrawal, TataMcGraw Hill
4. Materials Science and Engineering: A First Course,Raghavan V, Prentice Hall India
5. Automotive Materials, Brian Cantor

COs - POs & PSOs Mapping (Level 0 to 3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	2	0	2	1	1	0	1	3	3	3
CO2	3	2	3	2	0	2	1	1	0	2	3	3	3
C03	3	2	2	2	0	1	1	1	0	1	3	3	3
C04	3	3	3	2	0	2	1	1	0	1	3	3	3
C05	3	3	3	2	0	3	1	1	0	2	3	3	3
C06	3	3	3	3	0	3	2	1	1	1	3	3	3

(Level 3: Strong Mapping, Level 2: Moderate Mapping, Level 1: Weak Mapping, Level 0: No Mapping

Back to Scheme

Course Code	Course Name	Credits
MECH 206	Computer Aided Drafting*	1

Course Objectives:

1. To enable students to create, modify, and optimize both 2D and 3D CAD models.
2. To enable students to apply GD&T principles, including limits, fits, and tolerances, to produce accurate engineering drawings.
3. To teach students how to build assemblies and create surface models
4. Provide knowledge of CAD data exchange formats and practical applications through case studies like reverse engineering.

Course Outcomes: Upon successful completion of this course, the learner will be able to

1. Create and optimize 2D and 3D CAD models.
2. Apply Geometric Dimensioning and Tolerancing (GD&T) for precise engineering drawings.
3. Assemble, edit, and check 3D modeled parts for constraints and interferences.
4. Create and manipulate surface models.
5. Draft detailed parts and assemblies.
6. Utilize various CAD data formats and perform reverse engineering.

Module	Details	Hours
1	**CAD Introduction,GD & T** **Overview**: Introduction to CAD, including the creation of CAD models, types and uses of models from different perspectives, parametric and non-parametric modeling. **GD & T**: Understanding Geometric Dimensioning and Tolerancing (GD&T), along with limits, fits, and tolerance.	2
2.	**Part Modelling** **2D Modeling**: Creating geometric models of engineering components using sketching commands (line, arc, circle, etc.), modification commands (trim, move, rotate, etc.), and viewing tools (pan, zoom, rotate). **Solid Modeling**: Developing 3D geometric models of engineering components using commands like extrude, revolve, sweep, blend, and loft.	8
3.	**Assembly** **Assembly Process:** Assembling 3D modeled parts, editing parts within the assembly, applying constraints, creating exploded views, and performing interference checks.Utilizing 3D components from the software library (e.g., nut, bolt, screw).	4

4.	**Surface Modeling** **Surface Creation**: Using commands such as extrude, sweep, and trim to create and manipulate surfaces **Feature Manipulation**: Employing operations like copy, edit, pattern, suppress, and history operations.	4
5.	**Drafting** **Drafting Process**: Drafting parts and assemblies, creating layouts, standard and sectional views, detailing, and plotting. **Advanced Drafting**: Using ballooning, dimensioning, GD&T symbols, and printing drawing files.	6
6.	**Data Exchange and Case Study** **Data Exchange Formats**: Understanding and comparing CAD data exchange formats like IGES, PDES, PARASOLID, DXF, and STL. **Case Study**: Conducting a reverse engineering case study to generate a model.	2

Assessment:

Term work:

1. Printouts/Plots: 10 marks

2. Reverse Engineering: Continuous Evaluation for Case study:10Marks

3.Attendance : 05 marks

Using the above knowledge and skills acquired through six modules students should complete minimum six assignments/experiments from the given sets of assignments (two from each set) using standard CAD modeler like PTC Creo/CATIA/ Solid work/UG /any other suitable software.

Set 1: Beginner Level: 3D modeling of basic Engineering components likes Nuts, Bolts, Keys, cotter, Screws, Springs etc.

Set 2: Intermediate Level: 3D modeling of basic Machine components like Clapper block, Single tool post, Lathe and Milling tail stock, Shaper tool head slide, jigs and fixtures Cotter, Knuckle joint, Couplings: simple, muff, flanged Protected flange coupling, Oldham's coupling, Universal coupling, element of engine system and Miscellaneous parts.

Set 3: Advance Level:

1. Generation of any Assembly model (minimum five child parts) along with Production drawing for any of the system by creating 3D modeling with assembly constraints, Interference check, Exploded view, GD&T, Bill of material.

2. Reverse Engineering of a physical model: disassembling of any physical model having not less than five parts, measure the required dimensions of each component, sketch the minimum views required for each component, convert these sketches into 3-D model and create an assembly drawing with actual dimensions.

End Semester Practical/Oral examination:

To be conducted by pair of Internal and External Examiners

1. Practical examination duration is two hours, based on Advance level of the Term work. Oral examination should also be conducted to check the knowledge of CAD Modelling Tools.

2. The distribution of marks shall be as follows: Practical Exam : 30 marks Oral Exam : 20 marks

3. Evaluation of practical examinations to be done based on the printout of students' work.

4. Students work along with evaluation reports to be preserved till the next examination.

Books/References:

1. Machine Drawing by N.D. Bhatt.

2. A textbook of Machine Drawing by Laxminarayan and M.L.Mathur, Jain brothers Delhi.

3. Machine Drawing by Kamat and Rao.

4. Machine Drawing by M.B.Shah.

5. A text book of Machine Drawing by R.B.Gupta, Satyaprakashan, Tech. Publication.

6. Machine Drawing by K.I. Narayana, P. Kannaiah, K.Venkata Reddy.

7. Machine Drawing by Sidheshwar and Kannaiah.

COs - POs & PSOs Mapping (Level 0 to 3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	1	3	3	3	0	3	2	0	2	3	3
CO2	3	3	1	3	3	3	0	3	2	0	2	3	3
C03	2	3	1	3	3	3	0	3	2	0	2	3	3
C04	1	3	0	2	3	2	0	1	2	0	2	3	3
C05	2	3	0	2	3	2	0	1	2	0	2	3	3
C06	2	2	0	2	3	2	0	1	2	0	2	3	3

(Level 3: Strong Mapping, Level 2: Moderate Mapping, Level 1: Weak Mapping, Level 0: No Mapping

Back to Scheme

Course Code	Course Name	Credits
HUM 201	Human Values and Social Ethics	2

Prerequisite: Should have respect for justice and be able to reflect on one's personal beliefs and values

Course Objectives:

1. To enable learners to understand the core values that shape the ethical behaviour of a professional.
2. To develop an awareness of the different ethical dilemmas at the workplace and society.
3. To inculcate the ethical code of conduct in writing technical articles and technology development.
4. To internalize ethical principles and code of conduct of a good human being at home, society and at work place.

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

1. Recognize the relation between ethics and values pertinent for an engineering professional.
2. Exercise the responsibility for establishing fair and just processes for participation and group decision making
3. Demonstrate an awareness of self-held beliefs and values and how they are altered in interactions with others.
4. Acquire the writing skills necessary to analyse data from research and attribute the source with proper citation.
5. Incorporate values and ethical principles in social and professional situations.

Module	Details	Hours
1	**Ethics and Values** Meaning & Concept of Ethics Difference between Ethics and Values Ethical code of conduct	03
2	**Professional Ethics** Professional Ethics vs Personal ethics Components of professional ethics Professional values and its importance	05
3	**Ethics and Society** Relevance of values and ethics in social work Ethical dilemmas Values and ethical principles of social work • Service • Dignity and worth of a person • Importance of Human relationships • Integrity • Competence • Social Justice	04
4	**Ethics in Technical writing** Documenting sources Presentation of Information Ethics & Plagiarism	07

5	**Ethics and Technology Development** Risk management and Individual rights Moral issues in development and application of technology Privacy/confidentiality of information Managing Technology to ensure fair practices	07

Assessment:
Termwork : 50 marks (Continuous evaluation)

Reference Books:

1. Martin Cohen, *101 Ethical Dilemmas* Routledge, 2nd edition, 2007.
2. M. Govindarajan, S. Natarajan & V.S. Senthilkumar, *Professional Ethics and Human Values,* Prentice Hall India Learning Private Limited, 2013.
3. Mike W. Martin, *Ethics in Engineering*, McGraw Hill Education; Fourth edition, 2017.

COs - POs & PSOs Mapping (Level 0 to 3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	0	0	0	0	0	3	0	3	0	0	0	1	0
CO2	0	0	0	0	0	2	0	2	3	0	2	1	0
C03	0	0	0	0	0	2	0	3	2	0	0	1	0
C04	0	0	0	2	0	0	0	1	0	3	0	0	0
C05	0	0	0	0	0	2	0	3	0	0	1	1	0

(Level 3: Strong Mapping, Level 2: Moderate Mapping, Level 1: Weak Mapping, Level 0: No Mapping

Back to Scheme

Course Code	Course Name	Credits
AUTO 293	Minor Project I	1

Course Objectives:

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

Course Outcomes: Learner will be able to

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

Guidelines for Minor Project:

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

work on the extension of the Minor Project, in even semester with suitable improvements/modifications.

- Alternatively, student groups can work completely on a new project idea in the even semester, bearing no resemblance with the topic of odd semester. This policy can be adopted on a case to case basis.

Guidelines for Assessment of Minor Project –Continuous assessment and Term Work:

- The review/ progress monitoring committee shall be constituted by heads of departments of each institute. The progress of the minor project to be evaluated on a continuous basis, Minimum two reviews in each semester- 25 marks.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of term work marks for both semesters shall be as below:
  - Quality of project report and presentation- 25 marks

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

One-year project:

- In the first semester the entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on the presentation given by the student group.
  - If the problem is based on development of a mechanism or a simple device for attaining a desired objective, the first presentation shall be reviewed based on generation of multiple feasible solutions to the given problem and identification of the best possible solution based on various parameters which may include one of more of the following viz., the total weight, volume, power consumption, mechanical advantage, efficiency, cost (including labour) per piece once manufactured, and so on. This may include creation of unique free-hand sketches by each and every member of the group to contribute to the solution of the given problem. The best possible solution has to be finalized during one or more brainstorming sessions by the members of the student group. In case the problem is of a programming/coding type, then the first presentation may be dedicated to the understanding of the theory behind the problem related to a particular domain subject, including the drafting of an algorithm and/or flowchart, and may also include the introductory part of the programming.
  - Second review shall be based on the computerization (3D CAD model of parts and assembly), and possibly the animation, depicting the working characteristics of the proposed solution to the given problem, allocating material properties to each part, identifying mass properties of the assembled parts, and so on. Checking interference is one of the important criteria that can be used when assembling the parts. For software based projects, this may include the presentation based on the extension of the programming work so as to cover the major portion of the remaining part of the topic.
- In the second semester expected work shall be procurement of components/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester. For those selecting software based projects, this may include completing the other half of the programming related work, identifying the errors, optimizing the software code, customization, creating a graphical user interface of input and output (GUI), displaying output data in the form of graphs/tables/figures/diagrams, creation of the code in executable (.exe) format or in the form of a mobile App, etc.
  - First review shall be conducted based on the readiness of the working prototype, or

programming of the remaining code for software based projects.
  - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester. This may also include the testing and validation of tests with the literature/available data/theory. For software based projects, the presentation includes the remaining work other than the programming, as described above.
- Apart from the hardware type (development of device) and software (program/coding) type of projects, the topics may also include computer based work, viz., generation of virtual laboratory (for one or more experiments) for any subject/domain of choice, or CAD modeling, analysis, optimization, and/or product design, without any relevance to developing any physical product.

Half-year project:

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

Assessment criteria of Minor Project:

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

- In a **one year project**, the first semester evaluation may be based on the first six criteria as highlighted above and the remaining criteria may be used for second semester evaluation of performance of students in the minor project.
- In the case of a **half year project,** all criteria in general may be considered for evaluation of performance of students in the minor project.

Guidelines for Assessment of Minor Project - Practical/Oral Examination:

- The report should be prepared as per the guidelines issued by the Department.
- Minor projects shall be assessed through a presentation and demonstration of working model or the execution of programme code by the student project group to a panel of Internal and External Examiners preferably from industry or research organisations having experience of more than five years approved by the Head of Institution.
- Students shall be motivated to publish a paper based on the work in conferences or student competitions.

COs - POs & PSOs Mapping (Level 0 to 3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1	1	1	1	0	1	0	2	2	0	2	1	1
CO2	3	3	3	3	3	1	1	3	3	2	3	3	3
CO3	0	0	0	0	0	1	2	3	3	2	2	1	1
CO4	3	3	3	3	3	1	0	2	3	1	3	3	3
CO5	2	2	2	2	2	3	0	3	3	2	3	3	3
CO6	2	2	2	2	2	2	2	2	2	2	3	2	2
CO7	2	2	2	2	3	3	2	2	3	3	2	2	2
CO8	2	2	2	2	2	2	1	2	2	1	3	2	2
CO9	1	1	1	1	1	2	2	2	2	3	2	2	2

(Level 3: Strong Mapping, Level 2: Moderate Mapping, Level 1: Weak Mapping, Level 0: No Mapping)

Back to Scheme