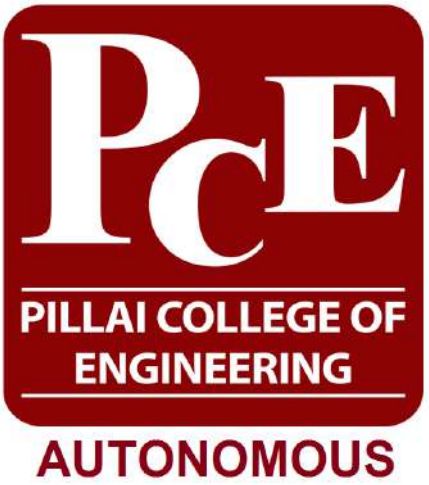
Mahatma Education Society's

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 2023-24

First Year - Effective from Academic Year **2023-24**

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

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

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

as per

NEP-2020

Mahatma Education Society's

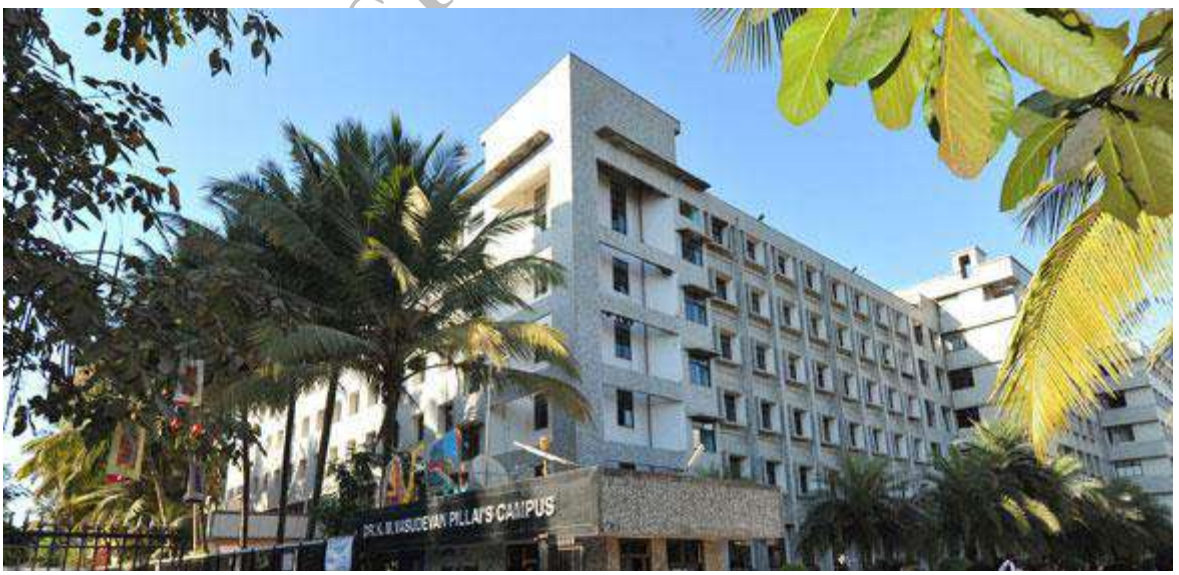
Pillai College of Engineering

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 an 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. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

1. Student should be able to generate and develop ideas that can result in self-employment (eg. 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 a 169 credit course which comprises basic sciences and mathematics, core courses, projects, internship, MOOC course and elective courses. The elective courses are distributed over 7 specializations. The specializations are:

1. Electric Vehicles
2. Additive Manufacturing
3. Motor Sports Engineering
4. Autonomous Vehicles
5. Transportation
6. Supply Chain Management and Logistics
7. Automotive Designing

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

1. Business and Entrepreneurship
2. Bioengineering
3. Engineering Design
4. Art and Humanities
5. Applied Science
6. Life Skills, Repair, Maintenance and Safety

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	18
Basic Science courses	18
Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc	15
Professional core courses	52
Professional Elective courses relevant to chosen specialization/branch	18
Open subjects – Electives from other technical and /or emerging subjects	34
Project work, seminar and internship in industry or elsewhere	15
Mandatory Courses - Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge	2
Human Values	2
Total Credits	**173**

Program Structure for
Bachelor of Technology in Automobile Engineering
W.E.F. A.Y.2023-24
Semester I

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract.	Theory	Pract.	Total
FY101	Engineering Mathematics I	BSC	3	2	3	1	4
FY102	Engineering Physics I	BSC	2	1	2	0.5	2.5
FY103	Engineering Chemistry I	BSC	2	1	2	0.5	2.5
FY105	Basic Electrical Engineering	ESC	3	-	3	-	3
FY106	Engineering Mechanics	ESC	3	2	3	1	4
FY109	Basic Electrical Engineering Lab	Skill	-	2	-	1	1
FY112	Engineering Workshop-I	Skill	-	2	-	2	1
FY113	Indian Knowledge Systems	HSSM	-	2+2#	-	2	2
FY114	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.					
FY101	Engineering Mathematics I	40	40	40	60	2	25	-	125
FY102	Engineering Physics I	30	30	30	45	2	25	-	100
FY103	Engineering Chemistry I	30	30	30	45	2	25	-	100
FY105	Basic Electrical Engineering	40	40	40	60	2	-	-	100
FY106	Engineering Mechanics	40	40	40	60	2	25	25	150
FY109	Basic Electrical Engineering Lab	-	-	-	-	-	25	25	50
FY112	Engineering Workshop-I	-	-	-	-	-	50	-	50
FY113	Indian Knowledge Systems	-	-	-	-	-	50	-	50
FY114	Co-curricular course-I	-	-	-	-	-	50	-	50
Total									**775**

Program Structure for
Bachelor of Technology in Automobile Engineering
W.E.F. A.Y.2023-24
Semester II

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract.	Theory	Pract.	Total
FY115	Engineering Mathematics II	BSC	3	2	3	1	4
FY116	Engineering Physics II	BSC	2	1	2	0.5	2.5
FY117	Engineering Chemistry II	BSC	2	1	2	0.5	2.5
FY120	Engineering Drawing	ESC	2	4	2	2	4
FY119	Python Programming	ESC	3	-	3	-	3
FY121	Professional Communication and Ethics-I	HSSM	1	2	1	1	2
FY122	Python Programming Lab	Skill	-	2	-	1	1
FY124	Engineering Workshop-II	Skill	-	2	-	1	1
FY125	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.					
FY115	Engineering Mathematics II	40	40	40	60	2	25	-	125
FY116	Engineering Physics II	30	30	30	45	2	25	-	100
FY117	Engineering Chemistry II	30	30	30	45	2	25	-	100
FY120	Engineering Drawing	40	40	40	60	3	25	25	150
FY119	Python Programming	40	40	40	60	2	-		100
FY121	Professional Communication and Ethics-I	20	20	20	30	1	25	-	75
FY122	Python Programming Lab	-	-	-	-	-	25	25	50
FY124	Engineering Workshop-II	-	-	-	-	-	50	-	50
FY125	Co-curricular Course-II	-	-	-	-	-	50	-	50
Total									**800**

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

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract.	Theory	Pract.	Total
AE201	Production Technology	PCC	3	-	3	-	3
AE202	Engineering Mathematics III*	MD M	2	-	2	-	2
AE203	Strength of Materials*	MD M	3	2	3	1	4
AE204	Thermodynamics*	PCC	3	-	3	-	3
AE205	Engineering Metallurgy and Automotive Materials	PCC	3	2	3	1	4
AE206	Computer Aided Drafting	VSEC	-	2	-	1	1
AE207	CNC and Additive Manufacturing Lab	VSEC	-	2	-	1	1
AE 208	Human Values and Social Ethics	HSSM	2	-	2	-	2
AE291	Minor Project I	CEP	1	2	1	1	2
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 201	Production Technology	40	40	40	60	2	-	-	100
AE 202	Engineering Mathematics III*	30	30	30	45	2	-	-	75
AE 203	Strength of Materials*	40	40	40	60	2	25	25	150
AE 204	Thermodynamics*	40	40	40	60	2	-	-	100
AE 205	Engineering Metallurgy and Automotive Materials	40	40	40	60	2	25	-	125
AE 206	Computer Aided Drafting	-	-	-	-	-	25	50	75
AE 207	CNC and Additive Manufacturing Lab	-	-	-	-	-	25	25	50
AE 208	Human Values and Social Ethics	-	-	-	-	-	50	-	50
AE291	Minor Project I	25(Mid Sem assessment)					25	25	75
Total									**800**

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

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

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract.	Theory	Pract	Total
AE 209	Automotive Engines and Combustion	PCC	3	2	3	1	4
AE 210	Theory of Machines and Mechanisms*	PCC	3	2	3	1	4
AE 211	Fluid Mechanics and Machinery*	PCC	3	2	3	1	4
AE 212	Elements of Machine Design	PCC	3	2	3	1	4
AE 213	Engineering Mathematics-IV	MD M	2	-	2	-	2
AE 214	Data Science	AEP	-	4	-	2	2
AE 292	Minor Project II	CEP	1	2	1	1	2
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 209	Automotive Engines and Combustion	40	40	40	60	2	25	25	150
AE 210	Theory of Machines and Mechanisms*	40	40	40	60	2	25	25	150
AE 211	Fluid Mechanics and Machinery*	40	40	40	60	2	25	25	150
AE 212	Elements of Machine Design	40	40	40	60	2	25	25	150
AE 213	Engineering Mathematics-IV	30	30	30	45	2	-	-	75
AE 214	Data Science	-	-	-	-	-	25	50	75
AE 292	Minor Project II	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 V

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract.	Theory	Pract.	Total
AE 301	Finite Element Analysis*	PCC	3	2	3	1	4
AE 302	Heat Transfer	MD M	2	2	2	1	3
AE 303	Automotive Systems	PCC	3	2	3	1	4
AE 304	Controls Engineering and Model based Systems	MD M	2	2	2	1	3
AE 3xx	Department Elective I	PEC	3	-	3	-	3
IL 3xx	Institute Elective I	OE	3	-	3	-	3
AE 391	Minor Project III	CEP	-	4	-	2	2
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	Finite Element Analysis*	40	40	40	60	2	25	25	150
AE 302	Heat Transfer	40	40	40	60	2	25	-	125
AE 303	Automotive Systems	40	40	40	60	2	25	25	150
AE 304	Controls Engineering and Model based Systems	40	40	40	60	2	-	25	125
AE 3xx	Department Elective I	40	40	40	60	2	-	-	100
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**

Group	Department Specialization	Course Code	DLOC I
1	Electric Vehicles	AE 305	Electric Vehicle Drives and Control
2	Additive Manufacturing	AE 306	CAD for Additive Manufacturing
3	Motorsports Engineering	AE 307	Material Selection and Manufacturing

Group	Institute Specialization	Course Code	ILOC I
1	IP Management and Digital Business	IL 360	IPR and Patenting
2	Business Management	IL 361	E- Commerce and E-Business
3	Bioengineering	IL 362	Introduction to Bioengineering
4	Bio Instrumentation	IL 363	Biomedical Instrumentation
5	Engineering Design	IL 364	Design of Experiments
6	Sustainable Technologies	IL 365	Design for Sustainability
7	Contemporary Studies	IL 366	Political Science
8	Art and Journalism	IL 367	Visual Arts
9	Applied Science	IL 368	Modern Day Sensor Physics
10	Green Technologies	IL 369	Energy Audit and Management
11	Maintenance Engineering	IL 370	Maintenance of Electronics Equipment
12	Life Skills	IL 371	Cooking and Nutrition
13	Environment	IL 372	Environmental Management
14	Safety	IL 373	Vehicle Safety
15	Quantum Computing and Technologies	IL 388	Quantum Computing and Technologies - Part 1

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

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract.	Theory	Pract.	Total
AE 308	Automotive Body and Chassis Systems	PCC	3	2	3	1	4
AE 309	Automotive Vibrations	PCC	3	2	3	1	4
AE 310	Automotive Design	PCC	3	-	3	-	3
AE 311	Professional Communication and Ethics II	VSEC	1	2	1	1	2
AE 3xx	Department Elective II	PEC	3	-	3	-	3
IL 3xx	Institute Elective II	OE	3	-	3	-	3
AE 392	Major Project I	CEP	-	6	-	3	3
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 308	Automotive Body and Chassis Systems	40	40	40	60	2	25	25	150
AE 309	Automotive Vibrations	40	40	40	60	2	25	25	150
AE 310	Automotive Design	40	40	40	60	2	-	-	100
AE 311	Professional Communication and Ethics II	-	-	-	-	-	50	-	50
AE 3xx	Department Elective II	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									**700**

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 (TL)
2	Additive Manufacturing	AE 313	Additive Manufacturing for Engineering application (T)
3	Motor Sports Engineering	AE 314	Race Car Designing (TL)

Group	Department Specialization	Course Code	DLOC III
4	Transportation	AE 315	Fundamentals of Transportation Engineering (T)
5	Supply Chain Management & Logistics	AE 316	Supply Chain and Operations Management (T)
6	Automotive Designing	AE 317	Concept Sketching, Rendering and Modelling (TL)
7	Autonomous Vehicles	AE 318	Introduction to Self-Driving Cars (T)

Group	Institute Specialization	Course Code	ILOC II
1	IP Management and Digital Business	IL 374	Digital Business Management and Digital Marketing
2	Business Management	IL 375	Business Analytics
3	Bioengineering	IL 376	Bio Mechanics
4	Bio Instrumentation	IL 377	Medical Image Processing
5	Engineering Design	IL 378	Product Design
6	Sustainable Technologies	IL 379	Technologies for Rural Development
7	Contemporary Studies	IL 380	Economics
8	Art and Journalism	IL 381	Journalism, Media and Communication studies
9	Applied Science	IL 382	Operation Research
10	Green Technologies	IL 383	Climate Informatics
11	Maintenance Engineering	IL 384	Maintenance of Mechanical Equipment
12	Life Skills	IL 385	Physical Education
13	Environment	IL 386	Industrial Regulations and Laws
14	Safety	IL 387	Industrial and high voltage Safety
15	Quantum Computing and Technologies	IL 389	Quantum Computing and Technologies - Part 2

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

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	Automotive Electronics and Diagnostics	PCC	3	-	3	-	3
AE 4xx	Department Elective III	PEC	3	-	3	-	3
AE 4xx	Department Elective IV	PEC	3	-	3	-	3
AE 491	Major Project II	CEP	-	8	-	4	4
Total			**15**	**12**	**15**	**6**	**21**

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	Automotive Electronics and Diagnostics	40	40	40	60	2	-	-	100
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									**700**

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	Automotive Product Design and Development
3	Motor Sports Engineering	AE 406	Simulation of Racing Cars

Group	Department Specialization	Course Code	DLOC V
4	Transportation	AE 407	Mass Transport Systems
5	Supply Chain Management & Logistics	AE 408	Logistics and Materials Management
6	Automotive Designing	AE 409	AR VR in Automobiles
7	Autonomous Vehicles	AE 410	Multi Object Tracking in Self-Driving Cars

Program Structure for
Bachelor of Technology in Automobile Engineering
Semester VIII

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract.	Theory	Pract.	Total
AE 411	Personal Financial Management	VEC	2	-	2	-	2
AE 412	Entrepreneurship and Innovation	VEC	2	-	2	-	2
AE 4xx	Department Elective V	PEC	3	-	3	-	3
AE 4xx	Department Elective VI	PEC	3	-	3	-	3
AE 492	Major Project III	CEP	-	4	-	2	2
AE 493	Internship*	AEC	-	-	-	8	8
Total			**10**	**4**	**10**	**10**	**20**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract./ Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs.)			
		1	2	Avg.					
AE 411	Personal Financial Management	20	20	20	40	2	-	-	60
AE 412	Entrepreneurship and Innovation	20	20	20	40	2	-	-	60
AE 4xx	Department Elective V	40	40	40	60	2	-	-	100
AE 4xx	Department Elective VI	40	40	40	60	2	-	-	100
AE 492	Major Project III	-	-	-	-	-	25	-	25
AE 493	Internship	-	-	-	-	-	200	-	200
Total									**545**

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

Semester VIII

Group	Department Specialization	Course Code	DLOC VI
4	Transportation	AE 413	Automotive Heating Ventilation & Air conditioning
5	Supply Chain Management & Logistics	AE 414	Quality Management (T)
6	Automotive Designing	AE 415	Aesthetics and Ergonomics (TL)
7	Autonomous Vehicles	AE 416	Decision making in Self Driving Cars (T)

Semester	I	II	III	IV	V	VI	VII	VIII	Total Credits
Credits	22	22	22	22	22	22	21	20	**173**
Grand Total of Credits									**173**

Department Specializations at a glance:

Minimum **Two** to be completed (Minimum **Three** subjects from each.)

Department Specializations						
1	**2**	**3**	**4**	**5**	**6**	**7**
Electric Vehicles	***Additive Manufacturing***	***MotorSports Engineering***	***Transportation***	***Supply Chain Management and Logistics***	***Automotive Designing***	***Autonomous Vehicles***
Electric Vehicle Drives and Control	CAD for Additive Manufacturing	Material Selection and Manufacturing	Fundamentals of Transportation Engineering	Supply Chain and Operations Management	Concept Sketching, Rendering and Modelling	Introduction to Self-Driving Cars
Automotive Embedded Systems	AM for Engineering applications	Race Car Designing	Motor Vehicles Acts & Loss Assessments	Logistics and Material management	ARVR in Automobiles	Multi Object Tracking in self-driving cars
Automotive Testing & Certification	Automotive Product Design and Development	Simulation of Racing Cars	Automotive Heating Ventilation and Air Conditioning	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) 25-26		Course 2 (Semester VI) 25-26	
1	IP Management and Digital Business	IL 360	IPR and Patenting	IL 374	Digital Business Management and Digital Marketing
2	Business Management	IL 361	E- Commerce and E-Business	IL 375	Business Analytics
3	Bio Engineering	IL 362	Introduction to Bioengineering	IL 376	Bio Mechanics
4	Bio Instrumentation	IL 363	Biomedical Instrumentation	IL 377	Medical Image Processing
5	Engineering Design	IL 364	Design of Experiments	IL 378	Product Design
6	Sustainable Technologies	IL 365	Design for Sustainability	IL 379	Technologies for Rural Development
7	Contemporary Studies	IL 366	Political Science	IL 380	Economics
8	Art and Journalism	IL 367	Visual Arts	IL 381	Journalism, Media and Communication studies
9	Applied Science	IL 368	Modern Day Sensor Physics	IL 382	Operation Research
10	Green Technologies	IL 369	Energy Audit and Management	IL 383	Climate Informatics
11	Maintenance Engineering	IL 370	Maintenance of Electronics Equipment	IL 384	Maintenance of Mechanical Equipment
12	Life Skills	IL 371	Cooking and Nutrition	IL 385	Physical Education
13	Environment	IL 372	Environmental Management	IL 386	Industrial Regulations and Laws
14	Safety	IL 373	Vehicle Safety	IL 387	Industrial and high voltage Safety
15	Quantum Computing and Technologies	IL 388	Quantum Computing and Technologies - Part 1	IL 389	Quantum Computing and Technologies - Part 2

Course Code	Course Name	Credits
FY101	**Engineering Mathematics I**	**3+1**

Course Code	Course Name	Theory	Practical	Tutorial	Total contact hours	Theory	Practical /Oral	Tutorial	Total credits
FY101	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				
		IA 1	IA2	Avg.					
FY101	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 in engineering subjects.
2. To acquaint students with the hyperbolic, inverse hyperbolic and logarithmic functions.
3. To understand differentiation and expansions of functions. which will serve as basic tools for specialized studies in many fields of engineering and technology.
4. To learn the partial differentiation techniques and its applications used in engineering problems.
5. To learn the applications of Matrices useful in engineering.
6. To provide hands-on experience using SCILAB 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 basic concept of Hyperbolic, Inverse Hyperbolic, and logarithmic functions in engineering problems.
3. Apply the concept of expansion of functions and successive differentiation in optimization problems.
4. Use the basic concepts of partial differentiation in finding the Maxima and Minima required in engineering problems.
5. Use the concept of matrices in solving the system of equations used in many areas of research.
6. Apply the concept of numerical Methods for solving the engineering problems with the help of SCILAB software.

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. 1.1. De Moivre's Theorem.(Without Proof) 1.2. Expansion of sinnθ, cosnθ in terms of powers of sinθ, cosθ and Expansion of sin^nθ, cos^nθ in terms of sines and cosines of multiples of θ. 1.3. Powers and Roots of complex number.	6
2	**Hyperbolic , Inverse Hyperbolic and Logarithmic functions** 2.1 Introduction to Hyperbolic functions, Inverse Hyperbolic Functions. 2.2 Logarithmic functions, Separation of real and Imaginary parts.	6
3	**Successive Differentiation and Expansion of Function** **Pre-requisite :-** Derivative of standard functions and Rules of derivative. 3.1 Successive differentiation: nth derivative of standard functions. Leibnitz's Theorem (without proof) and problems 3.2 Taylor's Theorem (Statement only) and Taylor's series, Maclaurin's series (Statement only). Expansion of e^{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
4	**Partial Differentiation and Applications of Partial Differentiation.** 4.1 Partial Differentiation: Function of several variables, Partial derivatives of first and higher order. Differentiation of composite function. 4.2.Euler's Theorem on Homogeneous functions with two independent variables (without proof). Deductions from Euler's Theorem. 4.3 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
5	**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
6	**Numerical Methods** 6.1 **Solution of system of linear algebraic equations**, (1) Gauss Elimination, (2)Gauss Jacobi Iteration Method (3) Gauss Seidel Iteration Method, 6.2 **Solutions of Transcendental equations** (1) Bisection Method (2) Secant Method (3) Newton Raphson Method.	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 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 4 SCILAB /MATLAB practical's and at least 6 assignments on the entire syllabus.

List of Scilab Programing

1. Gauss Elimination
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

Term Work:

The distribution of Term Work marks–

Attendance (Theory, Practicals)	:	05 marks
Assignments on entire syllabus	:	10 marks
SCILAB Practicals	:	10 marks

Course Code	Course Name	Credits
FY102	**Engineering Physics I**	**2 + 0.5**

Course Code	Course Name	Theory	Practical	Tutorial	Total contact hours	Theory	Practical /Oral	Tutorial	Total credits
FY102	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				
		IA 1	IA2	Avg.					
FY102	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 SQUID and Magnetic levitation.

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. Application of Lasers: Holography.	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. 2.3. Classification of optical fibres. 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. 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.Interference in thin films of constant thickness due to transmitted light: Conditions for maxima and minima 3.4.Interference in Wedge shaped film: Conditions for maxima and minima 3.5.Newton's Rings: Diameter of dark and bright rings	4
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. 4.3: Newton's Rings: Estimation of ring diameter for a particular wavelength and estimation of refractive index of gap medium.	**3**
5.	**Quantum Mechanics**: 5.1. De Broglie wave hypothesis, properties of matter waves: wave packet, Derivation of expressions for phase velocity and group velocity and their relationship. 5.2. Wave Function, its physical interpretation and salient features.	**7**

	5.3. Heisenberg's Uncertainty principle statements and their interpretation: momentum and position/energy time forms. 5.4. Derivation of Schrodinger's Time Dependent Wave equation and Schrodinger's Time Independent Wave Equation 5.5.Energy Levels and distribution of probabilities of a charged particle bounded in an infinite potential well	
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. BCS Theory (concept of Cooper pair) 6.4. Applications of superconductors: MAGLEV and qualitative discussion of Josephson effect and SQUID.	**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 3 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 .

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

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

Note: Individual teachers may follow a different rubric for distribution of marks for term work.
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
FY103	**Engineering Chemistry I**	**2+0.5**

Course Code	Course Name	Theory	Practical	Tutorial	Total contact hours	Theory	Practical /Oral	Tutorial	Total credits
FY103	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				
		IA 1	IA2	Avg.					
FY103	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 students to understand the role of engineering materials such as polymers.
5. To introduce composite 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 analyze the quality of water for application in industries and to suggest methods to improve water quality.
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 their applications in engineering.
5. To identify, describe and evaluate the properties of different types of composite materials.
6. To develop an understanding of the environmental challenges and suggest methods for their minimisation based on green chemistry principles.

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, Priming and Foaming, Scales and Sludges, caustic embrittlement, (Causes, methods of prevention), Langlier Index Softening of water- Ion exchange process.	3
2	**Module 2 - Water Treatment** Domestic water treatment : Steps involved in domestic water treatment - screening, sedimentation, filtration, disinfection - chlorination ,treatment with ozone. Desalination of brackish water- Reverse Osmosis, Electro dialysis, Ultrafiltration Sewage water treatment **:** BOD and COD, determination and numerical problems, Steps involved in sewage water treatment- primary, secondary (activated sludge process)	3
3	**Module 3 - Lubricants Pre - requisites** : Definition of Lubricants and Lubrication, functions of lubricants 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 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.	4
4	**Module 4 - Polymeric materials** **Pre - requisite** : 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 Additives in polymers Commercially important polymers - Polyethylene, Polyvinyl acetate, Polydimethyl Siloxane , Epoxy resins , Polylactic acid (PLA) Conducting polymers - Mechanism of conduction in polymers, Examples and applications.	6
5	**Module 5: Polymer Composites** **Prerequisite** :Definition and basic understanding of composite materials. Constitution of composite materials- Matrix and Dispersed phase	4

	Classification of composite materials - Particle reinforced composites, Fibre reinforced composites, structural composites . Advantages and Applications of composite materials	
6	**Module 6 - Environmental Chemistry** **Pre- requisites:** Definition of Environment and Primary concept of environmental pollution**.** Industrial Pollution- Causes, Effects and solutions, a case study on industrial pollution E-pollution- Causes, concerns and management , Carbon credit Concept of 12 principles of Green chemistry, discussion with examples (synthesis of indigo, adipic acid), numericals on atom economy.	4

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.
2. Determination of Chloride content in water.
3. Acid value of lubricating oil.
4. Viscosity Index by Redwood viscometer.
5. Determination of Dissolved oxygen in water.
6. Determination of COD.
7. Viscoelasticity of Silly putty.
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
FY105	**Basic Electrical Engineering**	**3**

Course Code	Course Name	Theory	Practical	Tutorial	Total contact hours	Theory	Practical /Oral	Tutorial	Total credits
FY105	Basic Electrical Engineering	3	-	-	3	3	-	-	**3**

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IA 1	IA2	Avg.					
FY105	Basic Electrical Engineering	40	40	40	60	-	-	-	100

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.

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**.**	1
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.

Course Code	Course Name	Credits
FY106	**Engineering Mechanics**	**3+1**

Course Code	Course Name	Theory	Practical	Tutorial	Total contact hours	Theory	Practical /Oral	Tutorial	Total credits
FY106	Engineering Mechanics	3	2	-	5	3	1	-	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IA 1	IA2	Avg.					
FY106	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. Determine the centroid and MI of plane lamina.
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 and acceleration, work-energy and impulse momentum principles.

Syllabus:

Module	Details	Hrs.
1	**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 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. **1.3 Equilibrium of the System of Coplanar Forces and Beams:** Conditions of equilibrium for concurrent forces, parallel forces and non-concurrent non- parallel forces and Couples. Equilibrium of rigid bodies' Free body diagrams. Types of beams, simple and compound beams, type of supports and reaction. Determination of reactions at supports for various types of loads on beams.	08
2	**Centroid and MI:** **2.1** First moment of Area, Centroid of composite plane Laminas **2.2** Second moment of Area, MI of composite plane Laminas	05
3	**Forces in Space:** **3.1** System of Non-Coplanar Force System **3.2** Resultant of Non-Coplanar Force System	05
4	**Friction:** **4.1 Static and Dynamic Friction:** Systems of Statics and Dynamic/ Kinetic Friction, Coefficient of Friction, Angle of Friction, Laws of friction. Concept of Cone of friction. **4.2 Wedge Friction:** Equilibrium of bodies on inclined plane. Application to problems involving wedges and ladders.	06
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	06
6	**Kinetics of a 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 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. **6.3 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.	06

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 second class test when 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 sub- questions of 5 marks will be asked.
4. Remaining questions will be mixed in nature. (e.g. Suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
5. In question paper weightage of each module will be proportional to the number of respective lecture hrs. as mentioned in the syllabus.

III End Semester Oral Examination:

Pair of Internal and External Examiners should conduct an Oral examination of 25 marks based on the entire syllabus.

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

Engineering Mechanics Laboratory

List of Experiments:

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

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. Determination of coefficient of friction using inclined plane
5. Collision of elastic bodies (Law of conservation of momentum).
6. Kinematics of particles. (Uniform motion of a particle, Projectile motion, motion under gravity)
7. Kinetics of particles. (collision of bodies)

Term Work:

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

Practical Work and Journal	: 10 marks
Assignments	: 10 marks
Attendance	: 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
FY109	**Basic Electrical Engineering Lab**	**1**

Course Code	Course Name	Theory	Practical	Tutorial	Total contact hours	Theory	Practical /Oral	Tutorial	Total credits
FY109	Basic Electrical Engineering Lab	-	2	-	2	-	1	-	1

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IA 1	IA2	Avg.					
FY109	Basic Electrical Engineering Lab	-	-	-	-	25	-	25	50

Basic Electrical Engineering Laboratory
Hardware Requirements: Hardware Kits, Three phase power supply.
List of Experiments:

1. Mesh and Nodal analysis.
2. Verification of Superposition Theorem.
3. Verification Thevenin's Theorem.
4. Study of R-L series and R-C series circuit.
5. R-L-C series resonance circuit
6. R-L-C parallel resonance circuit
7. Relationship between phase and line currents and voltages in three phase system (star & delta)
8. Power and phase measurement in three phase system by one wattmeter method.
9. Power and phase measurement in three phase system by two wattmeter method

Lab Assessment:
I Term work Assessment:
Term work consists of performing minimum 06 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
FY112	Engineering Workshop I	1.5

Course Code	Course Name	Theory	Practical	Tutorial	Total contact hours	Theory	Practical /Oral	Tutorial	Total credits
FY112	Engineering Workshop I	-	3	-	-	-	1.5	-	1.5

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IA 1	IA2	Avg.					
FY112	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.	**10**

	Term work to include one job involving following operations : filing to size, one simple male- female joint, drilling and tapping	
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 : 30 Marks
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
FY113	**Indian Knowledge System**	**2**

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

Course Code	Course Name	Examination Scheme				
		Theory Marks	Term Work	Practical	Oral	Total
FY113	Indian Knowledge System	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 in today's world and its historical background.
2. Gain an appreciation for the valuable cultural heritage found in our traditions.
3. Discover the history and the scientific aspects behind our traditional arts, practices, and rituals.

Syllabus :

Module	Detailed Contents	Hrs.
1	**Indian Knowledge Systems: An Overview** Traditional Knowledge System, Introduction to the Vedas, Chhandas, Veda and Vedāṅga, Itihāsa and Purāṇa, Dharmaśāstra, Darśanas, Nyāya. The role of Itihasas and Puranas in understanding the Vedas.	4
2	**History of Indian Knowledge Systems** Bhagwat Purana, Arthashastra, ,The importance of Sthapatya-veda. The ancient cities of the Indus Saraswati region. Town planning and drainage systems. Irrigation and Dams, Decline of Knowledge system, Attack on the Universities and Knowledge Creation	4
3	**Iron and Steel Technology in Ancient India** Vedic references to metals and metal working. Mining and manufacture in India of Zinc, Iron, Copper, Gold, etc., from ancient	4

	times. Significance and wide prevalence of ironsmith and other metal workers in the pre-modern era.	

Assessment

End Semester Examination:

1. Written Examination for 20 marks
2. Weightage of each module will be proportional to number of respective lecture 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
FY114	Co-curricular Course I	2

Course Code	Course Name	Theory	Practical	Tutorial	Total contact hours	Theory	Practical /Oral	Tutorial	Total credits
FY114	Co-curricular Course I	-	04	-	04	-	01	-	02

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IA 1	IA2	Avg.					
FY114	Co-curricular Course I	-	-	-	-	50	-	-	50

Sr No.	Name of Activity	Number of Hours
1	Meditation	3
2	Makers Day	4
3	Pre-Placement Talk	2
4	NPTEL Course	5
5	Any other Activity (Value Added course, Internship etc.)	12

Activity 1 - Meditation
Every student has to attend 3 sessions of Meditation activity. Each session will fetch 1 point. A student can score a maximum of 3 points. Their presence and participation in the activity will be certified by the faculty in charge.

Activity 2 - Makers Day
MAKERS DAY gives the spirit of hands-on learning by providing opportunities to explore various engineering-oriented projects from various domains of engineering. This will provide a chance to create new ideas and gain practical experience that goes beyond traditional classroom learning.
A visit to all the assigned laboratories, the students can score a maximum of 2 points. Their presence and participation in the activity will be certified by the faculty in charge.

Activity 3- Pre placement talk
Pre placement talk is scheduled for all the students, branch wise, where the students will be able to understand the aspects that they need to improve, criteria for the placement etc.

All the students have to attend the pre placement talk and will gain 2 points. Their presence and participation in the activity will be certified by the faculty in charge.

Activity 4 - NPTEL course
The students have to get enrolled in one NPTEL course related to their subjects.
On completing and submitting all the assignments, the students will get 2 points (they need to attach the summary of assignment to gain these points).
If the student has attended the examination, he /she will be given 5 points. Extra 3 points are also allotted on passing the course . If the student gets an ELITE grade, he/she will be given 5 extra points (They need to attach the certificate)

Activity 5 - Value added Course, Internship etc
The student can complete one value added course and can gain maximum 10 points , depending on the course duration.

Detailed Syllabus SEMESTER II

Course Code	Course Name	Credits
FY115	Engineering Mathematics II	3+1

Course Code	Course Name	Theory	Practical	Tutorial	Total contact hours	Theory	Practical /Oral	Tutorial	Total credits
FY115	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				
		IA 1	IA2	Avg.					
FY115	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 SCILAB 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 SCILAB software.

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*, *xV*. 2.2. Cauchy Differential equation, 2.3Method 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:** **Prerequisite**: Tracing of curves 4.1. 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 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. 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 4 SCILAB /MATLAB practical's and at least 6 assignments on the entire syllabus.

List of Scilab 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.

Term Work:

The distribution of Term Work marks–

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

Course Code	Course Name	Credits
FY116	**Engineering Physics II**	**2+0.5**

Course Code	Course Name	Theory	Practical	Tutorial	Total contact hours	Theory	Practical /Oral	Tutorial	Total credits
FY116	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				
		IA 1	IA2	Avg.					
FY116	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 and apply the same to electronic devices.
2. Apply the concepts of electromagnetism in focusing systems and CRO.
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.

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. 1.4 Energy level diagrams for unbiased and biased P-N junction. 1.5 Hall Effect: Derivation of expression for Hall Voltage and Hall coefficient. 1.6 Semiconductor Devices: I-V curves and mechanism for Solar Cell, LED and Zener Diode	7
2.	**Electron Optics and CRO**: 2.1. Bethe's law 2.2 Electrostatic and Magnetic focussing 2.3 Cathode Ray Tube and its applications. 2.4. Block diagram of a CRO: CRT, Sawtooth Sweep Generator, Synchronisation and power supply 2.5. Applications of CRO: Measurement of : DC and AC voltages, frequency value and phase difference	**4**
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 3.4.Moisture sensor	4
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 STM and AFM, SEM and TEM: Principle of operation and working using schematic diagram.	**3**
6.	**Ultrasonics** : 6.1. Ultrasonic Wave generation; Magnetostriction Oscillator; Piezoelectric Oscillator;	**2**

	6.2. Applications of ultrasonic: Echo sounding; NDT; ultrasonic cleaning(cavitation); ultrasonic sensors; 6.3.Industrial applications of ultrasonic(soldering, welding, cutting, drilling)	

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 3 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.

Term work:

Term Work shall consist of a minimum six experiments.

Overall Rubric for the distribution of term work marks:

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

Note: Individual teachers may follow a different rubric for distribution of marks for term work.
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
FY117	**Engineering Chemistry II**	**2+0.5**

Course Code	Course Name	Theory	Practical	Tutorial	Total contact hours	Theory	Practical /Oral	Tutorial	Total credits
FY117	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				
		IA 1	IA2	Avg.					
FY117	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 be able to characterize the 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 applications.

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 Solid fuels : Coal (Definition and Ranking) Analysis of coal - Proximate and Ultimate analysis, Numerical problems Liquid fuels: Petroleum -Composition, classification (Mining, Refining - Various fractions , their boiling points, composition and uses), Fuels for Internal Combustion Engines - Knocking, Octane number, Anti Knocking agents, Cetane number. Gaseous Fuels: Natural gas, CNG and LPG, (Composition, Properties and uses) Combustion of fuels – Numerical problems for calculating the amount of air needed for the complete combustion of solid and gaseous fuels. Green fuels - Biodiesel	6
2	**Module 2- Engineering Electrochemistry** **Pre -requisite :** redox reaction, cell reaction, electrode and its type, salt bridge Electrode potential, electrode reaction, derivation of Nernst equation for single electrode potential, numerical problems. Electrochemical cells, Concentration cells. Reference electrodes -Types of reference electrodes, Construction, working of SHE, 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 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 Protective Coatings: Metallic coatings - anodic coating (galvanizing) and cathodic coating (Tinning) Methods of Applying Metallic Coatings - Hot dipping, Metal Spraying, Electroplating and Diffusion coating Organic coatings – Paints	6

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 Fluorescence 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 Applications of nano materials	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 value in coal sample.
2. Preparation of bio- diesel.
3. Preparation of Fe2O3 nanoparticles.
4. Cu-Zn electrochemical cell- Effect of conc.on cell potential.
5. Determination of thinner content in paint.
6. Determination of strength of a strong acid by pH meter
7. Determination of strength of a strong acid by conductivity meter
8. EMF measurement

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
FY120	**Engineering Drawing**	**2+2**

Course Code	Course Name	Theory	Practical	Tutorial	Total contact hours	Theory	Practical /Oral	Tutorial	Total credits
FY120	Engineering Drawing	2	4	-	06	2	2	-	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IA 1	IA2	Avg.					
FY120	Engineering Drawing	40	40	40	60	25	25	-	150

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 the basic principles of projections in Projection of Lines and Planes
2. Apply the basic principles of projections in Projection of Solids.
3. Apply the basic principles of sectional views in Section of solids and development of surfaces.
4. Apply the basic principles of projections in converting 3D view to 2D drawing.
5. Read a given drawing and visualize an object from the given two views.
6. Create, Annotate, Edit and Plot drawings using basic AutoCAD commands and features.

Syllabus:

Module	Details	Hours
1	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 (of cylinder) only.	3
2	2.1 Projection of Points and Lines Lines inclined to both the Reference Planes (Excluding Traces of lines) and simple application-based problems on Projection of lines. 2.2 Projection of Planes Triangular, Square, Rectangular, Pentagonal, Hexagonal and Circular planes inclined to either HP or VP only. (Exclude composite planes).	4
3	Projection of Solids (Prism, Pyramid, Cylinder, Cone only) Solid projection with the axis inclined to HP and VP. (Exclude Spheres, Composite, Hollow solids and frustum of solids). Use change of position or Auxiliary plane method	5
4	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.	4
5	5.1 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. 5.2 Missing Views: The identification of missing views from the given views. Create the third view from the two available views so that all the details of the object are obtained.	5
6	6.1 Isometric Views: - Principles of Isometric projection – Isometric Scale, Isometric Views, Conversion of Orthographic Views to Isometric Views (Excluding Sphere).	3

Assessment:

I. Internal Assessment Test:

Assessment consists of two class tests of 40 marks each. Among the two tests one is Conventional (manual drawing) and Second using CAD Software.

II. End Semester Theory Examination:

1. Question paper will comprise of a total 06 questions, each carrying 15 marks.
2. Any 4 questions need to be solved. There won't be any compulsory Question
3. Total 04 questions need to be solved.
4. 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).

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

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 NewDelhi.
5. Dhananjay A Jolhe, "Engineering Drawing" Tata McGraw Hill.

Engineering Drawing Laboratory

Laboratory Syllabus:

Component-1 (Use half Imperial Drawing Sheet)

Sr. No.	Activities to be completed in the Drawing Laboratory.	Hours
1	One Practice sheet on projection of solids (Minimum 2 problems)	4
2	Sheet 1: Projection of Solids (3 Problems).	4
3	One Practice sheet on the Section of Solids. (Minimum 2 problems) # Term Sheet 2: Section of solids. (3 problems).	6
4	One practice sheet on Orthographic projection. (Minimum 1 problem) # Term Sheet 3: Orthographic Projection (With section 1 problem, without section 1 problem).	6
5	One practice sheet on Isometric drawing. (Minimum 2 problems) # Term Sheet 4: Isometric Projection. (3 problems).	4

Component-2

Self-study problems/ Assignment: (In A3 size Sketch book, to be submitted as part of Term Work)

1. Engineering Curves. (2 problems)
2. Projection of Lines (2 problems)
3. Projection of planes (2 problems)
4. Projection of solids. (2 problems)
5. Section of solids (2 problems)
6. Orthographic Projection. (With section 1 problem, without section 1 problem).
7. Missing views. (1 problem)
8. Isometric Drawing. (2 problems)

Component-3

Computer Graphics: Engineering Graphics Software - Orthographic Projections, Isometric Projections, Co-ordinate Systems, Multi-view Projection.

	To be Taught in laboratory.	Hours
PART - A	Overview of Computer Graphics Covering: Listing the computer technologies that impact on graphical communication, demonstrating knowledge of the theory of CAD software such as: The Menu System, Toolbars (Standard, Object	3

	Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.	
	Customization & CAD Drawing: Consisting of set up of the drawing page and the printer including scale settings, Setting up of units and drawing limits, ISO and ANSI standards for coordinate dimensioning.	3
	Annotations, layering & other Functions Covering: Applying dimensions to objects, applying annotations to drawings, Setting up and use of layers, layers to create drawings, Create, edit and use customized layers, Changing line lengths through modifying existing lines (extend/lengthen), Printing documents to paper using the print command, orthographic projection techniques, Drawing sectional views of objects (simple machine parts).	4
PART -B	Activities to be completed in the CAD Laboratory. (All printouts to be part of Term Work.	
	1. Orthographic Projections (without section)- 1 problem	4
	2. Orthographic Projection (with section)- 1 problem	4
	3. Orthographic Reading – 1 problem	2
	4. Isometric Drawing – 3 problems.	4

Term Work:

Component-1 : 7 Marks
Component-2 : 6 Marks
Component-3 : 7 Marks
Attendance : 5 Marks

Total Marks : 25 Marks

Note: Satisfactory submission of all 3 components is mandatory to fulfill the Term.

End Semester Practical Examination: (Auto CAD) (2 hours/ 50 Marks)

1. Isometric drawing (1 problem) (20 Marks)
2. Orthographic Projection (With Section) (1 problem). (30 Marks)

Course Code	Course Name	Credits
FY119	Python Programming	3

Course Code	Course Name	Theory	Practical	Tutorial	Total contact hours	Theory	Practical /Oral	Tutorial	Total credits
FY119	Python Programming	3	-	-	03	3	-	-	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IA 1	IA2	Avg.					
FY119	Python Programming	40	40	40	60	-	-	-	100

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.

Syllabus:

Module		Description	hrs
	Prerequisite	Python IDE installation and environment setup.	
1	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.	06

		Input/output Functions, Decorators, Iterators and Generators.	
2	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
3	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)	06
4	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
5	Modules and Packages	Modules: Writing modules, importing objects from modules, Pythonbuilt-in modules (e.g. Numeric and Mathematical module, Functional Programming module, Regular Expression module), Namespace and Scoping. Packages: creating user defined packages and importing packages. Multi-threading: process vs thread, use of threads, types of threads, creating threads in python, thread synchronization, deadlock of threads. Exception handling: Compile time errors, Runtime errors, exceptions, types of exception, try statement, except block, raise statement, Assert statement, User-Defined Exceptions.	06
6	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, Pickle in Python.	4

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 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 4/5 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

Course Code	Course Name	Credits
FY122	Python Programming Lab	1

Course Code	Course Name	Theory	Practical	Tutorial	Total contact hours	Theory	Practical /Oral	Tutorial	Total credits
FY122	Python Programming Lab	-	2	-	2	-	1	-	1

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IA 1	IA2	Avg.					
FY122	Python Programming Lab	-	-	-	-	25	25	-	50

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
FY121	**Professional Communication and Ethics-I**	**1+1**

Course Code	Course Name	Theory	Practical	Tutorial	Total contact hours	Theory	Practical /Oral	Tutorial	Total credits
FY121	Professional Communication and Ethics-I	02	02	--	01	01	--	02	02

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IA 1	IA2	Avg.					
FY121	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
FY124	Engineering Workshop II	1

Course Code	Course Name	Theory	Practical	Tutorial	Total contact hours	Theory	Practical /Oral	Tutorial	Total credits
FY124	Engineering Workshop II	-	3	-	03	-	1	-	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IA 1	IA2	Avg.					
FY124	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.Reporto n 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. Term work to include one carpentry job involving a joint and report on demonstration of a job involving wood turning	**10**
Trade-2	**Basic Electrical 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.	**08**

	9. Layout: drawing, layout transfer to pcb, etching and drilling and soldering technique	
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:

1. Job Work: 30 Marks
2. Workshop book 10 marks
3. 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
FY125	**Co-curricular Course II**	**2**

Course Code	Course Name	Theory	Practical	Tutorial	Total contact hours	Theory	Practical /Oral	Tutorial	Total credits
FY125	Co-curricular Course II	-	04	-	04	-	01	-	02

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IA 1	IA2	Avg.					
FY125	Co-curricular Course II	-	-	-	-	50	-	-	50

Sr No.	Name of Activity	Number of Hours
1	Yoga Day	4
2	F. E Sports Day	6
3	Mathematics Quiz	3
4	Treasure Hunt	3
5	Environmental Activity-I	4
6	Environmental Activity-II	4
7	NPTEL/Value Added Course	10
8	Cultural Activity(Algeria/ University level/ Inter college Level)	3
9	NSS/ NCC Attended camp	3
10	Any other Activity	

Activity 1 - Yoga
Every student has to attend 2 sessions of Yoga activity, each of 2 hours. Each session will fetch 3 points. A student can score a maximum of 6 points. Their presence and participation in the activity will be certified by the faculty in charge.

Activity 2 - Sports Participation
It is mandatory for all the students to participate in the sports activities. They have to participate in individual or team events. Points are awarded depending on participation or winning in the events. The students can score a maximum of 6 points.

Activity 3- Mathematics Quiz
Quiz will be conducted in two rounds. Round 1 is the preliminary round which is mandatory for all the students and those who clear the preliminary round will participate in the final round. The students can score a maximum of 6 points.

Activity 4 - Treasure Hunt
Treasure Hunt will be conducted in two rounds. Round 1 is the preliminary round which is mandatory for all the students and those who clear the preliminary round will participate in the final round. The students can score a maximum of 6 points.

Activity 5 - Environmental Activity I and II
Two activities related to environmental awareness will be conducted . All the students are made to participate in the activities. They can earn a maximum of 5 points each in these activities.
On completing and submitting all the assignments, the students will get 2 points (they need to attach the summary of assignment to gain these points).
If the student has attended the examination, he /she will be given 5 points. Extra 3 points are also allotted on passing the course . If the student gets an ELITE grade, he/she will be given 5 extra points (They need to attach the certificate)

Activity 5 - Value added Course, Internship etc
The student can complete one value added course and can gain maximum 10 points , depending on the course duration.
In addition, the students can attend NSS camp, NPTEL course, or cultural activities in College/University/National level

Course Code	Course Name	Credits
AE201	**Production Technology**	3

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 principle and working of non-traditional manufacturing
5. To introduce to them the Intelligent manufacturing in the context of Industry 4.0

Course Outcomes:

1. Demonstrate an understanding of casting process
2. Illustrate principles of forming processes.
3. Demonstrate applications of various types of welding processes.
4. Differentiate chip forming processes such as turning, milling, drilling, etc.
5. Illustrate the concept of producing polymer components and ceramic components.
6. Illustrate principles and working of non-traditional manufacturing
7. Understand the manufacturing technologies enabling Industry 4.0

Module	Details	Hours
1	**Introduction to Production Processes and Metal Casting** Classification of Production Processes and introduction to metal casting Pattern-making materials, Types of patterns and allowances. Sand moulding and Machine moulding Gating system: Types of risers, types of gates, solidification Special casting processes: CO2 and shell moulding, Investment casting, Die casting, Vacuum casting, Inspection & casting defects and remedies	6
2	**Joining Processes** Classification of various joining processes; Applicability, advantages and limitations of Adhesive bonding, Mechanical Fastening. Welding and allied processes. Principles and equipment used in Gas welding, Arc welding, Resistance welding, Thermitt welding. Soldering. Brazing. . Welding Joints, Welding Positions, Welding defects and their remedies.	6
3	**Forming Processes** Basic concepts and classification of forming processes. Principal equipment used and application of Forging, Rolling, Extrusion, Wire drawing. Classification of Sheet metal operations, types of Presses used in sheet metal operations, types of dies. Powder metallurgy, steps involved, applications.	7
4	**Conventional Machining** General principles of working. Types and commonly performed operations in Lathe, Shaper, Planer, Milling machine, Drilling machine, Grinding machine, Gear cutting.	8

	Geometry and nomenclature of single point cutting tool, Speed, feed, depth of cut, Taylor's tool life equation, Concept of chip formation and types of chips. Introduction to Jigs and Fixtures and types.	
5	**Maintenance of Lathe and Milling Machines** Importance of maintenance in industrial settings, key components of the machines, and common issues. Tools and equipment needed for maintenance, detailed procedures for cleaning, lubrication, alignment, and calibration, as well as troubleshooting common mechanical problems. Practical hands-on sessions to apply the learning in real-world scenarios, case studies and problem-solving exercises. Safety protocols and best practices.	**8**
6	**Unconventional Machining:** Need for unconventional machining processes. Principles and application of Abrasive jet machining, Ultrasonic machining, Electro discharge machining, Electromechanical machining, Chemical machining, Laser beam machining, Electron beam machining, Plasma arc machining.	**5**

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

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. Manufacturing Science by Ghosh and Malik
5. Rapid Manufacturing –An Industrial revolution for the digital age by N.Hopkinson, R.J.M.Hauge, P M, Dickens, Wiley
6. Rapid Manufacturing by Pham D T and Dimov, Springer Verlag
7. Production Technology by WAJ Chapman Vol I, II, III
8. Production Technology by P C Sharma.
9. Production Technology by Raghuvanshi.
10. Industry 4.0: The Industrial Internet of Things by Alasdair Gilchrist, 2016, Apress.
11. Cyber-Physical Systems: From Theory to Practice by Danda B. Rawat, Joel Rodrigues, Ivan Stojmenovic, 2015, C.R.C. Press.
12. Optimization of Manufacturing Systems using Internet of Things by Yingfeng Zhang, Fei Tao, 2017, Academic Press (AP), Elsevier.

Back to Scheme

Course Code	Course Name	Credits
AE202	**Engineering Mathematics III***	2

Course Objectives:

1. To learn the Laplace Transform of various functions, and its applications.
2. To Learn Inverse Laplace Transform of various functions, and its applications.
3. To learn the concept of Fourier Series and enhance problem-solving skills.
4. To learn complex form of Fourier series and Fourier Transform and enhance problem-solving skills.
5. To Learn the regression analysis and interpolation methods.
6. To Learn matrices eigen values and eigen vectors .

Course Outcomes

1. Able to solve examples of Laplace transform & apply the concept of Laplace transform and its application to solve the real integrals.
2. Able to solve examples of inverse Laplace transform of various functions & apply the concept of inverse Laplace transform in application to solve differential equations & engineering problems.
3. Able to find Fourier series & Apply the knowledge of Fourier series in engineering problems.
4. Able to solve examples of complex forms of Fourier series and Fourier Transform & Apply the knowledge of complex forms of Fourier series and Fourier Transform in problem solving.
5. 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.
6. 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.

Module	Details	Hours
1	**Laplace Transform** 1.1 Definition, Laplace Transforms of Standard Functions. 1.2 Linearity properties of Laplace Transform, First Shifting theorem, 1.3 Change of scale Property, Effect of multiplication by t, 1.4 Effect of Division by t.	4
2	**Inverse Laplace Transform** 2.1 Use of standard formulae of Inverse Laplace Transform , 2.2 Partial fractions method, 2.3 First shift property, 2.4 Convolution theorem (without proof) .	4
3	**Fourier Series** 3.1 Orthogonal and orthonormal set of functions. 3.2 Fourier series of periodic function with period 2π , 3.3 Fourier series of even and odd functions with period 2π, 3.4 Half range Sine and Cosine Series with period π. 3.5 Half range Sine and Cosine Series with period L, where $L \neq \pi$ (Definition only).	4

4	**Fourier Integral and Fourier Transform** 4.1 Complex form of Fourier Series with period 2π , 4.2 Fourier Integrals (Definition only). 4.3 Fourier transform of constant and exponential function. 4.4 Fourier cosine and sine transform of constant and exponential function.	4
5	**Interpolation, Regression , Correlation & Fitting of Curves** 5.1 Interpolation: - Lagrange's Linear and Quadratic 5.2 Linear Regression, Lines of regression 5.3 Karl Pearson's Coefficient of correlation (r) , Spearman's Rank correlation coefficient (R) (Repeated & non repeated ranks problems). 5.4 Fitting of Curves : Fitting of straight line and Second degree curve by Method of least squares.	5
6	**Matrices** **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 6.1 Eigenvalues and Eigenvectors of Matrices. 6.2 Properties of Eigenvalues (Without proof). 6.3 Cayley Hamilton theorem(Without Proof): Verification of Cayley Hamilton theorem (CHT) , 6.4 Application of CHT to find inverse of a matrix .	5

Assessment:

Internal Assessment Test:

Assessment consists of class tests of 30 marks each. The IA1 is to be conducted when approx. 40% syllabus is completed and IA2 marks shall be an average of six assignments', advised to be conducted during tutorials, marks , one assignment on each of the six modules separately for 30 marks .

End Semester Theory Examination:

1. Question paper will comprise of total 4 questions, each carrying 15 marks.
2. Total 03 questions need to be solved.
3. Question No: 01 will be compulsory and based on the entire syllabus wherein 5 sub-questions of 3 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 lectures 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. 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.

Back to Scheme

Course Code	Course Name	Credits
AE203	**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:**	07

	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,	
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	2

	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.	
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.

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

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

Back to Scheme

Course Code	Course Name	Credits
AE204	**Thermodynamics***	3+1

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. Able to describe basic concepts of thermodynamics.
2. Able to apply first law of thermodynamics for closed and open systems and construct conservation of mass and energy equations.
3. Able to calculate thermal efficiency and coefficient of performance for heat engine, refrigerators and heat pumps.
4. Able to explain the available and unavailable energy.
5. Able to calculate the properties of the steam and analyse the vapour power cycle.
6. Able to analyse the gas power cycles.

Module	Details	Hours
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:**	7

	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, entropy generation, Tds relations, entropy change for an ideal gas.	
4	**4.1 Availability:** Concept of high- and low-grade energy, available and unavailable energy, dead state, useful work, availability, irreversibility, availability of energy entering a system. **4.2 Thermodynamic Relations** Helmholtz and Gibbs functions, Maxwell equation (without derivation), Clausius-Clapeyron equation, 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 & applications of use of steam, **5.2 Vapour Power Cycle:** Carnot cycle, Limitations of Carnot vapour cycle, Rankine cycle, mean temperature of heat addition, Rankine cycle with superheat.	6
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 Otto and Diesel cycle for same compression ratio. Working principle of Brayton Cycle, Stirling Cycle, Ericsson Cycle, Lenoir cycle and Atkinson cycle. (No Numerical for Brayton, Stirling, Ericsson, Lenoir & Atkinson Cycle).	6

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.

Term Work Assessment (Based on Tutorial):

Term Work consists of assignments on the syllabus as decided by the course Instructor.
Term Work: 25 marks.

Submission of assignments: 20 Marks
Attendance: 5 Marks.

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, 5thedition, Longman Publishers
5. Engineering Thermodynamics by P Chattopadhyay, 2ndedition, 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/

Back to Scheme

Course Code	Course Name	Credits
AE205	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

Back to Scheme

Course Code	Course Name	Credits
AE206	**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:10 Marks

3.Attendance : 05 marks

Using the above knowledge and skills acquired through six modules students should complete a 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.

Back to Scheme

Course Code	Course Name	Credits
AE207	**CNC and Additive Manufacturing Lab**	1

Course Objectives:

1. To understand the use of measuring instruments in engineering practice.
2. To understand Conventional machine handling.
3. To lean tool path generation process in CAM
4. To observe and learn industrial CNC machines.
5. To use and learn all stages of any additive manufacturing process..
6. To understand various advanced fabrication processes in industry

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

1. Use and apply knowledge of measurement instrument handling.
2. Operate conventional machines for Various applications.
3. Implement tool path generation used in CAM.
4. Develop programs for CNC using simulations.
5. Learn and operate all stages of 3D Printing Process for additive manufacturing.
6. Learn various advanced fabrication processes in industry

Module	Details	Hours
1	Measurement using Vernier caliper and micrometer screw gauge.	2
2	Thread manufacturing using Conventional Machining - Lathe	4
3	Gear manufacturing using Conventional Machining - Milling Machine	4
4	Creation of 3D model from 2D images using any image processing software and printing it. (3D Slicer open source)	2
5	Tool-path generation by translation of part geometry from computer aided design (CAD) to computer aided manufacturing (CAM) systems. - Solidworks CAD to CAM]	2
6	Part programming simulation and part fabrication on CNC Turning trainer (Involving processes like Step turning, facing, Taper turning, threading, etc.)- Problem 1	2
7	Part programming simulation and part fabrication on CNC Turning trainer (Involving processes like Step turning, facing, Taper turning, threading, etc.) - Problem 2	2
8	Part programming simulation and part fabrication on CNC Milling trainer (Involving processes like contouring, drilling, facing, pocketing etc.) - Problem 1	2
9	Part programming simulation and part fabrication on CNC Milling trainer (Involving processes like contouring, drilling, facing, pocketing etc.) - Problem 2	2
10	Development of physical 3D mechanical structure using FDM - Basic of FDM, Importance of orientation and supports	2
11	Development of physical 3D mechanical structure using FDM - Advanced level - Assembly printing / embedding materials in 3D FDM Printing	2
12	Case Study: Report on a visit conducted to any Commercial CNC Machining Centre explaining the Design features, preprocessing in CAM software and its capabilities.	2

Note : 1. Minimum eight distinct practicals have to be performed during the semester.

2. Industrial visit is compulsory and cannot be a part of minimum required practicals.

Assessment:
Termwork:
Distribution of marks:

Practical Performance : 20 marks (Continuous Evaluation)
Attendance : 05 marks

Practical/Oral examination
To be conducted by pair of Internal and External Examiner
The distribution of marks for practical examination shall be as follows:

a. Oral Exam : 10 marks
b. Practical Exam : 15 marks

Books/References:

1. CAD/CAM Principles and Applications, P. N. Rao, Tata McGraw Hill Publications
2. CNC Technology and Programming, Krar, S., and Gill, A., McGraw Hill Publishers.
3. CNC Programming for Machining, Kaushik Kumar, Chikesh Ranjan, J. Paulo Davim, Springer Publication.
4. Medical Modelling The Application of Advanced Design and Rapid Prototyping Techniques in Medicine, Richard Bibb, DoMinorc Eggbeer and Abby Paterson, Woodhead Publishing Series in Biomaterials: Number 91, Elsevier Ltd.
5. Biomaterials, artificial organs and tissue engineering, Edited by Larry L. Hench and Julian R. Jones, Woodhead Publishing and Maney Publishing, CRC Press 2005
6. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, I. Gibson l D. W. Rosen l B. Stucker, Springer Publication.
7. Rapid Prototyping and Manufacturing, P. F. Jacobs, Society of Manufacturing Engineers

Back to Scheme

Course Code	Course Name	Credits
AE208	**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 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. Learners will be able to recognize the relation between ethics and values pertinent for an engineering professional.
2. Learners will be able to exercise the responsibility for establishing fair and just processes for participation and group decision making
3. Learners will be able to demonstrate an awareness of self-held beliefs and values and how they are altered in interactions with others.
4. Learners will be able to acquire the writing skills necessary to analyse data from research and attribute the source with proper citation.
5. Learners will be competent to 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	07

	Presentation of Information Ethics & Plagiarism	
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.

Back to Scheme

Course Code	Course Name	Credits
AE 291	**Minor Project I**	2

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:

- Report should be prepared as per the guidelines issued by the Department.
- Minor project 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.

Back to Scheme

Course Code	Course Name	Credits
AE209	**Automotive Engines & Combustion**	3+1

Course Objectives:

1. To provide fundamental ideas on Spark Ignition & Compression Ignition Engines.
2. To familiarize with the complexity in combustion processes.
3. To give a clear concept of power generation and engine performance.
4. To gather clear knowledge on effects of emission and its control.
5. To acquaint with recent trends in Engine Technology.

Course Outcomes: After completion of this course, learners will be able to

1. Explain the actual engine operation.
2. Analyse the combustion process in IC engines.
3. Illustrate different power boosting methods in IC Engines
4. Analyse operating parameters & performance of IC Engines.
5. Illustrate emission norms and emission control techniques.
6. Comprehend the recent trends in fuels and engines.

Theory Syllabus:

Module	Details	Hrs.
1	**Introduction** Classification of I.C. Engines, Parts of I.C. Engine and their materials, Atkinson Cycle and Miller Cycle, Fuel Air and Actual working cycles analysis, Valve Timing Diagram, LHR & VCR Engines, Homogeneous charge compression Ignition, Rotary Engine-Six stroke engine concept (No Numerical from this module)	4
2	**Spark Ignition Engines** **Fuel Supply System:** Automotive engine air-fuel mixture requirements, principle of carburetion & working (only introduction – No Numerical) Fuel Injection: Single-point and Multipoint injection, Gasoline Direct Injection **Ignition System:** Schematic details and working of different types of Ignition systems in SI Engines **Combustion:** Combustion phenomenon in SI Engines, Ignition delay, Flame propagation, Pressure-Crank angle diagram, Detonation and Knocking, Factors affecting combustion and detonation, Introduction to combustion chamber design, Types of combustion chambers	8
3	**Compression Ignition Engines** **Fuel Injection Systems:** Air injection systems, Airless/solid injection systems, Common rail, individual pump, distributor and unit systems. Injection pumps, Fuel injector, Types of nozzles, Electronically controlled CRDI system **Combustion:** Combustion phenomenon in C I engines, Stages of combustion, Delay period, Knocking, Pressure-Crank angle diagram, Factors affecting combustion and knocking, Types of combustion chambers	8
4	**Engine lubrication:** Types of Lubricants, their properties, SAE rating of Lubricants, Types of Lubrication systems.	6

	Engine Cooling: Necessity of engine cooling, disadvantages of overcooling, Cooling systems and their comparison: Air cooling, Liquid cooling **Supercharging/Turbo-charging:** Objectives, Limitations, Methods and Types, Different arrangements of Turbochargers. Latest Trends in power boosting methods.	
5	**Engine Testing and Performance:** Measurement of Brake Power, Indicated Power, Frictional Power, Fuel Consumption, Air flow, BMEP, Performance characteristics of SI and CI Engines, Effects of load and speed on Mechanical, Indicated Thermal, Brake Thermal and Volumetric Efficiencies, Heat Balance Sheet. **Engine Exhaust Emission and its control:** Constituents of exhaust emission and its harmful effects on environment and human health, Formation of NOx, HC, CO and particulate emissions, Methods of controlling emissions; Catalytic convertors, particulate traps, Exhaust Gas Recirculation, EURO and BHARAT norms.	8
6	**I C Engine Fuels:** Hydrogen - E diesel(Introduction to Flex Fuel Technology): Properties - Suitability - Engine Modifications - Merits and Demerits as fuels. **Basics of Electronic Engine Controls:** Electronic Control Module (ECM): Components, requirement & working. Sensors: Throttle Position, Crankshaft Position, Camshaft Position, Inlet Air Temperature, Coolant Temperature, Mass Air flow and Exhaust Gas Oxygen sensors (their construction and importance in ECM) Electronic Spark control, Air Management system, Idle speed control	5

Lab Syllabus:

PART A: Dismantle and assemble the following:

1. 2-Stroke/4-Stroke Engines
2. Carburetor
3. Ignition system
4. Fuel injection system

PART B: Actual Test experiments:

1. Morse Test on Multi-cylinder S.I. engine
2. Speed Test on Spark Ignition or/and Compression Ignition engine
3. Load Test on Diesel engine.
4. Heat Balance Sheet on S.I. or C.I. engine.
5. Determination of Air fuel ratio and volumetric efficiency of the engine
6. Exhaust Gas/Smoke analysis of S.I./ C.I. engines

PART C: Measurement Experiments:

1. Calibration of Tachometers.
2. Study of Pressure, Torque, Temperature, Flow Measurement Sensors in IC engine.
3. System Identification of any one of the sensors.

PART D: Topics for Case study of various models:

1. Variable Valve Timing
2. Twin and Triple Turbo charging
3. Variable Compression Ratio Engine
4. Electronic MPFI with various modes
5. Single overhead camshaft and double overhead camshaft
6. Engine Downsizing
7. Eco-boost Engine

8. Turbocharging for S.I. Engine

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:

Term work shall consist of minimum 8 exercises, from the list as per following details:

1. 2 must be actual experiments from Part A. From Part A exercise 1 is compulsory.
2. 4 must be actual experiments from Part B
3. 2 must be actual experiments from Part C
4. Case studies based on topics mentioned in Part D for various car models

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

1. Experiment write ups : 15 Marks
2. Attendance : 05 marks
3. Case study : 05 Marks

Practical and Oral Examination:

1. Pair of Internal and External Examiner should conduct practical/Oral exam.
2. Distribution of marks for practical and oral examination shall be as follows:
   Practical Exam : 15 marks
   Oral Exam : 10 marks
3. Evaluation of practical examination to be done based on the experiment performed and the output of the experiment during practical examination.
4. Student's work along with evaluation report to be preserved till the next exam.

Text Books:

1. Internal Combustion Engine - Mathur and Sharma
2. Internal Combustion Engine - V Ganesan
3. Internal Combustion Engines - Domkundwar

Reference Books:

1. Internal Combustion Engines Fundamentals, John B. Heywood
2. Internal Combustion Engine, P.M Heldt.
3. Internal Combustion Engines, V.L. Maleeve
4. Internal Combustion Engine, Gills and Smith
5. Internal Combustion Engines, Gupta H N, 2nd ed,
6. Internal Combustion Engine, S.L. Beohar

Back to Scheme

Course Code	Course Name	Credits
AE210	**Theory of Machines & Mechanisms**	3+1

Prerequisites:

1. Engineering Mathematics
2. Engineering Mechanics
3. Engineering Physics

Course Objectives:

1. Understand the fundamentals of kinematics and mechanisms.
2. Analyze mechanisms involving lower pairs.
3. Apply graphical methods for velocity and acceleration analysis in plane mechanisms up to six links.
4. Study the kinematics of cams and followers, flexible connector mechanisms, gears and gear trains, and their applications in machines.
5. Develop problem-solving skills in designing and analyzing mechanisms for various engineering applications.

Course Outcomes:

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

1. Calculate the mobility or degree of freedom of plane mechanisms.
2. Identify plane mechanisms and their inversions, and the mechanisms with lower pairs.
3. Compute velocity and acceleration of various links of plane mechanisms by different graphical methods.
4. Analyze velocity ratios and dynamics in belt and rope drives, and determine chain drive kinematics.
5. Analyze the various follower motions and draw the corresponding cam profiles.
6. Understand gear tooth terminology, and analyze the motion of gear trains.

Theory Syllabus:

Module	Details	Hours
1	**Fundamentals of Kinematics and Mechanisms** Concepts of Kinematics and Dynamics, Mechanisms and Machines, Planar and Spatial Mechanisms, Kinematic Pairs, Kinematic Chains, Kinematic Diagrams, Kinematic Inversion. Four bar chain and Slider Crank Mechanisms and their Inversions, Degrees of Freedom, Mobility and range of movement - Kutzbach and Grubler's criterion, Number Synthesis, Grashof's criterion.	06
2	**Mechanisms with Lower Pairs:** Straight line mechanisms - Exact and Straight, Steering gear mechanisms: Condition for correct steering, Davis steering gear mechanism, Ackermann steering gear mechanism. Hooke's joint-Single and Double.	06
3	**Velocity and Acceleration Analysis:** **Instantaneous center of rotation (ICR) method:** Definition of ICR, Types of ICRs, Methods of locating ICRs, Kennedy's Theorem. Velocity analysis of mechanisms (up to 6 links only).	08

	Relative velocity method: Relative velocity of a point on a link, Angular velocity of a link, Sliding velocity, Velocity polygons for simple mechanisms. **Relative acceleration method:** Relative acceleration of a point on a link, Angular acceleration of a link, Acceleration polygons for simple planar mechanisms (up to 6 links only). Coriolis component of acceleration.	
4	**Flexible Power Transmission Systems:** **Belts:** Introduction, Types and all other fundamentals of belting, Dynamic analysis—belt tensions, condition of maximum power transmission. **Chains:** Types of chains, chordal action, variation in velocity ratio, length of chain. **Ropes:** Introduction, Advantages and disadvantages, Types, Velocity ratio and slip, power transmission.	06
5	**Kinematics of Cams:** Types of cams and followers, Cam and follower terminology, displacement, velocity and acceleration diagrams of follower motions viz Uniform velocity, Simple harmonic motion, Uniform acceleration and retardation motion and cycloidal motion.	06
6	**Gears and Gear Trains:** **Gears:** Terminology, Law of Gearing, Characteristics of involute and cycloidal action, Interference and undercutting, centre distance variation, minimum number of teeth, contact ratio, spur, helical, spiral bevel and worm gears, problems. **Gear Trains:** Synthesis of Simple, compound & reverted gear trains, Analysis of epicyclic gear trains.	07

Laboratory Syllabus:

Module	Details	Hours
1	3 to 5 problems on velocity analysis using the ICR method.	04
2	3 to 5 problems on velocity and acceleration analysis using relative velocity and acceleration methods.	04
3	3 to 5 problems on velocity and acceleration analysis using relative velocity and acceleration methods involving Coriolis component.	04
4	Plotting of displacement–time, velocity-time and acceleration-time, jerk-time, and layout of cam profiles - 3 to 5 problems	06
5	Project based learning on design and fabrication of any one mechanism for a group of maximum 4 students.	08

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.

Laboratory Assessment:

Term Work: 25 marks

Students have to submit signed and completed assignments based on the modules listed in the table, as a part of the term work. They can also avail NPTEL Certification for this course, for which the assignment work may be suitably reduced, at the discretion of the instructor.

Viva-você: 25 marks

Viva-você exam shall be conducted at the end of the course.

Books/References:

1. S. S. Rattan, “Theory of Machines”, Tata McGraw Hill
2. R L Norton, Kinematics and Dynamics of Machinery, McGraw-Hill Education
3. Ashok G. Ambekar, “Mechanism and Machine Theory”, Prentice Hall, India
4. Theory of Machines, Singh Sadhu, Pearson Education.
5. Shigley J. E., and Uicker J.J., “Theory of Machines and Mechanism”, McGraw Hill Inc.
6. Wilson C.E., Sandler J. P. Kinematics and Dynamics of Machinery”, Pearson Education.

Back to Scheme

Course Code	Course Name	Credits
AE 211	**Fluid Mechanics & Machinery***	3+1

Course Objectives:

1. To study fluid statics and fluid dynamics
2. To study application of mass, momentum and energy equations in fluid flow.
3. To learn various flow measurement techniques.
4. To study utilization of hydraulic energy

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

1. Calculate the forces exerted by fluid at rest on submerged surfaces.
2. Apply Bernoulli equation to solve a variety of fluid flow problems.
3. Categorize the type of flow (whether laminar or turbulent) using Reynolds equation.
4. Estimate the loss of energy of the incompressible fluid associated with pipe flow.
5. Compare the impulse and reaction turbine.
6. Classify the pumps into centrifugal and positive displacement pumps.

Theory Syllabus:

Module	Details	Hours
1.	1.1 **Introduction:** Definition of Fluid, Properties of fluid (density, weight density, viscosity, specific gravity). No Numerical. 1.2 Newton's Law of viscosity, Classification of fluid. No Numerical on 1.2. 1.3 **Fluid Statics**: Hydrostatic pressure, Hydrostatic law, Forces on horizontal, vertical and inclined submerged plane.	6
2.	**Fluid Kinematics:** 2.1 Eulerian and Lagrangian approach, Velocity and acceleration in a Eulerian flow field. Classification of the fluid flow, streamlines, path lines and streak lines. 2.2 Definition and equations for stream function, velocity potential function, potential flow, vortex flow. No numerical on 2.2.	6
3.	**Fluid Dynamics:** Definition of control volume and control surface, Differential equations for conservation of mass, energy and momentum, Euler's equations in one and three dimensions. Derivation of Bernoulli's equation from principle of conservation of energy. Application of Bernoulli's equation in flow measurement device (pitot tube, venturimeter, orifice meter). Impulse momentum equation (Numerical on bent pipe only).	7
4.	**4.1 Laminar Viscous flow**: Introduction to Reynolds number, Derivation of relationship between shear stress and pressure gradient, Laminar flow between stationary parallel plates (only derivation), Laminar flow in circular pipe (Hagen-Poiseuille flow). **4.2 Flow through pipes**:	6

	Head loss in pipes due to friction (Darcy-Weisbach equation without proof), Loss of energy in pipe (major and minor losses), Hydraulic gradient and Energy gradient line, Pipes in series and parallel. **4.3 Hydrodynamic Boundary Layer Theory:** Concept of formation of boundary layer, boundary layer parameters. (No Numerical) **4.4 Flow around submerged objects:** Concept of drag and lift, Types of drag, Streamlined and bluff bodies. (No Numerical)	
5.	**Hydraulic Turbines:** General layout of hydro-electric power plant. Classification of hydraulic turbines, definition of various turbine parameters like head, Euler head, discharge, work done, input power, output power, efficiency, schematic representation of losses in turbine. 5.1 Pelton Turbine: Components, construction, working, workdone and efficiency, velocity triangle, Calculation of velocity of jet, speed ratio, jet ratio, number of jets, head, power and efficiency. 5.2 Francis Turbine: Components, construction and working, velocity diagram and numerical, Draft tube and its function.	7
6.	**Pumps** 6.1 Detailed classification of Pump, applications. 6.2 Reciprocating pumps: operating principle of reciprocating pump, Different types of head, discharge coefficient, slip. Calculation of work done and power input, concept of indicator diagram. 6.3 Centrifugal Pumps: Different types of head, Euler's equation and velocity triangles, pump losses and efficiency, Priming of pumps, Concept of NPSH (No Numerical) 6.4 Concept of multistage pump (No Numerical)	7

Laboratory Syllabus:

Any 8 of the following to be performed.

Sr. No.	Details	Hours
1	Calibration of Pressure gauge	2
2	Calibration of Venturimeter	2
3	Calibration of Orifice meter	2
4	Determination of Friction factor for pipes	2
5	Determination of Minor losses in pipe fittings	2
6	Verification of Bernoulli's equation	2
7	Trial on Pelton Wheel	2
8	Trial on Francis turbine	2
9	Trial on positive displacement pump (reciprocating/Gear pump/Vane pump/screw pump) (any one)	2
10	Trial on single stage Centrifugal pump	2

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

Laboratory Assessment:

Internal Assessment

Term Work Marks: 25 Marks

Laboratory Work (Journal Completion) : 20 Marks
Attendance : 5 Marks

End Semester Practical/Oral Examination:

Pair of Internal and External Examiners should conduct practical/viva based on contents.
Distribution of marks for practical/viva examination shall be as follows:

Practical Examination : 15 Marks
Oral Examination : 10 Marks

Books/References:

1. Fluid Mechanics by Yunus A Cengel and John M Cimbala, Tata McGraw Hill Education, 3rd Edition, 2014.
2. Fluid Mechanics and Machinery by C S P Ojha, Chandramouli and R Berndtsson, Oxford University Press, 1st Edition, 2010.
3. Fox and McDonald's Introduction to Fluid Mechanics by Philip J. Pritchard and John W. Mitchell, Wiley Publishers, 9th Edition,2016.
4. A textbook of Fluid Mechanics & Hydraulic machines by R K Bansal, Laxmi Publication, 9th Edition, 2005
5. A textbook of Fluid Mechanics & Hydraulic machines by R K Rajput, S. Chand & company ltd Laxmi Publication, 4th Edition, 2010
6. Fluid Mechanics by Frank M. White, McGraw Hill Education, 7th Edition, 2011.
7. Fluid Mechanics by Victor Streeter, Benjamin Wylie and K W Bedford, McGraw Hill Education, 9thEdition, 2010.
8. Engineering Fluid Mechanics by K. L. Kumar, Eurasia Publishing House (P) Ltd, 1 st Edition and Reprint 2016.
9. Fluid Mechanics and Hydraulic Machinery, Modi and Seth, Standard Book House
10. Introduction to Fluid Mechanics by James A. Fay, MIT Press, Campbridge, 1st Edition, 1996.
11. Fluid Mechanics and Hydraulics by Suresh Ukarande, Ane Books Pvt.Ltd, Revised & Updated 1st Edition, 2016

Back to Scheme

Course Code	Course Name	Credits
AE212	**Elements of Machine Design**	3+1

Course Objectives:

1. To study basic principles of machine design
2. To acquaint with the concepts of design based on strength & rigidity
3. To familiarize with the use of design data books & various codes of practice
4. To make conversant with preparation of working drawings based on designs

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

1. Demonstrate understanding of various design considerations
2. Illustrate basic principles of machine design
3. Design machine elements for static as well as dynamic loading
4. Design machine elements based on strength/ rigidity concepts
5. Use design data books in designing various components
6. Acquire skill in preparing production drawings of various designs

Module	Details	Hours
1	**Introduction** Mechanical Engineering Design, Design methods; Material properties and their uses in design; Different considerations in design: Design consideration of casting, forging, Manufacturing, Aesthetic & Ergonomics; Basic principle of Machine Design; Modes of failures; Theories of failures; Different Standards & Codes and Preferred Series and Numbers. Introduction to Reliability and DFMEA	05
2	**Design against static loads** Cotter joint (Socket & Spigot type); Knuckle joint; Turnbuckle; Eccentrically loaded Bolted Joints (considering initial tightening); Eccentrically loaded Welded joints; Power Screw – screw presses, C-clamps along with the Frame.	08
3	**Design against fluctuating loads** Fluctuating, reversed and repeated stresses; Fatigue failure: static and fatigue stress concentration factors; Endurance limit- estimation of endurance limit, Design for finite and infinite life: using Soderberg, Gerber and Goodman design criteria	06
4	**Design of Shafts** power transmission and power distribution shafts, under static criteria and using ASME code. **Keys** Types of Keys and their selection based on shafting condition Design of splines **Couplings** Classification of coupling; Design of Flange couplings and Bush pin type flexible couplings.	10

5	**Design of Gears** Design of Spur & Helical Gears: Selection of Material; Gear Blank Design; Number of Teeth; Face Width; Beam Strength of Gear Tooth; Permissible Bending Stress; Effective Load on Gear Tooth; Estimation of Module Based on Beam Strength and Wear Strength.	06
6	**Design of Springs** Helical compression spring under Static and Variable loads; Design of leaf Springs	05

Laboratory Syllabus:

Any 8 of the following to be performed

Sr. No.	Details	Hours
1	Design of Cotter joint	2
2	Design of Knuckle joint	2
3	Design of Turnbuckle	2
4	Design of power screw	2
5	Design of Flange Coupling	2
6	Design of Bush Pin type Flexible coupling	2
7	Design of single stage Gearbox (Spur Gear type)	2
8	Design of single stage Gearbox (Helical Gear type)	2
9	Design of Helical springs	2
10	Design of Leaf springs	2

Assessment:

Internal Assessment:

Consisting 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 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.
5. Duration of test will be two hours and of 60 marks

Laboratory Assessment:
Internal Assessment
Term Work Marks: 25 Marks
Laboratory Work (Journal Completion) : 20 Marks
Attendance : 5 Marks
End Semester Practical/Oral Examination:
Pair of Internal and External Examiners should conduct practical/viva based on contents.
Distribution of marks for practical/viva examination shall be as follows:
Practical Examination : 15 Marks
Oral Examination : 10 Marks

Text Books:
1. Design of Machine Elements - V.B. Banadari, Tata McGraw Hill Publication
2. Design of Machine Elements - Sharma, Purohit. Prentice Hall India Publication
3. Machine Design by Pandya & Shah, Charotar Publishing

Reference Books:
1. Machine Design -An Integrated Approach - Robert L. Norton, Pearson Education
2. Mechanical Engineering Design by J.E.Shigley, McGraw Hill
3. Machine Design by Reshetov, Mir Publication
4. Machine Design by Black Adams, McGraw Hill
5. Fundamentals of Machine Elements by Hawrock, Jacobson McGraw Hill
6. Machine Design by R.C.Patel, Pandya, Sikh, Vol-I & II C. Jamnadas & Co
7. Design of Machine Elements by V.M.Faires
8. Design of Machine Elements by Spotts
9. Recommended Data Books – PSG and Mahadevan& Reddy

Back to Scheme

Course Code	Course Name	Credits
AE213	**Engineering Mathematics IV***	2

Course Objectives:

The course is aimed.

1. To Learn the concepts of probability, random variables,

2. To Learn the concepts of probability distribution & expectation.

3. To Learn the various probability distributions.

4. To Learn the concepts of sampling theory.

5. To learn the partial differential equations and Analytical methods to solve it which are used in engineering problems.

6. To learn numerical methods to solve the partial differential equations which are used in engineering problems.

Course Outcomes:

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

1. Able to solve examples of probability & random variables & apply the concepts of probability & random variables.

2. Able to solve examples of probability distribution and expectation for decision making & apply the concepts of probability distribution and expectation for decision making..

3. Able to solve examples of various probability distributions & apply various probability distributions in data science.

4. Able to solve examples of sampling theory & apply the concept of sampling theory in data science.

5. Able to solve examples of analytical methods to solve partial differential equations & apply the analytical methods to find the solution of Mathematical Models of real-life problems, engineering problems.

6. Able to solve examples of the numerical methods to solve partial differential equations & apply the numerical methods to find the solution of Mathematical Models of real-life problems, engineering problems.

Module	Details	Hours
1	**Probability Theory** **1.1** Introduction to probability, 1.2 Conditional probability, 1.3 Total Probability 1.4 Baye's Theorem.	4
2	**Probability Distribution - I** 2.1 Discrete and Continuous random variables, 2.2 Probability mass and density function, 2.3 Probability distribution for random variables, 2.4 Expectation, Variance, Co-variance .	4
3	**Probability Distribution – II** 3.1 Binomial distribution, 3.2 Poisson distribution, 3.3 Normal distribution .	4

4	**Sampling Theory-** 4.1 Sampling distribution, Test of Hypothesis, Level of Significance, Critical region, 4.2 One-tailed, and two-tailed test, Degree of freedom. 4.3 Students' t-distribution (Small sample)- Test the significance of single sample mean 4.4 Test the significance of sample means of two independent sample means (paired t-test) .	5
5	**Partial Differential Equations : Analytical methods** 5.1 Introduction of Partial Differential equations Classification 5.2 Method of separation of variables to solve the problem of Vibrations of string, 5.3 One dimensional heat and wave equations.	3
6	**Partial Differential Equations** : **Numerical methods** : 6.1 Numerical methods to solve PDE 6.2 Bender Schmidt scheme 6.3 Simplified Crank Nicholson scheme.	6

Assessment:

Internal Assessment Test:

Assessment consists of class tests of 30 marks each. The IA1 is to be conducted when approx. 40% syllabus is completed and IA2 marks shall be an average of six assignments', advised to be conducted during tutorials, marks , one assignment on each of the six modules separately for 30 marks .

End Semester Theory Examination:

1. Question paper will comprise of total 4 questions, each carrying 15 marks.
2. Total 03 questions need to be solved.
3. Question No: 01 will be compulsory and based on the entire syllabus wherein

   5 sub-questions of 3 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 lectures 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. 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.

Recommended NPTEL Courses :
Students can choose any two of the following SWAYAM-NPTEL courses advised as follows :
1. One of the recommended NPTEL courses from Sr. No. 1 to Sr. No. 5
2. One of the recommended NPTEL courses from Sr. No. 6 to Sr. No. 8

1) Introduction to probability and Statistics
By Prof. G. Srinivasan | IIT Madras
Link : https://onlinecourses.nptel.ac.in/noc25_mg35/preview

2) Probability and Statistics
By Prof. Somesh Kumar | IIT Kharagpur
Link : Link : https://onlinecourses.nptel.ac.in/noc25_ma49/preview

3) Biostatistics and Design of experiments
By Prof. Mukesh Doble | IIT Madras
Link : https://onlinecourses.nptel.ac.in/noc25_bt10/preview

4) Engineering Statistics
By Prof. Manjesh Kumar Hanawal | IIT Bombay
Link : https://onlinecourses.nptel.ac.in/noc25_ge10/preview

5) Essentials of Data Science With R Software-1: Probability and Statistical Inference
By Prof. Shalabh | IIT Kanpur
Link : https://onlinecourses.nptel.ac.in/noc25_ma20/preview

6) Partial Differential Equations (PDE) For Engineers: Solution By Separation Of Variables
By Prof. Sirshendu De | IIT Kharagpur
Link : https://onlinecourses.nptel.ac.in/noc25_ma46/preview

7) First Course on Partial Differential Equations - I
By Prof. P.S. Datti, Prof. A. K. Nandakumaran | IISc Bangalore
Link : https://onlinecourses.nptel.ac.in/noc25_ma22/preview

8) Ordinary and Partial Differential Equations and Applications
By Prof. P. N. Agarwal, Prof. D. N. Pandey | IIT Roorkee
Link : https://onlinecourses.nptel.ac.in/noc25_ma45/preview.

Course Code	Course Name	Credits
AE214	**Data Science**	2

Course Objectives:

1. To introduce students to the fundamental concepts of Data Science and its real-world applications.
2. To provide hands-on experience with R and R Studio for data analysis and visualization.
3. To familiarize students with essential statistical and probability concepts used in data analysis.
4. To teach data cleaning, transformation, and preprocessing techniques for effective data management.
5. To develop an understanding of basic machine learning models, including regression and clustering techniques.
6. To equip students with skills to evaluate and interpret data models for informed decision-making.

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

1. Recognize the importance and applications of Data Science in various domains.
2. Utilize R programming to manipulate, analyze, and visualize data efficiently.
3. Apply statistical concepts and probability distributions in data analysis tasks.
4. Perform data cleaning, handling missing values, and implementing transformations to prepare data for analysis.
5. Develop and implement basic machine learning models such as Linear Regression, Logistic Regression, and K-Means Clustering.
6. Evaluate and interpret the performance of classification and clustering models using appropriate metrics.

Module	Details	Hours
1.	**Introduction to Data Science** What is Data Science, Importance of Data science, Data science project roles, Understanding the stages of a data science project, Application, Various programming tools to perform data analysis	02
2.	**Fundamentals of R** Installation of R & R Studio, Getting started with R Script, Basic & advanced data types in R, Variable operators in R, R functions and loops, Creating Data frames, Exploring data frames, Accessing columns in a Data frame, Reading a CSV text file, Removing rows and columns, Renaming rows and columns, sorting and merging data frames.	08
3.	**Data visualization** Need for data visualization, Components of data visualization, Visually checking distributions for a single variable, Visually checking relationships between two variables, Introduction to grammar of graphics, Using the ggplot2 package in R to create visualizations	06
4.	**Basics of Statistics & Probability** Mean, Median, Mode, Variance, Standard Deviations, Skewness, Standard probability distributions: Binomial, Normal etc., Central Limit Theorem, Hypothesis testing, Significance levels & P-Value, statistical tests : t-test, chi-square test, paired t-test, ANOVA	08

5.	**Data Managing** **Cleaning :** Needs & methods of data preparation, Handling missing values, Imputation Methods, Outlier treatment, Transformation, Modifying data with Base R, Data processing with dplyr package **Sampling for modeling and validation:** Test and training splits	06
6.	**Modelling :** Linear Regression, Logistic Regression, K-Means Clustering **Evaluating models :** Evaluating classification models, Evaluating clustering models	08

Assessment:
Lab Assessment:
Term Work: (25 Marks)
The distribution of marks for Term work shall be as follows:
Experiment write ups : 20 Marks
Attendance : 05 marks
Practical/Oral examination (50 Marks)
To be conducted by pair of Internal and External Examiner The distribution of marks for practical examination shall be as follows:
Practical Exam : 30 marks
Oral Exam : 20 marks

Books/References:
1. R for Data Science, Hadley Wickham, Garrett Grolemund, O'Reilly Media.
2. Hands-On Programming with R, Garrett Grolemund, O'Reilly Media.
3. Any digital resources and online guides for R or its packages.

Back to Scheme

Course Code	Course Name	Credits
AE 292	**Minor Project II**	2

Course Objectives:

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

Course 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 finalisation 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:

- Report should be prepared as per the guidelines issued by the Department.
- Minor project 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.

Back to Scheme

Third Year Automobile Engineering A.Y 2025-26

Course Code	Course Name	Credits
AE301	**Finite Element Analysis**	3+1

Course Objectives:

1. To equip with the Finite Element Analysis fundamentals.
2. To apply finite element formulation for the solution of mechanical engineering problems.
3. To make the students use simulation techniques to get results for complex problems.

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

1. Apply approximate methods to solve governing differential equations of the problem domain.
2. Discretize the problem domain using appropriate elements and apply boundary conditions.
3. Apply the finite element formulation to solve one-dimensional mechanical engineering problems.
4. Apply the finite element formulation to solve two-dimensional mechanical engineering problems.
5. Apply the finite element method to solve one-dimensional dynamic problems.
6. Use professional-level finite element analysis software to solve real life problems.

Theory Syllabus:

Module	Details	Hours
1.	**Introduction:** Weighted Residual Methods - Galerkin Method, Variational Approach - Rayleigh-Ritz Method, Elements of Elasticity, Mathematical modeling of field problems in engineering with One dimensional second order equation.	5
2.	**Elements and its shape functions:** Element types, 1D linear and higher order elements, derivation of shape functions in local and natural coordinate systems, Stiffness matrix and force vectors, assembly of elemental matrices.	6
3.	**1D Analysis - Bar Element:** Application of element stiffness matrix to find Solution of problems from solid mechanics , heat transfer, fluid flow etc.	8
4.	**1D Analysis - Truss and Beam Element:** Application of element stiffness matrix to find Solution of truss and beam problems	8
5.	**2D Analysis:** Introduction, Element matrix for Constant Strain Triangular elements, Shape functions for isoparametric elements - four node and eight node quadrilateral element	8
6.	**Dynamic Analysis:** Dynamic equations of motion, consistent and lumped mass matrices, free longitudinal vibration analysis.	4

Laboratory Syllabus:

Exercise	Details	Hours
1	Introduction to ANSYS (APDL and Workbench)	2
2	Analysis of Rod subjected to axial Load (Step bar, taper rod) (APDL)	2
3	Truss Analysis (APDL)	2
4	Beam Analysis (Workbench)	2
5	Thermal Analysis (Workbench/APDL)	2
6	Modal analysis (Workbench)	2
7	Axis-symmetry Analysis (APDL)	2
8	Convergence Study (Workbench)	2
9	Comparison of results while solving the same problem in 1D, 2D or 3D.	2
10	Writing a program using any programming language (Python, R, Matlab, Scilab, C++, etc.) for a finite element solution to any 1D/2D problem.	2
11	Course Project: Simulation of any assembly / Multi domain Analysis / Nonlinear analysis / Analysis of Composites etc.	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 the end semester examination will be proportional to the number of respective lecture hours mentioned in the curriculum.

Laboratory Assessment:
Internal Assessment: 25 marks
Term Work:

A. Minimum 6 exercises from 2-9 of the above list need to be undertaken.
B. Validation of the simulation results obtained through software with calculation.
C. Exercise 11 is compulsory. Presentation/Seminar of the study done is required.

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

Part A …….10 marks
Part B …….5 marks
Part C …….10 marks

End Semester Practical/Oral Examination:
A pair of Internal and External Examiners should conduct practical/viva based on contents.
Distribution of marks for practical/viva examination shall be as follows:

Practical Examination : 15 Marks
Oral Examination : 10 Marks

Text/Reference Books:

1. J. N. Reddy; An Introduction to Finite Element Method; 3rd Edition, McGraw Hill.
2. R. D. Cook, Davis S. Malkus, Michael E. Plesha and Robert J. Witt; Concepts and Applications of Finite Element Analysis; 4th Edition, Wiley.
3. S. S. Rao; The Finite Element Method in Engineering; 5th Edition, Elsevier, Butter Worth Heinemann.
4. O. C. Zienkiewicz and R. L. Taylor; The Finite Element Method, Vol. I and II, 6th Edition, Elsevier, Butter Worth Heinemann.
5. K.L. Bathe and E.L. Wilson; Finite Element Methods; Prentice Hall.
6. David V Hutton; Fundamentals of Finite element analysis; 7th Edition Tata McGraw Hill.
7. T. R. Chandrupatla and A. D. Belegundu; Introduction to Finite Elements in Engineering; 4th Edition, Pearson.
8. D. L. Logan; A first course in Finite Element Method; 5th Edition, Cengage Learning.
9. P. Seshu; Text book of Finite Element Analysis; 10th Edition, Prentice Hall of India.
10. N. S. Gokhale, S. S. Deshpande, S. V. Bedekar and A. N. Thite; Practical Finite Element Analysis; 1st Edition, Finite to Infinite.
11. https://nptel.ac.in/courses/112104193

Back to Scheme

Course Code	Course Name	Credits
AE302	**Heat Transfer**	3

Course Objectives:

1. To understand the fundamentals of heat transfer in fluids and solids during steady state and unsteady state.
2. To Study mathematical modeling and designing concepts of heat exchangers

Course Outcomes: Learner will be able to

1. Apply basic laws of heat transfer on various applications.
2. Identify, formulate, and solve heat transfer problems in thermal analyses of engineering systems.
3. Analyze problems and develop solution for steady state and unsteady state heat conduction problem in simple geometries
4. Evaluate heat transfer coefficients for natural convection and forced convection.
5. Calculate radiation heat transfer between black body and grey body surfaces.
6. Analyze heat exchanger performance and estimate the effectiveness of heat exchanger.

Theory Syllabus:

Module	Detail Content	Hrs.
1	**Basic concepts of heat transfer** Difference between heat transfer and Thermodynamics, Physical mechanism of different modes of heat transfer, Steady and unsteady heat transfer, one dimensional, two dimensional and three dimensional heat transfer, Fourier law of heat conduction, Thermal conductivity, Thermal resistance concept in heat transfer, Thermal diffusivity, Governing law of convection, Free and forced convection.	6
2	**Conduction** Generalized heat conduction equation in rectangular, cylindrical and spherical coordinates (only equation for cylindrical and spherical coordinates, no derivation), Steady state heat conduction through plane wall, Composite wall, cylinder, composite cylinder wall, sphere, and composite sphere wall, Critical radius of insulation in cylinder and sphere, Thermal contact resistance, Internal Heat generation concept.	7
3	**Heat transfer from Extended Surface** Types of extended surface and its significance Governing differential equation for fin and its solution, Fin performance: Fin effectiveness and Fin efficiency, Thermowell **Unsteady state heat transfer** Applications of unsteady state heat transfer, Lumped system Analysis, characteristic length, Biot Number, Thermal time constant and Response of a thermocouple, Heisler Charts	6
4	**Convection** Determination of heat transfer coefficient, Dimensional Analysis, Dimensionless numbers in free and forced convection and their significance. **External Flow**	7

	Velocity Boundary layer and Thermal Boundary layer, Laminar and turbulent, flow over a flat plate, Flow across cylinder and sphere, Flow across bank of tubes **Internal Flow** Velocity Boundary layer and Thermal Boundary layer, Laminar and Turbulent, flow in tubes, General thermal analysis: Constant heat flux and constant surface temperature **Heat Pipe** Introduction and application	
5	**Radiation** Emissivity, transmissivity, reflectivity, absorptivity, black body, Grey body, Opaque body, Radiation intensity, Basic laws of radiation, Radiation heat exchange between black bodies, Reciprocity theorem, Shape factor algebra, Radiation heat exchange between nonblack bodies, Electrical network approach for radiation heat exchange: Radiosity and irradiation, Radiation shield	6
6	**Boiling and Condensation:** Boiling heat transfer, Pool boiling: different regimes and pool boiling curve, Flow Boiling: Different Regimes and Boiling curve, Condensation heat transfer, Film condensation, Dropwise Condensation. **Heat Exchangers:** Types of heat exchangers, Overall heat transfer coefficient, Fouling factor Analysis of heat exchangers, LMTD, Effectiveness –NTU method, Correction factor Effectiveness of heat exchangers.	7

Laboratory Syllabus:

SN	Details	Hrs.
1	Measurement of thermal conductivity of insulating powder	2
2	Measurement of thermal conductivity of metal rod	2
3	Performance analysis of extended surfaces under free and force convection	2
4	Unsteady state heat transfer in cylinder/rod/wall	2
5	Measurement of Emissivity of Grey surface	2
6	Estimation of overall heat transfer coefficient and effectiveness of double pipe heat exchanger (parallel flow and Counter flow arrangement)	2
7	Simulation to estimate effect of various parameters on heat transfer	2
8	Heat Transfer analysis/estimation using numerical methods/computational techniques	2

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:

Experiment write ups : 20 Marks
Attendance : 05 marks

Books/References:

1. Introduction to thermodynamics and Heat transfer by Yunus A Cengel 2nd Edition, McGraw Hill International
2. Fundamentals of Heat and Mass Transfer by FPIncropera and D P deWitt, Wiley India
3. Heat Transfer by P S Ghoshdastidar, 2nd Edition, Oxford University Press
4. Heat and Mass Transfer, by R Rudramoorthy and L Malaysamy,2ndEdition, PEARSON
5. Heat Transfer by J P Holman, Mcgraw Hill
6. Heat Transfer by S P Sukhatme, University Press
7. Heat and Mass Transfer by PK Nag, TMH
8. Heat and Mass Transfer by Mahesh Rathod, Laxmi Publications
9. Heat and Mass Transfer byR K Rajput, S Chand and company

Back to Scheme

Course Code	Course Name	Credits
AE303	**Automotive Systems**	3+1

Course Objectives:

1. To study basic and advance automotive systems.
2. To study working of different automotive systems and subsystems.
3. To study different types of frames and vehicle layout.
4. To have basic idea about how automotive systems are developed.

Course Outcomes: Learner will be able to

1. Identify different types of frames and axles.
2. Comprehend working of Clutches and transmission systems in automobiles.
3. Interpret the need of driveline components in automobiles.
4. Compare different types of steering systems and analyze steering geometry.
5. Comprehend use of brakes, wheels and tires in automobiles.
6. Identify and Understand working of different vehicle systems and subsystems.

Theory Syllabus:

Module	Details	Hours
1	**Frames and Axles-** Frames-Layouts, types, material, construction, loads acting Front and Rear axles – Types of Front Axles and Stub axles,Construction and Materials, Layout of Two and Three Wheeler **Automotive Clutch-** Necessity of clutch in a automobile, Working and Construction of Single plate, Multi-plate, Centrifugal, Semi Centrifugal, Electromagnetic clutches, Fluid Flywheel ,Clutch Mechanism in Two-Wheeler and Three Wheeler.	06
2	**Automotive Transmission-** Purpose and Elements of Gear Box, Characteristic Curves, Types-Sliding mesh, Constant Mesh, Synchromesh, Determination of gear ratios for vehicles, Layout of transmission in two and three wheeler **Hydrodynamic Transmissions** - Torque converter – Principle - constructional details, Multistage torque converters and Polyphase torque converters. **Epicyclic Gearboxes used in automatic transmissions-** Principle of Planetary gear trains-Wilson, Cotal electromagnetic transmission, Continuously Variable Transmission-Types and Operation of typical CVT Automotive Powertrain, Powertrain Analysis and Transmission Matching , **Gear Shifting Mechanism -** Hand and Foot operated shifting mechanism	8
3	**Drive Line**: UV joint, CV joint, Propeller Shaft construction and arrangement, Elements of drive line, 2WD, 4WD, Part time and Full time 2WD and 4WD.Driving thrust and its effects, Torque reaction and Side thrust, Hotchkiss drive, Torque tube drive, Radius rods, Stabilizers **Final Drive** –Types of Final drive gears and Bearing **Differential** –Principle, Constructional details of Differential unit, Housing, Non slip differential and differential locks, gears and bearing	08
4	**Steering**-Introduction to steering systems, Manual Steering, Ackerman and Davis Steering Mechanisms, Steering Linkages Different types of Steering gear boxes, Reversible and Irreversible steering, Slip angle, Over and under steer Power steering systems, Front Wheel Geometry, Wheel alignment, Steering Frok , Handlebar arrangement.	06

5	**Brakes-** Introduction to Brake System, Components of Brake System, Hydraulic Brake, Air Brake, Anti Lock Brake System, Braking Analysis. Brake control system- Hand and Foot operated brake, Braking System of auto rickshaw.	06
6	**Suspension-** Dependent and Independent Suspension, Types of Suspension Springs-Single leaf, Multi Leaf spring, Coil, Torsion Bar, Rubber, Pneumatic and Hydro elastic suspension spring systems, Mono Shock suspension , Gas filled shock absorber, Preload adjustment procedure motorcycle rear wheel suspension, three wheeler rear suspension for auto rickshaw **Wheels and Tyres-** Tire requirement, tire characteristics, Constructional detail and retreading, tire dimensions and specifications, Types of wheels and Hubs,Selection criteria of wheels and tyre ,their specification for motorcycle , scooters and sports bike.	08

Lab Syllabus:

A. List of Experiments

1. Dismantling and reassembling of Clutch.
2. Dismantling and reassembling Gear box.
3. Dismantling and reassembling of the Propeller Shaft.
4. Dismantling and reassembling of Differential.
5. Dismantling and reassembling of Steering gear linkages and steering gear box.
6. Dismantling and reassembling any one type of braking system.

B. Case Study

Case study and detail report explaining all systems and subsystems on any two of following

1. Passenger Vehicle
2. 2/3 Wheeler
3. Off Road Vehicles
4. Military vehicles

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

Laboratory Assessment:

Term Work:

Comprises both A & B

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

1. Part A: 10 marks
2. Part B: 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.

Text Books:

1. Newton, Steed & Garret, Motor Vehicles, Butterworth Heinemann.
2. N. K. Giri, Automotive Mechanics, Khanna Publishers.
3. D. Crolla, D. E. Foster, T. Kobayashi and N. Vaughan (Editors-in-Chief), Encyclopedia of Automotive Engineering, Parts 1-6, Wiley, 2015.

Reference Books:

1. Crouse. W. H, Automotive Chassis and Body, McGraw Hill New York.
2. Jack Erjavec, Automotive Technology – A systems approach, Cengage Learning.
3. M. J. Nunny, Automotive Technology, SAE Publication.

Back to Scheme

Course Code	Course Name	Credits
AE304	**Controls Engineering and model based system**	2+1

Course Objectives:

1. To study concept of mathematical modeling of the control system
2. To acquaint with control system under different time domain
3. To study concepts of stability & various methods.
4. To study Multi-Input Multi-Output systems using state space
5. To study application of control systems for automobile systems.

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

1. Design mathematical models of system/process.
2. Analyze error and differentiate various types of control systems using time domain specifications
3. Analyze various methods and problems associated with stability
4. Analyze systems using graphical methods in frequency response
5. Analyse state space methods for system analysis using controllability and observability.
6. Comprehend and apply concepts of control systems in automobile applications.

Module	Details	Hours
1.	**Introduction to the Control Systems** Introduction to control systems, Classification of control systems. Open loop and closed loop systems. Mathematical modeling of control systems (Spring mass damper, electrical systems), concept of transfer function, Block diagram algebra - Rules and Problems.	06
2.	**Time Response Analysis** Transient and steady state analysis of first and second order systems. Time Domain specifications. Step response of second order system. Steady-state error, error coefficients, steady state analysis of different type of systems using step, ramp and parabolic inputs	08
3.	**Stability analysis** Introduction to concepts of stability, Concept of S-plane Routh-Hurwitz Criteria for stability; Relative stability analysis; Root-Locus technique and construction of root-loci.	08
4.	**Frequency Response Analysis** Introduction to frequency response; Frequency response plots: Polar plot and Bode plot; Performance specifications in frequency domain. Stability margins in frequency domain; Mapping contours in s-plane; The Nyquist criterion; Relative stability using Nyquist criterion.	08
5.	**State space modeling** Concept of state, state variable, state model. State space representation using physical and phase variables, decomposition of transfer function, diagonalisation. State transition matrix. Transfer function from state model. Controllability and observability of linear systems.	06
6	**Introduction to Model Based system -** Model based systems, Product development V cycle, MIL, SIL, HIL models, Technical Advances in Control systems.	04

Laboratory Syllabus:

Sr. No.	Experiment Title
1	MATLAB Onramp Certification - Introduction to MATLAB Environment
2	Simulink Onramp Certification - Introduction to Simulink Environment
3	To study the time response of a first and second order system to standard input signals.
4	To perform stability analysis of control systems using Root Locus Technique.
5	To perform stability analysis of control systems using Bode Plots.
6	Modeling and Simulation of Mass-Spring-Damper System Using Simulink
7	To understand state space analysis in MATLAB - Conversion from State space to Transfer function and Transfer function to state space
8	Design MATLAB simulink system for any one of the given system 1. Automotive Suspension system - 2. Inverted Pendulum system - 3. Anti Lock Breaking system - 4. Engine timing model - 5. Battery Management system in Simulink (Analyze and conclude on different input parameters and output graphs)

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:
End Semester Practical/Oral Examination: 25 Marks
Pair of Internal and External Examiners should conduct practical/viva based on contents.

Distribution of marks for practical/viva examination shall be as follows:

Practical Examination : **15 Marks**
Oral Examination : **10 Marks**

Text Books:

1. Norman Nise, "Control Systems Engineering", Wiley, 8th edition, 2019.
2. M. Gopal, "Control Systems: Principles and Design", 3rd edition, Tata McGraw Hill, 2008.
3. Richard Dorf, Robert Bishop, "Modern Control Systems", 11th edition, Pearson Education, 2008

Reference Books:

1. Golnaraghi Farid, B. C. Kuo, "Automatic Control Systems", 10th edition, McGraw Hill, 2017.
2. K. Ogata, "Modern Control Engineering", 6th edition, Prentice Hall, 2010.
3. I. J. Nagrath, M. Gopal, "Control System Engineering", New Age International, 2009.

Back to Scheme

Course Code	Course Name	Credits
AE305	**Electric Vehicle Drives and Control**	3

Course Objectives:

1.To study the concepts of magnetism and energy conversion.

2.To familiarize with the operational characteristics of AC machines, Special purpose machines and their applications

3.To introduce various power electronic components,different power conversion topologies such as ac to dc, dc to ac converters operation and control techniques used in electric vehicles.

Course Outcomes: Learner will be able to

1. Explain the importance, working and applications of DC Machines
2. Understand and analyze the importance, working and applications of AC Machines
3. Describe stepper, servo motor and its drive systems along with its applications
4. Illustrate the characteristics of power electronic components.
5. Analyze power electronic convertors and their applications.
6. Analyze the control of power converters and motors in electric vehicle.

Module	Details	Hours
1	**Introduction to Electrical machines** Aspects of Electromechanical Energy conversions, Features of Energy conversion, Energy balance equation. Commonly used Electrical machines in EV.Basic construction and principle of operation of DC Machines- Brushed and Brushless DC motors (BLDC). Characteristic Curves of Machines: Constant-Torque Mode, Constant-Power Mode, Efficiency Map.	04
2	**Ac Machines** Three phase Induction motors Classification, Principle, Construction of Squirrel cage Rotor and phase wound rotor motor, Relation between torque and rotor power factor, Starting torque for squirrel cage and slip ring motor,condition for maximum torque, Torque-slip characteristics. Speed control of the induction motor.Introduction of AC and DC drives, Synchronous Motors Construction, Operating principle, Equivalent circuit and power developed by motor.	06
3	**Special purpose Electric Machines** Stepper motor-PM Stepper motor, DC Servomotor, AC Servomotor, Switched Reluctance motor, Suitability of each machine in Electric vehicle domain for 2W, 3W, 4 wheeler and large size vehicles. Real life examples-Review of advancement in EV Motors and Drives.	06
4	**Introduction to Power Electronics** Construction, Steady state characteristics & Switching characteristics of SCR, power MOSFET and IGBT. Gate characteristics,Gate drive requirements,Gate drive circuits for Power MOSFET & IGBT.	04
5	**Power electronic Converter for EV drive**	

	Types of Power electronics converters, Advantages and Disadvantages of Power electronics converters. Power Conversion –Basic Principle, review of DC-DC converters, Switching mode regulators – Buck, Boost,Buck-Boost, Cuk converters, Full bridge DC-DC converters. Power Conversion –Basic Principle, review of inverters.Types- Single phase and three phase inverter - EV traction inverter Modulation schemes: Sinusoidal Pulse Width Modulation, SPWM with Third harmonic injection, Space vector modulation, comparison of modulation techniques.Converter-Inverter Loss calculation, Heat-sinking: passive and active cooling.	08
6	**Control of Power converters and Motors** Induction Motor Control: Variable-Voltage Variable-Frequency Control (VVVF), Field-Oriented Control (FOC), Direct Torque Control (DTC). PM Synchronous Motor Control: Field-Oriented Control of PMSM, Flux Weakening Control of PMSM, Position Sensorless Control of PMSM. SRM motor control: Current chopping control (CCC), Torque-Ripple Minimization Control BLDC Motor Control: Trapezoidal back EMF BLDC motor control.	08

Assessment:

Internal Assessment:

Consisting of Two Compulsory Tests first test based on approximately 40% of contents and second test based on matlab simulation experiment submission (approximately 40% but excluding contents covered in Test I). Duration of the first 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

Text Books:

1. Bimbhra P. S., Electric Machinery, Khanna Publisher,
2. B.L.Theraja, A.K.Theraja, Electrical technology Volume-II,S chand Publications.
3. M. H. Rashid, Power Electronics: Circuits, Devices, and Applications, Pearson Education, 2009.
4. N. Mohan and T. M. Undeland, Power Electronics: Converters, Applications and Design, John Wiley & Sons, 2007.

Reference Books:

1. Gopal Dubey,Fundamental of Electrical Drives,Narosa Publication
2. M. V. Deshpande, Electric Machines, PHI
3. S. K. Pillai, A first course on Electrical Drives, New Age Publication
4. Ashfaq Husain, Electric Machines, Dhanpat Rai and Co. Publications
5. R.W. Erickson and D. Maksimovic, Fundamentals of Power Electronics, Springer Science & Business Media, 2007.

Back to Scheme

Course Code	Course Name	Credits
AE306	**CAD for Additive Manufacturing**	3

Course Objectives:

1. To provide detailed understanding of additive manufacturing processes.
2. Understand the manufacturing procedure of a prototype

Course Outcomes: Learner will be able to…

1. Apply the knowledge of GD and T to the CAD model.
2. Select and use correct CAD formats while preparing the model for Additive Manufacturing.
3. Develop the STL file for 3D printing.
4. Comprehend the use of reverse engineering in automobile engineering.
5. Develop the ability to select appropriate Additive Manufacturing for the set of requirement given
6. Illustrate the use of CAD for AM for various fields via case studies.

Module	Details	Hours
1	**Fundamentals of Geometric Dimensioning and Tolerancing :** Introduction to Geometric Dimensioning and Tolerancing, Coordinate Tolerancing system, Comparison between GD and T and Coordinate Tolerancing,Geometric Tolerancing symbols and terms, Datums, Tolerance of Positions	8
2	**CAD for Additive Manufacturing:** CAD Data formats, Data translation, Data loss. STL format, importance of STL format	5
3	**Preparation of 3D-CAD model for Additive manufacturing:** 3D CAD model of new design concept, STL Conversion, STL error diagnostics, Part orientation and support generation and its importance , Slicing, troubleshooting and fixing slicing errors, Softwares used for slicing. Tool path Generation, Surface preparation of materials.	8
4	**Reverse Engineering:** Basic Concept, Digitization techniques, Model Reconstruction.	8
5	**Introduction to Additive Manufacturing (AM) and AM technologies:** Introduction to Additive Manufacturing. **AM technologies**:VAT Photopolymerisation,Material Jetting, Binder Jetting, Material Extrusion, Powder Bed Fusion,Sheet Lamination, Directed Energy Deposition Applications of additive manufacturing in automobile engineering.	6
6	**Case studies:** 1. Computer-Aided Design and Additive Manufacturing for Automotive Prototypes. 2. Comparison of CAD systems for generative design for use with additive manufacturing 3. Using Mesh Deformation to improve CAD for Additive Manufacturing	4

Assessment:

Self Study: NPTEL Online Course : Metal Additive Manufacturing, https://onlinecourses.nptel.ac.in/noc25_me130/preview

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

Text Books:

1. Gibson, I, Rosen, D W., and Stucker, B., Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2015
2. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third Edition, World Scientific Publishers, 2010
3. Chee Kai Chua, Kah Fai Leong, 3D Printing and Additive Manufacturing: Principles and Applications: Fourth Edition of Rapid Prototyping, World Scientific Publishers, 2014
4. Gebhardt A., "Rapid prototyping", Hanser Gardener Publications, 2003

Reference Books:

1. Ian Gibson, David W. Rosen, Brent Stucker, Additive manufacturing technologies: rapid prototyping to direct digital manufacturing Springer, 2010.
2. C.K. Chua, K.F. Leong and C.S. Lim, Rapid prototyping: principles and applications, 3rd Edition, World Scientific, 20 10.
3. Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2007
4. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer, 2006
5. Mahamood R.M., Laser Metal Deposition Process of Metals, Alloys, and Composite Materials, Engineering Materials and Processes, Springer International Publishing AG 2018
6. Ehsan Toyserkani, Amir Khajepour, Stephen F. Corbin, "Laser Cladding", CRC Press, 2004

Back to Scheme

Course Code	Course Name	Credits
AE307	**Material Selection and manufacturing**	3

Course Objectives:

1. To understand the requirements for selection of any material.
2. To select appropriate material as per requirement
3. To be able to manufacture the chosen material

Course Outcomes:

1. Evaluate the need for material selection for a new product or to improve an existing product
2. Estimate the requirement in terms of mechanical properties
3. Decide an appropriate processing route for a selected material
4. Use Ashby plots and performance indices to select materials for a specific application
5. Comprehend different materials used in Formula one
6. Analyze the impact of green biocomposites in race cars

Module	Details	Hours
1	**Motivation for Selection** New Product Development, Improving an existing product, Cost effectiveness and value analysis, Establishing the service requirements, Selection and design in relation to anticipated service	06
2	**Selection of Materials for Mechanical Properties:** Understanding the stress-strain diagram for different classes of materials, Static Strength, Stiffness, toughness, fatigue and creep and the material selection criteria, Ashby diagrams for correlating any two properties	07
3	**Material Selection and Material Processing** Purpose of processing and background to process selection. Casting of alloys, wrought alloys, processing of polymers, composites, powders processing-new trends in additive manufacturing, Joining and fastening processes, Importance of the structure -property-processing	07
4	**Ashby 's Selection of Materials** Defining Function, Objective, Constraints, Free variable and modelling the material index for Light and Stiff material selection, Cheap and Stiff material, Light and strong material. Using Material Index to select the most appropriate material	07
5	**Racing Cars and Technical Specifications** Materials Used in Formula One, making of NASCAR, Off Road trucks, GT,Ferrari	06
6	**Case study:** 1. Material Selection for Vehicle Body, commercial vs racing cars 2. Automobile Structures and materials used 3. Recent trends with green biocomposites in race cars	06

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

Text Books/References:

1. M. F. Ashby, Materials Selection in Mechanical Design, Elsevier Publication, 2005
2. J. G. Gerdeen, H. W. Lord and R. A. L. Rorrer, Engineering Design with Polymers and Composites, Taylor & Francis, 2005
3. J. A Charles, JAG Furness, Selection and use of Engineering Materials, JBH Publishers, 3rd edition.
4. Kenneth. G Budinski & Michael K. Budinski., Engineering Materials: Properties and Selection, 9th edition, 2010
5. M. F. Ashby and K. Johnson, Materials and Design, Butterworth Publication, 2002

Back to Scheme

Course Code	Course Name	Credits
AE391	**Minor Project III**	2

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 finalisation 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:

- 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.

Back to Scheme