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.

PCE
PILLAI COLLEGE OF ENGINEERING
AUTONOMOUS

Department of Mechanical Engineering

Syllabus

of

B.Tech. in Mechanical Engineering

for

The Admission Batch of AY 2021-22

First Year - Effective from Academic Year **2021-22**

Second Year - Effective from Academic Year **2022-23**

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

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

as per

Choice Based Credit and Grading System

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 Mechanical Engineering

Vision

To develop a world class programme with excellence in teaching, learning and research that would lead to growth, innovation and recognition.

Mission

The mission of the Mechanical Engineering Program is to benefit the society at large by providing technical education to interested and capable students. These technocrats should be able to apply basic and contemporary science, engineering and research skills to identify problems in the industry and academia and be able to develop practical solutions to them.

Program Educational Objectives (PEOs):

I. To prepare students for successful careers in industry to meet the needs of Indian and Global companies.
II. To provide students with a sound foundation in the mathematical, scientific and engineering fundamentals.
III. To develop the ability among students to synthesize data, interpret them appropriately and be able to apply concepts to mechanical system design or to a mechanical subsystem of an interdisciplinary system.
IV. To provide opportunity for students to work in their individual capacity as well as to function as teams on multidisciplinary projects.
V. To enable students for lifelong learning and introduce them to professional ethics and sustainable development.
VI. To develop among students an attitude towards self-employment through entrepreneurship

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 with an understanding of the limitations.T
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. Students should be able to design and develop mechanical systems(design, thermal and manufacturing) using core as well as interdisciplinary skills.
2. Students should be able to generate and develop ideas that can result in self employment (eg.Start-ups) and also result in creation of more jobs for the society.
3. Students should be able to apply technical and managerial skills to work as good team leader as well as players in diverse interdisciplinary projects.
4. Students should be able to model and develop solutions for problems relevant to industry.

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 Mechanical Engineering offers a B. Tech. programme in Mechanical Engineering. This is an eight semester course. The complete course is a 163 credit course which comprises core courses and elective courses. The elective courses are distributed over 7 specializations. The specializations are:

1. Thermal and Fluids Science
2. Design Engineering
3. Materials Science and Nanotechnology
4. Mechatronics & Robotics
5. Manufacturing Engineering
6. Energy Science and Engineering
7. Automotive System

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

1. Business and Entrepreneurship
2. Bio Engineering
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 during the B.Tech in Mechanical 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. The credit requirement for the B.Tech. in Mechanical Engineering course is tabulated in Table 1.

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

Category	Credits
Humanities and Social Sciences including Management courses	8
Basic Science courses	25
Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc	24
Professional core courses	60
Professional Elective courses relevant to chosen specialization/branch	20
Open subjects – Electives from other technical and /or emerging subjects	9
Project work, seminar and internship in industry or elsewhere	17
Mandatory Courses - Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge	Non credit
Total Credits	**163**

Program Structure for
Bachelor of Technology in Mechanical Engineering

Semester I

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract /Tut	Theory	Pract/ Tut	Total
ME 101	Engineering Mathematics I	TLP	3	2	3	1	4
ME 102	Engineering Physics I	TL	2	1	2	0.5	2.5
ME 103	Engineering Chemistry I	TL	2	1	2	0.5	2.5
ME 104	Engineering Mechanics	TL	3	2	3	1	4
ME 105	Basic Electrical and Electronics Engineering	TL	3	2	3	1	4
ME 106	Basic Engineering Workshop I	L	-	3	-	1.5	1.5
Total			**13**	**11**	**13**	**5.5**	**18.5**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
ME 101	Engineering Mathematics I	40	40	40	60	2	25	-	125
ME 102	Engineering Physics I	30	30	30	45	2	25	-	100
ME 103	Engineering Chemistry I	30	30	30	45	2	25	-	100
ME 104	Engineering Mechanics	40	40	40	60	2	25	25	150
ME 105	Basic Electrical and Electronics Engineering	40	40	40	60	2	25	25	150
ME 106	Basic Engineering Workshop I	-	-	-	-	-	50	-	50
Total				**180**	**270**	**10**	**175**	**50**	**675**

T- Theory , L- Lab , P-Programming, C- Communication

Program Structure for
Bachelor of Technology in Mechanical Engineering

Semester II

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract/ Tut	Theory	Pract/ Tut	Total
ME 107	Engineering Mathematics II	TLP	3	2	3	1	4
ME 108	Engineering Physics II	TL	2	1	2	0.5	2.5
ME 109	Engineering Chemistry II	TL	2	1	2	0.5	2.5
ME 110	Engineering Drawing	TL	2	4	2	2	4
ME 111	Programming with Python	TLP	1	2	1	1	2
ME 112	Professional Communication and Ethics I	TLC	1	2	1	1	2
ME 113	Basic Engineering Workshop II	L	-	3	-	1.5	1.5
Total			**11**	**15**	**11**	**7.5**	**18.5**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
ME 107	Engineering Mathematics II	40	40	40	60	2	25	-	125
ME 108	Engineering Physics II	30	30	30	45	2	25	-	100
ME 109	Engineering Chemistry II	30	30	30	45	2	25	-	100
ME 110	Engineering Drawing	40	40	40	60	2	25	25	150
ME 111	Programming with Python	20	20	20	30	1	25	25	100
ME 112	Professional Communication and Ethics I	20	20	20	30	1	25	-	75
ME 113	Basic Engineering Workshop II	-	-	-	-	-	50	-	50
Total				**180**	**270**	**10**	**200**	**50**	**700**

T- Theory , L- Lab , P-Programming, C- Communication

Program Structure for
Bachelor of Technology in Mechanical Engineering

Semester III

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract /Tut	Theory	Pract/ Tut	Total
ME 201	Manufacturing Processes	TL	3	2	3	1	4
ME 202	Engineering Mathematics III	TL	3	1	3	1	4
ME 203	Strength of Materials	TL	3	2	3	1	4
ME 204	Thermodynamics	T	3	-	3	-	3
ME 205	Metallurgy and Materials	TL	3	2	3	1	4
ME 206	Computer Aided Drafting	L	-	2	-	1	1
ME 291	Minor Project I	LC	-	4	-	2	2
Total			**15**	**13**	**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					
ME 201	Manufacturing Processes	40	40	40	60	2	50	-	150
ME 202	Engineering Mathematics III	40	40	40	60	2	25	-	125
ME 203	Strength of Materials	40	40	40	60	2	25	25	150
ME 204	Thermodynamics	50	50	50	50	2	-	-	100
ME 205	Metallurgy and Materials	40	40	40	60	2	25	-	125
ME 206	Computer Aided Drafting	-	-	-	-	-	25	50	75
ME 291	Minor Project I	50	50	50	-	-	-	25	75
Total				**260**	**290**	**10**	**150**	**100**	**800**

T- Theory , L- Lab , P-Programming, C- Communication

Program Structure for
Bachelor of Technology in Mechanical Engineering

Semester IV

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract/ Tut	Theory	Pract/ Tut	Total
ME 207	Advanced Manufacturing Technology	TL	3	2	3	1	4
ME 208	Data Science	TLP	-	1*+2	-	1.5	1.5
ME 209	Theory of Machines & Mechanisms	TL	3	2	3	1	4
ME 210	Fluid Mechanics and Machinery	TL	3	2	3	1	4
ME 211	Internet of Things	TL	-	1*+2	-	1.5	1.5
ME 212	Human Values and Social Ethics	T	2	-	2	-	2
ME 292	Minor Project II	LC	-	4	-	2	2
Total			**11**	**16**	**11**	**8**	**19**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract /Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
ME 207	Advanced Manufacturing Technology	40	40	40	60	2	50	-	150
ME 208	Data Science	-	-	-	-	-	25	50	75
ME 209	Theory of Machines and Mechanisms	40	40	40	60	2	25	25	150
ME 210	Fluid Mechanics and Machinery	40	40	40	60	2	25	25	150
ME 211	Internet of Things	-	-	-	-	-	50	25	75
ME 212	Human Values and Social Ethics	20	20	20	40	-	-	-	60
ME 292	Minor Project II	50	50	50	-	-	-	25	75
Total				**190**	**220**	**6**	**175**	**150**	**735**

*** - Theory class to be conducted for full class**

T- Theory , L- Lab , P-Programming, C- Communication

Program Structure for
Bachelor of Technology in Mechanical Engineering

Semester V

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract/ Tut	Theory	Pract /Tut	Total
ME 301	Finite Element Analysis	TL	3	2	3	1	4
ME 302	Measurements and Instrumentation	TL	3	2	3	1	4
ME 303	Machine Design I	TL	3	2	3	1	4
ME 304	Heat Transfer	TL	3	2	3	1	4
ME 305	Professional Communication and Ethics II	TLC	1	2	1	1	2
ME 30x	DLOC I	T/TL	3	-	3	-	3
ME 391	Minor Project III	LC	-	4	-	2	2
Total			**16**	**14**	**15**	**8**	**23**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract /Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
ME 301	Finite Element Analysis	40	40	40	60	2	25	25	150
ME 302	Measurements and Instrumentation	40	40	40	60	2	25	25	150
ME 303	Machine Design I	40	40	40	60	2	25	-	125
ME 304	Heat Transfer	40	40	40	60	2	25	25	150
ME 305	Professional Communication and Ethics II	-	-	-	-	-	50	-	50
ME 30x	DLOC I	50	50	50	50	2	-	-	100
ME 391	Minor Project III	50	50	50	-	-	-	25	75
Total				**260**	**290**	**10**	**150**	**100**	**800**

T- Theory , L- Lab , P-Programming, C- Communication

Group	Department Specialization	Course Code	DLOC I
1	Thermal Engineering and Fluid Science	ME 306	Advanced Fluid Mechanics (T)
2	Design Engineering	ME 307	Design for Excellence (T)
3	Materials Science and Nanotechnology	ME 308	Advanced Composites and Polymeric Materials (T)
4	Mechatronics & Robotics	ME 309	Signal Processing (T)

Program Structure for
Bachelor of Technology in Mechanical Engineering

Semester VI

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract/ Tut	Theory	Pract/ Tut	Total
ME 310	Mechatronics	TL	3	2	3	1	4
ME 311	Machine Design II	T	3	2	3	1	4
ME 312	Engineering Vibrations	T	3	2	3	1	4
ME 3xx	DLOC II	T/TL	3	-	3	-	3
ME 3xx	DLOC III	T/TL	3	-	3	-	3
IL 36x	ILOC I	T	3	-	3	-	3
ME 392	Minor Project IV	LC		4	-	2	2
Total			**18**	**10**	**18**	**5**	**23**

Course Code	Course Name	Examination Scheme							
		Theory							
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)	Term Work	Pract /Oral	Total
		1	2	Avg					
ME 310	Mechatronics	40	40	40	60	2	25	25	150
ME 311	Machine Design II	40	40	40	60	2	25	25	150
ME 312	Engineering Vibrations	40	40	40	60	2	25	25	150
ME 3xx	DLOC II	50	50	50	50	2	-	-	100
ME 3xx	DLOC III	50	50	50	50	2	-	-	100
IL 36x	ILOC I	40	40	40	60	2	-	-	100
ME 392	Minor Project IV	50	50	50	-	-	-	25	75
Total				**310**	**340**	**12**	**75**	**100**	**825**

T- Theory , L- Lab , P-Programming, C- Communication

Group	Department Specialization	Course Code	DLOC II
1	Thermal Engineering and Fluid Science	ME 313	Advanced Heat Transfer (T)
2	Design Engineering	ME 314	Reliability Engineering (T)
3	Materials Science and Nanotechnology	ME 315	Biomaterials & Tissue Engineering (T)
4	Mechatronics & Robotics	ME 316	Micro Electro Mechanical Systems (T)
5	Manufacturing Engineering	ME 317	World Class Manufacturing (T)
		ME 318	Quality Engineering (T)
6	Energy Science and Engineering	ME 319	Wind Energy & Conversion Systems (T)
7	Automotive System	ME 320	Vehicle Systems (T&L)

Group	Department Specialization	Course Code	DLOC III
1	Thermal Engineering and Fluid Science	ME 321	Experimental Methods for Thermal and Fluid Systems (T)
2	Design Engineering	ME 322	Failure Analysis (T)
3	Materials Science and Nanotechnology	ME 323	Nanotechnology, Nanostructures and Nanomaterials (T)
4	Mechatronics & Robotics	ME 324	Control Systems (T&L)
5	Manufacturing Engineering	ME 325	Optimization Techniques (T)
6	Energy Science and Engineering	ME 326	Thermal Energy Storage Systems and Applications (T)
7	Automotive System	ME 327	Automotive Chassis and Body Systems (T)

Group	Institute Specialization	Course Code	ILOC I
1	Business and Entrepreneurship	IL 360	Entrepreneurship (T)
		IL 361	IPR and Patenting (T)
2	Bio Engineering	IL 362	Introduction to Bioengineering (T)
3	Engineering Design	IL 363	Product Design (T)
4	Art and Humanities	IL 364	Visual Art (T)
		IL 365	Journalism, Media and Communication studies (T)
5	Applied Science	IL 366	Computational Physics (T)
		IL 367	Polymers and Polymeric Materials (T)
6	Life Skills, Repair, Maintenance and Safety	IL 368	Vehicle Safety (T)
		IL 369	Maintenance of Electronics Equipment (T)

Program Structure for
Bachelor of Technology in Mechanical Engineering

Semester VII

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract/ Tut	Theory	Pract/ Tut	Total
ME 401	Production Planning and Systems	T	3	-	3	-	3
ME 402	Power Engineering	TL	3	2	3	1	4
ME 4xx	DLOC IV	T/TL	3	-	3	-	3
ME 4xx	DLOC V	T/TL	3	2	3	1	4
IL 4xx	ILOC II	T	3	-	3	-	3
ME 491	Major Project I	LC	-	6	-	3	3
Total			**15**	**10**	**15**	**5**	**20**

Course Code	Course Name	Examination Scheme							
		Theory							
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)	Term Work	Pract /Oral	Total
		1	2	Avg					
ME 401	Production Planning and Systems	50	50	50	50	2	-	-	100
ME 402	Power Engineering	40	40	40	60	2	25	25	150
ME 4xx	DLOC IV	50	50	50	50	2	-	-	100
ME 4xx	DLOC V	40	40	40	60	2	25	25	150
IL 4xx	ILOC II	40	40	40	60	2	-	-	100
ME 491	Major Project I	-	-	-	-	-	50	-	50
Total				**220**	**280**	**10**	**100**	**50**	**650**

T- Theory , L- Lab , P-Programming, C- Communication

Group	Department Specialization	Course Code	DLOC IV
1	Thermal Engineering and Fluid Science	ME 403	Thermal Design of Electronic Equipment (T)
2	Design Engineering	ME 404	Design of Mechanical Systems (T)
3	Materials Science and Nanotechnology	ME 405	Electrical, Magnetic and Optoelectronic Materials (T)
4	Mechatronics & Robotics	ME 406	Robotics (T)
5	Manufacturing Engineering	ME 407	Manufacturing Analytics (T)
6	Energy Science and Engineering	ME 408	Sustainable/Zero Energy Buildings (T)
		ME 409	Energy Audit and Management (T)
7	Automotive System	ME 410	Alternate Fuels and Emissions (T&L)
		ME 411	Hybrid & Electric Vehicles (T&L)

Group	Department Specialization	Course Code	DLOC V
1	Thermal Engineering and Fluid Science	ME 412	Instrumentation in Thermal Systems (T&L)
2	Design Engineering	ME 413	Synthesis of Mechanisms (T&L)
3	Materials Science and Nanotechnology	ME 414	Characterization Techniques (T&L)
4	Mechatronics & Robotics	ME 415	Modelling and Simulation (T&L)
5	Manufacturing Engineering	ME 416	Additive Manufacturing (T)
6	Energy Science and Engineering	ME 417	Energy Systems Modelling & Analysis (T&L)
7	Automotive System	ME 418	Automotive Electronics (T&L)

Group	Institute Specialization	Course Code	ILOC II
1	Business and Entrepreneurship	IL 470	E commerce and E business (T)
		IL 471	Business Analytics (T)
2	Bio Engineering	IL 472	Biomedical Instrumentation (T)
3	Engineering Design	IL 473	Design for sustainability (T)
4	Art and Humanities	IL 474	Political Science (T)
5	Applied Science	IL 475	Research Methodology (T)
6	Life Skills, Repair, Maintenance and Safety	IL 476	Maintenance of Mechanical Equipment (T)
		IL 477	Cooking and Nutrition (T)

Program Structure for
Bachelor of Technology in Mechanical Engineering

Semester VIII

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract /Tut	Theory	Pract /Tut	Total
ME 419	Refrigeration and Air Conditioning	TL	3	2	3	1	4
ME 420	Finance and Wealth Management	T	2	-	2	-	2
ME 4xx	DLOC VI	T/TL	3	2	3	1	4
IL 4xx	ILOC III	T	3		3		3
ME 492	Major Project II	LC	-	12	-	6	6
Total			**11**	**16**	**11**	**8**	**19**

Course Code	Course Name	Examination Scheme							
		Theory							
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)	Term Work	Pract /Oral	Total
		1	2	Avg					
ME 419	Refrigeration and Air Conditioning	40	40	40	60	2	25	25	150
ME 420	Finance and Wealth Management	20	20	20	40	2	-	-	60
ME 4xx	DLOC VI	40	40	40	60	2	25	25	150
IL 4xx	ILOC III	40	40	40	60	2	-	-	100
ME 492	Major Project II	-	-	-	-	-	50	100	150
Total				**140**	**220**	**8**	**100**	**150**	**610**

T- Theory , L- Lab , P-Programming, C- Communication

Group	Department Specialization	Course Code	DLOC VI
1	Thermal Engineering and Fluid Science	ME 421	Computational methods in Thermal Engineering (T)
2	Design Engineering	ME 422	Tribology (T&L)
3	Materials Science and Nanotechnology	ME 423	Processing and Testing of Materials (T&L)
4	Mechatronics & Robotics	ME 424	Microprocessor and Controllers (T&L)
5	Manufacturing Engineering	ME 425	Tool Engineering (T)
6	Energy Science and Engineering	ME 426	Solar Energy Engineering (T&L)
7	Automotive System	ME 427	Vehicle Dynamics and Control (T&L)

Group	Institute Specialization	Course Code	ILOC III
1	Business and Entrepreneurship	IL 480	Digital Business Management and Digital Marketing (T)
2	Bio Engineering	IL 481	Medical Image Processing (T)
3	Engineering Design	IL 482	Technologies for Rural Development (T)
4	Art and Humanities	IL 483	Economics (T)
5	Applied Science	IL 484	GIS and Remote Sensing (T)
6	Life Skills, Repair, Maintenance and Safety	IL 485	Physical Education (T)
		IL 486	Environmental Management (T)

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

Department Specializations						
1	**2**	**3**	**4**	**5**	**6**	**7**
Thermal and Fluids Science	***Design Engineering***	***Materials Science & Nanotechnology***	***Mechatronics & Robotics***	**Manufacturing Engineering**	***Energy Science and Engineering***	***Automotive System***
Advanced Fluid Mechanics (T)	Design for Excellence (DFX) (T)	Advanced Composites and Polymeric Materials (T)	Signal Processing (T)	World Class Manufacturing (T)	Wind Energy & Conversion Systems (T)	Vehicle Systems (T&L)
Advanced Heat Transfer (T)	Reliability Engineering (T)	Biomaterials & Tissue Engg (T)	Micro Electro Mechanical Systems (T)	Quality Engineering (T)	Thermal Energy Storage Systems and Applications (T)	Automotive Chassis and Body Systems (T)
Experimental Methods for Thermal/Fluid Systems (T)	Failure Analysis (T)	Nanotechnology, Nanostructures and Nanomaterials (T)	Control Systems (T&L)	Optimization Techniques (T)	Sustainable/Zero Energy Buildings (T)	Alternate Fuels and Emissions (T&L)
Thermal Design of Electronic Equipment (T)	Design of Mechanical Systems (T)	Electrical, Magnetic and Optoelectronic Materials (T)	Robotics(T)	Manufacturing Analytics (T)	Energy Audit and Management (T)	Hybrid & Electric Vehicles (T & L) (P)
Instrumentation in Thermal Systems (T&L)	Synthesis of Mechanisms (T&L)	Characterization Techniques (T&L)	Modelling and Simulation (T&L)	Additive Manufacturing (T)	Energy Systems Modelling & Analysis (T&L)	Automotive Electronics (T&L)
Computational methods in Thermal Engg (T)	Tribology (T & L)	Processing and Testing of Materials (T&L)	Microprocessor and Controllers(T&L)	Tool Engg (T)	Solar Energy Engineering (T&L)	Vehicle Dynamics and Control (T&L) (P)

Institute Specialization:
Minimum **One Specialization** to be completed (Minimum **Three** subjects from each.)

Institute Specializations					
1	**2**	**3**	**4**	**5**	**6**
Business and Entrepreneurship	***Bio Engineering***	***Engineering Design***	***Art and Humanities***	***Applied Science***	***Life Skills, Repair, Maintenance and Safety***
Entrepreneurship	Introduction to Bioengineering	Product Design	Visual Art	Computational Physics	Vehicle Safety
IPR and Patenting	Biomedical Instrumentation	Design for Sustainability	Journalism, Media and Communication studies	Polymers and Polymeric Materials	Maintenance of Electronics Equipment
E- Commerce and E-Business	Medical Image Processing	Technologies for Rural Development	Political Science	Research Methodology	Maintenance of Mechanical Equipment
Business Analytics			Economics	GIS and Remote Sensing	Cooking and Nutrition
Digital Business Management and Digital Marketing					Physical Education
					Environmental Management

Course Code	Course Name	Credits
ME 101	**Engineering Mathematics I**	**3+1**

Course Objectives:

1. To develop the basic Mathematical skills of engineering students that are imperative for effective understanding of complex numbers and acquaint students with the hyperbolic, logarithmic functions in engineering subjects.
2. To understand the regression analysis and interpolation methods.
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 and eigenvalues and eigenvectors useful in engineering.
6. To provide hands on experience using SCILAB software to handle Mathematical modelling.

Course Outcomes:

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

1. Apply the basic concept of complex numbers, Hyperbolic and logarithmic functions used to solve problems in engineering.
2. Apply the concept of regression and interpolation in engineering problems.
3. Apply the concept of expansion of functions and successive differentiation.
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 and eigen values in many areas of research.
6. Apply the concept of numerical Methods for solving the engineering problems with the help of SCILAB software.

Module	Detail Content	Hrs.
1	**Complex Numbers** **Pre-requisite:** Review of Complex Numbers-Algebra of Complex Number, Cartesian, polar and exponential form of complex number. De Moivre's Theorem. 1.1. Applications of De Moivre's Theorem. 1.2. Powers and Roots of complex number. 1.3 Introduction to Hyperbolic and Inverse Hyperbolic functions and simple examples. 1.4 Logarithmic functions, Separation of real and Imaginary parts of Logarithmic Functions	6

2	**Regression Analysis and Correlation** 3.1 Interpolation: - Lagrange's Linear and Quadratic 3.2 Linear Regression, Lines of regression 3.3 Fitting a Regression Line: Method of least squares. 3.4 Karl Pearson's Coefficient of correlation (r) and related concepts, Spearman's Rank correlation coefficient (R) (Repeated & non repeated ranks problems).	6
3	**Successive Differentiation, Expansion of Function** 3.1 Successive differentiation: nth derivative of standard functions 3.2 Taylor's Theorem (Statement only) and Taylor's series, Maclaurin's series (Statement only). Expansion of$e^{\wedge}(x)$, sin(x), cos(x), tan(x), sinh(x), cosh(x), tanh(x), log(1+x), $\sin^{-1}(x)$, $\cos^{-1}(x)$, $\tan^{-1}(x)$.	6
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.	9
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. 5.4 Eigen values and Eigen vectors of Matrices.	9
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	6

Theory Assessment:

Internal Assessment (40 marks)

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.

End Semester Examination (60 marks)

1. Question paper will comprise of total 05 questions, each carrying 20 marks.
2. Total 03 questions need to be solved.
3. Question No: 01 will be compulsory and based on the entire syllabus wherein 4 sub-questions of 5 marks each will be asked.

Term Work:

General Instructions:

1. Batch wise practicals are to be conducted. The number of students per batch should be as per norms.
2. Students must be encouraged to write SCILAB Programs in the laboratory. Each Student has to perform at least 4 SCILAB practicals and at least 6 assignments on the entire syllabus.
3. SCILAB Practicals will be based on (i) Gauss Elimination(ii) Gauss Seidel Iteration method (iii) Gauss Jacobi Iteration Method (iv) Bisection method (v) Secant Method (vi) Newton Raphson (vii) Matrices (viii) Maxima and Minima.(At least four).

The distribution of Term Work marks will be as follows –

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

Text/ References Books:

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 .

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Course Code	Course Name	Credits
ME 102	**Engineering Physics I**	**2+0.5**

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.
4. To improve ability to analyze experimental results and write laboratory reports.

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. Able to explain the working principle of optical fibres and their applications especially in the field of communication.
3. Explain the limits of Classical Physics and apply the fundamentals of quantum mechanics to study the one dimensional motion of microscopic particles.
4. Apply the knowledge of superconductivity to SQUID and Magnetic levitation.
5. Apply the reasons for Acoustic defects and use this in the proper design of a Hall/Auditorium and use the knowledge of Piezoelectric and Magnetostriction effect for production of ultrasonic waves and its application in various fields.
6. Apply the knowledge of coordinate systems and vector calculus to various situations. Also the learner will be able to study further as the base is set in this topic.

Theory Syllabus:

Module	Detail Content	Hrs.
1.	**Lasers:** Laser: spontaneous emission and stimulated emission; metastable state, population inversion, types of pumping, resonant cavity, Einstein's equations; Helium Neon laser; Nd:YAG laser; Semiconductor laser, Applications of laser- Holography (construction and reconstruction of holograms) and industrial applications(cutting, welding etc), Applications in the medical field; LIDAR (Light Detection and Ranging)	4
2.	**Optical Fibres:** Working Principle and structure , Numerical Aperture for step index fibre; critical angle; angle of acceptance; V number; number of modes of propagation; types of optical fibres; Applications : Fibre optic communication system; sensors (Pressure, temperature, smoke, water level), applications in the medical field.	4

3.	**Quantum Mechanics:** De Broglie hypothesis of matter waves; properties of matter waves; wave packet, phase velocity and group velocity; Wave function; Physical interpretation of wave function; Heisenberg uncertainty principle; non existence of electron in nucleus; Schrodinger's time dependent wave equation; time independent wave equation; Free electron, Particle trapped in one dimensional infinite potential well, Quantum Computing.	6
4.	**Superconductivity:** Critical temperature, critical magnetic field, Meissner'seffect, Type I and Type II and high Tc superconductors; BCS Theory (concept of Cooper pair); Josephson effect Applications of superconductors- SQUID, MAGLEV	3
5.	**Ultrasonics and Acoustics:** Ultrasonic Wave generation; Magnetostriction Oscillator; Piezoelectric Oscillator; Applications of ultrasonic: Echo sounding; NDT; ultrasonic cleaning(cavitation); ultrasonic sensors; Industrial applications of ultrasonic(soldering, welding, cutting, drilling) Conditions of good acoustics; Reflection of sound(reverberation and echo); absorption of sound; absorption coefficient; Sabine's formula; Acoustic Design of a hall; Common Acoustical defects and acoustic materials	4
6.	**Vector Calculus:** Scalar and vector fields, Cartesian, polar, Cylindrical and Spherical Coordinate system, gradient, curl and divergence in Cartesian coordinate system, Central force, line integral, work energy theorem, surface integral, volume integral, divergence theorem, Continuity Equation, Stoke's theorem, Maxwell's Equations.	4

Laboratory Syllabus:

Sr. No.	List of Experiments (Any Five)	Hrs.
1	Determination of number of lines on the grating surface using LASER Source.	1
2	Determination of Numerical Aperture of an optical fibre.	1
3	Determination of wavelength using Diffraction grating. (Laser source)	1
4	Study of Ultrasonic Distance Meter.	1
5	Determination of angular divergence of laser beam.	1
6	Determination of absorption coefficient of sound of given material.	1
7	To measure the thickness of fine wire and grating element of the given grating with help of Laser source	1

Theory Assessment :

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.

End Semester Examination

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

1. Question paper will consist of 3 questions, each carrying 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.

Laboratory Assessment:

Term work:

Term Work shall consist of a minimum five experiments.

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

- Laboratory work (Experiments and Journal) **:** 10 marks
- Project Groupwise or Topic Presentation : 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.

Books/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- ArtherBeiser, 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.

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Course Code	Course Name	Credits
ME 103	**Engineering Chemistry I**	**2+0.5**

Course Objectives:

1. To impart a scientific approach and to familiarize the applications of chemistry in the field of engineering.
2. The student with the knowledge of the basic chemistry, will understand and explain scientifically the various problems related to chemistry in the industry/engineering field.
3. To develop abilities and skills that are relevant to the study and practice of chemistry.

Course Outcomes:

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

1. To understand and analyse the combustion mechanisms of various fuels and be able to characterize the fuels for practical purposes.
2. To determine the quality of the lubricants and be able to suggest lubricants for different industrial applications.
3. To become familiarized with corrosion types and the environmental factors affecting corrosion and to suggest the method of corrosion protection.
4. To analyse the quality of water and will be able to suggest methods to improve water quality
5. To apply phase rule to one and two component systems and understand the importance of phase diagrams in material science and engineering..
6. To acquire knowledge about the alloys and the determination of composition of the alloys.

Theory Syllabus:

Module	Detail Content	Hrs.
1	**Fuels and Combustion** **Pre-requisite:** What are fuels, Types of fuels, Characteristics of fuels. Calorific value of a fuel - HCV and LCV, Theoretical determination of calorific value of fuel by Dulong's formula, Numerical problems Solid fuels : Coal, Analysis of coal - Proximate and Ultimate analysis, Numerical problems Liquid fuels: Composition and refining, Knocking, Octane number, Cetane number, Biodiesel Gaseous Fuels: LPG and CNG Combustion of fuels – Numerical problems for calculating the amount of air needed for the complete combustion of solid and gaseous fuels. Limitations of fossil fuels. Alternate and non conventional energy sources- solar, wind, hydropower and biomass	6

2	**Lubricants** **Pre - requisites** : Definition of Lubricants and Lubrication, functions of lubricants Mechanisms of lubrication – Thick film, Thin film and Extreme pressure Classification of lubricants - Solid (MoS_2, graphite), Semi solid (greases), Liquid (animal/vegetable oils, mineral oils, synthetic oils) Properties of lubricants and their significance - Viscosity and Viscosity Index, Flash and Fire Points, Cloud and Pour Points, Acid Number, Saponification Number, Steam Emulsification Number and related numerical problems.	3
3	**Corrosion and its Control** **Pre-requisite:-** corrosion , corrosion product, electrochemical series, corrosive and non corrosive metals. 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 mitigating corrosion : Material selection, Design, Cathodic protection, Anodic protection Protective Coatings: Metallic coatings anodic coating (galvanizing) and cathodic coating (Tinning), Different Methods of Applying Metallic Coatings, Organic coatings	6
4	**Water and its Treatment** **Pre-requisite** : 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, and numerical problems. Effects of Hard water in boilers - Priming and Foaming, Scales and Sludges, Boiler corrosion, caustic embrittlement, Softening of water- Ion exchange process. Desalination of brackish water- Reverse Osmosis, Electrodialysis, Ultrafiltration	4
5	**Phase Rule** Gibbs Phase Rule - Introduction, definition of terms with examples, One component system (Water system), Reduced Phase rule, Two component system (Pb-Ag system) , Limitations of phase rule.	3
6	**Alloys** Introduction to Alloys, Plain Carbon Steel and Alloy Steels Alloys of Cu, Al and Pb	2

List of Experiments:

Experiment	Detail Content	Hrs.
1	Determination of Hardness in water	1
2	Determination of Viscosity of oil by Redwood Viscometer	1
3	Determination of Flash point of a lubricant using Abel's apparatus	1
4	Determination of Acid Value and Saponification Value of an oil.	1
5	Determination of Chloride content of water by Mohr's Method	1
6	Determination of moisture content and volatile matter in coal sample.	1
7	Study of the effect of different environments (Acid, Base) on corrosion rate.	1
8	Determination of COD Value of water.	1
9	Removal of hardness using ion exchange column.	1
10	Determination of Iron in Plain Carbon Steel.	1

Theory Assessment

Internal Assessment Test (30 marks)

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.

End Semester Examination (45 marks)

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.

Term work:

Term Work shall consist of minimum five experiments.

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 Tutorial) : 05 marks

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

Text books/Reference Books:

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. Engineering Chemistry – Wiley India (ISBN-9788126519880)
5. Essentials of Physical Chemistry - Arun Bahl, B.S. Bahl and G.D. Tuli ,
6. Textbook on Experimental and calculations in Engineering Chemistry – S.S. Dara S. Chand Publishing House
7. Experiments in Engineering Chemistry – I.K International Publishing House

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Course Code	Course Name	Credits
ME 104	**Engineering Mechanics**	**3+1**

Course Objectives:

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 it's constraints, and able to formulate the mathematical function of the system.
3. To study, analyse 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. Makes the students able to apply equilibrium equations in statics.
4. Evaluate co-efficient of friction between the different surfaces in contact.
5. Establish relation between velocity and acceleration of a particle and analyze the motion by plotting the relation.
6. The ability to understand Newton's law in motion, and recognize different kinds of particle motions.

Theory Syllabus:

Module	Detail Content	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 System of Coplanar Forces and Beams: Conditions of equilibrium for concurrent forces, parallel forces and non-concurrent non- parallel general 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. (Including problems on internal hinges)	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.	06

	4.2 Wedge Friction: Equilibrium of bodies on inclined plane. Application to problems involving wedges and ladders. 4.3 Rope and Belt Friction: Block Friction including Rope and Belt Friction.	
5.	**Kinematics of Particle and Rigid Body:** 5.1 Kinematics of Particle and Rigid Body: Motion of particle with variable acceleration. General curvilinear motion. Tangential& Normal component of acceleration, Motion curves (a-t, v-t, s-t curves). Application of concepts of projectile motion and related numerical. 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 Kinetics of a Particle: Force and Acceleration: -Introduction to basic concepts, D'Alemberts Principle, concept of Inertia force, Equations of dynamic equilibrium, Newton's second law of motion. (Analysis limited to simple systems only.) 6.2 Kinetics of a Particle: 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 Kinetics of a Particle: 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

Laboratory Syllabus:

Practical	Details	Hours
1	Verification of Polygon law of coplanar forces	2
2	Verification of Principle of Moments (Bell crank lever.)	2
3	Determination of support reactions of a Simply Supported Beam.	2
4	Determination of coefficient of friction) using inclined plane	2
5	Collision of elastic bodies (Law of conservation of momentum).	2
6	Kinematics of particles. (Uniform motion of a particle, Projectile motion, motion under gravity)	2
7	Kinetics of particles. (collision of bodies)	2

Theory Assessment:

Internal Assessment for 40 marks:

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.

End Semester Examination: 60 Marks

1. Question paper will comprise of total 06 questions, each carrying 15 marks.
2. 10 percent of marks will be asked from the self-study topics.
3. Total 04 questions need to be solved.
4. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of 2 to 5 marks will be asked.

6. 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)
7. In question paper weightage of each module will be proportional to number of respective lecture hrs as mentioned in the syllabus.

Laboratory Assessment:
Internal Assessment for 25 marks:
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.
End Semester Practical/Oral Examination: 25 Marks
Pair of Internal and External Examiner should conduct practical/viva based on entire syllabus.

Books/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& RawPublication
5. Engineering Mechanics by ShaumSeries

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Course Code	Course Name	Credits
ME 105	**Basic Electrical and Electronics Engineering**	**3+1**

Course Objectives:
The course is aimed

1. To provide knowledge on fundamentals of D.C. circuits and its applications
2. To impart knowledge on fundamentals of 1-Φ A.C. circuits and its applications.
3. To impart knowledge on fundamentals of 3-Φ A.C. circuits and its applications.
4. To provide knowledge on fundamentals of DC machines.
5. To impart knowledge of Basic Electronics circuits

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

1. To evaluate D.C. circuits using network theorems.
2. Apply the concept of ac circuit and its resonance phenomena for a given RL, RC and RLC circuit.
3. To evaluate 3-Φ AC circuits.
4. To illustrate the working principle of DC machines.
5. To apply the concept of rectification.

Theory Syllabus:

Module	Detail Content	Hrs.
1	**DC Circuits** Kirchhoff 's laws, Ideal and practical voltage and current source, Mesh and Nodal analysis (super node and super mesh excluded), Source transformation, Star-delta transformation, Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, (Source transformation not allowed for Superposition theorem, Mesh and Nodal analysis)	12
2	**AC Circuits** Generation of alternating voltage and currents, RMS and Average value, form factor , crest factor, AC through resistance, inductance and capacitance, R-L , R-C and R-L-C series and parallel circuits, phasor diagrams, power and power factor, series and parallel resonance, Q-factor	12
3	**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
4	**Electrical Machines (No Numericals)** Principle of operation of DC motors and DC generators, construction and classification of DC machines, emf equation.	3
5	**Basic Electronics** Semiconductor diode, Diode rectifier with R load: Half wave, full wave-center tapped and bridge configuration, RMS value and average value of output voltage, ripple factor, rectification efficiency,	3

	introduction to C and L filter (no derivation).CE, CB, CC transistor configuration, CE input-output characteristics	

Laboratory Syllabus:

Experiment	Details	Hours
1	Mesh and Nodal analysis	2
2	Verification of Superposition Theorem.	2
3	Verification Thevenin's Theorem.	2
4	Study of R-L series and R-C series circuit.	2
5	R-L-C series resonance circuit	2
6	R-L-C parallel resonance circuit	2
7	Relationship between phase and line currents and voltages in three phase system (star & delta)	2
8	Power and phase measurement in a three phase system by one wattmeter method	2
9	Power and phase measurement in a three phase system by two wattmeter methods.	2
10	Speed Control of DC motors.	2
11	Speed Control of Induction motors.	2
12	Half wave and Full wave rectifier .	2

Theory Assessment:

Internal Assessment : 40 marks

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.

End Semester Examination: 60 marks

1. Question paper will comprise of total 05 questions, each carrying 20 marks.
2. Total 03 questions need to be solved.
3. Question No: 01 will be compulsory and based on the entire syllabus wherein 4 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.

Lab Assessment:

Term Work:

General Instructions:

Term work consists of performing minimum 06 practicals . Final certification and acceptance of the term work ensures satisfactory performance of laboratory work.

The distribution of Term Work marks will be as follows –

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

End Semester Oral Examination:

Pair of Examiners should conduct Viva based on contents of the entire syllabus.

Oral Examination will be for 25 Marks

Books/References:

1. B.L.Theraja “Electrical Technology” Vol-I and II, S. Chand Publications, 23 rd ed. 2003.
2. Joseph A Edminister, “Schaum‟s outline of theory and problems of electric circuits” Tata McGraw Hill, 2 nd edition
3. Electronics Devices & Circuit Theory" by Boylestad, Pearson Education India
4. D P Kothari and I J Nagrath “Theory and Problems of Basic Electrical Engineering”, PHI 13 th edition 2011.

Back To Scheme

Course Code	Course Name	Credits
ME 106	**Basic Engineering Workshop I**	**1.5**

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 skill 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 plumping tools.
7. Demonstrate the turning operation with the help of a simple job.

Trade Nos.	**Detailed Content**	**Hrs.**
Note: Trade 1 and 2 are compulsory. Select any ONE trade topics out of the topic at trade 3 to 5. Demonstrations and hands on experience to be provided during the periods allotted for the same. Report on the demonstration including suitable sketches is also to be included in the term work. CO-1 is related to Trade-1, CO-2 to CO-4 is related to Trade-2 CO-5 is related to Trade-3, CO-6 is related to Trade-4 CO-7 is related to Trade-5 CO evaluation is to be done according to the opted Trades in addition to **Compulsory Trades.**		
Trade-1	**Fitting (Compulsory):** • Use and setting of fitting tools for chipping, cutting, filing, marking, center punching, drilling, tapping. • Term work to include one job involving following operations : filing to size, one simple male- female joint, drilling and tapping	10
Trade-2	**Hardware and Networking: (Compulsory)** • Dismantling of a Personal Computer (PC), Identification of Components of a PC such as power supply, motherboard, processor, hard disk, memory (RAM, ROM), CMOS battery, CD drive, monitor, keyboard, mouse, printer, scanner, pen drives, disk drives etc. • Assembling of PC, Installation of Operating System (Any one) and Device drivers, Boot-up sequence. Installation of application software (at least one) • Basic troubleshooting and maintenance • Identification of network components: LAN card, wireless card, switch, hub, router, different types of network cables (straight cables, crossover cables, rollover cables) Basic networking and crimping. NOTE: Hands on experience to be given in a group of not more than four students	08

Trade-3	**Welding:*** • Edge preparation for welding jobs. Arc welding for different job 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 one trade out of 3,4 and 5

Laboratory Assessment
Internal Assessment: 50 marks
Term Work:

1. All the jobs mentioned above
2. Complete Work-Shop Book giving details of drawing of the job and time sheet

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

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

Books/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
4. Workshop Technology by Chapman.

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Course Code	Course Name	Credits
ME 107	**Engineering Mathematics II**	**3+1**

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 modelling.
3. To acquaint the students with the Beta, Gamma functions and DUIS.
4. To learn different techniques to solve double and triple integrations.
5. To learn the concept of vector differentiation and Integration.
6. To provide knowledge of numerical techniques using SCILAB software to handle Mathematical modelling.

Course Outcomes:

Upon 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 higher order differential equations in mathematical modelling to solve real life problems.
3. Apply the basic concepts of beta, gamma and DUIS to solve engineering problems.
4. Apply the concept of double and triple integration in solving problems of engineering and technology.
5. Apply the concept of vector differentiation and Integration in optimization.
6. Apply the concept of differentiation and integration numerically for solving the engineering problems with the help of SCILAB software.

Module	Detail Content	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, equation reducible to linear form. 1.3 Application of differential equation of first order and first degree in engineering.	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 ^ax V, x V. 2.2 Cauchy Differential equation, Method of variation of parameters two variables	7
3	**Beta and Gamma Function, Differentiation under Integral sign** 3.1 Beta and Gamma functions and its properties. 3.2 Differentiation under integral sign with constant limits of integration(One parameter).	6
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 double integrals by changing to polar coordinates.	8

	4.3. Triple integration**:** Evaluation (Cartesian, cylindrical and spherical polar coordinates)	
5	**Vector Differentiation and Integration** 3.1 Vector function of scalar quantities, Vector operator del, Gradient, Divergence, Curl and their physical interpretation and Laplacian 3.2 Directional derivatives , Solenoidal and irrotational (conservative) vector fields. 3.3 Line integrals – definition and problems, circulation, work done, Engineering applications of Line integral.	6
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

Theory Assessment:

Internal Assessment (40 marks)

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.

End Semester Examination: (60 marks)

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.

Term Work:

General Instructions:

1. Batch wise practicals are to be conducted. The number of students per batch should be as per norms.
2. Students must be encouraged to write SCILAB Programs in the laboratory. Each Student has to perform at least 4 SCILAB practicals and at least 6 assignments on the entire syllabus.
3. SCILAB Practicals will be based on (i) Euler's method (ii) Modified Euler method, (iii)Runge-Kutta fourth order method (iv) Trapezoidal (v) Simpson's 1/3rd (vi) Simpson's 3/8th rule(vii) Differential equations (viii) Integratio.(At least four)

The distribution of Term Work marks will be as follows –

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

Books/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 .

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Course Code	Course Name	Credits
ME 108	**Engineering Physics II**	**2+0.5**

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.
4. To improve ability to analyze experimental results and write laboratory reports.

Course Outcomes:

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

1. Able to understand fundamental concepts of classical optics and applications of interference in science and technology.
2. Able to understand fundamental concept of diffraction of light and its applications
3. To comprehend the basic concepts of semiconductor physics and apply the same to electronic devices.
4. Apply the concepts of crystallography and to use XRD techniques for analysis of crystal structure .
5. Comprehend the properties of Supercapacitors to apply them in novel applications.
6. Comprehend the significance of nanoscience and nanotechnology and its current and futuristic frontier applications.

Theory syllabus:

Module	Detail Content	Hrs.
1.	**Thin Film Interference :** Interference by division of amplitude and by division of wave front; Interference in thin film of constant thickness due to reflected and transmitted light; origin of colours in thin film; Wedge shaped film(angle of wedge and thickness measurement); Newton's rings Applications of interference - Determination of thickness of very thin wire or foil; determination of refractive index of liquid; wavelength of incident light; radius of curvature of lens; testing of surface flatness; Anti-reflecting films and Highly reflecting film.	5
2.	**Diffraction of light:** Fraunhoffer diffraction at single slit, Fraunhoffer diffraction at double slit, Diffraction Grating, Resolving power of a grating, dispersive power of a grating Application of Diffraction - Determination of wavelength of light with a plane transmission grating.	4
3.	**Physics of semiconductor Devices:** Splitting of energy levels for band formation; Classification of semiconductors(direct & indirect band gap, elemental and compound); Conductivity, mobility, current density (drift & diffusion) in semiconductors(n type and p type); p-n junction Diode (unbiased, forward bias, reverse bias); Breakdown mechanism (zener & avalanche), Hall Effect.	5

	Applications of semiconductors: Rectifier diode, LED, Zener diode, Photo diode, Photovoltaic cell, BJT, FET, SCR., MOSFET	
4.	**Crystallography and X-Ray Diffraction Techniques:** Introduction to crystallography, Miller indices of crystallographic planes & directions; interplanar spacing; X-ray diffraction and Bragg's law; Determination of Crystal structure using Bragg's diffractometer; Frenkel and Schotkey crystal defects. EDAX technique for determination of elemental composition	4
5.	**Supercapacitors, Fuel cells and Hydrogen storage:** Principle, construction, materials and applications, comparison with capacitor and batteries : Energy density, Power density. Concept of Hydrogen adsorption/ desorption, techniques for determination of BET (Brunauer-Emmett-Teller) pore surface area, Adsorption/desorption isotherms	4
6.	**Nanoscience and Nanotechnology:** Introduction to nano-science and nanotechnology, Surface to volume ratio, Two main approaches in nanotechnology -Bottom up technique and top down technique; Important tools in nanotechnology such as Scanning Electron Microscope,Transmission Electron Microscope, Atomic Force Microscope. Nano materials: Methods to synthesize nanomaterials (Ball milling, Sputtering, Physical Vapour deposition, sol gel), properties and applications of nanomaterials.	3

Laboratory Syllabus:

Sr. No.	Title of the Experiment (Any Five)	Hrs.
1	Determination of radius of curvature of a lens using Newton's ring set up	1
2	Determination of diameter of wire/hair or thickness of paper using Wedge shape film method and estimation of Young's modulus of the material.	1
3	Determination of width of a slit using single slit diffraction experiment (laser source)	1
4	Study of Miller Indices, Plane and direction.	1
5	Study of Hall Effect.	1
6	Determination of energy band gap of semiconductor.	1
7	Study of I-V characteristics of light emitting diodes(LED).	1
8	Determination of 'h' using Photocell.	1
9	Study of I-V characteristics of semiconductor photodiode and determination of its spectral response.	1
10	Study of I-V characteristics of a photovoltaic solar cell and finding the efficiency.	1
11	Zener diode as a voltage regulator.	1

Theory Assessment:

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.

End Semester Examination

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

1. Question paper will consist of 3 questions, each carrying 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.

Laboratory Assessment

Term work:

Term Work shall consist of a minimum five experiments.

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

Laboratory work (Experiments and Journal) **:** 10 marks
Project Groupwise or Topic Presentation : 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.

Textbook/Reference Books:

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- ArtherBeiser, Tata McGraw Hill
6. A TextBook of Engineering Physics, S. O. Pillai, New Age International Publishers.
7. Optics - Ajay Ghatak, Tata McGraw Hill
8. Introduction to Nanotechnology- Charles P. Poole, Jr., Frank J. Owens, Wiley India edition
9. Solid State Electronic Devices- B. G. Streetman, Prentice Hall Publisher
10. Introduction to Solid State Physics- C. Kittel, John Wiley& Sons publisher
11. Ultracapacitors: The future of energy storage- R.P Deshpande, McGraw Hill
12. Nanotechnology: Principles and Practices, Dr. S.K. Kulkarni, Capital Publishing Company.
13. Physics for Engineers, M.R. Srinivasan, New Age International Publishers.

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Course Code	Course Name	Credits
ME 109	**Engineering Chemistry II**	**2+0.5**

Course objectives:

1. With the knowledge of the basic chemistry, the student will be able to understand and explain scientifically the various chemistry related problems in the industry/engineering field.
2. The student will be able to understand the new developments and breakthroughs efficiently in engineering and technology.

Course outcomes: Upon successful completion students will be able to

1. To recognize the electrochemical processes and determine the cell potentials in various electrochemical systems.
2. To develop knowledge on electrochemical energy storage systems and familiarization with the characterization methods of batteries.
3. To identify various polymeric materials and to determine polymer molecular weights from different types of experiments.
4. To acquire theoretical background of different classes of materials used in engineering applications and would be able to choose the right materials for specific applications
5. To describe the theoretical background of spectroscopic techniques such as NMR, IR, UV spectroscopy.
6. To assess the environmental impact and understand discuss some mitigation strategies.

Theory Syllabus:

Module	Detail Content	Hrs.
1	**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. Types of Electrochemical cells Reference electrodes - Introduction, Construction, working of SHE, Calomel electrode.	3
2	**Battery Technology** Pre- requisite : Electrochemical Reactions, Cell potential, Electrochemical series Introduction, classification – primary, secondary and reserve batteries. Characteristics – Capacity, Electricity storage density, energy efficiency, cycle life and shelf life. Construction, working and applications of Lead – Acid Storage cell Lithium batteries - Introduction, construction, working and applications of Li-MnO2 Fuel Cells: Introduction, classification of fuel cells, limitations & advantages of fuel cells, Construction of Hydrogen oxygen alkaline fuel cells.	4
3	**Polymeric Materials** Pre - requisite : Polymer, Monomer, Polymerization, Degree of polymerisation, Classification of polymers, Mechanism of polymerisation.	6

	Molecular weight of polymers: number average and weight average, numerical problems. , Polydispersity Index, Polymer crystallinity - glass transition temperature and its significance Compounding and Processing of Polymers Preparation , properties and uses of PMMA, Kevlar, Urea- Formaldehyde Elastomers: Natural rubber and vulcanized rubber, mechanism of vulcanization.	
4	**Advanced Engineering Materials** **4.1 Nanomaterials** Pre-requisite: Concept of nano scale, definition of nanoparticles Importance of nano size, Properties of nanomaterials – Size, optical properties, magnetic properties, electrical properties Nanoscale materials- carbon nanotubes, nano wires, fullerenes. Synthesis of Nanoparticles by Chemical vapor deposition (CVD) method and Laser Ablation Method Applications of nano materials **4.2 Composite Materials** Pre requisite : Definition and basic understanding of composite materials. Constitution of composite materials- Matrix and Dispersed phase Particle reinforced composites, Fibre reinforced composites, structural composites - properties and applications. Factors affecting the dispersion of nanoparticles in the matrix **4.3 Smart Materials** Shape Memory Alloys and Applications	6
5	**Spectroscopic Techniques** Pre-requisites **:** Electromagnetic radiation, characteristics of electromagnetic radiation, electromagnetic spectrum. Spectroscopy - Principle, Interaction of radiation with matter, Selection rules. Types of spectroscopy,: IR, UV, NMR, Emission Spectroscopy, (Flame Photometry), Fluorescence and Phosphorescence, Jablonski diagram	3
6	**Environmental And Green Chemistry** Pre- requisites: Definition of Environment and Primary concept of environmental pollution**.** Concept and Scope of Environmental Chemistry. Environmental Pollution and Control - Industrial Waste pollution Water Pollution - BOD and COD, determination and numerical problems. Concept of 12 principles of Green chemistry, discussion with examples, numericals on atom economy.	2

List of Experiments

Experiment	Details	Hrs.
1	Determination of Cell potential of Zn- Cu system	1
2	Molecular weight determination of polymers by Oswald Viscometer	1
3	Preparation of Urea Formaldehyde	1
4	Preparation of biodegradable polymer using corn starch or potato starch.	1
5	Preparation of Magnetic Nanoparticles.	1
6	Synthesis of Biodiesel	1
7	Determination of electrical conductivity of unknown solution.	1

8	Preparation of Hand Sanitizer using ethyl alcohol	1
9	Determination of Caffeine in Tea	1
10	Determination of pH using glass electrode.	1

Theory Assessment

Internal Assessment: 30 marks

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.

End Semester Examination: 45 marks

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

1. Question paper will consist of 3 questions, each carrying 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.

Term work:

Term Work shall consist of a minimum five experiments.

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 Tutorial) : 05 marks

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

Text books/Reference Books:

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. Engineering Chemistry – O.G. Palanna , Tata Mc Graw Hill
5. Environmental Chemistry – A.K.De, New Age International
6. Fundamentals of Molecular Spectroscopy – C.N . Banwell, Tata Mc Graw Hill
7. Instrumental methods of chemical analysis – B.K.Sharma, Goel Publishing House
8. Textbook on Experimental and calculations in Engineering Chemistry – S.S. Dara S. Chand Publishing House
9. Experiments in Engineering Chemistry – I.K International Publishing House

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Course Code	Course Name	Credits
ME 110	**Engineering Drawing**	**2+2**

Course Objectives:

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) tool

Course Outcomes:

Upon successful completion of this course, learner 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. Apply basic AutoCAD skills to draw different views of a 3D object.

Theory Syllabus:

Module	Detail Content	Hrs.
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. **Engineering Curves** Basic construction of Cycloid, Involutes and Helix (of cylinder) only.	1 3
2.	**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. **Projection of Planes** Triangular, Square, Rectangular, Pentagonal, Hexagonal and Circular planes inclined to either HP or VP only. (Exclude composite planes).	3 2
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	6
4.	**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. **Development of Lateral Surfaces** Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.	4 2
5.	**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.	4

	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.	2
6	**Isometric Views:-** Principles of Isometric projection – Isometric Scale, Isometric Views, Conversion of Orthographic Views to Isometric Views (Excluding Sphere).	3

Laboratory Syllabus:

Component-1: (Use half Imperial Drawing Sheet)

Sr. No.	Activities to be completed in the Drawing Laboratory.	Hrs.
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 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.

Part	To be Taught in laboratory	Hrs.
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 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.	3
	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).	
Part -B	**Activities to be completed in the CAD Laboratory.** (All printouts to be part of Term Work. Preferably, Use A3 size sheets for print out.)	
	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

Theory Assessment:
Internal Assessment: 40 Marks
Assessment consists of two class tests of 40 marks each.
Among the two tests one is Conventional (manual drawing) and Second using CAD Software
End Semester Examination: 60 Marks

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

Laboratory Assessment:
Internal Assessment for 25 marks:
Term Work:

Component-1	:	7 Marks
Component-2	:	6 Marks
Component-3	:	7 Marks
Attendance	:	5 Marks
Total Marks	**:**	**25 Marks**

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

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

Books/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.David V Hutton; Fundamentals of Finite element analysis; 7th Edition Tata McGraw Hill.
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.

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Course Code	Course Name	Credits
ME 111	**Programming with Python**	**1+1**

Course Objectives:

1. To introduce basic concepts of Python programming language as well as common packages and libraries.
2. To generate an ability to design, analyze and perform experiments on real life problems in mechanical engineering using python.

Course Outcomes: Learners will be able to

1. Demonstrate understand of basic concepts of python programming.
2. Identify, install and utilize python packages
3. Develop and execute python programs for specific applications.
4. Develop and build python program to solve real-world engineering problems
5. Prepare a report on case studies selected.

Module	Detail Content	Hrs.
1.	Introduction to python and its applications. Installation of Python and setting up a programming environment such as Anaconda and Spyder Python Basics: Variable and variable types, Booleans, Numbers (integers, floats, fractions, complex numbers), strings, lists, tuples, sets, dictionaries. bytes and byte arrays, Manipulating variables, indexing, slicing, basic operators (arithmetic, relational, logical, membership, identity). String methods, list methods, list slicing, set methods, in built python functions, input and output functions.	04
2.	Basic Coding in Python: If, else, elif statements, for loops, range function, while loops, List comprehensions, functions in python. Introduction to OOP, Classes, Objects, Reading and writing files.	02
3.	Python libraries: Installing of different libraries, packages or modules. Basic concepts of the following libraries: NumPy, Matplotlib, Pandas, SciPy Optional libraries based on case studies in Module 4: Pillow, Scikit, OpenCV, Python in Raspberry Pi	04
4.	Case Studies using Python (Select any 3): 1. Solving a linear differential equation using SciKit and plotting the result in matplotlib. Students can use differential equations from any previous topic studied in the programme such as mechanics, materials science, fluid mechanics, kinematics of machines, thermodynamics, production etc. 2. Image processing and manipulation and auto detection of any object. Applications in self-driving cars may be discussed. 3. Python programming of a Raspberry PI: Students can sense using a sensor, process the reading and then control some physical output (like motor or LED) 4. Project involving basic machine learning (Students should understand the basic concepts of machine learning and apply to specific situation) 5. Any other case study that uses Python to solve Mechanical Engineering problems. 6. Customizing applications by writing API programs using python like to create joints, get physical properties, get circle and arc data from edge.	06

Internal Assessment : 20 marks

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.

End Semester Examination: 30 marks

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.

Lab Assessment:

Termwork : 25 marks (Continuous evaluation)
Practical/Oral : 25 marks

Books/References:-

1. Core Python Programming, Dr. R. NageswaraRao, Dreamtech Press
2. Programming through Python, M.T.Savaliya and R.K.Maurya, StarEdu Solutions
3. Beginning Python: Using Python 2.6 and Python 3.1. James Payne,Wrox publication2.
4. Any digital resources and online guides for python or its packages. Such as "The Python Tutorial", http://docs.python.org/release/3.0.1/tutorial/

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Course Code	Course Name	Credits
ME 112	**Professional Communication and Ethics I**	**1+1**

Course Objectives:

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:

Upon 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.

Theory Syllabus:

Module	Detail Content	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	4
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	4

3	**Strategies and Techniques to build Reading Skill** 3.1 Global understanding of the text- inference, anticipation and deduction 3.2 Detailed understanding of text-scanning for specific information (special emphasis on reading comprehension exercises and summarisation)	2
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 complain letters)	4
5	**Etiquette and Grooming for Personality Development** 5.1 Social Etiquette 5.2 Corporate etiquette 5.3 Confidence building and Personality development	1
6	**Vocabulary and Grammar** 6.1 Contextual vocabulary Development- Word Maps 6.2 Identifying errors in a sentence.	1

Laboratory Syllabus

Prerequisite: Basic language skills

Sr. No.	Assignment	Detailed Lab/Tutorial Description
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)
2	Assignment 2	Transcription of the public speech along with a plagiarism report-Practice public speech
3	Assignment 3	Summarization through graphic organisers (1. Text to graphic organizer 2. Graphic organizer to text)
4	Assignment 4	1. Case studies on critical thinking 2. 2 business letters in complete block format
5	Assignment 5	Documentation of case studies/Role play based on Module 5
6	Assignment 6	1.Contextual Vocabulary Development 2. Aptitude Test

Theory Assessment:

Internal Assessment : 20 marks

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.

(Note: Summarization should be a compulsory question in Test II and not in the End Semester Theory Examination.)

End Semester Examination: 30 marks

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 number of hours assigned to each module.

Term work:
Term Work shall consist of 8 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

Text Books/Reference Books:

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:
4. Building Critical Skills. Place of publication not identified: Mcgraw-hill.
5. Murphy, H. (1999). Effective Business Communication. Place of publication not identified: Mcgraw-Hill.
6. Lewis, N. (2014). Word power made easy. Random House USA.

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Course Code	Course Name	Credits
ME 113	**Basic Engineering Workshop II**	**1.5**

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 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 measuring tools.
6. Develop the necessary skill required to use different sheet metal 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 ONE trade topics out of the topic trade 3 to 5. Demonstrations and hands on experience to be provided during the periods allotted for the same. Report on the demonstration including suitable sketches is also to be included in the term work 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 work shop:(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 work place safe work practices. Protective equipment, measures and tools. 9.Layout drawing, layout transfer to PCB, etching and drilling and soldering technique	**08**
Trade-3	**Measurement*** 10. Vernier Height gauge, wire gauge, Dial gauge. Use of the listed gauges and precaution.	**06**
Trade 4	**Sheet metal working *** 11. Use of sheet metal, working hand tools, cutting , bending , spot welding operation	**06**
Trade-5	**Forging (Smithy):*** 12. At least one forging job to be demonstrated and a simple job to be made for Term Work in a group of 4 students.	**06**

* Students can choose one trade out of Measurement, Sheet metal work and Forging.

Internal Assessment: 50 marks
Term Work:

1. All the jobs mentioned above
2. Complete Work-Shop Book giving details of drawing of the job and time sheet

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

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

Books/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
4. Workshop Technology by Chapman.

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Course Code	Course Name	Credits
ME 201	**Manufacturing Processes**	**3+1**

Course Objectives:

1. To familiarize with the various production processes used on shop floors
2. To study appropriate production processes for a specific application.
3. To introduce to the learner various machine tools used for manufacturing
4. To introduce to the learner various production toolings used for manufacturing

Course Outcomes:

Learner will be able to

1. Demonstrate an understanding of casting and forming process
2. Demonstrate applications of various types of welding processes.
3. Operate machine tools for various machining processes and Select proper machine tools and cutting tools for economic production.
4. Develop competency for selecting appropriate machining parameters to optimize output characteristics such as MRR, surface finish.
5. Design jigs and fixtures for simple jobs and Select dies for sheet metal processing
6. Illustrate the concept of producing polymer components and ceramic components.

Theory Syllabus:

Module	Detail Content	Hrs.
1	**Introduction to Production Processes and Metal Casting** 1.1. Classification of Production Processes and applications areas 1.2. Pattern making materials, Types of pattern and allowances. 1.3. Sand moulding and Machine moulding 1.4. Gating system :Types of riser, types of gates, solidification 1.5. Special casting processes : CO2 and shell moulding, Investment casting, Die casting, Vacuum casting, Inspection & casting defects and remedies	08
2	**Joining Processes** 2.1. Classification of various joining processes; Applicability, advantages and limitations of Adhesive bonding, Mechanical Fastening; Welding and allied processes, Hybrid joining processes. 2.2. Classification and Working of various welding methods: Gas, Arc, Chemical, Radiant, Solid State etc. 2.3. Welding Joints, Welding Positions, Welding defects and their remedies.	08
3	**Forming processes** 3.1 Introduction and classification of metalworking processes, hot and cold working processes 3.2 Introduction, classification and analysis of forging and rolling operations, Defects in rolled and forged components, 3.3 Extrusion process, Classification and analysis of wire and tube drawing processes.	06
4	**Machine Tools and Machining Processes** Lathe Machines, Milling Machines, Drilling Machines, and Grinding Machines and selection of grinding wheel (Dressing and Truing), Broaching machines, Lapping/Honing machines (Super Finishing Operations) and	08

	shaping/slotting/planning Machines. **Gear Manufacturing** Gear milling, standard cutters and limitations, Gear Hobbing, Gear Shaping, Gear Shaving and Gear Grinding processes	
5	**Machining science** Theory of metal cutting Mechanics of chip formation, Concept of chip formation and types of chips, Geometry and nomenclature of single point cutting tool, Speed, feed, depth of cut, Taylor's tool life equation, factors affecting tool life, MRR, Computation of tool life. **Sheet metal working processes** Classification of Sheet metal operations, types of Presses used in sheet metal operations, types of dies, metal cutting in a punch and die set up, die details and accessories, clearance, angular clearance, economic strip layout, centre of pressure, cutting forces, methods of reducing cutting forces. Force calculations. **Work holding devices** Introduction to Jigs and Fixtures and types, P3-2-1 principle of location and principles of clamping and guiding. Design of jig for simple component, design of milling fixture for simple component.	10
6	**Polymer Processing:** Polymer Molding Techniques for thermoplastic and thermosetting plastics. Applications of Plastics in engineering field, compression moulding, transfer moulding, injection moulding, film and sheet forming, thermoforming and their applications. **Powder Metallurgy** Introduction to PM, Powder making processes, Steps in PM. Compaction and Sintering processes. Secondary and finishing operations in PM.	04

Laboratory Syllabus:

S. No.	Details	Hrs.
1	Introduction to Lathe Machine, demonstration of various machining processes performed on lathe machine. One Job on Plain and Precision Turning, Taper Turning and; Screw Cutting by setting gear train; for desired thread cutting on lathe as per chart	15
2	Introduction to Shaping Machine and various machining processes performed on Shaping Machine One job on shaping machine to make horizontal and inclined surface	08
3	One composite job including welding, grinding, milling,	18
4	Lathe Machine maintenance activity, like apron overhauling, tailstock overhaul etc.	04

Theory Assessment:
Internal Assessment: 40 marks

1. Consisting of One Compulsory Class Tests - 40 Marks
2. Continuous evaluation- 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 for 50 marks.
Term Work:

1. All the jobs mentioned above
2. Complete Work-Shop Book giving details of drawing of the job and time sheet

The distribution of marks for Term work shall be as follows:
Job Work with complete workshop book : 40 marks
Attendance : 10 marks

Books/References:

1. Welding technology by O P Khanna
2. Foundry technology by O P Khanna
3. Elements of workshop technology. Vol. 1 & II by S K Hajra Choudhury
4. Tool Design by Cyril Donaldson, George H. LeCain, and V. C. Goold
5. Jigs and Fixtures by P H Joshi, Tata McGraw Hill
6. Manufacturing Science by Ghosh and Malik
7. Rapid Manufacturing –An Industrial revolution for the digital age by N.Hopkinson, R.J.M.Hauge, P M, Dickens, Wiley
8. Rapid Manufacturing by Pham D T and Dimov, Springer Verlag
9. Production Technology by WAJ Chapman Vol I, II, III
10. Production Technology by P C Sharma.
11. Production Technology by Raghuvanshi.
12. Industry 4.0: The Industrial Internet of Things by Alasdair Gilchrist, 2016, Apress.
13. Cyber-Physical Systems: From Theory to Practice by Danda B. Rawat, Joel Rodrigues, Ivan Stojmenovic, 2015, C.R.C. Press.
14. Optimization of Manufacturing Systems using Internet of Things by Yingfeng Zhang, Fei Tao, 2017, Academic Press (AP), Elsevier.

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Course Code	Course Name	Credits
ME 202	**Engineering Mathematics III**	**3+1**

Course Objectives:

1. To learn the Laplace Transform, Inverse Laplace Transform of various functions, and its applications.
2. To understand the concept of Fourier Series and enhance the problem-solving skills.
3. To learn complex form of Fourier series and Fourier Transform.
4. To acquaint with the concepts of probability, random variables, and expectations.
5. To acquaint with the concepts of probability distributions and sampling theory.
6. To learn the partial differential equations and numerical methods to solve it which are used in engineering problems

Course Outcomes:

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

1. Understand the concept of Laplace transform and its application to solve the real integrals, understand the concept of inverse Laplace transform of various functions and its applications in engineering problems.
2. Apply the knowledge of Fourier series in engineering problems.
3. Apply the knowledge of complex form of Fourier series and Fourier Transform in problem solving.
4. Illustrate understanding of the concepts of probability and expectation for decision making.
5. Use the concept of probability and sampling theory in data science.
6. To apply the numerical methods to find the solution of Mathematical Models of real-life problems.

Theory Syllabus:

Module	Detailed	Hrs.
1	**Laplace Transform and Inverse Laplace Transform** Definition, Condition of Existence, Laplace Transforms of Standard Functions. Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by t, Division by t, Laplace Transform of derivatives and integrals. Inverse Laplace Transform: use of standard formulae, using derivative, Partial fractions method, first shift property and second shifting property to find inverse Laplace transform, Convolution theorem (without proof) **Optional Topics:** Applications of Laplace Transform to solve initial and boundary value problems involving linear ordinary differential equations of first and second order, Bilateral Laplace Transform	6

2	**Fourier Series** Orthogonal and orthonormal set of functions, Dirichlet's conditions, Fourier series of periodic function with period 2π and $2l$, Fourier series of functions with point of discontinuity, and of even and odd functions, Half range Sine and Cosine Series. Parseval's Identity (without proof)	6
3	**Fourier Integral and Fourier Transform** Complex form of Fourier Series, Fourier Integrals Fourier cosine and sine transform. Applications of Fourier Transform, Comparison of Fourier and Laplace transforms.	6
4	**Probability Theory** Conditional probability, Total Probability and Baye's Theorem. Discrete and Continuous random variables, Probability mass and density function, Probability distribution for random variables, Expectation, Variance, Co-variance. **Optional Topics:** Moments, Moment generating functions, (Four moments about the origin & about the mean).	6
5	**Probability Distribution and Sampling Theory-I** Probability Distribution: Binomial, Poisson and Normal distribution, Sampling distribution, Test of Hypothesis, Level of Significance, Critical region, One-tailed, and two-tailed test, Degree of freedom. Students't-distribution (Small sample). Test the significance of single sample mean and two independent sample means and paired t-test) **Optional Topics:** Test of significance of large samples, Proportion test	6
6	**Partial Differential Equations** Introduction of Partial Differential equations Classification Method of separation of variables to solve the problem of Vibrations of string, One dimensional heat and wave equations. Numerical methods to solve PDE: Bender Schmidt scheme and Simplified Crank Nicholson scheme. **Optional Topics**: Approximation of derivatives by difference schemes, Solution of Laplace equation and applications.	6

Theory Assessment:

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.

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.

Lab Assessment:

Term Work:

General Instructions:

1. Batch wise practicals are to be conducted. The number of students per batch should be as per norms.
2. At Least 6 tutorials/assignments need to be submitted based on the entire syllabus.

Term Work assessment must be based on the overall performance of the student with every tutorial/assignment graded from time to time.

The distribution of Term Work marks will be as follows –

1. Attendance (Theory,Tutorial) : 05 marks
2. Assignments/Tutorials on entire syllabus : 20 marks

Books/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

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

Prerequisites:

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

Course Objectives:

1. To understand the mechanical behaviour of the body by determining the stresses, strains and deflections produced by the loads up to the elastic limit.
2. To understand the fundamental concepts related to shear force and bending moments, torsional moments, and strain energy.
3. To understand the fundamental concepts related to deflection of beams, columns and struts, thin cylindrical and spherical shells.
4. To measure properties of materials by conducting various experiments on suitable testing machines.
5. Compare analytical/theoretical results with the experimental results to identify loopholes in either the theoretical calculations or during the experiments.

Course Outcomes:

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

1. Apply principles of statics to determine reactions & internal forces in statically determinate beams.
2. Understand the different types of stresses and strains developed in the member subjected to axial, bending, shear & torsional effects.
3. Compute slope and deflection at various points of a beam.
4. Know behaviour & properties of engineering materials.
5. Conduct tests successfully to ascertain properties and strengths of materials, locate the failure zones and understand the failure characteristics.

Theory Syllabus:

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

	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, Maxwell's reciprocal theorems for computation of slopes and deflection in beams for point and distributed loads, derivation of formula for slope and deflection for standard cases, Area moment theorems for computation of slopes and deflections in beams – Conjugate beam method	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

Laboratory Syllabus:

Module	Details	Hrs.
1	Tension Test on Mild Steel Bar and other ductile materials using UTM (Universal Testing Machine), for specimens having diameter between 6 - 12 mm.	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.	2
8	Tensile Test on thin cross-section (rectangular/circular) specimens using Tensile Testing Machine.	2

Theory Assessment:
Internal Assessment: 40 marks.

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

End-Semester (Theory) 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:
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

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

Course Objectives:

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

Course Outcomes:

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

1. Able to solve energy balance problems for closed (fixed mass) systems that involve heat and work interactions
2. Able to apply the second law of thermodynamics to cycles and cyclic devices.
3. Able to evaluate internal energy, enthalpy, entropy of simple compressible systems from properties that are more readily measured.
4. Able to calculate the enthalpy of reaction, enthalpy of combustion, and the heating values of fuels.
5. Able to investigate the performance of vapour & gas power cycles.
6. Able to do the availability analysis for the design and analysis of thermal systems.

Module	Detail Content	Hrs.
1	**1.1 Introduction** Importance of Thermodynamics, concept of equation of state, energy, internal energy, specific properties, heat & work transfer, pdV work or displacement work. **1.2 First Law of thermodynamics** First law applied to the closed system undergoing a cycle and change of state, ideal gas processes, PMM1. Flow process and flow energy, First law applied to steady flow processes, − vdp work, relation between non flow work and flow work, Limitations of the 1st law.	6
2	**2.1 Second Law of Thermodynamics:** Thermal reservoir, Concept of heat engine, Heat pump and Refrigerator, Statement of the second law of thermodynamics, equivalence between Kelvin-Planck and Clausius statement, Reversible and irreversible Process, Causes of irreversibility, PMM2, Carnot cycle, Carnot theorem, Corollary of Carnot theorem, Thermodynamic temperature scale. **2.2 Entropy:** Clausius Inequality theorem, Entropy - a property of the system, Temperature-Entropy diagram, increase of entropy principle, entropy transfer and entropy generation, Entropy balance, Entropy change during a process.	7
3	**3.1 Availability:** Quality energy, available and unavailable energy, useful work and dead state, availability of closed system and steady flow process. **3.2 Thermodynamic Relations**	6

	Helmholtz and Gibbs functions, Maxwell equation (without derivation), TdS relations, Volumetric expansivity, Isothermal & isentropic compressibility, Clausius-Clapeyron equation, Joule Thomson coefficient – porous plug experiment, definition of third law of thermodynamics.	
4	**4.1 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, **4.2 Vapour Power Cycle:** Carnot cycle, Limitations of Carnot vapour cycle, Rankine cycle, mean temperature of heat addition, Rankine cycle with superheat, reheat.	7
5	**5.1 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, Brayton Cycle, Stirling Cycle, Ericsson Cycle, Lenoir cycle, and Atkinson cycle (Only theory).	6
6	**6.1 Combustion Thermodynamics:** Complete and incomplete combustion, air fuel ratio, theoretical and excess air for combustion, enthalpy of formation, analysis for a non flow process involving combustion at constant volume, analysis of steady flow or constant pressure combustion, heating values, adiabatic flame temperature, combustion efficiency enthalpy and internal energy of combustion.	6

Assessment:

Internal Assessment: 50 marks

1. Consisting of One Compulsory Class Tests of 50 Marks
2. Continuous evaluation : Class Test/ Assignments / Quiz/ Case studies/ Seminar presentation of 50 Marks

End Semester Examination: 50 Marks

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

Books/References:

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

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Course Code	Course Name	Credits
ME 205	**Metallurgy and Materials**	**3+1**

Prerequisites:

1. 12th std Chemistry
2. 12th std Physics

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

Course Outcomes:

Upon successful completion of this course, 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. Analyse the phase transformations in steels
5. Apply heat treatment to different components based on the property requirement
6. Evaluate the reasons of failure in components and take corrective actions

Theory Syllabus:

Module	Detail Content	Hrs.
1.	Classification of Materials, Crystal Structures,Miller's indices for planes and directions. Crystal Defects,	6
2.	Deformability and Strengthening mechanisms-Hot and Cold working, Recrystallisation-its effects and factors affecting it	6
3.	Concepts of solidification, Phases,Phase diagrams, Alloying - Fe-Fe3C diagram and cooling of steels and cast irons,	10
4.	Austenite transformation-equilibrium and non equilibrium, Hardenability and its importance, Alloy Steels-stainless steels, tool steels,	6
5.	Heat treatments-Thorough and Surface. Isothermal treatments - Patenting, Austempering and martempering, Ausforming and Maraging	5
6.	Failure by fracture-micromechanisms-fatigue and creep. Non destructive evaluation to prevent failures	6

Laboratory Syllabus:

Module	Details	Hrs.
1	Study of Characterization techniques and Metallographic sample preparation and etching	2
2	Comparison of Microstructures and 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 (Using different hardness testers to measure the Hardness)	2
5	Fatigue test – to determine number of cycles to failure of a given material at a given stress	2

6	Tension test on mild steel bar (stress-strain behaviour, determination of yield strength and modulus of elasticity)	2
7	Torsion test on mild steel bar / cast iron bar	2
8	Impact test on metal specimen (Izod/Charpy Impact test)	2
9	Hardness test on metals – (Brinell/ Rockwell Hardness Number	2

Theory 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.

Laboratory Assessment:
Term Work Marks: 25 Marks

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

Books/References:

1. Materials Science and Engineering: An Introduction: Willaim 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. Materials Science and Engineering: An Introduction: Willaim Callister Jr. and David G. Rethwisch, Wiley Publication
6. Introduction to Physical Metallurgy, Sidney H. Avner, Tata Mcgraw Hill
7. Introduction to Engineering Materials,BK Agrawal, TataMcgraw Hill
8. Materials Science and Engineering: A First Course,Raghavan V, Prentice Hall India
9. Automotive Materials, Brian Cantor

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

Prerequisites:

1. Engineering Drawing

Course Objectives:

1. To impart the 3D modeling skills for development of 3D models of basic engineering components.
2. To introduce Product data exchange among CAD systems.
3. To familiarize with production drawings with important features like GD&T, surface finish.

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

1. Visualize and prepare 2D modeling of a given object using modelling software.
2. Build a solid model of a given object using 3D modeling software.
3. Visualize and develop the surface model of a given object using modelling software.
4. Generate assembly models of given objects using assembly tools of a modelling software

Module	Detail Content	Hrs.
1	**CAD Introduction** CAD models Creation, Types and uses of models from different perspectives. Parametric modelling and Non - Parametric Modelling. **GD & T** Limits, Fits and Tolerance	4
2	**2D Sketching** Geometric modeling of an Engineering component, sketching commands of creation, modification commands and viewing the sketch.	4
3	**Solid Modeling** 3D Geometric modeling of an Engineering component, modeling features. Using 3D components from software library (Eg. Nut, Bolt, Screw etc.)	6
4	**Surface Modeling** Extrude, Sweep, Trim etc and Mesh of curves, free form surfaces etc. Feature manipulation using Copy, Edit, Pattern, Suppress, History operations etc.	6
5	**Assembly** Constraints, Exploded views, interference check. Drafting (Layouts, Standard & Sectional Views, Detailing & Plotting), Bill of materials, Giving machining symbols using software in drafting.	4
6	**Data Exchange** CAD data exchange formats Like IGES, PDES, PARASOLID, DXF and STL along with their comparison and applicability. **Case Study**	2

Assessment:

Term work:

1. Printouts/Plots: 20 marks
2. Attendance : 05 marks

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

Set 1: Beginner Level:

3D modeling of basic Engineering components likes Nuts, Bolts, Keys, cotter, Screws, Springs etc.

Set 2: Intermediate Level:

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

Set 3: Advance Level:

1. Generation of any Assembly model (minimum five child parts) along with Production drawing for any of the system by creating 3D modeling with assembly constraints, Interference check, Exploded view, GD&T, Bill of material.
2. Reverse Engineering of a physical model: disassembling of any physical model having not less than five parts, measure the required dimensions of each component, sketch the minimum views required for each component, convert these sketches into 3-D model and create an assembly drawing with actual dimensions.

End Semester Practical/Oral examination:

To be conducted by pair of Internal and External Examiners

1. Practical examination duration is two hours, based on Advance level of the Term work. Oral examination should also be conducted to check the knowledge of CAD Modelling Tools.
2. The distribution of marks shall be as follows:
   Practical Exam : 30 marks
   Oral Exam : 20 marks
3. Evaluation of practical examinations to be done based on the printout of students' work.
4. Students work along with evaluation reports to be preserved till the next examination.

Books/References:

1. Machine Drawing by N.D. Bhatt.
2. A textbook of Machine Drawing by Laxminarayan and M.L.Mathur, Jain brothers Delhi
3. Machine Drawing by Kamat and Rao
4. Machine Drawing by M.B.Shah
5. A text book of Machine Drawing by R.B.Gupta, Satyaprakashan, Tech. Publication
6. Machine Drawing by K.I. Narayana, P. Kannaiah, K.Venkata Reddy
7. Machine Drawing by Sidheshwar and Kannaiah

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Course Code	Course Name	Credits
ME 291	**Minor Project I**	**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 Outcome: 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 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 - Term Work:

- The review/ progress monitoring committee shall be constituted by heads of department. The progress of the minor project to be evaluated on a continuous basis, minimum two reviews in each semester.
- 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:
  - Marks awarded by guide/supervisor based on log book : 10
  - Marks awarded by review committee : 10
  - Quality of project report : 05

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

One-year project:

- In 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.
- 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.

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Course Code	Course Name	Credits
ME 207	**Advanced Manufacturing Technology**	**3+1**

Course Objectives:

1. To familiarize with subtractive manufacturing processes in particular CNC systems.
2. To familiarize with various additive manufacturing processes
3. To familiarize with principle and working of non-traditional manufacturing
4. To introduce to them the Intelligent manufacturing in the context of Industry 4.0
5. To acquaint with basic process of developing 3D model using biomedical data.

Course Outcomes:
Learner will be able to

1. Develop and execute CNC part program for various machining operations.
2. Understand the generation of tool paths through different approaches.
3. Identify the additive manufacturing process for development of a component.
4. Illustrate principles and working of non-traditional manufacturing and select the proper process for the purpose of manufacturing.
5. Understand the manufacturing technologies enabling Industry 4.0
6. Develop a 3D model using available 2D images.

Theory Syllabus:

Module	Detail Content	Hrs.
1	**Computer aided Manufacturing:** Introduction, NC/CNC/DNC machines, Machining Centers, Coordinate system. CNC machining practices and programming: Manual part programming method, Canned Cycles for milling, turning.	08
2	**CAPP:** APT, Loops, Macros and Subroutines	06
3	**Additive Manufacturing:** Product development cycle and importance of prototyping, types of prototypes-principles and advantages, different types of generative manufacturing process viz. Vat Photopolymerisation, Material extrusion, Material Jetting, Binder Jetting, Powder bed Fusion, Direct energy deposition, Sheet Lamination.	06
4	**Nano Manufacturing techniques and micro-machining:** High speed machining and hot machining. Introduction to microfabrication for MEMS, bulk micromachining of silicon, surface micromachining of MEMS, wafer bonding for MEMS, LIGA process, micromachining of polymeric MEMS devices, 3D microfabrication	08
5	**Non-traditional Manufacturing processes** – Introduction, Construction, Working principle, Types, Process parameters, problems, merits, demerits and applications of : Chemical Machining, Ultrasonic Machining, Electro-Chemical Machining, Electric Discharge Machining, Electron Beam Machining, Plasma Arc Machining, Laser beam Machining and Ion Beam Machining.	06
6	**Intelligent manufacturing in the context of Industry 4.0:** Collaborative Manufacturing: Definition and Concept, Aims of Collaborative Manufacturing, Business Process Change Considerations for Collaborative Manufacturing, Enabling Technologies for	04

	Collaborative Manufacturing, Benefits and Limitations of Collaborative Manufacturing, Cloud Manufacturing ● Cyber-physical systems (CPS) ● Internet of Things (IoT) enabled manufacturing	

Laboratory Syllabus:

Module	Details	Hrs.
	Part A	
1.	Part programming and part fabrication on CNC Turning trainer (Involving processes like Step turning, facing, Taper turning, threading, etc.)	2
2.	Part programming and part fabrication on CNC Milling trainer (Involving processes like contouring, drilling, facing, pocketing etc.)	2
3.	Part Programming Simulation for any Unconventional Machining Process (Electric Discharge Machining, laser cutting Machining, Plasma Cutting Machining etc.)	2
4.	Tool-path generation by translation of part geometry from computer aided design (CAD) to computer aided manufacturing (CAM) systems.	4
	Part B	
5.	Development of physical 3D mechanical structure using any one of additive manufacturing processes.	4
6.	Study of the effect of variation in various parameters involved in additive manufacturing	2
7.	Creation of 3D model from 2D images using any image processing software and printing it. (3D Slicer open source) (Application: Any body organ like Heart, Gallbladder etc. as per available Dicom files)	2
8.	Manufacturing Simulation and Integration	2
	Part C	
9.	Case Study: Report on a visit conducted to any Commercial CNC Machining Centre explaining the Design features, pre processing in CAM software and its capabilities.	4

Theory Assessment:

Internal Assessment for 40 marks:

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

End Semester Examination: 60 Marks

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

Laboratory Assessment:
Internal Assessment: 50 marks
Term Work:

A. Minimum 3 exercises from 1-4 of the above list need to be undertaken.
B. Minimum 3 exercises from 2-8 of the above list need to be undertaken.
C. Exercise 9 is compulsory. Presentation/Seminar of the study done is required.

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

Part A …….20 marks
Part B …….20 marks
Part C …….10 marks

Books/References:

1. CNC Programming for Machining, Kaushik Kumar, Chikesh Ranjan, J. Paulo Davim, Springer Publication.
2. Manufacturing Science by Ghosh and Malik
3. CAD/CAM Computer Aided and Manufacturing, Mikell P. Groover and Emory W. Zimmers, Jr., Eastern Economy Edition
4. CNC Technology and Programming, Krar, S., and Gill, A., McGraw Hill Publishers.
5. CAD/CAM Principles and Applications, P. N. Rao, Tata McGraw Hill Publications
6. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, I. Gibson l D. W. Rosen l B. Stucker, Springer Publication.
7. Rapid Manufacturing –An Industrial revolution for the digital age by N.Hopkinson, R.J.M.Hauge, P M, Dickens, Wiley.
8. Rapid Manufacturing by Pham D T and Dimov, Springer Verlag
9. Rapid Prototyping and Manufacturing, P. F. Jacobs, Society of Manufacturing Engineers
10. Production Technology by P C Sharma.
11. Industry 4.0: The Industrial Internet of Things by Alasdair Gilchrist, 2016, Apress.
12. Cyber-Physical Systems: From Theory to Practice by Danda B. Rawat, Joel Rodrigues, Ivan Stojmenovic, 2015, C.R.C. Press.
13. Optimization of Manufacturing Systems using Internet of Things by Yingfeng Zhang, Fei Tao, 2017, Academic Press (AP), Elsevier.
14. Medical Modelling The Application of Advanced Design and Rapid Prototyping Techniques in Medicine, Richard Bibb, Dominic Eggbeer and Abby Paterson, Woodhead Publishing Series in Biomaterials: Number 91, Elsevier Ltd.
15. Biomaterials, artificial organs and tissue engineering, Edited by Larry L. Hench and Julian R. Jones, Woodhead Publishing and Maney Publishing, CRC Press 2005

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Course Code	Course Name	Credits
ME 208	**Data Science**	**1.5**

Course Objectives:

1. To introduce concepts of Data Science using R programming language.
2. To introduce basic concepts of R programming language as well as common packages and libraries.
3. To generate an ability to utilize Data Science concepts with R programming to solve mechanical engineering related problems.

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

1. To understand concepts of data science with R programming language.
2. To understand fundamentals of R programming and data frame.
3. To be able to visualise the data using R programming package.
4. To be able to prepare the data for analysis.
5. Understanding hypothesis testing and being able to make decisions.

Module	Detail Content	Hrs.
1.	**Introduction to business analytics** What is analytics & why is it so important? - Applications of analytics - Different kinds of analytics - Various analytics tools - Analytics project methodology	02
2.	**Fundamentals of R** Installation of R & R Studio - Getting started with R - Basic & advanced data types in R - Variable operators in R - Working with R data frames - Reading and writing data files to R - R functions and loops - Special utility functions - Merging and sorting data	08
3.	**Data visualization in R** Need for data visualization - Components of data visualization - Utility and limitations - Introduction to grammar of graphics - Using the ggplot2 package in R to create visualizations	06
4.	**Data preparation and cleaning using R** Needs & methods of data preparation - Handling missing values - Outlier treatment - Transforming variables - Derived variables - Binning data - Modifying data with Base R - Data processing with dplyr package	06
5.	**Understanding the data using univariate statistics in R** Summarizing data, measures of central tendency - Measures of variability, distributions - Using R to summarize data **Hypothesis testing and ANOVA in R to guide decision making** Introducing statistical inference - Estimators and confidence intervals - Central Limit theorem - Parametric and non-parametric statistical tests - Analysis of variance (ANOVA) - Conducting statistical tests	08
6.	**Correlation and Linear regression** Correlation - Simple linear regression - Multiple linear regression - Model diagnostics and validation - Case study **Logistic regression** Moving from linear to logistic - Model assumptions and Odds ratio - Model assessment and gains table - ROC curve and KS statistic - Case Study	08

Lab Assessment:

Termwork : 25 marks (Continuous evaluation)
Practical/Oral : 50 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.

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Course Code	Course Name	Credits
ME 209	**Theory of Machines & Mechanisms**	**3+1**

Prerequisites:

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

Course Objectives:

1. To provide students with the knowledge on mechanisms and inversions.
2. To impart students with knowledge about forces acting on machine parts.
3. To enable students to understand the fundamental concepts of machines.
4. To study functioning of motion and power transmission machine elements.
5. To facilitate students to understand the functions of cams, gears, belt drives, chain drives and brakes.

Course Outcomes:

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

1. Identify mechanisms and their inversions.
2. Compute velocity and acceleration of various plane mechanisms by different methods.
3. Apply the principles for analyzing cams, gears and gear trains.
4. Synthesize mechanisms for following useful paths.
5. Draw cam profile for specific follower motion.
6. Develop and design mechanisms.

Theory Syllabus:

Module	Detail Content	Hrs.
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:** **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 mechanisms. (limit to only 4 link mechanisms) **Instantaneous center of rotation (ICR) method:** Definition of ICR, Types of ICRs, Methods of locating ICRs (limit to only 6 link mechanisms), Kennedy's Theorem, Coriolis component of acceleration.	08

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. **Brakes:** Introduction, types and working principles, Introduction to braking of vehicles.	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	Hrs.
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: 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:
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.

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Course Code	Course Name	Credits
ME 210	**Fluid Mechanics and 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. Define properties of fluids, classify fluids and evaluate hydrostatic forces on various surfaces.
2. Formulate and solve equations of the control volume for fluid flow systems and Apply Bernoulli's equation to various flow measuring devices.
3. Calculate pressure drop in laminar and turbulent flow, evaluate major and minor losses in pipes.
4. Calculate resistance to flow of incompressible fluids through closed conduits and over surfaces.
5. Analyze performance of hydraulic turbines and pumps

Theory Syllabus:

Module	Detail Content	Hrs.
1.	1.1 **Introduction :** Newtonian and Non Newtonian Fluids. 1.2 **Fluid Statics**: Forces on fluid elements, Hydrostatic thrust on Submerged surfaces (plane and curved). 1.3 **Fluid Kinematics:** Eulerian and Lagrangian approach to solutions; Velocity and acceleration in a Eulerian flow field; Definition of streamlines, path lines and streak lines; types of fluid flow, Definition and equations for stream function, velocity potential function (no numerical).	6
2.	2.1 **Fluid Dynamics:** Definition of control volume and control surface, Integral equations for the control volume: Reynolds Transport theorem (no numerical), Differential equations for conservation of mass, energy and momentum, Euler's equations in 1&3 dimensions and subsequent derivation of Bernoulli's equation and its application in flow measurement, pitot tube, venture, orifice	8
3.	3.1 **Laminar Viscous flow**: Introduction to Reynolds number, Navier-Stokes equation of motion (Without proof), Laminar flow between parallel plates (Plane Poiseuille & Couette flow), Laminar flow in circular pipe (Hagen-Poiseuille flow).	6
4.	4.1 **Hydrodynamic Boundary Layer Theory:** Concept of formation of boundary layer, boundary layer parameters, boundary layer along a long thin plate, 4.2 **Flow around submerged objects:** Concept of drag and lift, Types of drag, Streamlined and bluff bodies, Drag and lift on an aerofoil. 4.3 **Flow through pipes**: Head loss in pipes due to friction (Darcy-Weisbach equation (Without proof)), Loss of energy in pipe (major and minor), Hydraulic gradient and Energy gradient line, Pipes in series and parallel.	6

5.	5.1 **Types of hydro turbines** - impulse and reaction, definition of various turbine parameters like gross head, discharge, work done, input power, output power, efficiencies etc., Eulers' equation applied to a turbine, turbine velocities and velocity triangles, expression for work done. Pelton Turbine: Components of Pelton turbine, definition of design parameters like speed ratio, jet ratio, and estimation of various parameters like head, discharge, and efficiency etc., determination of number of buckets. Reaction Turbines: Types of reaction turbines - inward and outward flow, radial mixed and axial; elements of the turbine, estimation of various parameters 5.2 **Performance Characteristics:** Cavitations in turbines - causes, effects and remedies, Characteristics of turbines	7
6.	6.1 **Pumps:** Classification of pumps - positive displacement and non - positive displacement. Positive Displacement pumps: Types and applications, definition of head, discharge, work done and efficiency, types of reciprocating pumps, indicator diagram, use of air vessel. (No Numerical) 6.2 **Centrifugal Pumps:** Types - radial flow, mixed flow and axial flow, Priming of pumps, components of the pump, Euler's equation and velocity triangles 6.3 **Performance Characteristics**: Design constant e.g., head constant, flow constant etc., Concept of system and system characteristics, Series and parallel operation of pumps. Determination of operating point. Determination of available and required NPSH	6

Laboratory Syllabus:

Sr. No.	Details	Hrs.
1	Calibration of pressure gauge	2
2	Calibration of venture meter / orifice meter / nozzle meter / pitot tube	2
3	Determination of friction factor for pipes	2
4	Determination of minor losses in pipe fittings	2
5	Verification of Bernoulli’s equation	2
6	Trial on Impulse / reaction turbine	2
7	Trial on positive displacement pump (Gear pump/ Vane pump/screw pump)	2
8	Trial on single stage / multistage centrifugal pump	2

Theory 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 number of respective lecture hours mentioned in the curriculum

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

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Course Code	Course Name	Credits
ME 211	**Internet of Things**	**1.5**

Course Objectives:

1. To understand the need and justification of IOT
2. To familiarize with robotic systems in automated
3. To provide a IoT system for the collection of information from the environment and its transfer to a server, as well as the skills necessary for the development of control logics, processing and display of data.
4. To create an environment for research, design, development and testing of IoT solutions, in the field of energy management, communication systems, distributed sensor devices and advanced user interfaces
5. Provide students unique interdisciplinary learning and innovation experiences with IoT technologies

Course Outcomes:

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

1. Able to understand the application areas of IOT
2. Physical Design of IOT, Home Automation IOT, Environment, Agriculture, Industry, Health & LifeStyle.
3. Installing various necessary softwares, drivers and operating systems with knowledge of lots of hardwares like various microcontrollers and microprocessors.
4. Able to use different programming languages like C++, python, logical coding, blockly.
5. Control systems remotely over the internet.

List of Experiments

1. Familiarization with Arduino/Raspberry Pi and perform necessary software installation using C++ /python.
2. To interface LED/Bluzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds.
3. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
4. To interface DHT11 sensor with Arduino/Rasberry Pi and write a program to print temperature and humidity readings.
5. To interface OLED with Arduino/Rasberry Pi and write a program to print temperature and humidity readings on it.
6. Real time interfacing of sensors (temperature and humidity) and actuators (Servo motors) using Arduino. Controlling actuators & monitoring sensors output remotely using internet and wifi module.
7. To interface motor/Led bulb using relay with arduino/Raspberrypi and write a program to turn On motor from smartphone using blynk and Bluetooth module.
8. IOT Paralysis Patient Health Care Project using accelerometer, wifi module and microcontroller based notification system over smartphone for need of help.

Laboratory Assessment:

Internal Assessment

Term Work Marks: 50 Marks

Course Project	: 30 Marks
Laboratory Work (Journal Completion)	: 15 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. Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud by Cuno Pfister.
2. Internet of Things Programming Projects: Build Modern IoT Solutions with the Raspberry Pi 3 and Python Book by Colin Dow.
3. Beginning C for Arduino, Second Edition: Learn C Programming for the Arduino Book by Jack J Purdum.
4. Learning Python with Raspberry Pi, Book by Alex Bradbury and Ben Everard.

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Course Code	Course Name	Credits
ME 212	**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 on the different ethical dilemmas at the work place and society.
3. To inculcate the ethical code of conduct in writing technical article 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

Internal Assessment: 20 marks
Consisting of Two compulsory internal assessments 20 Marks each. The final marks will be average of score of both the assessments.
End Semester Examination: 40 Marks
Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum

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.

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Course Code	Course Name	Credits
ME 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:

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.
- 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;
  - Marks awarded by guide/supervisor based on log book :10
  - Marks awarded by review committee :10
  - Quality of Project report :05

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

One-year project:

- In 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.
- 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.

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