Sri Krishna College of Engineering and Technology

An Autonomous Institution, Affiliated to Anna University

Coimbatore – 641 008

REGULATION 2022

CURRICULUM AND SYLLABI

B.E. MECHANICAL ENGINEERING

(Students Admitted from the Academic Year 2024 -2025 Onwards)

DEPARTMENT OF MECHANICAL ENGINEERING

SRI KRISHNA COLLEGE OF ENGINEERING AND TECHNOLOGY

An Autonomous Institution Affiliated to Anna University
Kuniamuthur, Coimbatore - 641 008

VISION AND MISSION OF THE INSTITUTION

Vision

To Produce Globally Competitive Engineers with High Ethical Values and Social Responsibilities.

Mission

- To impart the highest quality state-of-the-art technical education by providing impetus to innovation, research, and development and empowering students with entrepreneurship skills.
- To instill ethical values, imbibe a sense of social responsibility, and strive for societal well-being.
- To identify the needs of society and offer sustainable solutions through outreach programs.

VISION AND MISSION OF THE DEPARTMENT

Vision

The department aspires to produce experts in Mechanical Engineering with moral values and it envisions to set up centers of excellence in innovative design and testing, composite materials, automation, automotive technology and green fuels.

Mission

- To produce world class mechanical engineering graduates by promoting core technical competency blended with advanced computing skills, creative thinking and desire to upgrade continuously.
- To empower them to the expectation of the industries in our country and abroad.
- To impart the interpersonal skills and make them realize the values of life.

Programme Outcomes (POs):-

At the time of their graduation students of Mechanical Engineering Programme should be in possession of the following Programme Outcomes

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.
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.

Programme Specific Outcomes (PSO's):-

At the end of the Programme, Graduate shall have

PSO 1	Design, develop and analyse the engineering components using advanced design softwares.
PSO 2	Ability to fabricate real time mechanical systems and test its worthiness.
PSO 3	Ability to apply the advancements in mechanical engineering to promote automation.

Programme Educational Objectives (PEOs):-

The following Programme Educational Objectives are designed based on the department mission

PEO 1:	Provide strong foundation in the science and engineering fundamentals necessary to formulate, solve and analyze real time mechanical engineering problems.
PEO 2:	Develop the ability to synthesize data and technical concepts for making decisions in an ethical manner considering the socio-economic scenario.
PEO 3:	Enable to work as part of teams on multidisciplinary projects with good communication and interpersonal skills in the emerging areas like automation, composite materials, automotive technology, green fuels etc.,
PEO 4:	Prepare for successful careers in industry that meet the needs of Indian and multinational companies and to inculcate the qualities of continuous learning and entrepreneurial skills.

Mapping of PO's and PSO's to PEO's

Programme Educational Objectives	**Programme Outcomes**												**Programme Specific Outcomes**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
PEO 1	3	3	3	3		1					2		3	3	2
PEO 2	3	3	3	3		3	3	3					3	3	2
PEO 3	2	2	2	1	3	3	3		3	3	3	1	3	3	3
PEO 4	3	3	2	2	2		1	2	1	3	2	3	3	3	3

3	Strongly agreed	**2**	Moderately agreed	**1**	Reasonably agreed

B.E. MECHANICAL ENGINEERING

REGULATION 2022
(Students Admitted from the Academic Year 2024 - 2025 Onwards)
CHOICE BASED CREDIT SYSTEM
I – VIII SEMESTER CURRICULUM AND SYLLABI

SEMESTER I								
SL. No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs./wk.**	**C**	**O**	**Ext./ Int**	**Cat.**
1.	23MA101	Mathematics I	3/1/0	4	4	-	60/40	BSC
2.	23EE113	Fundamentals of Electrical and Electronics Engineering	2/1/0	3	3	-	60/40	ESC
3.	23TA101	Heritage of Tamils / தமிழர்மரபு	1/0/0	1	1	-	60/40	HSMC
4.	23EN101	Oral and Written Communication Skills	2/0/2	4	3	-	50/50	HSMC
5.	23ME101	Engineering Drawing	1/0/4	5	3	-	50/50	ESC
6.	23CS101	Problem Solving using C++	1/0/4	5	3	-	50/50	ESC
7.	23EE115	Fundamentals of Electrical and Electronics Engineering Laboratory	0/0/2	2	1	-	40/60	ESC
8.	23MC101	Mandatory Course – I (Induction Programme)	3 WEEKS		0	-	0/100	MC
		Total	**10/2/12**	**24**	**18**	**-**	**800**	

SEMESTER II								
SL. No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs./wk.**	**C**	**O**	**Ext./ Int**	**Cat.**
1.	23ME201	Engineering Mechanics	3/0/0	3	3	-	60/40	PCC
2.	23ME202	Industrial Metallurgy	3/0/0	3	3	-	60/40	BSC
3.	23MA204	Calculus and Fourier Series	3/1/0	4	4	-	60/40	BSC
4.	23TA201	Tamils and Technology / தமிழரும் தொழில்நுட்பமும்	1/0/0	1	1	-	60/40	HSMC
5.	23PS101	Physical Science	4/0/0	4	4	-	60/40	BSC
6.	23IT211	Introduction to Python Programming	1/0/4	5	3	-	50/50	ESC
7.	23CD201	Database Management System	1/0/4	5	3	-	50/50	ESC
8.	23PS102	Physical Science Laboratory	0/0/4	4	2	-	40/60	BSC
		Total	**16/1/12**	**29**	**23**	**-**	**800**	

SEMESTER III								
SL. No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs./wk.**	**C**	**O**	**Ext./ Int.**	**Cat.**
1.	23ME301	Applied Thermodynamics	3/1/0	4	4	-	60/40	PCC
2.	23ME302	Mechanics of Deformable Solids	3/1/0	4	4	-	60/40	PCC
3.	23MA303	Numerical methods	3/1/0	4	4	-	60/40	BSC
4.	23ME303	Manufacturing Practices Workshop	1/0/4	5	3	-	50/50	BSC
5.	23CS311	Fundamentals of Java Programming	1/0/4	5	3	-	50/50	ESC
6.	23ME304	Strength of Materials Laboratory	0/0/2	2	1	-	40/60	PCC
7.	23ME305	Design Thinking and Idea Lab	0/0/2	2	1	-	40/60	ESC
8.	23MCZZZ	Mandatory Course – II	2/0/0	2	0	-	0/100	MC
		Total	**13/3/12**	**28**	**20**	**-**	**800**	

SEMESTER IV								
SL. No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs./wk.**	**C**	**O**	**Ext./ Int.**	**Cat.**
1.	23ME401	Measurements and Metrology	3/0/0	3	3	-	60/40	PCC
2.	23ME402	Kinematics and Dynamics of Machines	3/1/0	4	4	-	60/40	PCC
3.	23ME403	Fluid Mechanics and Hydraulic Machines	3/1/0	4	4	-	60/40	PCC
4.	23ME404	Heat Transfer and Thermal Machines	3/1/0	4	4	-	60/40	PCC
5.	23GE301	Universal Human Values	3/0/0	3	3	-	60/40	HSMC
6.	23ME405	Manufacturing Technology	3/0/2	5	4	-	50/50	PCC
7.	23ME406	Thermal and Fluid Mechanics Laboratory	0/0/2	2	1	-	40/60	PCC
8.	23ME407	Metrology and Dynamics Laboratory	0/0/2	2	1	-	40/60	PCC
9.	23MCZZZ	Mandatory Course – III	2/0/0	2	0	-	0/100	MC
		Total	**20/3/6**	**29**	**24**	**-**	**900**	

SEMESTER V								
SL. No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs./wk.**	**C**	**O**	**Ext./ Int.**	**Cat.**
1.	23ME501	Machine Element and System Design	3/1/0	4	4	-	60/40	PCC
2.	23ME502	Data Analytics for Mechanical Engineers	3/0/0	3	3	-	60/40	ESC
3.	23ME503	Vehicle Technology	3/0/0	3	3	-	60/40	PCC
4.	23ME504	Mechatronics, Robotics and Control	3/0/0	3	3	-	60/40	ESC
5.	23MEZZZ	HSS/Management Elective-1	3/0/0	3	3	-	60/40	HSMC
6.	23ME505	Vehicle Technology Laboratory	0/0/2	2	1	-	40/60	PCC
7.	23ME506	Mechatronics Laboratory	0/0/2	2	1	-	40/60	ESC
8.	23XXZZZ	Open Elective-I	0/0/6 (or) 1/0/4 (or) 3/0/0	6 (or) 5 (or) 3	3	-	40/60 (or) 60/40	OEC
		Total	**15/1/10**	**26**	**21**	**-**	**800**	

SEMESTER VI								
SL. No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs./wk.**	**C**	**O**	**Ext./ Int.**	**Cat.**
1.	23ME601	Production and Operation Management	3/1/0	4	4	-	60/40	PCC
2.	23ME602	Product Innovation and Entrepreneurship	3/1/0	4	4	-	60/40	PCC
3.	23ME603	Computer Aided Design and Analysis	3/1/0	4	4	-	60/40	PCC
4.	23ME604	Manufacturing Automation and Smart Factory	3/0/0	3	3	-	60/40	PCC
5.	23XXZZZ	Open Elective-II	0/0/6 (or) 1/0/4 (or) 3/0/0	6 (or) 5 (or) 3	3	-	40/60 (or) 60/40	OEC
6.	23ME605	Design and Analysis Laboratory	0/0/2	2	1	-	40/60	PCC
7.	23ME606	Smart Factory Laboratory	0/0/2	2	1	-	40/60	PCC
8.	23ME607	Engineering Project - 1	0/0/2	2	1		40/60	PROJ
		Total	**12/3/12**	**27**	**21**	**-**	**800**	

SEMESTER VII								
SL. No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs./wk.**	**C**	**O**	**Ext./ Int.**	**Cat.**
1.	23ME9ZZ	Professional Elective-I	3/0/0	3	3	-	60/40	PEC
2.	23ME9ZZ	Professional Elective-II	3/0/0	3	3	-	60/40	PEC
3.	23ME9ZZ	Professional Elective-III	3/0/0	3	3	-	60/40	PEC
4.	23ME9ZZ	HSS/Management Elective-2	3/0/0	3	3	-	60/40	HSMC
5.	23MEZZZ	Emerging Elective-I	0/0/6 (or) 1/0/4 (or) 3/0/0	6 (or) 5 (or) 3	3	-	40/60 (or) 60/40	EEC
6.	23ME701	Engineering Project-2 (Design and Analysis)	0/0/10	10	5	-	40/60	PROJ
7.	23ME702	Industrial Internship and Presentation	0/0/2	2	1	-	40/60	PCC
		Total	**12/0/18**	**30**	**21**	**-**	**700**	

SEMESTER VIII								
SL. No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs./wk.**	**C**	**O**	**Ext./ Int.**	**Cat.**
1.	23ME801	Engineering Project-3 (Prototype and Testing)	0/0/24	24	12	-	40/60	PROJ
		Total	**0/0/24**	**24**	**12**	**-**	**100**	

SCHEME OF CREDIT DISTRIBUTION – SUMMARY

SL. No.	**Stream**	**Credits/Semester**								**C**	**%**
		I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
1	Humanities & Social Sciences Including Management (HSMC)	4	1	-	3	3	-	3	-	14	8.8
2	Basic Sciences (BSC)	4	13	7	-	-	-	-	-	24	15
3	Engineering Sciences (ESC)	10	6	4		7	-	-	-	27	16.9
4	Professional Core (PCC)	-	3	9	21	8	17	1	-	59	36.9
5	Professional Electives (PEC)	-	-	-	-	-	-	9	-	9	5.6
6	Open Electives (OEC) / Emerging Elective Courses (EEC)	-	-	-	-	3	3	3	-	9	5.6
7	Project Work (PROJ)	-	-	-	-	-	1	5	12	18	11.2
8.	Mandatory Course (MC)	-	-	-	-	-	-	-	-	-	-
Total		**18**	**23**	**20**	**24**	**21**	**21**	**21**	**12**	**160**	**100**

STRUCTURE FOR UNDERGRADUATE ENGINEERING PROGRAM

S. No.	Course Work - Subject Area	AICTE Suggested Credits	SKCET Credits (168)
1.	Humanities and Social Sciences (HS), including Management;	12*	**14**
2.	Basic Sciences (BS) including Mathematics, Physics, Chemistry, Biology;	29*	**24**
3.	Engineering Sciences (ES), including Materials, Workshop, Drawing, Basics of Electrical/Electronics/Mechanical/Computer Engineering, Instrumentation;	27*	**27**
4.	Professional Subjects-Core (PC), relevant to the chosen specialization/branch; (May be split into Hard (no choice) and Soft (with choice), if required	58*	**59**
5.	Professional Subjects – Electives (PE), relevant to the chosen specialization/ branch;	9*	**9**
6.	Open Subjects- Electives (OE), from other technical and/or emerging subject areas;	9*	**9**
7.	Project Work, Seminar and/or Internship in Industry or elsewhere.	16*	**18**
8.	Mandatory Courses (MC)	Non-credit	
Total		160*	**160**
**Minor Variations is allowed as per need of the respective disciplines*			

HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT (14 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	23TA101	Heritage of Tamils / தமிழர்மரபு	1/0/0	1	1	HSMC
2.	23EN101	Oral and Written Communication Skills	2/0/2	4	3	HSMC
3.	23TA201	Tamils and Technology / தமிழரும் தொழில்நுட்பமும்	1/0/0	1	1	HSMC
4.	23GE301	Universal Human Values	3/0/0	3	3	HSMC
5.	23MEZZZ	HSS/Management Elective-1	3/0/0	3	3	HSMC
6.	23ME9ZZ	HSS/Management Elective-2	3/0/0	3	3	HSMC

BASIC SCIENCE COURSES (24 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	23MA101	Mathematics I	3/1/0	4	4	BSC
2.	23ME202	Industrial Metallurgy	3/0/0	3	3	BSC
3.	23MA204	Calculus and Fourier Series	3/1/0	4	4	BSC
4.	23PS101	Physical Science	4/0/0	4	4	BSC
5.	23PS102	Physical Science Laboratory	0/0/4	4	2	BSC
6.	23MA303	Numerical methods	3/1/0	4	4	BSC
7.	23ME303	Manufacturing Practices Workshop	1/0/4	5	3	BSC

ENGINEERING SCIENCE COURSES (27 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	23EE113	Fundamentals of Electrical and Electronics Engineering	2/1/0	3	3	ESC
2.	23ME101	Engineering Drawing	1/0/4	5	3	ESC
3.	23CS101	Problem Solving using C++	1/0/4	5	3	ESC
4.	23EE115	Fundamentals of Electrical and Electronics Engineering Laboratory	0/0/2	2	1	ESC
5.	23IT211	Introduction to Python Programming	1/0/4	5	3	ESC
6.	23CD201	Database Management System	1/0/4	5	3	ESC
7.	23CS311	Fundamentals of Java Programming	1/0/4	5	3	ESC
8.	23ME305	Design Thinking and Idea Lab	0/0/2	2	1	ESC
9.	23ME502	Data Analytics for Mechanical Engineers	3/0/0	3	3	ESC
10.	23ME504	Mechatronics, Robotics and Control	3/0/0	3	3	ESC
11.	23ME506	Mechatronics Laboratory	0/0/2	2	1	ESC

PROFESSIONAL CORE COURSES (59 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	23ME201	Engineering Mechanics	3/0/0	3	3	PCC
2.	23ME301	Applied Thermodynamics	3/1/0	4	4	PCC
3.	23ME302	Mechanics of Deformable Solids	3/1/0	4	4	PCC
4.	23ME304	Strength of Materials Laboratory	0/0/2	2	1	PCC
5.	23ME401	Measurements and Metrology	3/0/0	3	3	PCC
6.	23ME402	Kinematics and Dynamics of Machines	3/1/0	4	4	PCC
7.	23ME403	Fluid Mechanics and Hydraulic Machines	3/1/0	4	4	PCC
8.	23ME404	Heat Transfer and Thermal Machines	3/1/0	4	4	PCC
9.	23ME405	Manufacturing Technology	3/0/2	5	4	PCC
10.	23ME406	Thermal and Fluid Mechanics Laboratory	0/0/2	2	1	PCC
11.	23ME407	Metrology and Dynamics Laboratory	0/0/2	2	1	PCC
12.	23ME501	Machine Element and System Design	3/1/0	4	4	PCC
13.	23ME503	Vehicle Technology	3/0/0	3	3	PCC
14.	23ME505	Vehicle Technology Laboratory	0/0/2	2	1	PCC
15.	23ME601	Production and Operation Management	3/1/0	4	4	PCC
16.	23ME602	Product Innovation and Entrepreneurship	3/1/0	4	4	PCC
17.	23ME603	Computer Aided Design and Analysis	3/1/0	4	4	PCC
18.	23ME604	Manufacturing Automation and Smart Factory	3/0/0	3	3	PCC
19.	23ME605	Design and Analysis Laboratory	0/0/2	2	1	PCC
20.	23ME606	Smart Factory Laboratory	0/0/2	2	1	PCC
21	23ME702	Industrial Internship and Presentation	0/0/2	2	1	PCC

PROFESSIONAL ELECTIVE COURSES (9 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
ELECTIVE STREAM I – MODERN MOBILITY SYSTEMS						
1.	23ME901	Electric and Hybrid Vehicle Technology	3/0/0	3	3	PEC
2.	23ME902	Autotronics	3/0/0	3	3	PEC
3.	23ME903	Alternate Energy Source for Automobiles	3/0/0	3	3	PEC
4.	23ME904	Automotive Component Manufacturing	3/0/0	3	3	PEC
5.	23ME905	Smart and Intelligent Mobility	3/0/0	3	3	PEC
6.	23ME906	Drone and UAV Technologies	3/0/0	3	3	PEC
ELECTIVE STREAM II - DIGITAL AND ROBOTIC SYSTEMS						
1.	23ME907	Digital Manufacturing	3/0/0	3	3	PEC
2.	23ME908	Modern Robotics	3/0/0	3	3	PEC
3.	23ME909	Applied Hydraulics and Pneumatics	3/0/0	3	3	PEC
4.	23ME910	PLC SCADA	3/0/0	3	3	PEC
5.	23ME911	Immersive Technologies	3/0/0	3	3	PEC
6.	23ME912	Product Life Cycle Management	3/0/0	3	3	PEC
ELECTIVE STREAM III - ADVANCED MATERIALS AND MANUFACTURING SYSTEMS						
1.	23ME913	Composite and Smart Materials	3/0/0	3	3	PEC
2.	23ME914	Advanced Manufacturing Techniques	3/0/0	3	3	PEC
3.	23ME915	Failure Analysis and NDT Techniques	3/0/0	3	3	PEC
4.	23ME916	Green and Sustainable Manufacturing	3/0/0	3	3	PEC
5.	23ME917	Additive Manufacturing	3/0/0	3	3	PEC
6.	23ME918	Design for Manufacturing and Assembly	3/0/0	3	3	PEC
ELECTIVE STREAM IV – THERMAL SYSTEM AND ENERGY TECHNOLOGY						
1.	23ME919	Power Plant Engineering	3/0/0	3	3	PEC
2.	23ME920	Bioenergy Conversion Technologies	3/0/0	3	3	PEC
3.	23ME921	Gas Dynamics and Jet Propulsion	3/0/0	3	3	PEC
4.	23ME922	Heating, Ventilation and Air-Conditioning Systems	3/0/0	3	3	PEC
5.	23ME923	Renewable Energy Technologies	3/0/0	3	3	PEC
6.	23ME924	Energy Storage Devices and Thermal Management of Batteries	3/0/0	3	3	PEC
ELECTIVE STREAM V – COMPUTATIONAL ENGINEERING						
1.	23ME925	Computational Solid Mechanics	3/0/0	3	3	PEC
2.	23ME926	Computational Fluid Dynamics and Heat transfer	3/0/0	3	3	PEC
3.	23ME927	Theory on Computation and Visualization	3/0/0	3	3	PEC
4.	23ME928	Computational Bio-Mechanics	3/0/0	3	3	PEC
5.	23ME929	CAD and CAE	3/0/0	3	3	PEC
6.	23ME930	Machine Learning for Intelligent Systems	3/0/0	3	3	PEC
ELECTIVE STREAM VI – DIVERSIFIED COURSES GROUP						
1.	23ME931	Design Concepts in Engineering	3/0/0	3	3	PEC
2.	23ME932	Non-traditional Machining Processes	3/0/0	3	3	PEC
3.	23ME933	Design of Transmission System	3/0/0	3	3	PEC
4.	23ME934	Casting and Welding Processes	3/0/0	3	3	PEC
5.	23ME935	Surface Engineering	3/0/0	3	3	PEC
6.	23ME936	Product Design and Development	3/0/0	3	3	PEC

HSS/MANAGEMENT ELECTIVE (6 Credits)

HUMANITIES AND SOCIAL SCIENCES /MANAGEMENT						
1.	23ME937	Lean Six Sigma	3/0/0	3	3	HSMC
2.	23ME938	Industrial Layout, Safety and Production Management	3/0/0	3	3	HSMC
3.	23ME939	Engineering Management and Financial Accounting	3/0/0	3	3	HSMC
4.	23ME940	Supply Chain Management	3/0/0	3	3	HSMC
5.	23ME941	Operations Research	3/0/0	3	3	HSMC
6.	23ME942	Principles of Management and Industrial Psychology	3/0/0	3	3	HSMC

OPEN ELECTIVE COURSES (Offered to Other Branches)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	23ME001	Industrial Safety	3/0/0	3	3	OEC
2.	23ME002	Fundamentals of MEMS/NEMS	3/0/0	3	3	OEC
3.	23ME003	Total Quality Management	3/0/0	3	3	OEC
4.	23ME004	Product Development	3/0/0	3	3	OEC
5.	23ME005	Fundamentals of Additive Manufacturing	3/0/0	3	3	OEC
6.	23ME006	Technology Management	3/0/0	3	3	OEC

EMERGING ELECTIVE COURSES

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	23ME007	Expert System and Machine Learning	3/0/0	3	3	EEC
2.	23IT007	NoSQL Data Modeling	3/0/0	3	3	EEC
3.	23CS007	Node JS	3/0/0	3	3	EEC
4.	23CY007	Application Security	3/0/0	3	3	EEC
5.	23CD007	Data Visualization	3/0/0	3	3	EEC
6.	23AD007	AR / VR Programming	3/0/0	3	3	EEC

PROJECT WORK (18 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	23ME606	Engineering Project - 1	0/0/2	2	1	PROJ
2.	23ME701	Engineering Project - 2 (Design and Analysis)	0/0/10	10	5	PROJ
3.	23ME801	Engineering Project - 3 (Prototype and Testing)	0/0/24	24	12	PROJ

MANDATORY COURSES (Non-Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	23MC101	Induction Program	3 WEEKS		0	MC
2.	23MC102	Environmental Sciences	2/0/0	2	0	MC
3.	23MC103	Soft Skills	2/0/0	2	0	MC
4.	23MC104	Management Organizational Behavior	2/0/0	2	0	MC

5.	23MC105	General Aptitude	2/0/0	2	0	MC
6.	23MC106	Life Skills and Ethics	2/0/0	2	0	MC
7.	23MC107	Stress Management	2/0/0	2	0	MC
8.	23MC108	Constitution of India	2/0/0	2	0	MC
9.	23MC109	Essence of Indian Traditional Knowledge	2/0/0	2	0	MC
10.	23MC110	Biology	2/0/0	2	0	MC
11.	23MC500	Sports and Yoga	2/0/0	2	0	MC

* Courses conducted either by internal faculty or through MOOCs

ONE CREDIT COURSES (Additional Credits)/ VALUE ADDED COURSES

S.No	Course Code	Course Title	Credits
1.	23VA130	Effective Communication Skills	1
2.	23VA500	Geometric Dimensioning and Tolerancing	1
3.	23VA501	Automotive Interior/Exterior Plastic Parts Design	1
4.	23VA502	Project Management Process	1
5.	23VA503	Quality Management	1
6.	23VA504	Geometric Modeling	1

SERVICE SUBJECTS

SL. No.	Course Code	Course	L/T/P	Contact hrs/week	Credit	Ext/Int	Category
1	23ME111	Engineering Graphics	1/0/4	5	3	50/50	ES

SEMESTER WISE CREDIT DISTRIBUTION: -

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	18	23	20	24	21	21	21	12	160

Total Credits: 160

L: Lecture **T:** Tutorial **P:** Practical **C:** Credit **O:** Outside Class hours **Cat.:** Category

HSMC : Humanities and Social Sciences including Management
BSC : Basic Science Courses
ESC : Engineering Science Courses
PCC : Professional Core Courses
PEC : Professional Elective Courses
OEC : Open Elective Courses
EEC : Emerging Elective Courses
EC : Emerging Courses
PROJ : Project Work
EES : Employability Enhancement Skills
MC : Mandatory Course

Definition of Credit:

L – Lecture	1 Hr. Lecture (L) per week	1 credit
T – Tutorial	1 Hr. Tutorial (T) per week	1 credit
P - Practical/Practice (Project and Industry based Courses)	1 Hr. Practical (P) per week	0.5 credit

Semester – 01

23MA101	MATHEMATICS I	3/1/0/4
Nature of Course	Problem Analytical J	
Pre requisites	-	
Course Objectives:		
1	To use logical notation to define the fundamental data types and structures used in computer algorithms and systems.	
2	To use the concepts of graph theory in practical situations.	
3	To acquire thorough knowledge of fundamental notions of proof's and its application in Cryptography.	
4	To analyse data pertaining to discrete and continuous random variables to interpret the results.	
5	To impart the knowledge of counting principles, to think critically and apply it in real world problems.	
Course Outcomes (Theory) **Upon completion of the course, students shall have ability to**		
C101.1	Recall the basic concepts of logical laws, structures and probability.	[R]
C101.2	Understand the concepts of proof techniques, structures and random variables.	[U]
C101.3	Apply the logical and foundational structures of mathematics with an emphasis on writing proofs.	[AP]
C101.4	Apply the concepts of graph and number theory in cryptography.	[AP]
C101.5	Apply the probability concepts in transition from real problem to a probabilistic model.	[AP]

Course Contents:

MODULE I : LOGICAL PROOF'S & FUNCTIONS (20 Hrs)

Proofs: Definitions - Proof by cases - Proof by contradiction - Logical formulas - Propositions - Truth table - Logical operators - Tautologies and Contradictions – Contrapositive - Equivalences and implications - Predicates - Free and bound variables – Quantifiers - Universe of discourse - **Sets:** Basic sets - Operations on Sets – Law on Sets (without proof) - Cartesian product of sets. **Relations:** Binary relation -Types of relations and their properties - Relational matrix and graph of a relation - Equivalence relations - Partial ordering relation **Functions:** Classifications of functions – Induction - Ordinary induction and Strong induction - Recursive data types - Definition of recursive and structural induction.

MODULE II : NUMBER THEORY & GRAPH THEORY (20 Hrs)

Number Theory: Divisibility - Greatest common divisor - Euclid's algorithm - Prime numbers - Fundamental theorem of arithmetic - Modular arithmetic - Remainder arithmetic - Multiplicative inverses and cancelling - Relatively prime - Euler's theorem.- Chinese Reminder Theorem **Graph Theory:** Vertices and Degrees - Types of graphs - Handshaking theorem - Adjacency matrices - Walks and paths - Connectivity - Isomorphism - Directed acyclic graphs and scheduling –Matchings - The Stable marriage problem –Forests and trees - Spanning trees - Minimum weight spanning trees – Prim's algorithm - Kruskal's algorithm..

MODULE III : COUNTING & PROBABILITY (20 Hrs)

Sums and Asymptotics - Sums of Powers - Harmonic Numbers - Asymptotic Notation -The Division Rule - Counting Subsets - Sequences with Repetitions - The Pigeonhole Principle -Events and Probability Spaces - The Four Step Method - Conditional Probability - The Four-Step Method for Conditional Probability - The Law of Total Probability - Baye's theorem - Random Variables – Discrete and continuous random variables - Distribution Functions - Bernoulli Distribution - Uniform Distribution - Binomial Distribution - Great Expectations - Conditional Expectation - Linearity of Expectation - Infinite Sums - Expectations of Products

Total Hours:	**60**

Text Books:	
1	Tremblay J.P and Manohar R, “Discrete Mathematical Structures with applications to Computer Science”, Tata McGraw–Hill Pub. Co. Ltd, New Delhi, 30th Reprint, 2011.
2	Koshy. T, “Elementary Number Theory with Applications”, Elsevier Publications, New Delhi, Second Edition, 2007.
3	Eric Lehman, F. Thomson Leighton and Albert R. Meyer, “Mathematics for Computer Science”, 14thEdition, MIT Open courseware, 2018.
Reference Books:	
1	Bernard Kolman, Robert C. Busby, Sharan Cutler Ross, “Discrete Mathematical Structures”, sixth edition, Pearson Education Pvt Ltd., New Delhi, 2017
2	Kenneth H. Rosen, “Discrete Mathematics and its Applications”, Eighth Edition, Tata McGraw – Hill Pub. Co. Ltd., New Delhi, Eighth Edition, 2021.
3	Thomas Koshy, “Discrete Mathematics with Applications”, Elsevier Publications, 2004.
4	P. Grimaldi, “Discrete and Combinatorial Mathematics: An Applied Introduction”, Fifth Edition, Pearson Education Asia, New Delhi, Fifth Edition, 2019.
Web References:	
1	https://onlinecourses.nptel.ac.in/noc23_cs109/preview
2	https://onlinecourses.nptel.ac.in/noc23_cs120/preview
3	https://onlinecourses.nptel.ac.in/noc23_ma77/preview
4	https://onlinecourses.nptel.ac.in/noc23_ma72/preview
Online Resources:	
1	https://www.coursera.org/specializations/discrete-mathematics
2	https://www.cs.ucdavis.edu/~rogaway/classes/20/fall21/mit-book.pdf
3	https://mathworld.wolfram.com/topics/DiscreteMathematics.html
4	https://mathworld.wolfram.com/topics/NumberTheory.html

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Continuous Assessment				End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom’s Level	Assessment Component	FA (16%) [80 Marks]
C101.1	Remember	Quiz	20
C101.2	Understand	Presentation	20
C101.3 – C101.5	Apply	Tutorial	20
C101.3 – C101.5	Apply	Assignment	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	50	50	50
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1: 100 Marks			**CA 2: 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)(Theory)

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C101.1	1	1													
C101.2	2	2													
C101.3	3	3													
C101.4	3	3													
C101.5	3	3													

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

23EE113	Fundamentals of Electrical and Electronics Engineering (Common to MECH and CIVIL)	2/1/0/3

Nature of Course	G (Theory analytical)
Course Pre-requisites	Nil

Course Objectives:

1	To import the students with a basic understanding of Electrical circuits.
2	To learn the working principle of static machine.
3	To understand the rotating Machines working principles and to have a knowledge on selection of machine for specific types of applications.
4	To give a comprehensive exposure to Electrical installations.

Course Outcomes:
Upon completion of the course, students shall have ability to

C113.1	Analyze the concepts in AC circuit and DC circuits.	[A]
C113.2	Examine the working principle of Static machines.	[A]
C113.3	Understand the working principle of Rotating machines.	[U]
C113.4	Utilize the basic components for Electrical installations.	[AP]
C113.5	Interpret the basic devices in Electronics and Instrumentation.	[A]

Course Contents:

Course Contents:

Module I: DC Circuits and AC Circuits **15 Hrs**

DC Circuits - Electrical circuit elements (R, L and C) - Voltage and Current Sources - Kirchoff's current and voltage law - analysis of simple circuits with DC excitation - Mesh and Nodal Analysis. **AC Circuits** - Representation of sinusoidal waveforms, Peak and RMS values, Phasor representation, Real power, Reactive power, Apparent power, Power factor. Analysis of single phase ac circuits consisting of R, L, C, RL and RC. Three phase balanced circuits - Voltage and Current relations in star and delta connections.

Module II: Electrical Machines and Installations **15 Hrs**

Static machines: BH characteristics, construction & working principle of single-phase and three phase transformers. Rotating machines: Generation of rotating magnetic fields, construction and working principle of DC machines, three-phase induction motor and synchronous motor. Components of LT Switchgear - Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Domestic wiring, Types of Wires and Cables, Earthing.

Module III: Fundamentals of Semiconductor Devices and Instrumentation **15 Hrs**

Semiconductor - PN junction diode - Zener diode - Bipolar Junction Transistor Introduction - Field Effect Transistor Introduction - Construction and characteristics of JFETs - MOSFET - Depletion type MOSFET, Enhancement type MOSFET, Transfer characteristics. Sensors, Solenoids, Pneumatic controls with electrical actuator, Mechatronics, types of valves and its applications, Electro-Pneumatic systems, Proximity sensors, Limit switches.

Total Hours	**45**

Text Books:

1	Fitzgerald. A.E., Charles Kingsely Jr, Stephen D.Umans, 'Electric Machinery', Tata McGraw Hill, 7th edition, 2020.
2	Vincent. Del. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 2nd edition, 2015.
3	E. Hughes, "Electrical and Electronics Technology", Pearson, 10th edition, 2011.
4	Donald .A. Neamen, Electronic Circuit Analysis and Design, 2nd Edition reprint, Tata Mc Graw Hill, 2013.

Reference Books:	
1	Charles A.Gross, Thaddeus A.Roppel, “Fundamentals of Electrical Engineering”, CRC press, 2012.
2	D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, Revised 1st edition 2017.
3	Theodore F. Bogart, Jeffery S. Beasley and Guilermo Rico, ‘Electronic Devices and Circuits’, Pearson Education, 6th edition, 2013.
Web References:	
1	http://nptel.ac.in/course.php?disciplineId=108
2	https://ocw.mit.edu/courses/find-bytopic/#cat=engineering&subcat=electricalengineering&spec=electricpower
3	https://nptel.ac.in/video.php?subjectId=117103063
4	https://onionesquereality.wordpress.com/.../more-video- lectures-iit-open
5	https://nptel.iitg.ernet.in/Elec_Comm_Engg/.../Video-ECE.pdf
Online Resources:	
1	http://www.electrical-knowhow.com/
2	https://www.edx.org/course/electricity-magnetism-part-1-ricex-phys102-1x-1
3	https://www.mooc-list.com/course/fundamentals-electrical-engineering-coursera
4	https://nptel.ac.in/course.php

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	tTotal	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms’ Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom’s Level**	**Assessment Component**	**FA (16%) [80 Marks]**
C113.1	Analyze	Assignment	20
C113.2	Analyze		
C113.3	Understand	Simulation	20
C113.4	Apply	Class Presentation	20
C113.5	Analyze	Quiz	20

Assessment based on Summative and End Semester Examination			
Bloom’s Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

No. of the CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C113.1	3												1		
C113.2	3												1		
C113.3	3		1										1		
C113.4	3		1										1		
C113.5	3		1										1		
1	Reasonably Agreed				2	Moderately Agreed					3	Strongly Agreed			

23TA101	HERITAGE OF TAMILS / தமிழர்மரபு	1/0/0/1
Nature of Course:	C (Theory Concept)	
Pre requisites:	NIL	

Course Objectives:

1	To know various concepts of Tamil Language families.
2	To know about the essentialities of Heritage.
3	To understand the Aram concepts of Tamils and the cultural influence.

Course Outcomes:
Upon completion of the course, students shall have ability to

C101.1	Know about the language families in India, impact of religions and the contribution of Bharathiyar and Bharathidhasan.	[U]
C101.2	Observe the growth of sculpture, making of musical instruments and the role of temples in socio and economic lives.	[U]
C101.3	Understand the significance of folklore and martial arts.	[U]
C101.4	Learn the sangam literature, sangam age and overseas conquest of Cholas.	[U]
C101.5	Understand the contribution of Tamils to Indian Freedom Struggle, role of Siddha medicine and print history of Tamil Books.	[U]

Course Contents:

Language and Literature: Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

Heritage - Rock Art Paintings to Modern Art – Sculpture: Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils. **Folk And Martial Arts:** Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

Thinai Concept of Tamils - Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas. Contribution of Tamils to Indian national movement and Indian culture: Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

Total Hours:	**15**

Text-cum-Reference Books:

1	தமிழகவரலாறு – மக்களும்பண்பாடும் – கே. கே. பிள்ளை(வெளியீடு: தமிழ்நாடுபாடநூல்மற்றும்கல்வியியல்பணிகள்கழகம்).
2	கணினித்தமிழ் – முனைவர்இல. சுந்தரம் . (விகடன்பிரசுரம்).
3	கீழடி – வைகைநதிக்கரையில்சங்ககாலநகரநாகரிகம் (தொல்லியல்துறைவெளியீடு)
4	பொருநை – ஆற்றங்கரைநாகரிகம். (தொல்லியல்துறைவெளியீடு)
5	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

8	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
10	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author).
11	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
12	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component**	**FA (16%) [80 Marks]**
C101.1	Understand	Quiz	20
C101.2	Understand	Seminar	20
C101.3	Understand	Seminar	20
C101.4	Understand	Quiz	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1: [60 Marks]	**CIA2: [60 Marks]**	
Remember	40	40	40
Understand	60	60	60
Apply	-	-	-
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C101.1									1			1			
C101.2								1	1			1			
C101.3								1	1			1			
C101.4									1						
C101.5								1	1						

23EN101	ORAL AND WRITTEN COMMUNICATION SKILLS	2/0/2/3

Nature of Course	Theory Skill Based
Pre requisites	Basics of English Language

Course Objectives:

1	To empower students to comprehend different aspects of communication using LSRW skills.
2	To highlight the essential aspects of effective oral and written communication necessary for professional success.
3	To expand the skills of the students in preparing job search artefacts and negotiating their use in GDs and interviews.
4	To enable students to communicate contextually in specific, personal and professional situations with courtesy.
5	To enrich students to carry out day-to-day communication at the workplace and facilitate efficient interpersonal communication.

Course Outcomes:
Upon completion of the course, students shall have ability to

C101.1	Remember and expand writing skills through guided activities.	R
C101.2	Apply communication skills in a corporate environment.	AP
C101.3	Analyse and collaborate better with colleagues, building stronger professional and personal relationships.	AN
C101.4	Apply technical writing skills to write letters, emails and prepare technical documents.	AP
C101.5	Analyze and communicate effectively in personal and professional situations.	AN

Course Contents

Module I

Reading: Reading techniques -Skimming and scanning - Cloze reading - Reading and understanding technical articles – Reading for detailed comprehension: Email and letters - Reading advertisements - Table completion: Interpreting charts and graphs - Verbal reasoning – Comprehending reviews – Reading and responding to instant messages.

Module II

Writing: Formal letters (Sales letter, calling for quotations, seeking clarification, placing an order, complaint letter, inviting, accepting and declining letters) - Emails - Minutes of meeting - Professional report writing - Proposal writing - Resume / job application letter - Case study.

Module III

Listening: Situational listening - Listening about an experience - Listening about short extracts - Listening an interview - Conversational speaking. Speaking: Conversational speaking - Decipher the picture given and answer the question posed along with it - Decipher the mind map given and speak about it - Listen to the questions posed and answer them appropriately

Lab Components

1	Conversational listening	[U]
2	Speaking - Pictography	[AP]
3	Listening about an experience	[U]
4	Listening to short extracts	[U]
5	Writing - Resume Writing, Job application letter	[AP]
6	Mock interview	[AP]
	Total Hours:	60

Text Books:	
1	Jay Sullivan, “Simply Said: Communicating Better at Work and Beyond”, Wiley Publication, 2018.
2	Alred J Gerald, Brusaw T Charles,. Oliu E Walter, “Handbook of Technical Writing”, Bedford/St. Martin’s Boston publication,New York, 2012.
3	Liz Hamp-Lyons and Ben Heasly, “Study Writing :A Course in Written English for Academic Purposes”, Updated Edition, Cambridge University Press, 2006.
4	Dr.Praveen Sam and K N Shoba - A Course in Technical English by Cambridge University press, 2020.
Reference Books:	
1	Rutherfoord J Andrea, “Basic Communication Skills for Technology”, Upper Saddle River, N.J. : Prentice Hall, 2001.
2	Singh Hardeep (Author), Kothari (Author), “Written & Oral Technical Communication Skills For Engineers/Scientists” - LAMBERT Publications, 2019.
Web References:	
1	http://www.academiccourses.com/Courses/English/Business-English
2	https://www.liveworksheets.com/worksheets/en/English_as_a_Second_Language_(ESL)/Technical_English
Online Resources:	
1	https://www.coursera.org/specializations/business-english
2	https://www.businessenglishresources.com/learn-english-for-business/student-section/practice-exercises-new/

Assessment									End Semester Examination	Total
Theory				Practical			Total (A+ B)	Total Continuous Assessment		
Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Total (B)				
80	120	200	100	75	25	100	200	50	50	100

Formative Assessment based on Capstone Model - Theory			
Course Outcome	Bloom’s Level	Assessment Component	FA (10%) [80 Marks]
C101.1 C101.2	Understand	Listening to Short Extracts	20
C101.3	Apply	Speaking - Pictography	20
C101.4	Apply	Mock Interview	20
C101.5	Apply	Assignment	20

Assessment based on Summative and End Semester Examination - Theory			
Bloom’s Level	Summative Assessment (15%) [120 Marks]		End Semester Examination (25%) [100 Marks]
	CIA1: (60 Marks)	CIA2: (60 Marks)	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination - Practical			
Bloom's Level	**Continuous Assessment (25%) [100 Marks]**		**End Semester Examination (25%) [100 Marks]**
	FA: (75 Marks)	**SA: (25 Marks)**	
Remember	20	20	20
Understand	30	30	30
Apply	50	50	50
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Course Outcomes (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C101.1										3					
C101.2								2		3					
C101.3								2		3	2				
C101.4										3					
C101.5										3		3			

23ME101	ENGINEERING DRAWING	1/0/4/3
Nature of Course	Practical Application	
Pre Requisites	General Drawing skill	

Course Objectives:

1	To develop skills for communication of concepts, ideas and design of engineering products.
2	To expose them to existing national standards related to technical drawings.
3	Ability to create basic geometries using the modelling software.

Course Outcomes:
Upon completion of the course, students shall have ability to

C101.1	Interpret and sketch the basic and intermediate geometries.	[U]
C101.2	Visualize and sketch the 2D diagram from 3D diagrams.	[A]
C101.3	Imagine the parametric features of solids.	[A]
C101.4	Envisage the sectional and lateral geometrical properties of solids.	[E]
C101.5	Interpret the isometric to orthographic projection and vice versa.	[C]

Course Contents:

Concepts and conventions: Drafting instruments, BIS conventions, drawing sheets, general principles of projection: First angle projection - Layout of views. **(Not for examination)**

Manual drafting of the following using mini-drafter
General Plane Curves: Conic curves: ellipse and parabola by eccentricity method. Drawing normal and tangents to these curves, Involutes- Square and Circle, Simple Cycloid. **Orthographic projection**- Conversion of isometric/pictorial into orthographic views.

Projection of solids (Solid axis inclined to any one reference plane)**:** Drawing front and top views of Prisms- Square, Pentagonal, hexagonal and circular prisms. Drawing front and top views of Pyramids - Square, Pentagonal, hexagonal and circular pyramids.

Sectioning of solids- Basic concepts using a simple prism/pyramid in vertical position. **Development of lateral surfaces of solids-** Development of lateral surfaces of Simple Prisms/Pyramids and Truncated Prisms only.

Introduction to CAD: Basics of 2D and 3D modeling, Drafting of simple geometrics: Line, planes and simple 2D drawings.

S.No	List of Experiments	CO Mapping	RBT
1	Study the Basics of 2D and 3D drawing	C101.1	[U]
2	Drafting of title block and Co-ordinate system	C101.1	[U]
3	Construction of conic curves (Ellipse, Parabola and Hyperbola)	C101.1	[U]
4	Construction of special curves (Cycloid and Involutes)	C101.1	[U]
5	Isometric to orthographic projections	C101.2	[A]
6	Projection of solids (Prism) – inclined to HP / VP	C101.3	[A]
7	Projection of solids (Pyramid) – inclined to HP / VP	C101.3	[A]
8	Section of solids (Prism / Pyramid) – inclined to HP / VP	C101.4	[E]
9	Development of surfaces (Prism / Pyramid / Truncated Prisms)	C101.4	[E]
10	Drafting of simple2D and 3D model	C101.5	[C]
	Total Hours:		**75**

Text Books:

1	K. V. Natarajan, “A Text Book of Engineering Graphics", Dhanalakshmi Publishers, 2018.
2	Varghese P.I., “Engineering Drawing”, McGraw Hill Education Pvt. Ltd., 3e-2019.

3	Parthasarathy N.S and Veera Murali, “Engineering Drawing”, Oxford University Press, 2015.
4	Basant Agarwal and C M Agarwal., “Engineering Drawing”, 2e, McGraw Hill Education, 2019.
Reference Books:	
1	Bhatt N.D and Panchal, “Engineering Drawing”, Charotar Publishing House, 50th Edition, 2014.
2	Venugopal K. and Prabhu Raja V, “Engineering Graphics”, New Age Int. (P) Limited, 4th Edition- 2016.
Web References:	
1	http://nptel.ac.in/courses/112103019/Engineering drawing
2	http://pioneer.netserv.chula.ac.th/~kjirapon/self-practice.html

Continuous Assessment									**End Semester Practical Examination**	**Total**
Theory				**Practical**			**Total (A+B)**	**Total Continuous Assessment**		
Formative Assessment	**Summative Assessment**	**Total**	**Total (A)**	**Formative Assessment**	**Summative Assessment**	**Total (B)**				
80	**120**	**200**	**100**	**75**	**25**	**100**	**200**	**50**	**50**	**100**

Formative Assessment based on Capstone Model - Theory			
Course Outcome	**Bloom’s Level**	**Assessment Component**	**FA (10%) [80 Marks]**
C101.1	Understand	Assignment	**20**
C101.2	Analyze	Assignment	**20**
C101.3	Analyze	Model Making	**40**
C101.4	Evaluate		
C101.5	Create		

Assessment based on Summative Assessment - Theory		
Bloom’s Level	**Summative Assessment (15%) [120 Marks]**	
	CIA1: (60 Marks)	**CIA2: (60 Marks)**
Remember	10	10
Understand	20	20
Apply	40	30
Analyse	30	30
Evaluate	-	10
Create	-	-

Assessment based on Continuous and End Semester Examination - Practical			
Bloom’s Level	**Continuous Assessment (25%) [100 Marks]**		**End Semester Examination (50%) [100 Marks]**
	FA: (75 Marks)	**SA: (25 Marks)**	
Remember	30	30	30
Understand	30	30	30
Apply	20	20	20
Analyse	20	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination															
Continuous Assessment (50%)															End Semester Practical Examination (50%)
CA 1 (100 Marks)				CA 2 (100 Marks)				Practical Exam (100 Marks)							
SA 1 (60M)	FA 1			SA 2 (60M)	FA 2			FA (75M)	SA (25M)						
	Component-I (20 Marks)		Component-II (20 Marks)		Component-I (20 Marks)		Component-II (20 Marks)								

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C101.1	3			1						3			2		
C101.2	3			1						3			3	1	
C101.3	3		1							3			2		
C101.4	3		1		1					3			3	1	
C101.5	3									3			2		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

23CS101	PROBLEM SOLVING USING C++	1/0/4/3
Nature of Course	K (Problem Programming)	
Pre requisites	NIL	

Course Objectives:

1	To learn the fundamental programming concepts and methodologies which are essential to build good C++ programs.
2	To gain knowledge on control structures and functions in C++.
3	To provide the basic object-oriented programming concepts and apply them in problem solving.
4	To introduce file streams and operations for storing data permanently.
5	To know generic programming paradigm.

Course Outcomes:
Upon completion of the course, students shall have ability to

C101.1	Illustrate the fundamental concepts and methodologies required to develop a program for given problems.	[U]
C101.2	Develop a program for real-time problems with pointers and objects.	[AP]
C101.3	Apply the Constructors, destructors, and overloading concepts to solve the solve.	[AP]
C101.4	Develop C++ programs with Interfaces, Exception and File processing	[AP]
C101.5	Implement the concepts on file streams, I/O and Lambda Expression.	[AP]

Course Contents:

Module I C++ Programming Fundamentals

C vs C++, Basic of OOPS, the main () function, Header files, Basic Input and Output (I/O) using cin and cout, Variable, Constant. **Operators:** Arithmetic Operators, Assignment Operators, Relational Operators, Logical Operators, Bitwise Operators, Other Operators, Operator Precedence. Control Statements: if, if...else and Nested if...else, switch case, break and continue, Loops - for loop, while loop, do while loop, goto. **Arrays and Strings:** 1D array, 2D array, Strings, String functions. **Function:** Basics, call by value, call by reference & return by reference, Inline function, overloading Functions, inline Functions, Recursive Functions. **Pointers:** Pointer, Dynamic Memory Allocation.

Module II Object Oriented Concepts

Classes and Objects, public, private, protected. **Constructors and destructors**: Overloaded Constructor, Copy Constructor, Shallow Copying Deep Copying. **Overloading:** this' Pointer, structs vs Classes, Friends of a class, Operator Overloading, Inheritance, Overloading vs Overriding, Polymorphism, Virtual Functions, Pure Virtual Functions and Abstract Classes.

Module III Files and Generic Programming

Abstract Classes as Interfaces, Exception, Files, Streams and I/O, STL, Generic Programming, Lambda Expression.

Lab Component

S.No.	Lab Exercise
1.	Practice of C Programming using Branching and Iterative constructs.
2.	Programs using arrays and strings.
3.	Programs using Functions.
4.	Programs using Structures and Pointers.
5.	Programs using classes and objects.
6.	Programs using constructor and destructor.
7.	Programs using method overloading, operator overloading and polymorphism concepts.
8.	Programs using friend class.

9.	Programs using virtual functions and abstract class.
10.	Programs using inheritance concepts.
11.	Programs using exception handling concept.
12.	Programs using Files.
13.	Mini project
	Total Hours | **75 Hours**
Text Books:	
1.	E Balagurusamy,"Object Oriented Programming With C++", 4th Edition, Tata McGraw-Hill Education, 2008.
2.	YashavantP. Kanetkar, "Let us C++", BPB Publications, 2020.
3.	M. Sprankle, "Problem Solving and Programming Concepts", 9th Edition, Pearson Education, New Delhi, 2011.
Reference Books:	
1.	Herbert Schildt, "The Complete Reference C++", 4th edition,MH, 2015.
2.	John Hubbard, "Schaum's Outline of Programming with C++", MH, 2016.
Web References:	
1.	https://www.geeksforgeeks.org/c-plus-plus/
2.	http://web.stanford.edu/class/cs106l/
Online Resources:	
1.	https://nptel.ac.in/courses/106101208
2.	https://www.hackerrank.com/domains/cpp
3.	https://codeforces.com/blog/entry/74684
4.	https://www.hackerearth.com/practice/notes/tricky-and-fun-programming-in-c/

Continuous Assessment									**End Semester Practical Examination**	**Total**
Theory				**Practical**			**Total (A+B)**	**Total Continuous Assessment**		
Formative Assessment	**Summative Assessment**	**Total**	**Total (A)**	**Formative Assessment**	**Summative Assessment**	**Total (B)**				
80	**120**	**200**	**100**	**75**	**25**	**100**	**200**	**50**	**50**	**100**

Formative Assessment based on Capstone Model - Theory			
Course Outcome	**Bloom's Level**	**Assessment Component**	**FA (10%) [80 Marks]**
C101.1	Understand	Quiz	20
C101.2 & C101.3	Apply	Assignment	20
C101.4	Apply	Group Assignment	20
C101.5	Apply	Case Study	20

Assessment based on Summative Assessment - Theory		
Bloom's Level	**Summative Assessment (15%) [120 Marks]**	
	CIA1: (60 Marks)	**CIA2: (60 Marks)**
Remember	20	20
Understand	40	30
Apply	40	50
Analyse	-	-
Evaluate	-	-
Create	-	-

Assessment based on Continuous and End Semester Examination - Practical			
Bloom's Level	**Continuous Assessment (25%) [100 Marks]**		**End Semester Practical Examination (50%) [100 Marks]**
	FA: (75 Marks)	**SA: (25 Marks)**	
Remember	10	20	20
Understand	30	20	20
Apply	50	50	50
Analyse	10	10	10
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Practical Examination										
Continuous Assessment (50%)										**End Semester Practical Examination (50%)**
CA 1 (100 Marks)			**CA 2 (100 Marks)**				**Practical Exam (100 Marks)**			
SA 1 (60M)	**FA 1**		**SA 2 (60M)**	**FA 2**			**FA (75M)**	**SA (25M)**		
	Component-I (20 Marks)	**Component-II (20 Marks)**		**Component-I (20 Marks)**	**Component-II (20 Marks)**					

Course Outcome (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C101.1	3	3													
C101.2	3	3	3	2	2				2	1		3			
C101.3	3	3	3	2	3				2	1		3			
C101.4	3	3	3	3	3				3	2		3			
C101.5	3	3	3	3	3				2	2		2			
C101	**3**	**3**	**3**	**3**	**3**				**3**	**2**		**2**			

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

23EE115	Fundamentals of Electrical and Electronics Engineering Laboratory (Common to MECH and CIVIL)	0/0/2/1
Nature of Course	: M(Practicalapplication)	
Pre-requisites	: Nil	

Course Objectives:

1	To learn the safety precautions and troubleshooting in using Electricity.
2	To estimate the current flow and voltage across the circuit elementsunder different loading conditions.
3	To understand the basic components for electrical installations.

Course Outcomes:
Upon completion of the course, students shall have ability to

C115.1	Illustrate Electrical and Electronic components and its specifications.	[U]
C115.2	Verify the current flow and voltage across the circuit elements using different analysis method.	[A]
C115.3	Measure power and power factor of single and three phase AC circuits.	[AP]
C115.4	Comprehend the cut-out sections of DC Motor and Induction Motor.	[U]
C115.5	Utilize the basic components for electrical installations.	[AP]

Course Contents:

S.No	List of Experiments	CO Mapping	RBT
1	Demonstration of meters, electrical and electronic components with specification.	C115.1	[U]
2	Safety precautions with electrical components.	C115.1	[U]
3	Troubleshooting of electrical equipment.	C115.1	[A]
4	Testing of CRO and Electronic components using Multimeter.	C115.2	[A]
5	Determination of mesh current by Mesh Analysis.	C115.2	[A]
6	Estimation of Voltage and Current in star and delta connections.	C115.2	[A]
7	Measurement of power and energy.	C115.3	[A]
8	Soldering practice - Components devices and Circuits using general purpose PCB.	C115.5	[A]
9	Residential house wiring.	C115.4	[A]
10	Demonstration of cut-out sections of DC Motor and Induction Motor.	C115.3	[U]
11	Demonstration of components of LT Switch Gears.	C115.5	[U]
12	Familiarization of digital basic gate ICs.	C115.5	[U]
	Total Hours	**30**	

Text Books:

1	Fitzgerald. A.E., Charles Kingsely Jr, Stephen D.Umans, 'Electric Machinery', Tata McGraw Hill, 7th edition, 2020.
2	Vincent. Del. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 2nd edition, 2015.
3	E. Hughes, "Electrical and Electronics Technology", Pearson, 10th edition, 2011.
4	Donald .A. Neamen, Electronic Circuit Analysis and Design, 2nd Edition reprint, Tata Mc Graw Hill, 2013.

Reference Books:

1	Charles A.Gross, Thaddeus A.Roppel, "Fundamentals of Electrical Engineering", CRC press, 2012.
2	D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, Revised 1st edition 2017,
3	Theodore F. Bogart, Jeffery S. Beasley and Guilermo Rico, 'Electronic Devices and Circuits', Pearson Education, 6th edition, 2013.

Web References:	
1	http://nptel.ac.in/course.php?disciplineId=108
2	https://ocw.mit.edu/courses/find-bytopic/#cat=engineering&subcat=electricalengineering&spec=electricpower
3	https://nptel.ac.in/video.php?subjectId=117103063

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
75	25	100	60	40	100

Assessment based on Continuous and End Semester Examination			
Bloom's Level	Continuous Assessment (60%) [100 Marks]		End Semester Practical Examination (40%) [100 Marks]
	FA (75 Marks)	SA (25 Marks)	
Remember	0	0	0
Understand	30	30	30
Apply	30	30	30
Analyse	40	40	40
Evaluate	0	0	0
Create	0	0	0

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO2	PSO3
C115.1	3	1											3		
C115.2	3	1													
C115.3	3	1													
C115.4	3	2													
C115.5	3	1													
1	Reasonably Agreed				2	Moderately Agreed					3	Strongly Agreed			

23MC101	INDUCTION PROGRAMME (FOR ALL BRANCHES OF B.E / B.TECH/ M.TECH PROGRAMMES)	1/0/0/0

Nature of Course	InductionProgramme
Pre requisites	Nil

Course Objectives:

1.	To have broad understanding of society and relationships
2.	To nurture the character and fulfil one's responsibility as an engineer, a citizen and a human being
3.	To incorporate meta skills and values

Course Outcomes:
Upon completion of the course, students shall have ability to

C101.1	Explore academic interest and activities	[AP]
C101.2	Work for excellence	[AP]
C101.3	Promote bonding and give a broader view of life and character	[AP]

Course Contents:

PHYSICAL ACTIVITY: Research over the past years has shown Yoga to have stress-relieving powers on students, paving the way for improved academic performance with the practice of asanas, meditation and breathing exercises. To prove these words Yoga classes has been planned in this module.(CO mapping: C101.1, C101.2, C101.3)

CREATIVE ARTS (students can select any one of their choice): Cultural development supports students to understand, feel comfortable with, value and appreciate the potential enrichment of cultural diversity. They should challenge discrimination, whether based on cultural or racial difference. Students should experience cultural traditions embedded in arts, crafts, language, literature, theatre, song, music, dance, sport, Science, technology and travel. Students should develop an appreciation of beauty both in experiencing artistic expression and by exploring their own creative powers. To inculcate those skills they are given a chance to exhibit their talents through painting, sculpture, pottery, music, dance, craft making and so on. .(CO mapping: C101.1, C101.2, C101.3)

UNIVERSAL HUMAN VALUES: Moral development involves supporting students to make considered choices around their behaviour and the values that provide a framework for how they choose to live. Moral development is also learning about society's values, understanding the reasons for them, how they are derived and change; and how disagreements are resolved. Students must consider the consequences of personal and societal decisions on the wider community – local and global- and on the environment and future generations. To acquire this the students are exposed to training to enhance their soft skills. .(CO mapping: C101.1, C101.2, C101.3)

LITERARY AND PROFICIENCY MODULES: Social development helps students to work effectively together, developing the inter-personal skills required to relate positively with their peers and people of all ages. Students must also understand how to participate productively in a diverse and plural society and learn about, and how to effectively engage with societal institutions and processes. They should understand that a person may have different roles and responsibilities within society. To reach this the

following aspects are given in the form of Reading, writing, speaking – debate, role play etc.Communication and computer skills. (CO mapping: C101.1, C101.2, C101.3)

LECTURES BY EMINENT PEOPLE: Teaching with Lectures. ... It is essential to see lectures as a means of helping students learn to think about the key concepts of a particular subject, rather than primarily as a means of transferring knowledge from instructor to student. During the induction period students will attend to Guest lectures by subject experts.(CO mapping: C101.1, C101.2, C101.3)

VISIT TO LOCAL AREAS:Traveling is in fact a way of learning to learn. You are out of your comfort zone and so you must learn to be able to adapt to a new learning environment in a very short time. It also helps in your overall learning as well. In the induction period students will be taken to different places near college to learn new things. Eg.Meditationcentre/orphanage/Hospital.(CO mapping: C101.1, C101.2, C101.3)

FAMILIARIZATION TO DEPARTMENT/BRANCH INNOVATION: Hod's of different branches will present about their department followed by department visit to view various facilities available at their department, new innovations from students and faculties etc.(CO mapping: C101.1, C101.2, C101.3)

Course Articulation Matrix (Lab)

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
1						3	3	3	3	3	3	3			
2						3	3	3	3	3	3	3			
3						3	3	3	3	3	3	3			
Avg						3	3	3	3	3	3	3			

1	Reasonably agreed	2	Moderately agreed	3	Strongly agreed

Semester – 02

23ME201	ENGINEERING MECHANICS	3/0/0/3
Nature of Course	Concepts and Analytical	
Pre-Requisites	Fundamentals of basic mathematics and physics	

Course Objectives:

1	To make the students understand the vector and scalar representation of forces and moments and the static equilibrium of particles and rigid bodies.
2	To understand the effect of friction on equilibrium, laws of motion, kinematics of motion and their interrelationship.
3	To make the students understand the properties of surfaces and solids, prediction of behaviour of particles and rigid bodies under motion.

Course Outcomes:
Upon completion of the course, students shall have ability to

C201.1	Define and illustrate the basic concepts of force system	[U]
C201.2	Calculate the resultant force, moment and geometrical properties of 2D, objects	[Ap]
C201.3	Analyse the resistance force of objects for impending motion	[A]
C201.4	Determine the displacement, velocity and acceleration of particles and objects.	[Ap]
C201.5	Determine the dynamic forces exerted in various mechanisms of planar motion	[Ap]

Course Contents:

Equilibrium of Particles and Rigid Bodies: Force Systems – Basic concepts, Laws of Mechanics, Principle of Transmissibility, System of Forces, Coplanar Concurrent Forces, Resolution and resultant of several concurrent forces, Equilibrium of particles in 2D. Statics of Rigid bodies in two dimensions- Varignon's theorem; Couples and Resultant of Force System, Equations of equilibrium of rigid bodies in 2D. Beams - types of supports, loads and reactions.

Centre of Gravity, Moment of Inertia and Friction: Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Parallel Axis theorem and perpendicular axis theorem, Moment of inertia of standard sections and composite sections (problems only); Introduction to Mass moment of inertia.
Friction: Types of friction, Limiting friction, Laws of friction – Static Friction-simple contact friction in blocks only.

Dynamics of Particles: Kinematics of Particles: Displacements, Velocity and acceleration, their relationship in linear motion (Horizontal only), projectile motion.
Kinetics of Particles: D'Alembert's principle and its applications; Work-kinetic energy, Impulse-momentum.

Total Hours:	**45**

Text Books:

1	Beer F.P, and Johnston ER, Vector Mechanics for Engineers – Statics and Dynamics, McGraw Hill Education, New Delhi, 2017.
2	Dhiman A.K, Dhiman P, Kulshreshtha D.C, Engineering Mechanics-Statics and Dynamics, McGraw Hill Education, 2017.

Reference Books:

1	Kottiswaran N, Engineering Mechanics - Statics and Dynamics, Sri Balaji Publications- 2017.
2	Meriam JL and Craige, "Engineering Mechanics statics and dynamics", John Willey and Son's publication, 9th edition.2021
3	Sanju Unadkat, "Engineering Mechanics", Tech-Neo Publications-2020.
4	Irving H. Shames, Engineering Mechanics - Statics and Dynamics, Pearson Education Asia Pvt. Ltd., 2016.

Web References:	
1	http://nptel.ac.in/courses/122104015/
2	http://nptel.ac.in/courses/112103109/
Online Resources:	
1	https://ocw.mit.edu/courses

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C201.1	Understand	Quiz	20
C201.2	Apply	Assignment	20
C201.3	Analyze	Assignment	20
C201.4	Apply	Tutorial	20
C201.5			

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C201.1	3		1										2		
C201.2	3	2	2										3	1	
C201.3	3	3	3										3		
C201.4	3	2	3										3	1	
C201.5	3	2	2										3	1	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed	

23ME202	INDUSTRIAL METALLURGY	3/0/0/3
Nature of Course	Theory concepts	
Pre Requisites	Engineering Physics	
Course Objectives:		
1	To impart knowledge on phase diagrams and use of phase diagrams	
2	To understand the heat treatments processes and apply the same to modify the material properties.	
3	To impart knowledge on various metals and non-metals and its applications	
4	To demonstrate the various material testing methods.	
Course Outcomes:		
Upon completion of the course, students shall have ability to		
C202.1	Recall the various metallic and non-metallic materials properties and applications	[R]
C202.2	Interpret the structure mechanisms that contributing properties of materials	[U]
C202.3	Describe the alloy, phase diagrams and the use of phase diagrams.	[U]
C202.4	Identify and executing the heat treatment processes and coatings to modify the properties of materials.	[Ap]
C202.5	Implement the various testing procedures to study the properties of materials.	[Ap]

Course Contents:

Structure and phase diagrams: Atomic structure – atomic binding - characteristics of covalent bond, ionic bond and metallic bond – Crystal structure - BCC, FCC, HCP - Mechanism of Crystallization- Nucleation and growth –grain and grain size – constitution of alloys - solid solutions - Phase diagrams- cooling curves- phase rule- lever rule – application of phase rule and lever rule in Cu-Ni phase diagram - Iron and carbon phase diagram – phases and reactions in iron-carbon diagram – classification of steel and cast iron – properties and applications- specification of steel.

Heat treatment of steel: Definition – purposes – types - annealing, normalizing, hardening and tempering of steel – hardenability - jominy end quench test - TTT diagram for eutectoid steel – continuous cooling curve and interpretation of final microstructure – austempering and mar tempering - surface modification - case hardening - carburising, nitriding, carbonitriding, flame, induction, electron beam and laser beam hardening- coating - PVD process using plasma -

Materials, Mechanical properties and testing of materials: Effect of alloying elements on steel - stainless steel, HSLA steel, Maraging steel– properties and applications of nickel, magnesium, copper, titanium and aluminium alloys - precipitation hardening – polymers - Thermoplastics and thermosets, properties and applications (ABS, PA, PPO, PEEK, UF, PF and epoxy) –Ceramics - properties and applications of SiC, Al_2O_3 and PSZ – introduction to composites and smart materials (SMA) - mechanical properties of materials - metallography – specimen preparation and optical microscope and scanning electron microscope -– Deformation – slip and twinning - fractures – types of fractures – testing under tension, compression and shear loads - hardness tests – impact test – fatigue test- creep test- corrosion test- wear test – ASTM for above testing methods – Non destructive testing – liquid penetrant test, ultrasonic test and magnetic particle inspection.

Total Number of Theory Hours	**45**

Text Books:	
1	William D. Callister Jr., David G. Rethwisch , 'Material Science and Engineering – An introduction' 10th edition, Wiley India, 2018.
2	Kenneth G Budinski and Michael K Budinski, "Engineering Materials properties and selection", PHI learning private limited, 9th edition, 2016.
Reference Books:	
1	Sidney.H Avner, "Introduction to Physical Metallurgy", McGraw Hill Education, 2nd edition, 2017.
2	G. E.Dieter, Mechanical Metallurgy, McGraw Hill, 3rd edition, 2017.

Web References:	
1	nptel.iitm.ac.in./courses/113105028/
2	www.sciencedaily.com/articles/m/metallurgy.html

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C202.1	Remember	Quiz	20
C202.2	Understand	Assignment	20
C202.3	Understand	Assignment	20
C202.4	Apply	Presentation / seminar	20
C202.5			

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	50	20	20
Understand	50	30	40
Apply	-	50	40
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C202.1	3	1	1											2	
C202.2	3	1	1											2	
C202.3	3	1	2											2	
C202.4	3	2	3											2	
C202.5	3	2	3											3	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

23MA204	CALCULUS AND FOURIER SERIES	3/1/0/4
Nature of Course	J (Problem analytical)	
Pre requisites	-	

Course Objectives:

1	To gain knowledge in integrals, which are needed in engineering applications.
2	To develop logical thinking and analytical skills in evaluating multiple integrals.
3	To familiarize the concepts of differential and Integral calculus which are applicable in many branches of engineering.
4	To familiarize with the concepts of vector calculus needed for problems in all engineering disciplines.
5	To understand the different possible forms of Fourier series.

Course Outcomes: (Theory)
Upon completion of the course, students shall have ability to

C204.1	Determine the Curvature and Evolutes by applying the techniques of differentiation.	[R]
C204.2	Develop the understanding of integration techniques needed for problems in engineering disciplines.	[U]
C204.3	Apply multiple integral ideas in solving areas, volumes and other practical problems.	[AP]
C204.4	Differentiate and integrate a vector-valued functions to solve real world applications.	[AP]
C204.5	Apply Fourier series solutions to the engineering problems	[AP]

Course Contents

MODULE I - DIFFERENTIAL AND INTEGRAL CALCULUS (20 Hrs)

Curvature, Centre, Radius and Circle of curvature in Cartesian co-ordinates – Evolutes – Envelopes – Evolute as envelope of normals. Definite integrals: Evaluation of definite integrals using Bernoulli's formula - Double integration in Cartesian coordinates – Area as double integral – Triple integration in Cartesian coordinates –Volume as triple integral

MODULE II - VECTOR CALCULUS (20 Hrs)

Vector differential operator – Gradient and Directional derivatives – Angle between the surfaces – Divergence and Curl – Scalar potential – Equation of the tangent plane and normal line – Irrotational and Solenoidal vector fields –Vector integration: Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelepipeds.

MODULE III – FORIER SERIES (20 Hrs)

Fourier series: Dirichlet's conditions - General Fourier Series : Problems under $(0,2\pi)$- Problems under $(0,2l)$ - Odd and Even Functions : Problems under $(-\pi,\pi)$ - Problems under $(-l,l)$ - Half range sine series and cosine series - Parseval's Identity.

Total hours	**60**

Text Books:

1.	G.B.Thomas and R.L.Finney, Calculus and Analytic Geometry, 14th Edition, Pearson, Reprint,2018.
2.	Kreyszig. E, "Advanced Engineering Mathematics" Tenth Edition, John Wiley and Sons (Asia) Limited, Singapore 2020.
3.	Grewal. B.S, "Higher Engineering Mathematics", 44th edition, Khanna Publications, Delhi, 2021.

Reference Books:

1.	Veerarajan. T, "Engineering Mathematics II",Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2018.

2.	Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, 5th edition, 2018.
3.	N.P.Bali and Dr.ManishGoyal,"A Text book of Engineering Mathematics" 10th edition, Laxmi publications ltd, 2020.
Web References:	
1.	https://ocw.mit.edu/courses/18-02sc-multivariable-calculus-fall-2010/
2.	https://archive.nptel.ac.in/courses/111/107/111107108/
3.	https://www.youtube.com/watch?v=jNC0jxb0OxE
Online Resources:	
1.	https://www.coursera.org/learn/integration-calculus
2.	https://www.coursera.org/learn/vector-calculus-engineers
3.	https://www.coursera.org/learn/differential-equations-engineers

Continuous Assessment				End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component**	**FA (16%) [80 Marks]**
C204.1	Remember	Quiz	20
C204.2	Understand	Seminar	20
C204.3 – C204.5	Apply	Tutorial	20
C204.3 – C204.5	Apply	Assignment	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	50	50	50
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1: 100 Marks			**CA 2: 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C204.1	1	1	1												
C204.2	1	2	1												
C204.3	3	3	2												
C204.4	1	1	2												
C204.5	2	1	2												

23TA201	TAMILS AND TECHNOLOGY / தமிழரும் தொழில்நுட்பமும்	1/0/0/1
Nature of Course:	C (Theory Concept)	
Pre requisites:	NIL	

Course Objectives:

1	To know about weaving, ceramic, design and construction technologies in sangam age.
2	To know the significance of technologies such as manufacturing, agriculture and irrigation.
3	To understand the development of Scientific Tamils and Tamil Computing.

Course Outcomes:
Upon completion of the course, students shall have ability to

C201.1	Describe about the weaving industry in sangam age and ceramic technology.	[U]
C201.2	Observe the design of houses, sculptures and construction of temples.	[U]
C201.3	Relate the various manufacturing materials and stone types in Silappathikaram.	[U]
C201.4	Understand the significance of agriculture and irrigation technology in ancient period.	[U]
C201.5	Explain the growth of scientific Tamil, Tamil computing and digitization of Tamil books.	[U]

Course Contents:

Weaving and Ceramic Technology: Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries. **Design and Construction Technology:** Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple) - Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

Manufacturing Technology: Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel - Copper and gold - Coins as source of history - Minting of Coins – Beads making-industries Stone beads - Glass beads - Terracotta beads - Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram. **Agriculture and Irrigation Technology:** Dam, Tank, ponds, Sluice, Significance of KumizhiThoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

Scientific Tamil & Tamil Computing: Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

Total Hours: 15

Text-cum-Reference Books:

1	தமிழகவரலாறு – மக்களும்பண்பாடும் – கே.கே.பிள்ளை(வெளியீடு: தமிழ்நாடுபாடநூல்மற்றும்கல்வியியல்பணிகள்கழகம்).
2	கணினித்தமிழ் – முனைவர்இல. சுந்தரம் . (விகடன்பிரசுரம்).
3	கீழடி – வைகைநதிக்கரையில்சங்ககாலநகரநாகரிகம் (தொல்லியல்துறைவெளியீடு)
4	பொருநை – ஆற்றங்கரைநாகரிகம். (தொல்லியல்துறைவெளியீடு)
5	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

9	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
10	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author).
11	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
12	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	**Bloom's Level**	**Assessment Component**	**FA (16%) [80 Marks]**
C201.1	Understand	Seminar	20
C201.2	Understand	Quiz	20
C201.3	Understand	Quiz	20
C201.4 C201.5	Understand	Seminar	20

Assessment based on Summative and End Semester Examination

Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	40	40	40
Understand	60	60	60
Apply	-	-	-
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C201.1										1		1			
C201.2										1		1			
C201.3										1		1			
C201.4										1		1			
C201.5										1		1			

23PS101	PHYSICAL SCIENCE (Common to I Year B.E. – CIVIL & MECH)	4/0/0/4

Nature of Course	: E (Theory based)
Pre requisites	: Fundamental knowledge in applied sciences

Course Objectives:

1	To learn the fundamental concepts of physics and apply this knowledge to both scientific and engineering problems.
2	To make the students enrich basic knowledge in various fields such as Oscillation, Laser, electromagnetism and crystallography.
3	To understand the principles and applications of electrochemistry and learning electroanalytical methods.
4	To learn the effect of corrosion in materials and the methods for prevention of corrosion, and explore the knowledge of various energy sources and storage devices.
5	To understand the concepts of photophysical and photochemical processes in spectroscopy.

Course Outcomes:

Upon completion of the course, students shall have ability to

C101.1	Understand the basic concepts of oscillation, laser and Electromagnetic waves.	[U]
C101.2	Interrelate electric and magnetic fields, and predict the behaviour of electromagnetic waves	[AP]
C101.3	Estimate the Atomic packing, acquire the basic knowledge about Crystal Lattice and Unit cell.	[U]
C101.4	Understand the principle and working of reference electrodes, and acquire the knowledge of corrosion control technique and energy sources.	[U]
C101.5	Interpret the principle and working of analytical techniques.	[AP]

Course Contents:

Harmonic oscillations, Laser and Electromagnetic waves: periodic motion – Simple harmonic motion: characteristics of simple harmonic motion – Simple spring-mass system – Resonance **Laser:** Characteristics of laser – Principle of spontaneous emission and stimulated emission – Population inversion – Pumping – Different types of lasers: CO_2– Qualitative industrial applications of lasers: welding, drilling and cutting.

Electromagnetic waves: Concept of Del operator, gradient, divergence and curl operators - Gauss divergence theorem, Stokes theorem. Gauss law of electricity, Gauss law of magnetism, Biot-Savart law and its application: Magnetic field due to Line charge – Ampere's law and its application: magnetic field due to a solenoid, Faraday' law of electromagnetic induction.

Crystallography and Electrochemistry: crystal system – lattice –Bravais lattice, calculation of atomic packing factor for simple cubic, body centered cubic, face centered cubic and hexagonal close packed lattice – Miller indices – Crystal imperfections – Point and line imperfections.

Electrochemistry: Electrochemical cells-electrolytic cell-reversible and irreversible cells - Free energy and emf series, cell potentials, Nernst equation and applications. Oxidation and reduction potentials-standard hydrogen electrode, saturated calomel electrode, glass electrode-pH-measurement.

Corrosion and *Energy sources, Spectroscopic techniques:* Introduction-types–mechanism of dry and wet corrosion-protective coatings-electroplating of gold-electroless plating of nickel. Energy Sources-Fuel cells (H_2-O_2). Storage Devices-Batteries-Alkaline, Lead acid, Nickel cadmium and Lithium-ion batteries.

Spectroscopic techniques: Spectroscopy-Beer Lambert's law, principle, instrumentation, and applications of electronic spectroscopy (UV-visible), Vibrational and rotational spectroscopy (IR) and Flame emission spectroscopy (FES).

	Total Hours:	**60**

Text Books:

1	Rajendran, V "Engineering Physics" Mc Graw Hill Publications ltd, New Delhi, 2017.
2	David Halliday, Robert Resnick, Jearl Walker "Fundamentals of Physics", 11th edition, Wiley, 2018.
3	Gaur, R.K. and Gupta, S.L., "Engineering Physics", DhanpatRai Publishers, 2017.
4	Bhattacharya, D.K. and Poonam, T., "Engineering Physics ", Oxford University Press, 2017.
5	Dara S.S, Umare S.S, "Engineering Chemistry", First revised Edition by S. Chand & Company Ltd., New Delhi 2015.
6	Jain P. C. & Monica Jain., "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2020.
7	Fundamentals of Molecular Spectroscopy, 4th Edition by C. N. Banwell Publishing McGraw-Hill Book Company (P) Ltd, England, 2001.
8	Physical Chemistry, 11th Edition by P. W. Atkins Publishing Oxford University Press (P) Ltd, United Kingdom, 2018.

Reference Books:

1	William T. Silfvast "Laser Fundamentals" Cambridge University Press, 2013
2	R. Wolfson, "Essential University Physics", Volume 1 & 2. Pearson, 2020.
3	William D CallisterJr, "Materials Science and Engineering-An Introduction", John Wiley and Sons Inc., NewYork, tenth edition, 2018.
4	S.O. Kasap, "Principles of Electronic Materials and Devices", McGraw Hill Education, 2017.
5	David Griffiths 'Introduction to Electrodynamics' 4th Edition, Cambridge University Press 2017.
6	Avadhanulu M.N., Kshirshagar P.G., Arun Murthy TVS "A Text Book of Engineering Physics"S.Chand& Co Ltd, 2018.
7	Richard P. Feynman. Robert B. Leighton, Matthew Sands "The Feynman Lectures on Physics Vol. II": The New Millennium Edition.2015.
8	Donald Neamen, "Semiconductor Physics And Devices: Basic Principles" McGraw-Hill Education, 2011
9	Perez, Nestor, "Electrochemistry and Corrosion Science", Springer, 2016.
10	Shikha Agarwal., "Engineering Chemistry and Applications", Cambridge University press, 2016.
11	Ghazi A.Karim. "Fuels, Energy and the Environment", CRC Press, Taylor and Francis group, 2012.

Web References:	
1	https://www.eatm.in/upload/srit__unit_i_laser.pdf
2	http://hyperphysics.phy-astr.gsu.edu/hbase/index.html
3	https://physics.info/
4	https://nptel.ac.in/courses/115101005
5	https://archive.nptel.ac.in/courses/115/106/115106122/
6	https://archive.nptel.ac.in/courses/112/106/112106293/
7	https://www.kth.se/.../electrochem/welcome-to-the-division-of-applied-electrochemistry
8	www.corrosionsource.com/
9	https://www.sciencedirect.com/book/9780750646253/battery
10	http://www.rnlkwc.ac.in/pdf/study-material/chemistry/Spectroscopy
11	https://ocw.mit.edu/courses/chemistry
12	nptel.ac.in/courses/105106112/1_introduction/5_corrosion.pdf
13.	https://ocw.mit.edu/courses/chemistry

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component**	**FA (16%) [80 Marks]**
C101.1	Understand	Assignment - I	20
C101.2	Apply	Quiz – I	20
C101.3	Understand	Assignment - II	20
C101.4	Understand	Quiz - II	20
C101.5	Apply		

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	30	30	30
Understand	50	50	50
Apply	20	20	20
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C101.1	3	2	2		1							1			
C101.2	3	2	2		1							1			
C101.3	3	2	2	1	1							1			
C101.4	3	2	2		1							1			
C101.5	3	2	2	1	1							1			

23IT211	INTRODUCTION TO PYTHON PROGRAMMING	1/0/4/3
Nature of Course	F(Theory Programming)	
Prerequisites	Nil	

Course Objectives:

1.	To understand and execute Python script using types and expressions.
2.	To understand the difference between expressions & statements and to understand the concept of assignment semantics.
3.	To utilize high level data types such as lists and dictionaries.
4.	To import and utilize a module and to perform read & write operations on files.

Course Outcomes

Upon completion of the course, students shall have ability to

C211.1	Demonstrate programs using simple python statements and expressions.	[U]
C211.2	Build control flow and string concept in python for solving problems.	[AP]
C211.3	Develop python programs using functions.	[AP]
C211.4	Analyze compound data using python lists, tuples and dictionaries.	[A]
C211.5	Apply python programs using files, exception, modules and packages.	[AP]

COURSE CONTENTS:

DATA, EXPRESSIONS, STATEMENTS:
Data Types, Variables and Identifiers, Operators and Expression, Conditional Branching Statements, Iterative statements Nested Loops, Break, Continue, Pass statements, Function - definition and function call, arguments, return statements, Lambda Function and Recursive Function.

STRING, LISTS, FUNCTIONS:
Strings – Concatenation, Append, Comparing Strings, Iterating Strings, Strings Modules and Functions, Modules – NumPy, Math, List: Operations, Nested list, Cloning, Methods, Looping, Tuple: Operations, Nested Tuple, Tuple assignments, Checking the index, Dictionary: Operations, looping over and Nested Dictionary, Built in functions and Methods.

FILES, INHERITANCE:
Classes and Objects, Inheritance, Polymorphism, File Handling and Exception Handling.

Laboratory Component:

S. No	List of Experiments
1.	Compute the GCD of two numbers.
2.	Find the square root of a number (Newton's method).
3.	Exponentiation (power of a number).
4.	Find the maximum of a list of numbers.
5.	Linear search and Binary search.
6.	First n prime numbers.
7.	Multiply matrices.
8.	Programs that take command line arguments (word count).
9.	Extract the functionality of Book class in Library class.
10.	File Handling
	Total Hours 75

Text Books:

1.	Allen B. Downey, "Think Python: How to Think Like a Computer Scientist'', 2nd Edition, Updated for Python 3, Shroff / O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/).
2.	Tony Gaddis, "Starting out with Python'', 4th Edition, Addison Wesley, Pearson, 2017.

Reference Books:	
1.	Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition, 2021.
2.	G Venkatesh and Madhavan Mukund, “Computational Thinking: A Primer for Programmers and Data Scientists”,1st Edition, Notion Press, 2021.
3.	John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data”, 3rd Edition, MIT Press, 2021.
Web References:	
1.	http://nptel.ac.in/courses/106106145/
2.	https://www.codecademy.com/learn/learn-python
3.	https://www.coursera.org/learn/python-data-analysis#syllabus
Online Resources:	
1.	https://www.programiz.com/python-programming
2.	https://www.fullstackpython.com/best-python-resources
3.	https://www.udemy.com/course/easy-way-to-learn-python-for-beginners-2021/
4.	https://stackify.com/learn-python-tutorials/

Continuous Assessment									End Semester Practical Examination	Total
Theory				Practical			Total (A+B)	Total Continuous Assessment		
Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Tota l (B)				
80	120	200	100	75	25	100	200	50	50	100

Formative Assessment based on Capstone Model - Theory			
Course Outcome	Bloom’s Level	Assessment Component	FA (10%) [80 Marks]
C211.1	Understand	Assignment - 1	20
C211.2	Apply	Quiz	20
C211.3	Apply	Assignment - 2	20
C211.4	Analyze	Case Study	20
C211.5	Apply		

Assessment based on Summative Assessment - Theory		
Bloom’s Level	Summative Assessment (15%) [120 Marks]	
	CIA1: (60 Marks)	CIA 2: (60 Marks)
Remember	10	10
Understand	40	40
Apply	40	40
Analyse	10	10
Evaluate	-	-
Create	-	-

Assessment based on Continuous and End Semester Examination – Practical			
Bloom's Level	**Continuous Assessment (25%) [100 Marks]**		**End Semester Examination (50%) [100 Marks]**
	FA: (75 Marks)	**SA: (25 Marks)**	
Remember	10	10	10
Understand	30	30	30
Apply	40	40	40
Analyse	20	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination								
Continuous Assessment (50%)								**End Semester Practical Examination (50%)**
CA 1 (100 Marks)			**CA 2 (100 Marks)**			**Practical Exam (100 Marks)**		
SA 1 (60M)	**FA 1**		**SA 2 (60M)**	**FA 2**		**FA (75M)**	**SA (25M)**	
	Component -I (20 Marks)	**Component- II (20 Marks)**		**Component -I (20 Marks)**	**Component- II (20 Marks)**			

Course Outcomes (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C211.1	1	2	1	1								2			
C211.2	3	3	3	3	2							2			
C211.3	3	3	3	3								2			
C211.4	3	3	3	3	3							2			
C211.5	3	2	3	3	3							1			

23CD201	DATABASE MANAGEMENT SYSTEMS	1/0/4/3
Nature of Course:	D (Theory Application)	
Prerequisites:	Nil	

Course Objectives:

1	To introduce fundamental concepts of Data Base Management Systems and concepts of Relational Data Models.
2	To explain Relational algebra, Relational calculus and Normalization.
3	To implement different relational model constraints and SQL queries.
4	To manage Database using transactions, concurrency and query optimization.

Course Outcomes:

Upon completion of the course, students shall have ability to:

C201.1	Discuss the basic concepts and various data models used in database design	[U]
C201.2	Illustrate Relational algebra, Relational calculus and Normalization.	[AP]
C201.3	Write SQL commands and Subqueries with Constraints.	[AP]
C201.4	Determine Appropriate transactions, views, cursors and triggers to perform the given task.	[AP]
C201.5	Analyze database storage structures, query processing and recovery system.	[A]

Course Contents:

MODULE I INTRODUCTION

Introduction to DBMS, Characteristics of DBMS, DBMS vs File Systems, need for DBMS, Three Level DBMS Architecture, Data Models – Introduction, Benefits, and Phases, ER Diagrams – Symbols, Components, Relationships, Weak entities, Attributes, Cardinality, Relational Algebra, Domain Relational Calculus, Tuple Relational Calculus, Normalization - 1NF, 2NF, 3NF, BCNF, 4NF

MODULE II CONSTRAINTS AND SQL COMMANDS

DDL Commands - Create, Drop, Alter, Truncate, Rename, Keys - primary Key, Foreign Key DML Commands - Select, Insert, Update, Delete, Any, All, In, Exists, Non Exists, Union, Intersection, Subqueries - nested, correlated, Joins- Inner, Outer, and Equi, Functions - SUM, COUNT, AVG, MIN, MAX, Clauses - Group By, Having By, Embedded SQL, Dynamic SQL, Transaction Concepts – Transaction model – ACID Properties – Serializability –Transactions as SQL statements.

MODULE III QUERIES AND TRANSACTIONS

Creation and Dropping of Views, Creation and Execution of Stored Procedures Cursors and Triggers - Opening, Fetching and Closing, Creation , Insertion, Deletion and Updating Database Applications: Payroll Processing Systems, Railway Reservation Systems, Bank Management System Introduction, Storage media and file structures, B+ Tree Hashing – static and Dynamic, Introduction to Query Processing – Issues in query optimization – Steps in query processing, Concurrency control and transactions, Lock based protocols Recovery System – Failure classification

Lab Experiments:

1. Conceptual Database design using E-R DIAGRAM
2. Implementation of SQL commands DDL, DML, DCL and TCL
3. Queries to demonstrate implementation of Integrity Constraints
4. Practice of Inbuilt functions
5. Implementation of Join and Nested Queries AND Set operators
6. Implementation of virtual tables using Views

7. Practice of Procedural extensions (Procedure, Function, Cursors, Triggers) 8. Mini Project (Application Development) i) IT Training Group Database ii) Blood Donation System iii) Salary Management System iv) Traffic Light Information System	
Total Hours:	**75**

Text Books:	
1	Abraham Silberschatz, Henry F Korth, S Sudarshan, “Data base System Concepts”, 7th Edition, McGraw hill, 2020.
2	Vijay Krishna Pallaw, “Database Management Systems”, 2nd Edition Asian Books Private Limited, 2010.
3	Mark L. Gillenson, "Fundamentals of Database Systems", 7th Edition, Wiley India Pvt. Limited, 2008.
Reference Books:	
1	Raghu Ramakrishnan, Johannes Gehrke, Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", McGraw-Hill Education, 2017
2	C. Date, "SQL and Relational Theory", O'Reilly Media, Incorporated, 2011.
Web References:	
1	http://www.sqlcourse.com/
2	https://www.w3schools.com/sql/
3	https://www.geeksforgeeks.org/dbms/
Online Resources:	
1	https://www.coursera.org/learn/database-management
2	https://www.udemy.com/database-management-system/
3	https://onlinecourses.swayam2.ac.in/cec22_cs18/preview

Continuous Assessment									**End Semester Practical Examination**	**Total**
Theory				**Practical**			**Total (A+B)**	**Total Continuous Assessment**		
Formative Assessment	**Summative Assessment**	**Total**	**Total (A)**	**Formative Assessment**	**Summative Assessment**	**Total (B)**				
80	**120**	**200**	**100**	**75**	**25**	**100**	**200**	**50**	**50**	**100**

Formative Assessment based on Capstone Model - Theory			
Course Outcome	**Bloom’s Level**	**Assessment Component**	**FA (10%) [80 Marks]**
C201.1	Understand	Quiz	20
C201.2	Apply	Case Study	20
C201.3, C201.4	Apply	Tutorial	20
C201.5	Analyse	Assignment	20

Assessment based on Summative and End Semester Examination - Theory		
Bloom's Level	**Summative Assessment (15%) [120 Marks]**	
	CIA1: (60 Marks)	**CIA2: (60 Marks)**
Remember	10	10
Understand	40	30
Apply	50	40
Analyse	-	20
Evaluate	-	-
Create	-	-

Assessment based on Continuous and End Semester Examination - Practical			
Bloom's Level	**Continuous Assessment (25%) [100 Marks]**		**End Semester Examination (50%) [100 Marks]**
	FA: (75 Marks)	**SA: (25 Marks)**	
Remember	20	10	10
Understand	20	20	20
Apply	40	40	40
Analyse	20	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination								
Continuous Assessment (50%)								**End Semester Practical Examination (50%)**
CA 1 (100 Marks)			**CA 2 (100 Marks)**			**Practical Exam (100 Marks)**		
SA 1 (60 M)	**FA 1**		**SA 2 (60 M)**	**FA 2**		**FA (75 M)**	**SA (25 M)**	
	Component-I (20 Marks)	**Component-II (20 Marks)**		**Component-I (20 Marks)**	**Component-II (20 Marks)**			

Course Outcome (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C201.1	3	3	2	2								2			
C201.2	3	3	2	2	2				2	2	2	3			
C201.3	3	3	2	2	2				2	2	2	3			
C201.4	3	3	2	2	2				2	2	2	3			
C201.5	3	3	2	2								3			

23PS102	PHYSICAL SCIENCE LABORATORY (Common to I Year B.E. – CIVIL & MECH)	L/T/P/C 0/0/4/2

Nature of Course	: E (Skill based)	
Pre requisites	: Basic Applied Science laboratory skills	
Course Objectives:		
1	Providing a hands-on learning experience in measuring the basic parameters of laser and determine the frequency of oscillation.	
2	To carry out experiments to understand the basic laws of magnetism.	
3	To provide hands on training to measure the time constant of RC circuit and lattice constant of cubic crystal structure	
4	To understand the principles and applications of electrochemistry and learning electro-analytical methods, and explore the knowledge of various energy sources and storage devices.	
5	To understand the concepts of photo-physical and photochemical processes in spectroscopy.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C102.1	To determine the frequency of oscillation and laser parameters using melde's apparatus and diode laser	[E]
C102.2	To determine the magnetic field around a current carrying conductor	[E]
C102.3	To determine the time constant of RC circuit and lattice constant of cubic crystal structure	[E]
C102.4	To determine the pH, single electrode potential using reference electrodes and Electroplating process based on electrolytic cell.	[E]
C102.5	Interpret the principle and working of Spectroscopic technique.	[E]
Lab Components:		
1	Determination of frequency of transverse and longitudinal wave modes – Melde's experiment and characteristics of Simple harmonic motion – Simulation lab.	[E]
2	Determination of wavelength, particle size and angle of divergence using diode laser source.	[E]
3	Determination of Magnetic field along the axis of current carrying coil-Stewart and Gee method.	[E]
4	Determination of characteristics of RC circuit to find the time constant	[E]
5	Determination of lattice constant of cubic crystal structure.	[E]
6	Determination of strength of strong acid by pH metry.	[E]
7	Estimation of dissolved oxygen in waste water using Winkler's method.	[E]
8	Determination of single electrode potential of Zinc and Copper by Potentiometric method.	[E]
9	Determination of cathode efficiency of Nickel using electroplating process.	[E]
10	Spectrophotometry-Estimation of iron in sample water.	[E]
	Total Hours:	**30**

Text Book:	
1	Anoop Sing Yadav “Applied Physics Lab Manual” Vayu Education of India Publisher, 2018.
2	P. Kulkarni,Manual for Experiments in Engineering Physics,2015
3	C. S. Robinson, Dr. Ruby Das, “A text book of Engineering practical physics”, Laxmi Publications Pvt. Ltd., 2016.
4	S.L.Gupta and V Kumar “Practical Physics Volume -II”, Pragati Prakashan ., 2023.
5	Method of Sampling and Test (Physical and Chemical) for Water and Wastewater-Iron, 2003, Part-53; First Revision.
6	Method of Sampling and Test (Physical and Chemical) for Water and Wastewater: pH Value (2001; Part-50; Coagulation Test).
7	Method of Sampling and Test (Physical and Chemical) for Water and Wastewater, Chemical Oxygen Demand, 2012, Part-58.
8	Science and Technology Laboratory Manual. E-Book. NIOS, 2012.
References:	
1	Dr. Ruby Das and Prashant Kumar Sahu,A Textbook of Engineering Physics Practical , 2016,2nd Edition
2	S.L.Gupta and Dr.V.Kumar, “Practical physics with viva voice”, Pragati Prakashan Publishers, Revised Edition, 2009.
3	M.N.Avadhanulu, A.A.Dani and Pokely P.M, “Experiments in Engineering Physics”, S.Chand&Co,2008.
4	Sawyer, C. N., McCarty, P. L., and Parkin, G. F. 2017. Chemistry for Environmental Engineering. Fifth Edition, McGraw-Hill, Inc., New York.
5	American Public Health Association et al, Standard Methods for the Examinations of Water and Waste Water, APHA. 2017.
6	AWWA, WEF, APHA, 2017, Standard Methods for the Examination of Water and Wastewater (Method: 5210B, BOD).
Web References:	
1	https://vlab.amrita.edu/
2	https://bop-iitk.vlabs.ac.in/basics-of-physics/
3	http://vlabs.iitb.ac.in/
4	https://www.iitg.ac.in/
5	https://ee1-nitk.vlabs.ac.in/exp/determination-of-ph/simulation.html
6	https://ee1-nitk.vlabs.ac.in/exp/determination-of-biological-oxygen/simulation.html
7	https://www.youtube.com/watch?v=pORJQyP-2j8
8	https://ee1-nitk.vlabs.ac.in/exp/determination-of-ph/simulation.html
9	https://ee1-nitk.vlabs.ac.in/exp/determination-of-ph/simulation.html

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
75	**25**	**100**	**60**	**40**	**100**

Assessment based on Continuous and End Semester Examination			
Bloom’s Level	**Continuous Assessment (60%) [100 Marks]**		**End SemesterPractical Examination (40%) [100 Marks]**
	FA (75 Marks)	**SA (25 Marks)**	
Remember	0	0	0
Understand	10	10	10
Apply	30	30	30
Analyse	30	30	30
Evaluate	30	30	30
Create	0	0	0

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C102.1	3	2	1	2					2			1			
C102.2	3	2	1	2					2			1			
C102.3	3	2	1	2					2			1			
C102.4	3	2	1	2					2			1			
C102.5	3	2	1	2					2			1			
	3	Strongly agreed		2	Moderately agreed					1	Reasonably agreed				

Semester – 03

23ME301	APPLIED THERMODYNAMICS	3/1/0/4
Nature of Course	Concepts and Analytical	
Pre-Requisites	Fundamentals of basic mathematics and physics	
Course Objectives:		
1	To understand the thermodynamic laws and their applications.	
2	To study the properties of steam, the use of steam tables and Mollier Chart and principles of psychrometry.	
3	To learn about reciprocating compressors with and without intercooling.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C301.1	Paraphrase about the thermodynamic properties, work, heat and entropy.	[U]
C301.2	Apply laws of thermodynamics to open and closed systems.	[Ap]
C301.3	Examine the properties of pure substances and analyse the vapour power cycle used in steam power plants and gas power cycles.	[A]
C301.4	Classify, solve and calculate the performance of psychrometry processes and air conditioning systems.	[Ap]
C301.5	Estimate the performance of reciprocating and rotary equipment.	[Ap]

Course Contents:

First law of thermodynamics: Application of First law to non- flow system, Steady flow energy equation and its application to various thermal equipments. **Second Law of thermodynamics and Entropy**: Second law of Thermodynamics – Kelvin's and Clausius statements of Second law, Reversibility and Irreversibility, Heat reservoirs - Refrigerator and heat pump, Carnot theorem, Carnot cycle, Reversed Carnot cycle, Efficiency, COP.

Vapor power cycles: Rankine cycle with superheat, reheat and regeneration, exergy analysis. Super- critical and ultra-super-critical Rankine cycle, Flow of steam through nozzle - **Gas power cycles**, Air standard Otto, Diesel and Dual cycles- Vapor compression refrigeration cycles, refrigerants and their properties- Properties of dry and wet air, use of pschyrometric chart, processes involving heating/cooling and humidification/ dehumidification, dew point.

Reciprocating compressors: staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors. **Rotary compressor** (Descriptive): Vane compressor, Screw compressor and lobe compressor.

	Total Hours:	**60**

Text Books:

1	Nag. P.K, "Engineering Thermodynamics", 6th Edition, McGraw Hill Education, New Delhi, 2020.
2	Yunus. N.J, Cengel. A and Michael Boles. A, "Thermodynamics- An Engineering Approach" 9th Edition, McGraw Hill Education, New Delhi, 2019.
3	Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.
4	Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.
5	Kothandaraman.C.P, Domkundwar.S, AnandDomkundwar, "A Course in Thermal Engineering", Dhanpat Rai & Co. (P) Ltd., 2017.

Reference Books:

1	Mahesh M. Rathore, "Thermal Engineering", Mc Graw Hill Education private limited, Reprint 2020.
2	Michael Moran.J, and Howard Shapiro.N, "Fundamentals of Engineering Thermodynamics", 8th Edition, John Wiley & Sons, New York, 2019.

3	Rudramoorthy R, Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2016.
4	R.K.Rajput. “Thermal Engineering” Tata McGraw Hill, 2017.
Web References:	
1	http://nptel.ac.in/courses/112103016/
2	http://nptel.ac.in/courses/112105128/
3	https://archive.nptel.ac.in/courses/112/105/112105123/
Online Resources:	
1	https://www.grc.nasa.gov/www/k-12/airplane/thermo.html
2	https://www.livescience.com/50776-thermodynamics.html

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	**Bloom’s Level**	**Assessment Component**	**FA (16%) [80 Marks]**
C301.1	Understand	Quiz	20
C301.2	Analyse	Assignment	20
C301.3			
C301.4	Apply	Tutorial	20
C301.5	Apply	Assignment	20

Assessment based on Summative and End Semester Examination

Bloom’s Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	30	30	30
Analyse	20	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C301.1	3	3	2										2		
C301.2	3	2	2										2		
C301.3	3	3	2										1		
C301.4	3	2													
C301.5	3	2	3										2		
	3 Strongly agreed			2 Moderately agreed						1 Reasonably agreed					

23ME302	MECHANICS OF DEFORMABLE SOLIDS	3/1/0/4
Nature of Course	Theory - Analytical	
Pre-Requisites	Engineering Mechanics	
Course Objectives:		
1	To familiarize the concepts of stress, strain, principal stresses and principal planes.	
2	To explore the nature of stresses developed in beams due to transverse loading.	
3	To evaluate the behavior of columns due to concentrated and eccentric load.	
4	To compute slope and deflection of beams by various methods.	
5	To examine the stresses and deformations induced in circular shafts, helical springs and thin shells.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C302.1	Identify the strength of various structural elements subjected to axial loading.	[U]
C302.2	Interpret the principal stresses and strain energy theorem.	[AP]
C302.3	Draw the shear force and bending moment diagram for different types of beams and evaluate the effect of transverse loading on beams.	[A]
C302.4	Analyze the stability of columns and stresses in circular shafts.	[A]
C302.5	Evaluate the deflection and slope of beams under flexural loading.	[E]
C302.6	Analyze the stresses and deformations in helical springs and thin shells.	[A]

Course Contents:

Axial loading: Definition of Stress and Strain, Types of stresses and strains, Hooke's law, Stress-Strain diagram for ductile and brittle materials, Factor of safety, Transverse strain, Poisson's ratio, Deformation of simple, variable cross-section and composite bars, Thermal stresses, Composite bars subjected to thermal stresses, Volumetric strain, Elastic moduli and their relations. **Stresses on inclined planes:** Principal stresses and principal planes - Analytical method, Mohr's circle method. **Strain energy theorem:** Virtual work principle, Castigliano's first theorem, Maxwell's reciprocal theorem.

Transverse Loading: Beam definition, Various beam types, understanding shear force and bending moment concepts, Shear force and bending moment diagrams for cantilever, simply supported, and overhanging beams under point loads, uniformly distributed loads and combinations of these loads, Exploration of the point of contraflexure. **Theory of simple bending:** Assumptions, Derivation of bending equation, Calculation of bending stresses and determination of section modulus for rectangular, circular, I and T sections. **Columns:** Buckling load by Euler's & Rankine equations for different end conditions, Columns with eccentric load.

Torsion of Circular Shafts: Torsion stresses and deformation in solid and hollow circular shafts, Polar moment of inertia, Torsional rigidity and Polar modulus, Maximum power transmitted by a uniform shaft and shaft of varying sections. Stress, deflection and stiffness of helical springs. **Deflection of Beams**: Determination of slope and deflection for cantilever and simply supported beams subjected to point loads and UDL using Double integration and Macaulay's methods. **Thin Cylinders and spherical shells**: Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thin cylinders and spherical shells subjected to internal pressure.

Total Hours:	**60**

Text Books:

1	Ferdinand P. Beer, E. Russell Johnston Jr, John T. DeWolf, David F. Mazurek, Sanjeev Sanghi, "Mechanics of Materials", Tata McGraw Hill Publishing co. Ltd., New Delhi, 8th Edition, 2020
2	S.S. Rattan "Strength of Materials", McGraw Hill Education (India) Pvt. Ltd., 3rd Edition, 2017.

Reference Books:

1	Egor. Popov, "Mechanics of Materials" 2nd Edition, Pearson Education India, 2015
2	Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2018

Web References:	
1	https://lecturenotes.in/subject/260/strength-of-materials-som
Online Resources:	
1	https://nptel.ac.in/courses/112107146

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C302.1	Understand	Quiz	20
C302.2	Apply		
C302.3	Analyse	Group Assignment	20
C302.4			
C302.5	Evaluate	Individual Assignment	40
C302.6	Analyse		

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	10	10	10
Understand	20	20	20
Apply	30	20	30
Analyse	30	30	30
Evaluate	10	20	10
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]					End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks		
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)	
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (40 Marks)	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C302.1	3	3	3	1									2		
C302.2	3	3	3	1									2		
C302.3	3	3	3	1									2		
C302.4	3	3	3	1									2		
C302.5	3	3	3	1									2		
C302.6	3	3	3	1									2		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed	

23MA303	NUMERICAL METHODS	3/1/0/4
Nature of Course	B (100% Analytical)	
Pre requisites	-	
Course Objectives:		
1	To study the concept of finding the roots of linear equations and nonlinear equations	
2	To learn and construct approximate polynomial for the given numerical data and to find the intermediate missing values	
3	To find the numerical solutions of large system of differential equations and interpolation of the given numerical data.	
4	To find the solution of ordinary differential equations as most of the Engineering problems are characterized in this form.	
5	To study the concept of mathematical formulation of certain practical problems in terms of partial differential equations and solving for physical interpretation.	
Course Outcomes (Theory) **Upon completion of the course, students shall have ability to**		
C303.1	Remember numerical methods to solve algebraic, transcendental and simultaneous equations	[R]
C303.2	Understanding the ordinary differential equations generated from the current scenario to solve by numerical techniques.	[U]
C303.3	Apply numerical methods to find the interpolation of numerical data	[AP]
C303.4	Apply numerical methods to fit the polynomial.	[AP]
C303.5	Apply numerical methods to solve wave and heat equation with boundary conditions	[AP]

Course Contents:

MODULE I : NUMERICAL SOLUTION TO ALGEBRAIC AND TRANSCENDENTAL EQUATIONS (20 Hrs)

Numerical Solution To Algebraic And Transcendental Equations**:** Newton-Raphson method – Iteration method- Regula - Falsi method. Numerical Solution to system of equations: Gauss Elimination method -Gauss Jordan method - Gauss Seidel method – Inverse of a matrix by Gauss Jordan method –Eigen value of a matrix by power method.

MODULE II : INTERPOLATION, NUMERIAL DIFFERENTIATION AND INTEGRATION (20 Hrs)

Interpolation - Interpolation with equal intervals –Newton's Forward and Backward difference formula - Interpolation with unequal intervals –Newton's Divided difference formula – Lagrange's interpolation formula. Numerical Differentiation and integration: Differentiation using Newton forward and Backward interpolation formulae - Trapezoidal rule – Simpson's 1/3 and 3/8 rules.

MODULE III : NUMERICAL SOLUTION TO PARTIAL DIFFERENTIAL EQUATION (20 Hrs)

Numerical solution to first order ordinary differential equations: Single step methods: Modified Euler's Method – Runge- Kutta Method of fourth order. Numerical Solution to Partial differential Equation - Elliptic equations - Laplace equation - Liebmann's Iteration Process -Poisson equation - Parabolic Equation (one dimensional heat equation) - Bender-Schmidt's Difference Scheme – Crank-Nicholson's Difference Scheme - Hyperbolic Equation (one dimensional wave equation).

Total Hours:	**60**

Text Books:

1	Gerald C.F. and Wheatley, P.O. "Applied Numerical Analysis", 6th edition Pearson Education Asia, New Delhi.
2	Grewal B.S. – Numerical methods in Engineering and Science. 10th edition, Khanna Publishers, 2014.

3	Jain M.K. Iyengar, K & Jain R.K., Numerical Methods for Scientific and Engineering Computation, New Age International (P) Ltd, Publishers,6th edition, 2016.
Reference Books:	
1	Kreyszig. E – Advanced Engineering Mathematics, 10th edition , John Wiley and Sons (Asia) Limited, Singapore, 2014
2	P. Kandasamy, K. Thilagavathy and K. Gunavathy, “Numerical methods”, S.Chand Co. Ltd., New Delhi, 2003.
Web References:	
1	https://nm.mathforcollege.com/
2	https://www.math.wsu.edu/kcooper/M448/resources.php
3	https://global.oup.com/uk/orc/biosciences/maths/reed/01student/numerical_tutorials/
4	https://www.youtube.com/watch?v=QLIFxllwNL0
Online Resources:	
1	https://onlinecourses.nptel.ac.in/noc19_ma21/preview
2	https://www.coursera.org/courses?query=numerical%20analysis
3	https://ocw.mit.edu/courses/18-335j-introduction-to-numerical-methods-spring-2019/
4	https://www.coursera.org/learn/numerical-methods-engineers

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	**Bloom’s Level**	**Assessment Component**	**FA (16%) [80 Marks]**
C303.1	Remember	Quiz	20
C303.2	Understand	Presentation	20
C303.3 – C101.5	Apply	Tutorial	20
C303.3 – C101.5	Apply	Assignment	20

Assessment based on Summative and End Semester Examination

Bloom’s Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	50	50	50
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1: 100 Marks			CA 2: 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)(Theory)															
COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C303.1	1	1											1		
C303.2	2	2											1		
C303.3	3	3											2		
C303.4	3	3											2		
C303.5	3	3											2		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

23ME303	MANUFACTURING PRACTICES WORKSHOP	1/0/4/3
Nature of Course	Theory concepts and lab	
Pre-Requisites	Nil	

Course Objectives:

1	To make the students understand the various manufacturing processes available to produce the desired components
2	To impart the methodologies to be followed in casting, welding and forming of engineering materials
3	To enable the students to select a particular manufacturing process for the required product based on its process characteristics

Course Outcomes:
Upon completion of the course, students shall have ability to

C303.1	Describe the concepts of basic manufacturing processes like casting, plastic moulding, welding, and forming processes	[U]
C303.2	Select an appropriate casting technique for making various components	[Ap]
C303.3	Suggest an ideal joining process for an engineering application	[Ap]
C303.4	Apply a suitable metal forming processes or other manufacturing processes for making an industrial component	[Ap]
C303.5	Explore the possible defects and its causes in various manufacturing processes.	[A]

Course Contents:

METAL CASTING: Metal casting processes: Sand casting and its procedure – die casting – shell moulding – investment casting – centrifugal casting – lost foam casting – stir casting - casting defects.
PLASTIC MOULDING PROCESSES: injection moulding – blow moulding – rotational moulding
METAL JOINING PROCESSES: Welding – classification- Gas welding processes – Arc welding processes – Types – friction stir welding process - common welding defects
METAL FORMING PROCESSES: Hot and cold working processes – forging and forging operations– Rolling – types of rolling - Extrusion – various sheet metal operations

Total Number of Theory Hours	**15**

Laboratory Components

S.No	List of Experiments	CO Mapping	RBT
1	Preparation of solid wooden pattern using carpentry tools	C303.1	[Ap]
2	Preparation of a sand mould using solid pattern / split pattern	C303.2	[Ap]
3	Making components using smart foundry setup	C303.2	[Ap]
4	Making components using stir casting setup	C303.2	[Ap]
5	Making plastic components using injection moulding	C303.1	[Ap]
6	Joining of plates in lap and butt joint configuration using arc welding process	C303.3	[Ap]
7	Welding of aluminum plates using TIG / MIG welding process	C303.3	[Ap]
8	Joining of plates using friction stir welding process	C303.3	[Ap]
9	Prepare a square tray with the sheet metal forming process	C303.4	[Ap]
10	Industrial visit to four manufacturing process industries.	C303.1	[Ap]
	Total Number of Laboratory Hours		**60**

Text Books:	
1	Serope Kalpakian, Steven R. Schmid, Manufacturing Engineering and Technology, Pearson Education, Seventh edition, 2018.
2	P. N. Rao, “Manufacturing Technology”, Vol.1, Fourth edition, McGraw-Hill Education, 2017.
Reference Books:	
1	Hajra Choudhury, “Elements of Workshop Technology”, Vol. I & II, Media Promotors Pvt Ltd., 2014
2	P.C. Sharma, “A Text Book of Production Engineering”, S. Chand and Co. Ltd, Eighth Revised edition, 2014
3	Radhakrishnan, “Manufacturing Technology I”, SciTech Publications Pvt Ltd, 2020.
Web References:	
1	https://onlinecourses.nptel.ac.in/noc22_me28/preview
2	https://www.coursera.org/learn/3d-printing-revolution
Online Resources:	
1	https://ocw.mit.edu/courses/2-008-design-and-manufacturing-ii-spring 2004/pages/lecture-notes/x

Continuous Assessment									**End Semester Practical Examination**	**Total**
Theory				**Practical**			**Total (A+B)**	**Total Continuous Assessment**		
Formative Assessment	**Summative Assessment**	**Total**	**Total (A)**	**Formative Assessment**	**Summative Assessment**	**Total (B)**				
80	**120**	**200**	**100**	**75**	**25**	**100**	**200**	**50**	**50**	**100**

Formative Assessment based on Capstone Model - Theory

Course Outcome	**Bloom’s Level**	**Assessment Component**	**FA (10%) [80 Marks]**
C303.1	Understand	Quiz	20
C303.2	Apply	Assignment	20
C303.3	Apply	Technical Seminar	20
C303.4	Apply	Model making	20
C303.5	Analyze		

Assessment based on Summative Assessment - Theory

Bloom’s Level	**Summative Assessment (15%) [120 Marks]**	
	CIA1: (60 Marks)	**CIA2: (60 Marks)**
Remember	10	10
Understand	10	10
Apply	40	40
Analyse	40	40
Evaluate	-	-
Create	-	-

Assessment based on Continuous and End Semester Examination - Practical

Bloom’s Level	**Continuous Assessment (25%) [100 Marks]**		**End Semester Examination (50%) [100 Marks]**
	FA: (75 Marks)	**SA: (25 Marks)**	
Remember	10	10	10
Understand	10	10	10

Apply	30	30	30
Analyse	40	40	40
Evaluate	10	10	10
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (50%)								End Semester Practical Examination (50%)
CA 1 (100 Marks)			CA 2 (100 Marks)			Practical Exam (100 Marks)		
SA 1 (60M)	FA 1		SA 2 (60M)	FA 2		FA (75M)	SA (25M)	
	Component-I (20 Marks)	Component-II (20 Marks)		Component I (20 Marks)	Component-II (20 Marks)			

Mapping of Course Outcomes (CO) with Programme Outcomes (PO), Programme Specific Outcomes (PSO)

COs	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C303.1	3	3	2											3	
C303.2	3	3	2											3	
C303.3	3	3	2											3	
C303.4	3	3	2											3	
C303.5	3	3	2											3	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

23CS311	FUNDAMENTALS OF JAVA PROGRAMMING	1/0/4/3
Nature of Course:	G (Theory Programming)	
Prerequisites	Nil	

Course Objectives:

1.	To gain insight knowledge of OOP concepts.
2.	To analyze different types of constructor, Inheritance and polymorphism.
3.	To understand and apply package, Interface concepts and java frameworks
4.	To know the fundamental concepts of exceptions, threads with real world examples.

Course Outcomes:
Upon completion of the course, students shall have ability to:

C311.1	Infer the basic concepts of java programming.	[U]
C311.2	Analyze, and interpret Inheritance and polymorphism in real world projects.	[A]
C311.3	Apply the basis of Packages and interfaces.	[AP]
C311.4	Apply the concepts of Exceptions handling in real world projects.	[AP]
C311.5	Develop Java frameworks like spring, spring MVC and Springboot.	[AP]

Course Contents:

MODULE I JAVA Basics **5 hours**

Review of Object-oriented concepts – History of Java – Java buzzwords – JVM architecture– Data types – Variables – Scope and life time of variables –Arrays – Operators – Control Statements – Type conversion and casting –Classes and objects – Methods –Strings– Static block – Access specifier – Command line arguments.

MODULE II Inheritance, Polymorphism & Packages **5 hours**

Basic concepts – Constructor - Types of inheritance – Member access rules – Usage of this and Super keyword – Method Overloading – Method overriding – Abstract classes –Usage of final keyword – Defining package – Access protection –Importing packages.

MODULE III Interfaces, Exception handling & Frameworks **5 hours**

Defining and Implementing interfaces, and Extending interfaces – Exception handling fundamentals– Exception Types – Usage of Try, Catch, Throw, Throws and Finally keywords – Built-in Exceptions – Creating own Exception classes - Introduction to threads - Multithreading - Templates - Introduction to Java frameworks –Spring - Spring MVC & Spring Boot.

Total Hours:15

Laboratory Component:

S. No	List of Experiments
1	Basic Java Programs.
2	Implementation of Student application using Class and Objects
3	Implement a Java program to perform String operations.
4	Implement a java program to demonstrate Overloading and Overriding
5	Implement a java program to demonstrate Inheritance
6	Implement a java program to demonstrate Abstract Class
7	Implement a java program using interface
8	Implement a java program to demonstrate package
9	Implement a java program to demonstrate Exception Handling
10	Implement a java program to demonstrate Multithreading
	Total Hours : 75

Text Books:

1.	Herbert Schildt, “Java: The Complete Reference”, 11th edition, Mc craw Hill, 2020.

Reference Books:

1.	Y. Daniel Liang, “Introduction to Java Programming”, 9th Edition, Prentice Hall Publications, 2015.

2.	Paul Deitel, Harvey Deitel, “Java How To Program”, 10th Edition, Prentice Hall Publications, 2014.
3.	T. Budd, An Introduction to Object Oriented Programming, 3rd edition, Pearson Education, India, 2009.
4.	ShagunBakliwal, Hands-on Application Development using Spring Boot, bpb publisher, 2021.
Web References:	
1.	https://onlinecourses.nptel.ac.in/noc19_cs84/preview
2.	https://www.scientecheasy.com/2018/07/core-java-tutorial.html/
Online Resources:	
1.	https://www.edx.org/course/java-programming-fundamentals

Continuous Assessment									**End Semester Practical Examination**	**Total**
Theory				**Practical**			**Total (A+B)**	**Total Continuous Assessment**		
Formative Assessment	**Summative Assessment**	**Total**	**Total (A)**	**Formative Assessment**	**Summative Assessment**	**Total (B)**				
80	**120**	**200**	**100**	**75**	**25**	**100**	**200**	**50**	**50**	**100**

Formative Assessment based on Capstone Model - Theory			
Course Outcome	**Bloom’s Level**	**Assessment Component**	**FA (10%) [80 Marks]**
C311.1	Understand	Quiz	20
C311.2	Apply	Quiz	20
C311.3	Apply	Mini Project	20
C311.4	Apply		
C311.5	Apply	Mini Project	20

Assessment based on Summative Assessment - Theory		
Bloom’s Level	**Summative Assessment (15%) [120 Marks]**	
	CIA1: (60 Marks)	**CIA2: (60 Marks)**
Remember	10	10
Understand	30	30
Apply	40	40
Analyse	20	20
Evaluate	-	-
Create	-	-

Assessment based on Continuous and End Semester Examination - Practical			
Bloom’s Level	**Continuous Assessment (25%) [100 Marks]**		**End Semester Examination (50%) [100 Marks]**
	FA: (75 Marks)	**SA: (25 Marks)**	
Remember	-	-	-
Understand	10	-	10
Apply	50	60	50
Analyse	40	40	40
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination									
Continuous Assessment (50%)									End Semester Practical Examination (50%)
CA 1 (100 Marks)			CA 2 (100 Marks)			Practical Exam (100 Marks)			
SA 1 (60 M)	FA 1		SA 2 (60 M)	FA 2		FA (75 M)	SA (25 M)		
	Component-I (20 Marks)	Component-II (20 Marks)		Component-I (20 Marks)	Component-II (20 Marks)				

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C311.1	3	2	3	3	3							2			
C311.2	3	2	2	2	2							2			
C311.3	3	3	3	3	3							3			
C311.4	3	3	3	3	2							3			
C311.5	3	3	3	3	2							3			
C311	**3**	**3**	**3**	**3**	**3**							**3**			

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

23ME304	STRENGTH OF MATERIALS LABORATORY	0/0/2/1
Nature of Course	Practical application	
Pre Requisites	Industrial Metallurgy	

Course Objectives:

1	To study the mechanical properties of materials when subjected to different types of loading.
2	To learn the concept of preparation of the samples to perform microstructural characterization.
3	To study the concepts of improving the mechanical properties of materials by different methods such as heat treatment and surface treatment.

Course Outcomes:
Upon completion of the course, students shall have ability to

C304.1	Determine the tensile, compression, shear, impact, fatigue and hardness properties of the materials.	[A]
C304.2	Evaluate the deflection of beams.	[E]
C304.3	Calculate the stiffness of springs.	[A]
C304.4	Assess the theoretical and experimental strain of mild steel.	[E]
C304.5	Summarize the effect of heat treatment on hardness and impact resistance of the materials.	[E]
C304.6	Examine the microstructure of various specimens and the influence of sand blasting process.	[Ap]

Course Contents:

S.No	List of Experiments	CO Mapping	RBT
1	Tension test on a mild steel rod to calculate the percentage of elongation, yield, ultimate and breaking stress.	C304.1	[A]
2	Compression test on wood - Compare the compression strength when load applied parallel and perpendicular to grains.	C304.1	[E]
3	Double shear test on Mild steel / Aluminium rods to calculate the shear strength.	C304.1.	[A]
4	Torsion test on mild steel rod to evaluate the modulus of rigidity.	C304.1	[A]
5	Impact test on metal specimen to calculate the impact strength and toughness - Izod and Charpy test.	C304.1	[A]
6	Hardness test on Aluminium, Brass and Mild Steel to evaluate the Brinell and Rockwell Hardness Number - Before and after shot peening process.	C304.1	[E]
7	Fatigue test on a mild steel specimen to calculate the fatigue strength.	C304.1	[A]
8	Deflection test on beams to evaluate the young's modulus of the given beam (Steel & Aluminium).	C304.2	[E]
9	Compression test on open coil helical springs to determine the deflection and stiffness.	C304.3	[A]
10	Compare the theoretical and experimental strain of mild steel using digital strain indicator.	C304.4	[E]
11	Evaluate the improvement in hardness and impact resistance of steels. a. Unhardened specimen b. Quenched specimen and c. Tempered Specimen	C304.5	[E]
12	Study of Microstructure of (i) Unhardened sample (ii) Quenched and tempered samples	C304.6	[Ap]

13	Study the effect of shot blasting process on the given specimen by measuring surface roughness and hardness.	C304.6	[Ap]
		Total Hours:	**30**

Reference Books:	
1	Ferdinand P. Beer, E. Russell Johnston Jr, John T. DeWolf , David F. Mazurek , Sanjeev Sanghi , ""Mechanics of Materials", Tata McGraw Hill Publishing 'co. Ltd., New Delhi, 8th Edition , 2020
2	S.S. Rattan "Strength of Materials", McGraw Hill Education (India) Pvt. Ltd., 3rd Edition, 2017.
Web References:	
1	https://sm-nitk.vlabs.ac.in/
2	https://www.vlab.co.in/participating-institute-nitk-surathkal

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
75	**25**	**100**	**60**	**40**	**100**

Assessment based on Continuous and End Semester Examination

Bloom's Level	**Continuous Assessment (60%) [100 Marks]**		**End Semester Practical Examination (40%) [100 Marks]**
	FA (75 Marks)	**SA (25 Marks)**	
Remember	10	10	10
Understand	10	10	10
Apply	20	20	20
Analyse	40	40	40
Evaluate	20	20	20
Create	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C304.1	3	3							2			2	2		
C304.2	3	3							2			2	2		
C304.3	3	3							2			2		2	
C304.4	3	3							2			2		3	
C304.5	3	3							2			2		3	
C304.6	3	3							2			2		2	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

23ME305	DESIGN THINKING AND IDEA LAB	0/0/2/1
Nature of Course	Practical	
Pre Requisites	Nil	

Course Objectives:

1	To Accelerate development of indigenous products to promote “Make in India” campaign
2	To encourage aspiring Engineers and Researchers to actualize their ideas under one roof.
3	To Impart multidisciplinary education and research among all stakeholders
4	To promote experiential learning and entrepreneur skills

Course Outcomes:
Upon completion of the course, students shall have ability to

C305.1	Describe all the skills associated with the tools and inventory associated with the IDEA Lab.	[R]
C305.2	Associate useful mechanical and electronic fabrication processes.	[U]
C305.3	Apply necessary skills to build useful and standalone system/ project with enclosures.	[Ap]
C305.4	Develop Innovative products which are useful for a student in preparing for an engineering career.	[C]
C305.5	Devise necessary skills to create print and electronic documentation for the system/project.	[E]

Course Contents:

An Insight to Learning : Understanding the Learning Process, Kolb’s Learning Styles, Assessing and Interpreting **Remembering Memory :** Understanding the Memory process, Problems in retention, Memory enhancement techniques **Emotions: Experience & Expression** Understanding Emotions: Experience & Expression, Assessing Empathy, Application with Peers **Basics of Design Thinking :**Definition of Design Thinking, Need for Design Thinking, Objective of Design Thinking, Concepts & Brainstorming, Stages of Design Thinking Process (explain with examples) – Empathize, Define, Ideate, Prototype, Test

Being Ingenious & Fixing Problem : Understanding Creative thinking process, Understanding Problem Solving, Testing Creative Problem Solving **Process of Product Design :** Process of Engineering Product Design, Design Thinking Approach, Stages of Product Design, Examples of best product designs and functions, Assignment – Engineering Product Design **Prototyping & Testing :** Rapid Prototype Development process, Testing, **Sample Example**, Test Group Marketing **Celebrating the Difference :** Understanding Individual differences & Uniqueness, Group Discussion and Activities to encourage the understanding, acceptance and appreciation of Individual differences

Design Thinking & Customer Centricity : Practical Examples of Customer Challenges, Use of Design Thinking to Enhance Customer Experience, Parameters of Product experience, Alignment of Customer Expectations with Product Design **Feedback, Re-Design & Re-Create :** Feedback loop, Focus on User Experience, Address “ergonomic challenges, User focused design, rapid prototyping & testing, final product, Final Presentation – **“Solving Practical Engineering Problem through Innovative Product Design & Creative Solution”**

S.No	List of Experiments	CO Mapping	RBT
1	Schematic and PCB layout design of a suitable circuit, fabrication and testing of the circuit	C305.1	[Ap]
2	Machining of 3D geometry on soft material such as soft wood or modelling wax.	C305.1	[Ap]

3	3D scanning of computer mouse geometry surface. 3D printing of scanned geometry using FDM or SLA printer	C305.2	[Ap]
4	2D profile cutting of press fit box/casing in acrylic (3 or 6 mm thickness)/ cardboard, MDF (2 mm) board using laser cutter & engraver.	C305.3	[Ap]
5	2D profile cutting on plywood /MDF (6-12 mm) for press fit designs.	C305.3	[C]
6	Familiarity and use of welding equipment.	C305.4	[C]
7	Familiarity and use of normal and wood lathe.	C305.4	[C]
8	Embedded programming using Arduino and/or Raspberry Pi.	C305.5	[C]
9	Design and implementation of a capstone project involving embedded hardware, software and machined or 3D printed enclosure	C305.5	[E]
		Total Hours:	**30**

Reference Books:

1	AICTE's Prescribed Textbook: Workshop / Manufacturing Practices (with Lab Manual), ISBN: 978-9391505332
2	E Balaguruswamy (2022), Developing Thinking Skills (The way to Success), Khanna Book Publishing Company.

Web References:

1	https://www.innovationtraining.org/how-to-use-design-thinking-to-design-an-innovation-lab/
2	https://www.erdster.co.in/design-thinking-lab.html

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
75	**25**	**100**	**60**	**40**	**100**

Assessment based on Continuous and End Semester Examination

Bloom's Level	**Continuous Assessment (60%) [100 Marks]**		**End Semester Practical Examination (40%) [100 Marks]**
	FA (75 Marks)	**SA (25 Marks)**	
Remember	10	10	10
Understand	10	10	10
Apply	40	40	40
Analyse	-	-	-
Evaluate	10	10	10
Create	30	30	30

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C305.1	3		3		3				1		1			1	
C305.2	3		3		2				1		2			3	
C305.3	3		3		2				3		2			3	
C305.4	3		2		3				2		3			1	
C305.5	3		2		2				2	3	3			1	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

Semester – 04

23ME401	MEASUREMENTS AND METROLOGY	3/0/0/3
Nature of Course	Theory applications	
Pre Requisites	Manufacturing Practices Workshop	
Course Objectives:		
1	To familiarize the students with basic and advanced metrology concepts.	
2	To provide knowledge on the correct procedure to be adopted to measure the dimension of the components.	
3	To expose the students in the measurement of linear dimensions, angular dimensions, surface roughness, Parameters of threads and gears	
4	To expose students to force, torque and flow measurement techniques	
5	To identify the techniques for the quality assurance of the products and the optimality of the process in terms of resources and time management.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C401.1	Describe the concepts of measurements and study the various metrological instruments	[U]
C401.2	Outline the principles of linear and angular measurement tools used for industrial applications	[U]
C401.3	Demonstrate the techniques of form measurement used for industrial components	[Ap]
C401.4	Measure the force, torque, power, flow based on the industrial standards.	[Ap]
C401.5	Determine the temperature through appropriate electrical instruments.	[Ap]
C401.6	Organize measurement systems for process monitoring and control, and apply to real-world problems in various domains.	[A]
Course Contents:		
BASICS OF METROLOGY: Introduction to Metrology, Distinction between precision and accuracy. Limits, fits and tolerances, Tolerance grades, Types of fits, Factors considered in selection of instruments. **LINEAR AND ANGULAR MEASUREMENTS:** Linear Measuring Instruments – Evolution – Types – Classification, Limit gauges, Angular measuring instruments – Types, Comparators - Constructional features and operation of mechanical, optical, electrical / electronics and pneumatic comparators, Principle of interferometry, Michelson interferometer, NPL flatness interferometer. **FORM MEASUREMENT**: Principles and Methods of straightness – Flatness measurement, Surface Texture Measurement – Thread measurement, gear measurement, surface finish measurement, Roundness measurement – Applications. **ADVANCES IN METROLOGY:** Basic concept of lasers Advantages of lasers – laser Interferometers – types – DC and AC Lasers interferometer – Applications. Special Measuring Equipments - Principles of measurement using Tool Maker's microscope profile projector & 3D coordinate measuring machine. Nano-measurements: Scanning Electron Microscope-Atomic Force Microscopy- Transmission Electron Microscopy. **INDUSTRIAL MEASUREMENTS:** Force, torque, power - Mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement: Venturimeter, Orifice meter, rotameter, pitot tube – Temperature: bimetallic strip, thermocouples, electrical resistance thermometer – Reliability and Calibration. **DESIGN OF EXPERIMENTS AND STATISTICAL ANALYSIS:** DOE techniques; Taguchi orthogonal arrays; Data acquisition, signal processing and conditioning; Error of a system of ideal elements; Error probability density function of a system of non-ideal elements; Error reduction techniques; Quality control and assurance in industry.		
	Total Number of Theory Hours	**45**

Text Books:	
1	R.K Jain, 'Engineering Metrology', 22nd edition, Khanna Publishers, 2022.
2	E.O Doebelin and Dhanesh Manik, "Measurement Systems", 7th edition, McGraw Hill, 2019.
Reference Books:	
1	Alan S Morris, Reza Langari , "Measurement and Instrumentation: Theory and Application", Academic Press, 2015.
2	Venkateshan S P , "Mechanical Measurements", John Wiley & Sons, 2015.
3	Madhav S. Phadke, Quality Engineering using Robust Design, Prentice Hall, 1989.
Web References:	
1	http://www.nplindia.in/research-areas
Online Resources:	
1	https://nptel.ac.in/courses/112/106/112106138/
2	https://nptel.ac.in/courses/112/103/112103261/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Formative Assessment based on Capstone Model - Theory			
Course Outcome	**Bloom's Level**	**Assessment Component**	**FA (16%) [80 Marks]**
C401.1	Understand	Assignment -I	20
C401.2	Understand		
C401.3	Apply	Assignment -II	20
C401.4	Apply	Case Study	20
C401.5	Apply	Quiz	20
C401.6	Analyse		

Assessment based on Summative and End Semester Examination - Theory			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1: (60 Marks)	**CIA2: (60 Marks)**	
Remember	20	20	20
Understand	30	30	30
Apply	40	30	30
Analyse	10	20	20
Evaluate			
Create			

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C401.1	3	3	3											3	
C401.2	3	3	3											3	
C401.3	3	3	3											3	
C401.4		3	3	3										3	
C401.5		3	3	3										3	
C401.6		3	3	3										3	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed	

23ME402	KINEMATICS AND DYNAMICS OF MACHINES	3/1/0/4
Nature of Course	Theory - Analytical	
Pre-Requisites	Engineering Mechanics	
Course Objectives:		
1	To understand the kinematics and rigid- body dynamics of kinematically driven machine components.	
2	To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link	
3	To be able to design linkage mechanisms and cam systems to generate specified output motion	
4	To understand the kinematics of gear trains	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C402.1	Illustrate the student conversant with commonly used mechanism for industrial application.	[U]
C402.2	Compute the position, velocity, acceleration and equations of motion of four bar and single slider mechanisms	[Ap]
C402.3	Construct cam profile for various types of followers.	[Ap]
C402.4	Discriminate the gear terminologies.	[Ap]
C402.5	Analyze the kinematics of gear trains	[A]

Course Contents:

Mechanisms: Definition and types of joints; Lower and higher pairs; Classification of mechanisms based on function and constraints; Common mechanisms such as slider crank and 4-bar mechanisms and their inversions; Quick return mechanism, Straight line generators, rocker mechanisms, universal joints, steering mechanisms, etc. **Basic Kinematic Concepts and Definitions** Degree of freedom and Grübler's formula; Grashof's rule and rotatability limits; Mechanical advantage; Transmission angle; Limit positions

Kinematic Analysis of Simple Mechanisms: Displacement, velocity, and acceleration analysis; Velocity analysis of four bar and single slider mechanisms using relative velocity method. Equations of motion for four-bar and slider-crank mechanisms. **Cams and Followers:** Classification and terminology; Displacement, velocity, acceleration diagrams; Uniform velocity, parabolic, simple harmonic and cycloidal motions; Derivatives of follower motions, Pressure angle and undercutting; Graphical disc cam profile synthesis for roller and flat face followers.

Gears: Involute and cycloidal profiles; gear parameters; Fundamental law of gearing and conjugate action; Spur gear contact ratio and interference; Helical, bevel, worm, rack & pinion gears; **Gear trains:** Simple, compound, reverted and epicyclic gear trains – speed ration analysis by tabular method**.**

Total Hours:	**60**

Text Books:	
1	Rattan, S.S, "Theory of Machines", 5th Edition, Tata McGraw-Hill, 2019.
2	Uicker, Jr, John J., et al. Theory of Machines and Mechanisms. N.p., Cambridge University Press, 2023
Reference Books:	
1	R.S.Khurmi & J.K.Gupta" Theory of Machines", 14th Edition, S Chand Publications, 2020
2	Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", 3rd Edition Affiliated East-West Pvt. Ltd., New Delhi, 2020
Web References:	
1	https://ocw.mit.edu/courses/2-032-dynamics-fall-2004/
Online Resources:	
1	https://nptel.ac.in/courses/112105268

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

ourse Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C402.1	Understand	Quiz	20
C402.2	Apply		
C402.3	Apply	Group Assignment	20
C402.4			
C402.5	Analysis	Individual Assignment	40

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	10	10	10
Understand	30	30	30
Apply	30	30	30
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]					End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks		
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)	
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (40 Marks)	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C402.1	3	3	1										2		
C402.2	3	3	2	2									2		
C402.3	3	3	3	2									2		
C402.4	3	3	2	2									2		
C402.5	3	3	3	2									2		
C402.6	3	3	3	2									2		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

23ME403	FLUID MECHANICS AND HYDRAULIC MACHINES	3/1/0/4
Nature of Course	Theory, Analytical	
Pre-Requisites	-	
Course Objectives:		
1	To learn about the application of mass and momentum conservation laws for fluid flows.	
2	To understand the importance of dimensional analysis.	
3	To obtain the velocity and pressure variations in various types of simple flows.	
4	To analyse the flow in water pumps and turbines.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C403.1	Understand the fundamental properties of the fluids	[U]
C403.2	Formulate the relationship among the parameters in fluid phenomenon and to predict the performances of prototype by model studies.	[Ap]
C403.3	Analyse the behaviour of fluids and its application through fluid kinematics.	[A]
C403.4	Mathematically analyze simple flow situations.	[A]
C403.5	Evaluate the performance of various pumps and turbines	[E]
Course Contents:		
Properties of Fluid: Definition of fluid, Newton's law of viscosity, Units and dimensions - Physical properties of fluids, Control volume, Continuity equation and momentum equation - Incompressible flow, Bernoulli's equation and its applications - **Dimensional Analysis:** Dimensionally homogeneous equations, Buckingham π theorem, Calculation of dimensionless parameters, Similitude and complete similarity, Model scales - Basic boundary layer theory. **Fluid Kinematics:** Different approaches, Reynolds transport theorem, Flow visualization, Types of flow, Strain rate, stream line, streak line, path lines and stream tubes - Continuity equation in Cartesian coordinates in 3D forms, Velocity and acceleration of fluid particles; Velocity potential function and stream function. **Laminar and Turbulent Flow:** Laminar flow, Plane Poiseuille flow and Couette flow, Laminar flow through circular pipes, Loss of head and power absorbed in viscous flow - turbulent flow – Reynolds experiment, Frictional losses in pipe flow, Shear stress in turbulent flow, Major and minor losses, Darcy's and Chezy's equation, branching pipes and equivalent pipe. **Rotodynamic Machines:** Euler's equation, Theory of Rotodynamic machines, Various efficiencies, Velocity components at entry and exit of the rotor, Velocity triangles, Centrifugal pumps, working principle, work done by the impeller and performance curves, Cavitation in pumps - Reciprocating pump, working principle. **Hydraulic Turbines:** Classification of water turbines, Heads and efficiencies, velocity triangles, axial, radial and mixed flow turbines - Pelton wheel, Francis turbine and Kaplan turbines, working and design principles.		
	Total Hours:	**60**
Text Books:		
1	S.S. Rattan, Fluid Mechanics & Hydraulic Machines, Khanna Book Publishing, 2021.	
2	R. K. Bansal, "A Textbook of Fluid Mechanics and Hydraulic Machines," Laxmi Publication, 2024.	
3	S. K. Som, G. Biswas and S. Chakraborty, "Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill, 2017.	
Reference Books:		
1	P.J. Pritchard, A.T. McDonald and R.W. Fox, "Introduction to Fluid Mechanics," Wiley India, 2019.	
2	F.M. White, "Fluid Mechanics," Tata McGraw Hill, 2022.	
3	Yunus Cengel and John Cimbala, Fluid Mechanics Fundamentals and Application, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi 2019	

Web References:	
1	https://onlinecourses.nptel.ac.in/noc22_ce85/preview
Online Resources:	
1	https://www.britannica.com/science/fluid-mechanics/Hydrodynamics
2	https://www.sciencedirect.com/topics/earth-and-planetary-sciences/fluid-mechanics

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C403.1	Understand	Quiz	20
C403.2	Apply	Tutorial	20
C403.3	Analyze		
C403.4	Analyze	Assignment	40
C403.5	Evaluate		

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	10	10	10
Understand	20	10	20
Apply	20	20	20
Analyse	50	40	30
Evaluate	-	20	20
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]					End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks		
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)	
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (40 Marks)	
60	20	20	60	40	100

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C403.1	3	1	1												3
C403.2	3	3	2												2
C403.3	3	1	1												2
C403.4	3	3	2												2
C403.5	3	3	2												2

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

23ME404	HEAT TRANSFER AND THERMAL MACHINES	3/1/0/4
Nature of Course	Theory analytical.	
Pre-Requisites	Thermal Engineering, Engineering Thermodynamics.	
Course Objectives:		
1	To impart a solid foundation in heat transfer, exposing students to the three basic modes namely conduction, convection and radiation.	
2	To enable the students to apply laws of heat and mass transfer in engineering applications and develop governing equations, solution procedures.	
3	To provide a brief insight on boiling and condensation heat transfer, and the analysis and design of heat exchangers.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C404.1	Compute heat transfer and temperature distribution in simple, composite systems and extended surfaces.	[Ap]
C404.2	Interpret and analyze forced and free convection heat transfer.	[A]
C404.3	Appraise the performance of heat exchangers using LMTD and NTU methods.	[A]
C404.4	Classify and appraise the different modes of mass transfer.	[A]
C404.5	Assess the radiative properties of a surface.	[E]

Course Contents:

Introduction and Conduction Heat Transfer: Three modes of heat transfer, Examples of equipment (like air conditioner and air cooler) involving heat transfer; Derivation of heat conduction equation in Cartesian, cylindrical and spherical geometry. Steady 1D solution for conduction heat transfer, Concept of conduction and film resistances, Critical insulation thickness, Lumped system approximation and Biot number; Heat transfer through pin fins, 2D conduction solutions for steady and unsteady heat transfer.

Convection Heat Transfer and Heat Exchangers: Basic equations; Boundary layers; Forced convection; External and internal flows; Natural convective heat transfer; Dimensionless parameters for forced and free convection heat transfer; Correlations for forced and free convection; Approximate solutions to laminar boundary layer equations for internal and external flow; Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.- Pool boiling, Flow boiling; Film and drop wise condensation, Function, classification and configuration of heat exchangers, Evaluation of mean temperature difference, Heat exchanger effectiveness, Analysis, design using LMTD , NTU methods and selection of heat exchangers.

Radiation Heat Transfer and Mass transfer: Interaction of radiation with materials; Definitions of radiative properties; Stefan Boltzmann's law; Black and grey body radiation; Calculation of radiation heat transfer between surfaces using radiative properties; View factors and the radiosity method; Examples for two-body enclosures; Radiation shield. Analogy between heat and mass transfer, Mass diffusion, Fick's Law, Steady and transient mass diffusion, Simultaneous heat and mass transfer.

Total Hours:	**60**

Text Books:

1	Sachdeva R C, "Fundamentals of Engineering Heat and Mass Transfer", New Age International, 2019.
2	Kothandaraman C.P "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 2018.

Reference Books:	
1	Yunus.A.Cengel, Afstin J.Ghajar, “Heat and Mass Transfer – Fundamentals and Applications”, McGraw Hill, Fifth Edition, 2017.
2	Incropera, F. P. and De Witt, D. P., “Fundamentals of Heat and Mass Transfer”, 8th Edition, John Wiley and Sons, New York, 2018.
3	Nag P.K, “Heat and Mass Transfer”, McGraw-Hill, 2019.
Web References:	
1	https://archive.nptel.ac.in/courses/112/108/112108149/
2	https://www.accessscience.com/content/article/a311100
Online Resources:	
1	https://onlinecourses.nptel.ac.in/noc22_ch65/preview
2	https://archive.nptel.ac.in/courses/103/101/103101137/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom’s Level	Assessment Component	FA (16%) [80 Marks]
C504.1	Apply	Quiz	20
C504.2	Analyze	Assignment	20
C504.3,C504.4	Analyze	Group Assignment	20
C504.5	Evaluate	Tutorial	20

Assessment based on Summative and End Semester Examination

Bloom’s Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	10	10	10
Understand	10	10	10
Apply	30	20	20
Analyse	30	30	30
Evaluate	20	30	30
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C404.1	2	2	3											3	
C404.2	3	3	3												
C404.3	3	3	2	2					1					3	
C404.4	3	3	2						1						
C404.5	3	3	3	3					1					3	
	3 Strongly agreed | 2 Moderately agreed | 1 Reasonably agreed														

23GE301	UNIVERSAL HUMAN VALUES (Common to all branches)	3/0/0/3

Nature of Course	Descriptive
Pre-Requisites	Interpersonal Communication and Value Sciences

Course Objectives:

1	Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2	Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.
3	Strengthening of self-reflection.
4	Development of commitment and courage to act.
5	Helping the students to appreciate the essential complementarily between 'VALUES' and 'SKILLS, to ensure sustained happiness and prosperity, which are the core aspirations of all human beings.
6	Highlighting plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Course Outcomes:
Upon completion of the course, students shall have ability to

C301.1	Understand and take responsibilities in life and handle problems to attain sustainable solutions while keeping human relationships and human nature in mind.	[U]
C301.2	Apply responsibilities towards their commitments (human values, human relationship and human society).	[AP]
C301.3	Apply what they have learnt to their own self indifferent day-to-day settings in real life, atleast a beginning would be made in this direction.	[AP]
C301.4	Analyze ethical and unethical practices, and formulate strategies to actualize a harmonious environment wherever they work.	[AN]
C301.5	Understand the harmony in nature and existence, and work out mutually on fulfilling participation in nature.	[U]

Course Contents:

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education, Understanding Harmony in the Human Being-Harmony in Myself!

15 Hours

Self-evaluation of the students- Pre-test of UHV**-** Purpose and motivation for the course. Self-Exploration–Its content and process- A look at basic Human Aspirations. Understanding Happiness and Prosperity correctly-Understanding the needs of Self('I') and 'Body'-Understanding the Body as an instrument of 'I'(being the doer, seer and enjoyer)-Understanding the characteristics and activities of 'I' and harmony in 'I' - Understanding theharmony of'I' with the Body- Social activities – Waste Management - Water Conservation-Soil Pollution - Physical Health and related activities - Lectures by eminent persons- Literary activities.

Module 2: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship, Understanding Harmony in the Nature and Existence- Whole existence as Coexistence

15 Hours

Understanding values in human relationship - Understanding the harmony in the society (society being an extension of family): - Visualizing a universal harmonious order in society-Understanding the harmony in Nature.-Understanding Existence as Coexistence of mutually Interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence-Buddy program-Relationships-Homesickness- Managing peer pressure-Projects-Socially responsible engineers-Visit to local areas (orphanages, special children)- Physicalactivities(games).

Module 3: Implications of the above Holistic Understanding of Harmony on Professional Ethics **15 Hours**
Natural acceptance of human values- Definitiveness of Ethical Human Conduct- Basis for Humanistic Education-Humanistic Constitution and Humanistic Universal Order-Competence in professional ethics-Case studies of typical holistic technologies, management models and eco-friendly production systems - Strategy for transition from the present state to Universal Human Order-Sum up: Self-evaluation of the students-Post test of UHV.
Total Hours: 45

Text Books:	
1	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010
2	Rajni Setia, Priyanka Sharma, “Human Values”, Genius Publication”, Jaipur, 2019.
Reference Books:	
1	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
2	The Story of My Experiments with Truth –by Mohandas Karamchand Gandhi
3	India Wins Freedom-Maulana Abdul Kalam Azad.
Web References:	
1	https://examupdates.in/professional-ethics-and-human-values/
2	http://hvpe1.blogspot.com/2016/06/notes-human-values-and-professional.html
3	https://www.yourmorals.org/schwartz.2006.basic%20human%20values.pdf
Online Resources:	
1	https://nptel.ac.in/courses/109/104/109104068/
2	https://medium.com/the-mission/the-12-important-life-skills-i-wish-id-learned-in-school-f4593b49445b
3	https://www.thebalancecareers.com/life-skills-list-and-examples-4147222

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	**Bloom’s Level**	**Assessment Component**	**FA (16%) [80 Marks]**
C301.1	Understand	Online Quiz	20
C301.2	Apply	Group Assignment	20
C301.3	Apply	Presentation	20
C301.4	Analyse		
C301.5	Understand	Seminar	20

Assessment based on Summative and End Semester Examination

Bloom’s Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	10	10	10
Understand	10	20	20
Apply	40	40	40
Analyse	40	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination															
Continuous Assessment (40%) [200 Marks]															End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks								CA 2 : 100 Marks							
SA 1 (60 Marks)	FA 1 (40 Marks)							SA 2 (60 Marks)	FA 2 (40 Marks)						
	Component - I (20 Marks)					Component - II (20 Marks)			Component - I (20 Marks)				Component - II (20 Marks)		

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C301.1						3									
C301.2						3			3						
C301.3						3		3							
C301.4						3	3	3			2				
C301.5						3	3								

23ME405	MANUFACTURING TECHNOLOGY	3/0/2/5
Nature of Course	Theory concepts and lab	
Pre Requisites	Manufacturing practices workshop	

Course Objectives:

1	To understand the concepts of manufacturing processes
2	To impart the methodologies to be followed in material removal and material addition process
3	To understand the working of standard machine tools, special purpose machines and allied machining processes

Course Outcomes:

Upon completion of the course, students shall have ability to

C405.1	Comprehend the basic terms related to various manufacturing processes	[U]
C405.2	Choose a suitable material removal processes and machine tools for making an industrial component	[Ap]
C4053	Apply CNC concepts and create part programming to generate components	[Ap]
C405.4	Describe various processes used for machining hard materials	[U]
C405.5	Choose the manufacturing techniques to process the resin, particulates or powders as per requirement of components	[Ap]

Course Contents:

CONVENTIONAL MANUFACTURING PROCESSES: CUTTING TOOLS – single and multipoint, materials and tool life – orthogonal cutting – various force components - MACHINE TOOLS – lathe, milling, drilling and grinding machines – WORK HOLDING DEVICES - cylindrical and non-cylindrical components – OPERATIONS – turning, milling, drilling and finishing operations - CHIP FORMATION – types of chip.

COMPUTER ASSISTED MANUFACTURING PROCESSES: COMPUTER NUMERICAL CONTROL (CNC) MACHINE TOOLS - constructional details - special features – Drives, Recirculating ball screws, tool changers - Machine axis and Co-ordinate system - CNC Control systems – Open/closed, point-to-point/continuous – working principle of CNC Turning and machining centres – PROGRAMMING OF CNC MACHINE TOOLS **-** Absolute vs Incremental programming - Programming formats - G and M codes - Manual part programming for CNC Turning center and machining centre.

SPECIAL MANUFACTURING PROCESSES: UNCONVENTIONAL MACHINING PROCESSES – abrasive jet machining, ultrasonic machining, electric discharge machining, electrochemical machining, laser and electron beam machining – POWDER METALLURGY PROCESS – powder preparation, compaction and sintering- ADDITIVE MANUFACTURING PROCESSES – steps involved in additive manufacturing – vat polymerization process type – stereolithographic – extrusion process type – FDM, powder bed fusion process types – selective laser sintering process, selective laser melting process and electron beam melting process – 3D scanner in reverse engineering

Total Number of Theory Hours	**45**

Laboratory Components

Sl.No	List of experiments	CO mapping	RBT
1	Measurement of cutting forces using lathe tool dynamometer	C405.2	Ap.
2	Facing, turning and taper turning using center lathe	C405.2	Ap.
3	External dovetail / internal dovetail using shaping machine	C405.2	Ap.
4	Contour milling / keyway cutting using milling machine	C405.2	Ap.
5	Drilling, reaming and tapping processes	C405.2	Ap.
6	Improve the surface finish of the given component using Surface grinding process	C405.2	Ap.
7	Write part programme for turning, taper turning operation and execute using CNC turning centre	C405.3	Ap.

8	Write part pprogramme for linear and circular operation and perform using CNC machining centre	C405.3	Ap.
9	Fabrication of parts using stereolithographic additive manufacturing process	C405.5	Ap.
10	Preparing 3D model using extrusion based FDM	C405.5	Ap.
11	Study on effect of FDM parameters on dimensional accuracy	C405.5	Ap.
12	Modelling of component using 3D Scanner of real-life object of unknown dimension in reverse engineering	C405.5	Ap.
	Total Number of Laboratory Hours		**30**

Text Books:	
1	Amitabha Ghosh and A.K. Mallick, Manufacturing Science. Affiliated East-West Press Pvt. Ltd. 2010
2	Serope Kalpakjian, “Manufacturing Engineering and Technology”, Pearson India, 7th edition. 2018
3	Rao, P.N. “Manufacturing Technology - Metal Cutting and Machine Tools,” McGraw – Hill Education, New Delhi, 2018.
Reference Books:	
1	Hajra Choudhury, “Elements of Workshop Technology”, Vol. I & II, Media Promotors Pvt Ltd., 2014.
2	HMT - “Production Technology”, McGraw-Hill Education, 2017.
Web References:	
1	https://nptel.ac.in/courses/112105127/
2	www.sme.org
Online Resources:	
1	https://archive.nptel.ac.in/noc/courses/noc18/SEM1/noc18-me05/
2	https://archive.nptel.ac.in/noc/courses/noc16/SEM2/noc16-me17/
3	https://www.mooc-list.com/tags/manufacturing

Continuous Assessment										
Theory				**Practical**			**Total (A+B)**	**Total Continuous Assessment**	**End Semester Examination**	**Total**
Formative assessment	**Summative assessment**	**Total**	**Total (A)**	**Formative assessment**	**Summative assessment**	**Total (B)**				
80	**120**	**200**	**100**	**75**	**25**	**100**	**200**	**50**	**50**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative Assessment based on Capstone Model -Theory

Course Outcome	**Bloom’s Level**	**Assessment Component**	**FA (10%) [80 Marks]**
C405.1	Understand	Quiz	20
C405.2	Apply	Assignment	20
C405.3	Apply		
C405.4	Understand	Presentation / seminar	20
C405.5	Apply	Assignment	20

Assessment based on Summative and End Semester Examination- Theory			
Bloom's Level	**Summative Assessment (15%) [120 Marks]**		**End Semester Examination (35%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	10
Understand	30	50	30
Apply	50	30	60
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on continuous and End Semester Examination-Practical			
Bloom's Level	**Continuous Assessment (25%) [100 Marks]**		**End Semester Examination (15%) [100 Marks]**
	FA : [75 Marks]	**SA: [25 Marks]**	
Remember	-	-	-
Understand	-	-	-
Apply	100	100	100
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination									
Continuous Assessment (40%) [200 Marks]									**End Semester Examination (50%)**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			**Practical exam (100 marks)**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		**FA (75 M)**	**SA (25 M)**		**Theory examination (35%) practical examination (15%)**
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**				

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
COs	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C405.1	3	1	2											1	
C405.2	3	2	3											3	
C405.3	3	2	3											3	
C405.4	3	2	3											3	
C405.5	3	2	3											3	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

23ME406	THERMAL AND FLUID MECHANICS LABORATORY	0/0/2/1

Nature of Course	Practical
Pre Requisites	Fluid Mechanics and Hydraulic Machines, Heat Transfer and Thermal Machines

Course Objectives:

1	Understand the properties of fluids & working principle of Internal combustion engines.
2	Conduct experiments and analyze engine performance parameters and combustion characteristics.
3	Analyze and compare the efficiency and characteristics of different pumps.
4	Collaborate effectively as part of multi-disciplinary teams specializing in fluid and thermal sciences

Course Outcomes:
Upon completion of the course, students shall have ability to

C406.1	Calculate the coefficient of discharge and friction factor of the fluid flow through pipes using an apparatus	[A]
C406.2	Determine the performance of Hydraulic Machines through tests at different conditions	[Ap]
C406.3	Evaluate the performance of engines and compare their performance characteristics	[E]
C406.4	Compute heat transfer and temperature distribution in steady-state, unsteady-state heat conduction and extended surfaces	[E]
C406.5	Conduct test and calculate the properties of fuels and lubricants	[A]
C406.6	Classify, solve and calculate the psychrometric processes and performance of air conditioning systems	[Ap]

Course Contents:

S.No	List of Experiments	CO Mapping	RBT
1	Determination of the Coefficient of discharge of Orifice meter and Venturimeter	C406.1	[Ap]
2	Determination of the rate of flow using Rotameter and compare the result with orifice and venturimeter.	C406.1	[Ap]
3	Calculation of friction factor for a given set of pipes	C406.1	[A]
4	Conduct a test on centrifugal pump and determine the performance characteristics	C406.2	[A]
5	Determination of the performance characteristics of Pelton turbine	C406.2	[A]
6	Determination of the performance characteristics of a Francis Turbine	C406.2	[A]
7	Determination of the performance characteristics of a Kaplan Turbine	C406.2	[A]
8	Determination of Thermal Conductivity of given specimen by two slab guarded hot plate method.	C406.4	[E]
9	Determination of Viscosity, flash point and fire point of engine oil.	C406.5	[E]
10	Performance and combustion test on computerized Kirloskar TV1 engine with eddy current dynamometer. (In diesel mode).	C406.3	[A]
11	Determination of heat transfer coefficient of Forced convection inside tube.	C406.4	[Ap]
12	Determination of the emissivity of a given sample	C406.4	[Ap]
13	Determination of the performance characteristics of a vapour compression system	C406.6	[A]

	Total Hours:	**30**

Reference Books:	
1	Bansal, R.K. “Fluid Mechanics and hydraulic Machines”, Laxmi Publications (P) Ltd., New Delhi, Eleventh edition, 2023
2	R S Khurmi, “Thermal Engineering”, Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2022.
3	Ganesan V, Internal Combustion Engine; Tata McGraw Hill Publishers Co. Ltd., New Delhi, Fourth edition,2017.
4	Kothandaraman C.P, Domkundwar S, “A course in Thermal Engineering”, DhanpatRai& Co. pvt ltd, Sixth edition, 2019.

Web References:	
1	https://fm-nitk.vlabs.ac.in
2	http://nptel.ac.in/courses/112104033/
3	http://nptel.ac.in/courses/112105128/

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
75	**25**	**100**	**60**	**40**	**100**

Assessment based on Continuous and End Semester Examination

Bloom’s Level	**Continuous Assessment (60%) [100 Marks]**		**End Semester Practical Examination (40%) [100 Marks]**
	FA (75 Marks)	**SA (25 Marks)**	
Remember	10	10	10
Understand	10	10	10
Apply	30	30	30
Analyse	40	40	40
Evaluate	10	10	10
Create	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C406.1	3	3	3	2									1		
C406.2	3	3	3	2									1		
C406.3	3	3	3	1									1		
C406.4	3	3	3	3									3		
C406.5	3	3	3	3									1		
C406.6	3	3	3	1									3		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed	

23ME407	METROLOGY AND DYNAMICS LABORATORY	0/0/2/1
Nature of Course	Practical application	
Pre Requisites	Manufacturing Practices Workshop Engineering mechanics Mechanics of Deformable Solids	

Course Objectives:

1	To measure the dimensions of mechanical components using various measuring instruments.
2	To develop programs for applications using Lab View software.
3	To enable the students to understand the principles of static force analysis and dynamic force analysis of mechanisms.
4	To provide an insight regarding the undesirable effects of unbalance in rotors and engines.
5	To introduce the concept of vibratory systems and damping methods.

Course Outcomes:
Upon completion of the course, students shall have ability to

C407.1	Perform the experiments to check linear and angular measurements.	[Ap]
C407.2	Develop programs for various applications using Lab View software.	[A]
C407.3	Determine the forces acting on machines and mechanisms such as flywheels, and engines.	[Ap]
C407.4	Determine the gyroscopic couple on motorized gyroscope both experimentally and analytically.	[A]
C407.5	Evaluate the various types of vibrations and to impart knowledge in calculating natural frequency and forces caused due to unbalance in masses.	[E]
C407.6	Perform static and dynamic balancing calculations for rotating parts of machinery.	[A]

Course Contents:

S.No	List of Experiments (Using analysis and simulation softwares)	CO Mapping	RBT
1	Measure the various physical parameters of the given workpiece using linear and angle measuring instruments	C407.1	[Ap]
2	Analyze the tolerance of the manufactured component using mechanical and optical comparator.	C407.1	[Ap]
	Study of Virtual instrumentation for simple applications.		
3	Simulate the basic arithmetic and logic operations using VI.	C407.2	[A]
4	Measure the Real time temperature Using DAQ	C407.2	[A]
5	Determination the moment of inertia of turn table apparatus and bifilar suspension.	C407.4	[Ap]
6	Determination of gyroscopic couple using motorized gyroscope.	C407.4	[A]
7	Determination of transmissibility ratio using vibrating table.	C407.5	[E]
8	Determination of transverse frequency of beam.	C407.5	[E]
9	Balancing of rotating masses and reciprocating masses.	C407.6	[A]
10	Determination of Natural frequency of Free longitudinal Vibration	C407.5	[A]
11	Determination of Critical speed of Shaft	C407.5	[A]
12	Fabrication of model utilizing the applications of three bar, four bar mechanisms, gear trains etc.,	C407.5	[A]

Total Hours: 30

Reference Books:	
1	R.K Jain, 'Engineering Metrology', 21st edition, Khanna Publishers, 2018.
2	Sanjay Gupta and Joseph john, "Virtual Instrumentation using Labview", Mcgraw Hill Education; 2nd edition, 2017.
3	Rattan S.S., "Theory of Machines", 5th edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2019.
4	Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 2013.
Web References:	
1	https://nptel.ac.in/courses/112/106/112106180/
2	https://nptel.ac.in/courses/112106179/

Continuous Assessment				End Semester Examination	TOTAL
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
75	25	100	60	40	100

Assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment (60%) [100 Marks]		End Semester Practical Examination (40%) [100 Marks]
	FA (75 Marks)	SA (25 Marks)	
Remember	30	30	30
Understand	30	30	30
Apply	20	20	20
Analyse	20	20	20
Evaluate	-	-	-
Create	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C407.1	3	3	2											2	
C407.2	3	3	2		3								3	2	
C407.3	3	3	3										1		
C407.4	3	3	3										1		
C407.5	3	3	3										2		
C407.6	3	3	3										2		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

Professional Elective

23ME901	ELECTRIC AND HYBRID VEHICLE TECHNOLOGY	3/0/0/3

Nature of Course	Theory Skill based
Pre-Requisites	NIL

Course Objectives:

1	To enable the students to understand the working of different configurations of electric and hybrid vehicles.
2	To expose the students to the recent propulsion technologies used in automotive industries.
3	To enable the students to realize the technical characteristics of energy storage system.

Course Outcomes:
Upon completion of the course, students shall have ability to

C901.1	Describe the need, concept and types of EV/HEV.	[U]
C901.2	Report the basic components of hybrid and electric vehicles.	[U]
C901.3	Choose suitable electric propulsion and control systems for EV/HEV.	[Ap]
C901.4	Evaluate the performance of electric vehicles.	[A]
C901.5	Employ proper energy storage systems for vehicle applications.	[Ap]

Course Contents:

Introduction to Electric Vehicle and Hybrid Electric Vehicle: Environmental impact of conventional vehicle, overview of air pollution, need for electric vehicle, history of electric vehicles & hybrid electric vehicles, social and environmental importance of electric vehicles and hybrid electric vehicles. **Types of Electric Vehicles:** Battery Electric Vehicle (BEV), Hybrid Electric Vehicle (HEV), plug-in hybrid electric vehicle, fuel cell electric vehicle, solar powered vehicle. **Types of Hybrid Vehicle:** Hybridization – micro hybrid, mild hybrid, fully hybrid – advantages, disadvantages & its applications.

Electric Vehicle Propulsion Systems: Types of EV motors - DC motor drives, induction motor drives, permanent magnetic brushless DC motor drives, hub motor drive system, configurations of electric vehicle, performance of electric vehicle – tractive effort in driving conditions – energy consumption. **Hybrid Electric Vehicle Drive Trains:** IC engine, electric motor, controller, DC/DC converter, transmission unit, batteries. **Drive train Configuration:** Parallel hybrids, series hybrids, and power-split hybrids **–** control strategies.

energy storage systems: batteries – lead acid batteries, nickel-based batteries, and lithium-based batteries, battery charging techniques, battery characterization – capacity, discharge rate, state of charge, state of discharge, depth of discharge, technical characteristics, battery pack design, smart battery management system. Fuel cell-based energy storage, hybridization of various energy storage devices. **Control Systems for EV/HEV**: Electronics power steering – torque sensor – EPS motor, suspension system – semi trailing arm type, trailing arm, air suspension, regenerative suspension system, and regenerative braking system for EV/HEV.

Total Hours:	45

Text Books:

1	M. Ehsani, Y. Gao and A. Emadi, 'Modern electric, hybrid electric and fuel cell vehicles: Fundamentals, Theory and design', 3rd edition, CRC press, 2018.
2	T. Denton, "Electric and Hybrid Vehicles", Second Edition, Routledge, 2020.

Reference Books:

1	K. T. Chau, 'Electric vehicle machines and drives: Design, analysis and application', first edition, John Willey and Sons Singapore Pvt. ltd., 2015.
2	Electric Vehicle Battery Systems" - Sandeep Dhameja, Butterworth Heinemann, 2002.
3	Iqbal Hussain, "Electric & Hybrid Vehicles – Design Fundamentals", Second Edition, CRC Press, 2018.

Web References:	
1	https://www.edu.autobotindia.com
2	http://web.mit.edu/evt/links.html
Online Resources:	
1	https://nptel.ac.in/courses/108/103/108103009/
2	https://nptel.ac.in/courses/108/102/108102121/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment	FA (16%) [80 Marks]
C901.1	Understand	Hands on Training/Industrial Case Study with Poster Presentation	40
C901.2			
C901.3	Apply	Project Work – Fabricate EV/HEV sub-systems	40
C901.4	Analyse		
C901.5	Apply		

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	20	20
Understand	40	40	40
Apply	30	30	30
Analyse	10	10	10
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%)[200 Marks]				End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks		CA 2 : 100 Marks		
SA 1 (60 Marks)	FA 1 (40 Marks) Component - I (40 Marks)	SA 2 (60 Marks)	FA 2 (40 Marks) Component - I (40 Marks)	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C901.1	3	2	2									3			
C901.2	3	3										2			
C901.3	3	3	2		2	3	2					2		2	
C901.4	3	3		3											
C901.5	3	3	2		2							2			

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

23ME902	AUTOTRONICS	3/0/0/3
Nature of Course	Theory	
Pre-Requisites	Vehicle Technology	

Course Objectives:

1	To enable the students to understand the evolution of electronics in automobiles and impart them the basics of charging and starting system
2	To impart the knowledge on ignition and injection systems
3	To acquaint students with various sensors and actuators for controlling engine parameters

Course Outcomes:
Upon completion of the course, students shall have ability to

C902.1	Recall the basic electrical and electronics systems used in automotive electronics.	[U]
C902.2	Classify the different types of batteries used in the automotives.	[U]
C902.3	Select the suitable sensors for various applications used in automotives.	[Ap]
C902.4	Recall the principles and applications of vehicle control and safety systems used in the automotives.	[R]
C902.5	Design and develop the components for automotives.	[C]

Course Contents:

Autotronics Systems: Introduction to electrical systems in automobiles - charging system - working of charging circuit diagram - alternators - regulator - battery - types of batteries - lead acid battery and lithium-based batteries - construction and working principle - battery rating - battery testings – battery charging methods, starting system - working of starter circuit diagram - starter motor - types of starter drive - bendix drive - over running clutch type. **Ignition System** - Types of ignition system - battery coil ignition system and its components - electronic ignition system and its components. **Lighting System** - Circuits and various components. Auxiliary systems/accessories in automobiles.

Sensors, Actuators and Engine Management System: Sensors - types of automotive sensors - working principle of various sensors - crankshaft position sensors - throttle position sensor - oxygen sensor - manifold pressure sensor - mass air flow sensor - engine coolant temperature sensors - vehicle speed sensors - exhaust gas oxygen sensors - knock sensors. **Actuators** - Types of actuators - idle speed actuator - unit injector - Exhaust Gas Recirculation (EGR) valve and control. Engine management system - block diagram and working principle - ECUs used in the engine management - On Board Diagnosis (OBD) -Purpose of On Board Diagnostic second generation - OBD II concept - SAE J2012 standard diagnostic trouble code (DTC).

Vehicle Control and Safety Systems: Automatic Transmission System - electronic clutch - active suspension system - electronic suspension system - traction control system - electronic power steering control – electronic differential - Advanced Driver Assistance Systems (ADAS) - adaptive cruise control system - anti-lock braking system - vehicle and artificial intelligence - autonomous vehicles - object detection - collision warning and avoidance systems - airbags. Case studies - Technological development in modern automotives.

Total Hours:	45

Text Books:

1	Tom Denton, “Automobile Electrical and Electronic Systems” 5th edition, Routledge, United Kingdom, 2018.
2	William.B.Ribbens, “Understanding Automotive Electronics” 8th edition Butterworth-Heinemann publications, 2017.

Reference Books:	
1	Robert Bosch Gmbh, “Bosch Automotive Electric and Electronics” 5th edition Springer-Vieweg.2013
2	Barry Hollembeak, “Automotive Electricity and Electronics” Cengage Learning, 2017.
3	Tom Denton, “Electric and Hybrid Vehicles” 2nd edition, Routledge, United Kingdom, 2020.
Web References:	
1	https://www.udemy.com/course/basics-of-automotive-electronics/
2	https://archive.nptel.ac.in/courses/107/106/107106088/
Online Resources:	
1	https://www.youtube.com/watch?v=BOP8qLQzhDc
2	https://elearn.nptel.ac.in/shop/iit-workshops/completed/emobility-and-electric-vehicle-engineering-cohort-2/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom’s Level	Assessment Component	FA (16%) [80 Marks]
C902.1	Understand	Assignment	20
C902.2		Case study	20
C902.3	Apply	Project work / Vehicle fabrication	40
C902.4	Remember		
C902.5	Create		

Assessment based on Summative and End Semester Examination

Bloom’s Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	30	20	20
Understand	30	30	30
Apply	40	40	40
Analyse	-	10	10
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]					End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks		
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)	
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (40 Marks)	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C902.1	3	3										3			
C902.2	3	3													
C902.3	3	3	3			3			2			3		2	3
C902.4	3	3					3								
C902.5	3	3	3						3		2			3	3
	3 Strongly agreed				2 Moderately agreed							1 Reasonably agreed			

23ME903	ALTERNATE ENERGY SOURCE FOR AUTOMOBILES	3/0/0/3

Nature of Course	Theory technology
Pre-Requisites	Engineering Thermodynamics, Thermal Engineering, Vehicle Technology

Course Objectives:

1	To expose the students to the available alternate energy resources.
2	To provide insights about new energy sources like CNG, Renewable oils, and Hydrogen.
3	To recognize the ways of utilizing the energy resources in conventional vehicles.

Course Outcomes:
Upon completion of the course, students shall have ability to

C903.1	Study the need, availability and difficulty in using alternate fuels.	[U]
C903.2	Analyze properties of alternate fuels and know the standards followed.	[A]
C903.3	Analyze the performance and emission characteristics of engines using alternate fuels.	[A]
C903.4	Discover the developments in hybrid energy and fuel cells.	[Ap]
C903.5	Analyze the technology behind developing of electric, hybrid and fuel cell vehicles.	[A]

Course Contents:

Introduction: Need for alternate fuels, Properties of alternate fuels, general use of alcohols, LPG, hydrogen, CNG, LNG. **Alcohols:** Properties of engine fuel, alcohols andgasoline blends, Performance, combustion characteristics and Emission characteristics in SI and CI engine.

Natural Gas, LPG, Hydrogen and Biogas: CNG vehicles, availability of CNG, properties, modifications required to use in engines, performance and emission characteristics of CNG and LPG in SI and CI engines, hydrogen storage and handling, performance and safety aspects. **Renewable Oils:** Esterification, Performance and emission characteristics in engines. Hybrid oils in engines. Renewable Fuel Standard (RFS)

Electric, Hybrid, Fuel Cell and Solar Cars: Layout of an electric vehicle, advantage and limitations, specifications, system components, electronic control system, high energy and power density batteries, hybrid vehicle, series and parallel hybrid vehicle, fuel cell vehicles, solar powered vehicle.

Total Hours:	45

Text Books:

1	Amit Sarin, “Biodiesel- Production and Properties”- RSC Publishing - ISBN:978-1-84973-470-7, 2019.
2	Sunggyu Lee, James G. Speight, Sudarshan K. Loyalku- “Handbook ofAlternative Fuel Technologies”- CRC Press- 2015

Reference Books:

1	James D. Halderman, “Hybrid and Alternative Fuel Vehicles”- Pearsonpublication-2015
2	Curtis D. Anderson and Judy Anderson, “Electric and Hybrid Cars- A History”- McFarlad& Company, Inc, Publishers- 2013.

Web References:

1	https://nptel.ac.in/courses/112104033/39
2	https://fueleconomy.gov/feg/current.shtml

Online Resources:

1	https://afdc.energy.gov/fuels/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C903.1	Understand	Quiz	20
C903.2	Analyze	Assignment	20
C903.3			
C903.4	Apply	Case Study	20
C903.5	Analyze	Group Assignment	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	10	20
Understand	30	40	30
Apply	40	40	20
Analyse	10	10	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]					End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks		
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)	
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C903.1	3	2	3			1									
C903.2	2	3					3								
C903.3	3	3					3								
C903.4	3	2	2									1			
C903.5	3	3	1				3					3		2	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

23ME904	AUTOMOTIVE COMPONENT MANUFACTURING	3/0/0/3

Nature of Course	Theory
Pre-Requisites	Vehicle Technology, Manufacturing Technology.

Course Objectives:

1	To impart knowledge on various processes involved in the manufacturing of automotive components.
2	To address the underlying concepts and methods behind automobile engine component manufacturing.
3	To understand the fundamentals of modern manufacturing methods in automotive industry.

Course Outcomes:
Upon completion of the course, students shall have ability to

C904.1	Describe the various manufacturing processes employed for producing engine components	R
C904.2	Illustrate the appropriate manufacturing process for manufacturing transmission system components.	U
C904.3	Select the relevant heat and surface treatment methods for engine and transmission Components	AP
C904.4	Outline the automotive body components manufacturing methods	AP
C904.5	Choose a suitable material and process for manufacturing of automobile components like chassis, wheel, brake and tyres	AP

Course Contents:

Engine Components: Casting of engine block - conventional and expendable pattern, casting of cylinder heads, cylinder liners, crankshaft, connecting rod and gudgeon pins-forging and casting, machining and heat treatment. Casting of piston - gravity casting, squeeze casting, machining and finishing and piston ring manufacturing. Upset forging of valves - heat treatment and surface improvement. Engine bearing manufacturing.

Transmission Components: Manufacturing of friction plates using conventional blanking and fine blanking. Manufacture of composite friction lining, composite moulding of phenol formaldehyde lining. Casting of gear box casing, precision forging of gears, gear hobbing, shaping, powder metallurgy, orbital forming of spur, helical, and bevel gears, hypoid gears, heat treatment and finishing. Propeller shaft – continuous casting, extrusion, heat treatment and surface hardening, composite propeller shaft manufacturing. Forging of rear axles, casting of rear axle casing, manufacturing of wheels and brake drums.

Chassis Components, Tyres and Advanced Manufacturing: Selection of material and manufacturing methods for vehicle frame manufacturing, steering systems, shock absorbers, dead axle – casting, forging, machining and finishing operation- Heat treatment procedures for chassis components. Tyre and tube manufacturing, prototype manufacturing -RPT,3-D Printing, chemical vapour deposition, physical vapour deposition, cryogenic grinding of powders, sealants, sound proof materials, structural adhesives, MMC liners

Total Hours:	45

Text Books:

1	Philip F. Ostwald & Jairo Munuz, “Manufacturing Processes and Systems”, John Wiley & Sons, New York, 2018
2	Degarmo E.P., “Materials and process in Manufacturing”, Macmillan Publishing Co, 2019.

Reference Books:

1	Kalpakjian, “Manufacturing Engineering and Technology”, Publisher: Pearson, 2013.
2	Sanjay K Mazumdar, “Composites Manufacturing”, CRC Press, NY, 2014.

Web References:	
1	https://www.youtube.com/watch?v=hs7bABMtOMI&t=71s
2	https://www.youtube.com/watch?v=H_RgFXjg-5s
Online Resources:	
1	https://www.youtube.com/watch?v=hs7bABMtOMI&t=41s

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C904.1	Remember	Assignment	20
C904.2	Understand	Quiz	20
C904.3	Apply	Seminar, case study	40
C904.4			
C904.5			

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%)[120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	30	30	30
Understand	40	40	30
Apply	30	30	40
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%)[200 Marks]					End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks		
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)	
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (40 Marks)	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C904.1	3	3	2											2	
C904.2	3	3	1											2	
C904.3	3	3	2											3	
C904.4	3	2	1											3	
C904.5	3	3	1	3										3	

	3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed	

23ME905	SMART AND INTELLIGENT MOBILITY	3/0/0/3
Nature of Course	Theory	
Pre-Requisites	Vehicle Technology	

Course Objectives:

1	To understand the basics of autonomous and connected vehicle
2	To elaborate various technologies used in autonomous vehicle
3	To understand the impact of automating various driving functions, connecting the automobile to sources of information that assist the task

Course Outcomes:
Upon completion of the course, students shall have ability to

C905.1	Summarize the concept of fully autonomous vehicles.	U
C905.2	Recall the concept of remote sensing and the types of sensor technology needed to implement remote sensing.	R
C905.3	Apply the technologies of cyber physical control systems to avoid collision in autonomous vehicles.	Ap
C905.4	Apply various decision and control technologies in intelligent vehicles.	Ap
C905.5	Analyze the concept of the connected vehicle and its role in automated vehicles.	A

Course Contents:

Introduction to Autonomous and Connected vehicles:
Concept of automotive electronics, history & evolution, body, chassis and powertrain electronics. Introduction to automated, connected, intelligent vehicles, unmanned aerial vehicle and drones, case studies. Fundamentals of connectivity, navigation and other applications, multimedia communication in vehicles, vehicle-to-vehicle technology and applications, vehicle-to-roadside and vehicle-to-infrastructure applications, challenges and issues.

Technologies for Smart Mobility: Overview of technologies in autonomous cars, basics of radar technology and systems, ultrasonic sonar systems, lidar sensor technology and systems, camera technology, night vision technology, other sensors, integration of sensor data to on-board control systems, overview of the operation of ECUs, basic cyber-physical system theory, role of surroundings sensing systems and wireless data networks.

Intelligent Vehicle Decision and Control Techniques: Adaptive control system techniques, system model for adaptive control. Design of self-tuning controllers. Fuzzy control systems. Fuzzy control of distance and tracking. Sharp control and decisional architecture for autonomous vehicles. Motion planning for vehicles. Trajectory planning and state time space, nonholonomic path planning.

Total Hours:	45

Text Books:

1	Radovan Miucic, “Connected Vehicles: Intelligent Transportation Systems”, Springer, 2019.
2	George Dimitrakopoulos, Aggelos Tsakanikas, Elias Panagiotopoulos, ‘Autonomous Vehicles – Technologies, Regulations and Societal Impacts, Elsevier, 2021.

Reference Books:

1	Alaa Khamis, ‘Smart Mobility – Exploring Foundational Technologies and wider impacts’, Apress, Canada, 2021.
2	Hussein T. Mouftah, Melike Erol-Kantarci, Sameh Sorour, ‘Connected and Autonomous Vehicles in Smart Cities’ CRC Press, 2021.
3	Tom Denton, “Automobile Electrical and Electronic systems, Roultedge”, Taylor & Francis Group, 2018.

Web References:

1	https://intellias.com/smart-mobility-ecosystem/
2	https://www.lslidar.com/solution/smart-mobility/

Online Resources:	
1	https://www.coursera.org/learn/electric-vehicles-mobility
2	https://www.coursera.org/learn/people-technology-and-the-future-of-mobility

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C905.1	Understand	Quiz	20
C905.2	Remember		
C905.3	Apply	Assignment	20
C905.4	Apply		
C905.5	Analyse	Case Study	40

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	20	10
Understand	20	20	10
Apply	40	40	40
Analyse	20	20	40
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]					End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks		
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)	
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (40 Marks)	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C905.1	3	3	3		3				2			3			3
C905.2	3	2	3		3				3			3			3
C905.3	3	3	3		3				2			3			3
C905.4	3	3	3		3				3			3			3
C905.5	3	3	3	2	3				3			3		2	3

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed	

23ME906	DRONE AND UAV TECHNOLOGIES	3/0/0/3
Nature of Course	Theory	
Pre-Requisites	Fundamentals of Electrical and Electronics Engineering	

Course Objectives:	
1	To understand the basics concepts, fabrication and programming of drone.
2	To impart the knowledge of a flying and operation of drone
3	To understand the applications of drones in various industries

Course Outcomes: **Upon completion of the course, students shall have ability to**		
C906.1	Recall the various types of drones and its components.	[U]
C906.2	Select appropriate sensors required and operating principles of the drones.	[Ap]
C906.3	Describe various testing methods and applications for drones.	[Ap]
C906.4	Execute the drone control systems and programming.	[U]
C906.5	Design and development of a drones for specific applications.	[C]

Course Contents:

Introduction to Drones: Introduction to Unmanned Aerial Vehicles - History of UAV, drone technology – Classification of UAV - Types of drones based on propulsion and applications – Drone Components and Systems - Drone construction components and configurations - Frames and propellers – Batteries, Motor and power systems - Sensors and payloads - Flight controllers - Drone Flight Principles. Internet of Thinks Systems and Controls - Intelligence Systems in Drones.

Drone Design, Development and Control Systems: Aerodynamics effects of drones - UAV Material Selection – Design and Fabrication for Balancing of Gliders, Aspect Ratio, Tail and Winglets Design Configuration, Controls Deflection and Mixing. Basic flight maneuvers - Flight planning and navigation. Drone Control Systems – Transmitter, Remote control systems - Autopilot systems - Telemetry systems - Methods of drone programming.

Drone Testing Methods and Applications – Thrust Calculation, Weight Calculation, CG Balancing, Roll Balancing, Servo Testing, LiPo Balancer and Tester, Propeller Balancing, Payloads, Range Testing, Vibration Testing. Drone Maintenance - Troubleshooting common problems. Drone Regulations and Safety - Drone License. Overview of Drone Applications, localization and mapping.

Total Hours:	45

Text Books:	
1	Daniel Tal and John Altschuld, “Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation”, John Wiley & Sons, Inc., 2021.
2	Garg, P. K, “Unmanned Aerial Vehicles: An Introduction”, Stylus Publishing, LLC., 2021.

Reference Books:	
1	Terry Kilby and Belinda Kilby, “Make:Getting Started with Drones “,Maker Media, Inc, 2016.
2	John Baichtal, “Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs”, Que Publishing, 2016.
3	Zavrsnik, “Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance”, Springer, 2018.

Web References:	
1	https://nptel.ac.in/courses/101104073
2	http://www.jetaero.in/internship/page-11564021

Online Resources:	
1	https://www.youtube.com/watch?v=P9adBgSz--g
2	https://www.youtube.com/watch?v=qBx-uCaAltM

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C906.1	Understand	Assignment	20
C906.2	Apply		20
C906.3	Apply	Project work / Drone fabrication	40
C906.4	Understand		
C906.5	Create		

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	30	30	20
Understand	30	30	30
Apply	40	30	40
Analyse	-	10	10
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]					End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks		
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)	
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (40 Marks)	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C906.1	3	3	1									1			
C906.2	3	3	2									1			3
C906.3	3	3	2									1			3
C906.4	3	3	1									1			
C906.5	3	3	3		3				3		3	3		3	3

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

23ME907	DIGITAL MANUFACTURING	3/0/0/3
Nature of Course	Theory	
Pre-Requisites	Manufacturing Technology	
Course Objectives:		
1	To study the various aspects of digital manufacturing and understand the importance of digital manufacturing in product lifecycle management and supply chain management.	
2	To elaborate the significance of digital twin.	
3	To formulate smart manufacturing systems in the digital work environment.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C907.1	Describe the fundamental concepts of digital manufacturing.	U
C907.2	Select tools and technologies used in implementation of digital manufacturing.	U
C907.3	Apply digital technologies in various manufacturing and process industry.	Ap
C907.4	Analyze and optimize various practical manufacturing process through digital twin.	A
C907.5	Implement digital environment in product life cycle and supply chain management.	Ap

Course Contents:

Introduction to Digital Manufacturing: Introduction – need – overview of digital manufacturing. Technologies behind digital manufacturing – benefits of digital manufacturing. **Smart Factory:** Smart factory – levels of smart factories, key principles of a smart factory – creating a smart factory – smart factories and cyber security.

IoT and Industry 4.0: Industry 4.0 – internet of things – industrial internet of things, monitoring manufacturing processes, intelligent machining – cloud computing – big data analytics – cyber physical systems - collaborative robots. Artificial Intelligence and Machine Learning in Manufacturing. Augmented Reality and Virtual Reality in Manufacturing. Case Study.

Digital Twin: Digital twin concept, digital twin in manufacturing, digital twin platform ecosystem, digital twin implementation and guidelines, business advantages of digital twin, challenges and risk. case study. **Digital Product Life Cycle & Supply Chain Management:** Phases of digital life cycle, digital technologies in product life cycle, collaborative product development, case study. Overview of digital supply chain – effective digital transformation - scope & challenges in digital supply chain – case study.

Total Hours:	45

Text Books:	
1	Kaushik Kumar, Divya Zindani, J. Paulo Davim, 'Digital Manufacturing and Assembly in Industry 4.0, Taylor & Francis Ld., 2020.
2	Zude Zhou, Shane (Shengquan) Xie and Dejun Chen, Fundamentals of Digital Manufacturing Science, Springer-Verlag London Limited, 2018.
Reference Books:	
1	Lihui Wang and Andrew YehChing Nee, Collaborative Design and Planning for Digital Manufacturing, Springer-Verlag London Limited, 2019.
2	Andrew Yeh Chris Nee, Fei Tao, and Meng Zhang, "Digital Twin Driven Smart Manufacturing", Elsevier Science., United States, 2019.
3	Alp Ustundag and Emre Cevikcan, "Industry 4.0: Managing the Digital Transformation", Springer Series in Advanced Manufacturing., Switzerland, 2017
Web References:	
1	https://www.plm.automation.siemens.com/global/en/our-story/glossary/digital-manufacturing/13157
2	https://www.twi-global.com/technical-knowledge/faqs/what-is-digital-manufacturing

Online Resources:	
1	https://www.coursera.org/specializations/digital-manufacturing-design-technology
2	https://www.udemy.com/course/digital-manufacturing-and-industry-40-training-course/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C907.1	Understand	Assignment	20
C907.2	Understand		
C907.3	Apply	Case Study	20
C907.4	Analyse	Quiz	20
C907.5	Apply	Case Study	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	20	20
Understand	30	30	20
Apply	30	30	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C907.1	2	2	3		3							3		2	3
C907.2	2	2	3		3							3		2	3
C907.3	3	3	3		3							3		2	3
C907.4	3	3	3		3							3		2	3
C907.5	3	3	3		3							3		2	3

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

23ME908	MODERN ROBOTICS	3/0/0/3

Nature of Course	Concept and Theory
Pre-Requisites	Engineering Mechanics, Kinematics and Dynamics of Machines

Course Objectives:

1	To introduce the history of robotics and robot anatomy.
2	To impart knowledge on robot end effectors, arm and their design.
3	To understand the simulation of robot kinematics.
4	To study the mobile robots and its manipulation.
5	To study the application of robots in various sectors.

Course Outcomes:
Upon completion of the course, students shall have ability to

C908.1	Discuss the definition, history of robotics and robot anatomy.	R
C908.2	Elaborate the types of robotic manipulators and gripper configuration based on kinematics and dynamics of robot.	U
C908.3	Develop the simulation of robot kinematics.	Ap
C908.4	Analyze the drive mechanism and power transmission methods used in robots.	A
C908.5	Describe the mobile robot and the application of robots in various sectors.	U

Course Contents:

INTRODUCTION TO ROBOT, SIMULATION OF ROBOT KINEMATICS

Robot: Definition, history of robotics, robot anatomy, co-ordinate systems, types and classification, configuration space and degrees of freedom of rigid bodies and robots, configuration space topology and representation; configuration and velocity constraints; task space and workspace, rigid-body motions, rotation matrices, angular velocities, and exponential coordinates of rotation, homogeneous transformation matrices. robot kinematics, forward and inverse kinematics (two three four degrees of freedom), homogeneous transformation matrices.

ROBOT DRIVES, CONTROLS AND POWER TRANSMISSION

Robot drive mechanisms – hydraulic – pneumatic and electric, mechanical transmission methods. electronic and pneumatic manipulators - construction of manipulators. Different types of controllers-proportional, integral, differential, PID controllers. Classification of end effectors - drive system for grippers - mechanical-adhesive-vacuum-magnetic-grippers, active and passive grippers.

MOBILE ROBOTS AND APPLICATIONS OF ROBOTS

Mobile robot, Wheeled Mobile Robots: Kinematic models of omnidirectional and non-holonomic wheeled mobile robots, controllability, motion planning, feedback control of non-holonomic wheeled mobile robots; odometry for wheeled mobile robots; and mobile manipulation. Reference trajectory generation, feed forward control. applications of robots: industrial robots, service robots, domestic and house hold robots, medical robots, military robots, agricultural robots, space robots, aerial robotics role of robots in inspection, assembly, material handling, underwater, space and healthcare.

Total Hours:	45

Text Books:

1	Julian Evans, “Modern Robotics: Mechanics, Systems and Control”, Larsen and Keller Education, 2019
2	Mikell P. Groover, Mitchell Weiss, "Industrial Robotics, Technology, Programming and Applications ", McGraw Hill Education, 2nd Edition, 2018.

Reference Books:

1	Jared Kroff, “Modern Robotics: Designs, Systems and Control”, Willford Press, 2019.
2	Chenguang Yang, Hongbin Ma, Mengyin Fu, “Advanced Technologies in Modern Robotic Applications”, Springer, 2018.

3	Harry Henderson, “Modern Robotics: Building Versatile Machines”, Facts on File Inc; Illustrated edition, 2006.
4	Francis X. Govers, “Artificial Intelligence for Robotics”, Packt Publishing Limited; Standard Edition, 2018.
Web References:	
1	http://www.robotics.org/
2	http://www.robotbooks.com/general-robotics-links.htm
Online Resources:	
1	https://www.edx.org/course/robotics-columbiax-csmm-103x
2	https://www.edx.org/course/robot-mechanics-control-part-i
3	https://www.edx.org/course/robot-mechanics-control-part-ii

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	**Bloom’s Level**	**Assessment Component**	**FA (16%) [80 Marks]**
C908.1	Remember	Quiz	20
C908.2	Understand	Assignment	20
C908.3	Apply	Assignment	20
C908.4	Analyse/ Understand	Seminar	20
C908.5			

Assessment based on Summative and End Semester Examination

Bloom’s Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	40	20	20
Understand	40	20	30
Apply	20	30	30
Analyse	-	30	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C908.1	3	2	2		3										3
C908.2	3	3	2									2			
C908.3	3	3	2									2			
C908.4	3	2	3		3									2	3
C908.5	3	1	1		2							2		2	3
	3 Strongly agreed				2 Moderately agreed							1 Reasonably agreed			

23ME909	APPLIED HYDRAULICS AND PNEUMATICS	3/0/0/3

Nature of Course	Theory Application
Pre-Requisites	Fluid Mechanics and Hydraulic Machines

Course Objectives:

1	To introduce the working of fluid power components and their needs.
2	To enable the students to understand the operation of various fluid power circuits.
3	To enable the students to understand the concepts like synchronizing and sequencing for automation.
4	To prepare the students to design electro-pneumatic circuit and ladder diagrams.
5	To allow students to design and simulate the circuits.

Course Outcomes:
Upon completion of the course, students shall have ability to

C909.1	Recall the fundamentals of hydraulic and pneumatic systems	[U]
C909.2	Select the components and control elements required for hydraulic and pneumatic systems as per the application.	[Ap]
C909.3	Analyze the scenario and provide suitable solution to the problems usinghydraulic and pneumatic systems.	[A]
C909.4	Design customized circuits in hydraulic systems for various industrialneeds	[C]
C909.5	Design customized circuits in pneumatic and servo systems for various industrial needs.	[C]

Course Contents:

Fluid power systems and Fundamentals: Introduction to fluid power, advantages of fluid power, application of fluid power system. Types of fluid power systems, properties of hydraulic fluids, general types of fluids, fluid power symbols. properties of air - perfect gas laws. fluid power - ANSI symbol. **Hydraulic System and Components**: Sources of hydraulic power- pumping theory pump classification, gear pump, vane pump, piston pump. Construction and working of pumps, pump performance, variable displacement pumps. Fluid power actuators, linear hydraulic actuators, types of hydraulic cylinders, single acting, double acting special cylinders like tandem, rod less, telescopic, cushioning mechanism. Construction of double acting cylinder, rotary actuators, fluid motors, gear, vane and piston motors.

Design of Hydraulic Circuits: Construction of control components, directional control valve, 3/2 way valve, 4/2 way valve, shuttle valve, check valve, pressure control valve, pressure reducing valve, sequence valve, flow control valve, fixed and adjustable, electrical control solenoid valves, relays, ladder diagram. Accumulators and intensifiers, types of accumulators, accumulator's circuits, sizing of accumulators, intensifier, applications of intensifier, intensifier circuit, control of single, double hydraulic, regenerative, sequencing, synchronizing, continuous reciprocation, speed control, fail-safe circuit, control of hydraulic motor.

Pneumatic System and Components: Pneumatic components, properties of air, compressors, filter, regulator, lubricator unit, air control valves, quick exhaust valves, and pneumatic actuators. control of single, double pneumatic, sequencing, semi-automatic, automatic, speed control, synchronizing circuit, pneumatic motor, pneumo-hydraulic circuit, sequential circuit design for simple applications using cascade method and KV map method
Design of Fluid Power Circuits: Servo systems, hydro mechanical servo systems, electro hydraulic servo system and proportional valves, introduction to electro hydraulic pneumatic logic circuits, ladder diagrams, PLC and SCADA applications in fluid power control. Fluid power circuits, failure and troubleshooting.

Total Hours:	45

Text Books:

1	Ilango Sivaraman, "Introduction to Hydraulics and Pneumatics", PHI Learning, 2019.
2	Jagadeesha T, "Hydraulics and Pneumatics systems", Wiley Publications, 2019.

Reference Books:	
1	Anthony Esposito, “Fluid Power with Applications”, Pearson Education, 2019.
2	James R. Daines , Martha J. Daines, “Fluid Power: Hydraulics and Pneumatics”, Goodheart-Willcox; Third Edition, Revised, 2018.
Web References:	
1	http://www.nfpa.com
2	http://www.fluidpowerjournal.com

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom’s Level	Assessment Component	FA (16%) [80 Marks]
C909.1	Understand	Assignment	20
C909.2	Apply	Group Assignment	20
C909.3	Analyze	Mini project/ Simulation of circuits	40
C909.4	Create		
C909.5			

Assessment based on Summative and End Semester Examination

Bloom’s Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	10	10
Understand	40	30	30
Apply	40	30	30
Analyze	-	20	20
Evaluate	-	10	10
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]					End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks		
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)	
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (40 Marks)	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C909.1	3	3	2	2									1		3
C909.2	3	3	3	2									2		3
C909.3	3	3	3	2									2		3
C909.4	3	2	3	3							3		2		3
C909.5	3	2	3	3							3		2		3

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed	

23ME910	PLC SCADA	3/0/0/3
Nature of Course	Theory Application	
Pre-Requisites	Fundamentals of Electrical and Electronics Engineering	

Course Objectives:

1	To get acquainted with the building blocks of PLC & SCADA, characteristics and taxonomy of industrial automation and control levels.
2	To study the value creation for an industry through PLC & SCADA.
3	To gain knowledge on the real time application of PLC & SCADA.

Course Outcomes:
Upon completion of the course, students shall have ability to

C910.1	Recall the main components used in the world of PLC &SCADA.	[R]
C910.2	Describe the applications of PLC and SCADA systems along with their design, installation, and operation.	[U]
C910.3	Programming and configuring PLC and SCADA systems, using industry-standard programming languages and software tools.	[Ap]
C910.4	Integrate PLC and SCADA systems with other automation systems and devices, such as sensors, actuators, and controllers.	[Ap]
C910.5	Design PLC and SCADA based systems for real time applications.	[A]

Course Contents:

INTRODUCTION
Basic Of electronics, electrical, instrumentation-understanding for automation & control system-job opportunity for PLC / SCADA- history of PLC / SCADA-basic components of automation-hardware / software classification of automation. **Introduction to PLC Systems-** Basic principles and architecture of PLCs- introduction to PLC- need of PLC in designing -advantages and limitations of PLCs-types of PLC systems.

PLC (PROGRAMMABLE LOGIC CONTROLLER)
Automation concept and basic design-PLC programming-introduction of ladder logic- basic ladder logic symbols and operations-ladder logic programming rules and techniques- ladder logic programming examples and exercises-introduction of SFC- introduction of instruction list -creating & editing ladder logic program-different types of sensors-sinking, sourcing, NPN, PNP NO/ NC concept. **Troubleshooting and maintenance -** Fault identification and diagnosis - component replacement and repair - maintenance practices and procedures - **Design and implementation of simple PLC systems -** Process control and automation-monitoring and reporting systems - safety systems.

SCADA (Supervisory Control and Data Acquisition)
Introduction to SCADA systems- Basic principles and architecture of SCADA systems-advantages and limitations of SCADA systems- types of SCADA systems. **SCADA software tools-** Introduction to industry - standard SCADA software tools - SCADA system configuration and design- HMI design and configuration. **Alarm management-**Basic principles of alarm management- alarm design and configuration. **Design and implementation of simple SCADA systems**-Process control and automation.

Total Hours:	45

Text Books:

1	Stephen P Tubbs, “Programmable Logic Controller (Plc) Tutorial, Siemens Simatic S7-200", 2007.
2	Kevin Collins, "PLC Programming for Industrial Automation", 2016.
3	Ronald L. Krutz and Russell Dean Vines, "Industrial Automation and Control System Security Principles", 2022.

Reference Books:	
1	Frank Petruzella, "Programmable Logic Controllers", 2016.
2	Francis G. L , “SCADA: Beginner's Guide”, 2016.
3	Stuart A Boyer, “SCADA: Supervisory Control and Data Acquisition”, Fourth Edition 4th Edition, 2016.
4	PLC Handbook,Practical Guide to Programmable Logic Controllers.
Web References:	
1	https://electrical-engineering-portal.com/scada-systems
2	https://www.automationdirect.com/plc-training/
Online Resources:	
1	https://www.coursera.org/lecture/intelligent-machining/programmable-logic-controllers-plc-fGz3r
2	https://www.plcacademy.com/
3	https://www.coursera.org/lecture/electrical-power-distribution/introduction-to-scada-4bqDt

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom’s Level	Assessment Component	FA (16%) [80 Marks]
C910.1	Remember	Quiz	20
C910.2	Understand	Assignment	20
C910.3	Apply		
C910.4	Apply	Case Study	20
C910.5	Analyse	Seminar	20

Assessment based on Summative and End Semester Examination

Bloom’s Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1: [60 Marks]	CIA2: [60 Marks]	
Remember	40	30	20
Understand	30	30	30
Apply	30	30	30
Analyse	-	10	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1: 100 Marks			CA 2: 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C910.1	3	2	2		3										3
C910.2	3	3	2									2			
C910.3	3	3	2									2			
C910.4	3	2	3		3									2	3
C910.5	3	1	1		2							2		2	3
	3 Strongly agreed				2 Moderately agreed							1 Reasonably agreed			

23ME911	IMMERSIVE TECHNOLOGIES	3/0/0/3

Nature of Course	Theory
Pre-Requisites	-

Course Objectives:

1	To understand various immersive technologies via VR, AR and MR.
2	To learn software related to immersive technologies.
3	To understand the logic of developing AR applications, VR and unreal engine

Course Outcomes: Upon completion of the course, students shall have ability to

C911.1	Elucidate the fundamentals of immersive technologies.	U
C911.2	Analyse the different types of tools and devices used in immersive technology.	A
C911.3	Use the features of unity and unreal engine.	A
C911.4	Discuss about haptics in immersive technologies.	U
C911.5	Developing the applications related to AR/VR systems.	C

Course Contents:

INTRODUCTION TO IMMERSIVE TECHNOLOGIES Introduction on virtual reality – augmented reality – mixed reality – extended reality – VR devices – AR devices – applications.

SOFTWARE TOOLS - Intro to unity – unity editor workspace – intro to C# and visual studio - programming in unity – intro to unreal engine – UE4 Editor workspace – intro to blueprint programming – programming in Ue4.

BUILDING AR APPLICATION WITH UNITY - AR SDKs for unity and unreal engine – working with SDKs for unity – developing AR application in unity - building AR application. **BUILDING VR APPLICATION WITH UNREAL ENGINE -** VR SDKs for unity and unreal engine – developing VR application in Ue4 – building VR application

Total Hours:	45

Text Books:

1	Steve Aukstakalnis, “Practical Augmented Reality”, Addison-Wesley Professional; 2nd edition 2017.
2	Simon Moore, “Strategic Communication and AI”, Roland Hübscher, Routledge; 1st edition 2022.

Reference Books:

1	Kim Marriott, “Immersive Analytics”, Falk Schreiber, Springer; 1st ed. 2018 edition, 2018.
2	Gerardus Blokdyk, “Immersive Analytics a Clear and Concise Reference”, 5STARCooks, 2018.

Web References:

1	Kelly S. Hale, Kay M. Stanney, “Handbook of Virtual Environments: Design, Implementation, and Applications”, Second Edition (Human Factors and Ergonomics), 2014.

Online Resources:

1	Michael Heim. 1994. The Metaphysics of Virtual Reality. http://doi.org/10.1093/acprof:oso/9780195092585.001.0001
2	Anton Nijholt. 2014. Playful User Interfaces. https://doi.org/10.1007/978-981-4560-96-2

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component**	**FA (16%) [80 Marks]**
C911.1	Understand	Quiz	20
C911.2	Analyse	Assignment /Case Study	20
C911.3	Analyse	Seminar	20
C911.4	Understand		
C911.5	Create	Group Project	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	-	-	-
Understand	20	20	20
Apply	30	30	30
Analyse	50	50	50
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination							
Continuous Assessment (40%) [200 Marks]							**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks				**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**			**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**			**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C911.1	3	2	2		3							1	1		1
C911.2	3	3	3		3							1	3		1
C911.3	3	3	2		3							1	1		1
C911.4	3	2	2		3							1	1		1
C911.5	3	3	3	3	3							3	3	1	3
	3 Strongly agreed				2 Moderately agreed							1 Reasonably agreed			

23ME912	PRODUCT LIFECYCLE MANAGEMENT	3/0/0/3
Nature of Course	Theory	
Pre requisites	-	
Course Objectives:		
1	To acquire knowledge on the principles, best practices, current advancements and applications of Product Life cycle Management.	
2	To study all the aspects of a product's life cycle from "design phase" to "end of life phase".	
3	To understand and experience effective integration of PLM technologies into product development process that provides competitive advantage to industries of various sectors to deliver innovative products.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C912.1	Familiarize with the fundamentals of the product lifecycle and thus acquire the capability to apply them.	[R]
C912.2	Recall the methods and technologies for adopting PLM strategies.	[R]
C912.3	Manage and analyze the challenges in different stages of product development.	[A]
C912.4	Apply the tools/techniques of product life cycle management to industrial problems.	[Ap]
C912.5	Apply digital manufacturing framework in product development process with business considerations.	[Ap]
Course Contents:		
MOTIVATION AND INTRODUCTION: Product Lifecycle -Definition, Need and Overview; Elements; Stages; Corporate Challenges; E-Commerce -B To B, B ToC Forms of Business, Extended Enterprise**,** Product Data Management -CIM Data, PDM Functions, Definition And Architectures Of PDM Systems, Information Flow Model In Product Development, Engineering Bill Of Materials And Manufacturing Bill Of Materials. **PRODUCT DEVELOPMENT PROCESS & METHODOLOGIES:** Integrated Product development process Conceive – Specification, Concept design, Design - Detailed design, Validation and analysis, Concurrent engineering - work structuring and team Deployment, Product Modeling - Definition of concepts - Fundamental issues - Role of Process chains and product models, Value engineering in product design. **Introduction to product design** tools - Computer Aided Design, DFM, DFA, Ergonomics in product design, Product launch & engineering change, Sustainable design. **ENABLING TECHNOLOGIES AND RECENT ADVANCEMENTS:** Business Process Reengineering; Enterprise Resource Planning; Managing a design project; Introduction to Digital Manufacturing; Applications of soft computing in product development process; PLM Softwaresover view;,Use of visuaization in several stages of lifecycle – Case studies.		
	Total Hours	**45**
Text Books:		
1	Uthayan Elangovan, "Product Lifecycle Management (PLM): A Digital Journey Using Industrial Internet of Things (IIoT) ", CRC Press; 1st edition July 9, 2020.	
2	John Stark, "Product Lifecycle Management: 21 Century Paradigm for Product Realisation", 2nd Edition Springer Publisher, 2011.	
3	Grieves Michael, Product Lifecycle Management- Driving the Next Generation of Lean Thinking, McGraw-Hill, 2006.	

Reference Books:	
1	Kevin Roebuck, Product Lifecycle Management (PLM): High-impact Strategies – What You Need to Know: Definitions, Adoptions, Impact, Benefits, Maturity, Vendors, Emereo, 2020.
2	Ohn Stark, Product Lifecycle Management: 21st Century Paradigm for Product Realisation, Springer Publisher, 2020
3	Abele, E. et al., Environmentally-friendly Product Development Methods and Tools, Springer, 2005.
Web References:	
1	http://plmbook.com/
2	www.aberdeen.com
Online Resources:	
1	https://nptel.ac.in/courses/110104070/9
2	https://nptel.ac.in/courses/110/104/110104084/
3	https://nptel.ac.in/courses/112107217/2

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	tTotal	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C912.1	Remember	Quiz	20
C912.2	Remember	Assignment	20
C912.3	Analyze	Project / Lab Tutorial	40
C912.4	Apply		
C912.5	Apply		

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1: [60 Marks]	CIA2: [60 Marks]	
Remember	30	20	20
Understand	50	50	30
Apply	20	20	40
Analyse	-	10	10
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1: 100 Marks			CA 2: 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C912.1	3	3									3			1	
C912.2	3							2			2			2	
C912.3	3	3	3					2			2			2	
C912.4	3							2				3			
C912.5	3				3			2						3	
3	Strongly agreed		2	Moderately agreed			1	Reasonably agreed							

23ME913	COMPOSITE AND SMART MATERIALS	3/0/0/3
Nature of Course	Theory Application	
Pre-Requisites	Metallurgy and Materials Testing	

Course Objectives:		
1	Introduce the concepts of modern composite materials and equip the students with knowledge on fabrication and testing of composites.	
2	To enable them to understand the different types of composite materials, their properties and applications.	
3	To understand the fundamentals of smart materials.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C913.1	Recall the types of composite materials and their characteristic features.	[R]
C913.2	Identify the suitable technique for manufacturing different types of composite materials.	[U]
C913.3	Predict the advances in composite materials and their applications in automotive, aerospace and industrial sectors.	[Ap]
C913.4	Examine the mechanical properties of composites.	[Ap]
C913.5	Discover the principle concepts of smart materials, characteristics and its applications.	[Ap]

Course Contents:

Polymer matrix composites: Understand the concepts of polymer matrix resins thermosetting, thermoplastic-various types of reinforcements used in PMC, merits, demerits and applications of PMC. **PMC manufacturing processes**: Hand layup processes, spray up processes, bag moulding, compression moulding, reinforced reaction injection moulding, resin transfer moulding, pultrusion, filament winding.

Metal matrix composites: Understand the concepts of MMC, types of metal matrix composites, Types of reinforcements used in MMC, merits, demerits and applications of MMC. **Processing of MMC** – Powder metallurgy process - diffusion bonding, stir casting – squeeze casting, friction stir processing, **Ceramic matrix composites:** Understand the concepts of Engineering ceramic materials, ceramic matrix composites, and various types of Ceramic Matrix composites, merits, demerits and applications of CMC. **Processing of CMC**: Sintering - hot pressing, cold isostatic pressing (CIP), hot isostatic pressing - testing of composites as per ASTM standard.

SMART MATERIALS: Electro rheological and magneto rheological Fluids. **Piezoelectric**, Magneto strictive materials, active smart polymer and shape-memory alloy. Material characteristics of smart materials, applications. **Vibration Absorbers** - Parallel damped vibration absorber, gyroscopic vibration absorbers.

	Total Hours:	**45**

Text Books:	
1	Ronald, F. Gibson, “Principles of Composite Material Mechanics”, Fourth Edition, CRC Press, 2020.
2	Daniel Gay “Composite Materials: Design and Applications”, Third Edition, CRC Press, 2015.
3	Srinivasan A V and Michael McFarland, “Smart Structures: Analysis and Design”, Cambridge University Press, UK, 2016.
Reference Books:	
1	Deborah D.L. Chung, “Composite Materials”, Second Edition, Springer, 2020.
2	Nikhilesh Chawla, Krishan K. Chawla, “Metal Matrix Composites”, Second Edition, Springer, 2018.
3	Ricky Peyret, “Smart Materials: Advanced Concepts and Research”, NY Research Press ,2015.

Web References:	
1	https://www.youtube.com/watch?v=VMH6qbED7pg
2	https://www.pnas.org/doi/10.1073/pnas.96.15.8330
Online Resources:	
1	https://nptel.ac.in/courses/112104168/
2	http://nptel.ac.in/courses/101104010/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C913.1	Remember	Quiz	20
C913.2	Understand	Assignment	20
C913.3	Apply	Assignment	20
C913.4		Technical Presentation	20
C913.5			

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	40	30	30
Understand	30	30	30
Apply	30	40	40
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]					End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks		
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)	
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C913.1	3													2	
C913.2	3													2	
C913.3	3	3	3											3	
C913.4	3	3	3											3	
C913.5	3	3	3											3	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

23ME914	ADVANCED MANUFACTURING TECHNIQUES	3/0/0/3
Nature of Course	Theory	
Pre-Requisites	Manufacturing Technology II (with lab)	

Course Objectives:

1	To acquaint the basic concepts and applications of micro and nanomanufacturing processes.
2	To encourage the students for developing the models of micro and nano machining processes.
3	To select an appropriate surface modification technique depending on the need.

Course Outcomes:
Upon completion of the course, students shall have the ability to

C914.1	Recognize the fundamental micro and nano machining processes and their process parameters.	[R]
C914.2	Examine the appropriate machining process based on tool-workpiece interaction and source of energy for the end product.	[A]
C914.3	Discover the advanced finishing processes.	[Ap]
C914.4	Describe the process of surface cleaning techniques, coating methods and property enhancement methods.	[U]
C914.5	Select and use an appropriate deposition technique for various materials.	[Ap]

Course Contents:

Introduction: Fundamentals of micro and nano machining processes - theory of micromachining, micromilling, micro-grinding. Operating principles and process parameters, applications and limitations. EDM and wire cut EDM process – process parameters, surface finish and MRR. **Advanced High Energy processes:** Laser beam machining – plasma arc machining - electron beam machining – principles, equipments, beam control techniques, advantages, disadvantages and applications.

Nano manufacturing processes: General methods of preparation – bottom up, top down approach – Co precipitation – ultrasonication – mechanical milling – **Advanced Finishing process –** Abrasive flow machining, chemo-mechanical polishing, magnetic abrasive finishing, magneto rheological finishing, magneto rheological abrasive flow finishing, working principles, equipments, effect of process parameters. Thermal barrier coating – laser shock peening – nano scale surface hardening. **MEMS and Actuators** - Sensors and actuators, mems, wet and dry etching - surface micromachining, metrology for micro manufactured products.

Surface engineering: Fundamental of surface engineering - surface Cleaning - methods of cleaning - surface coating types –ceramic and plastic coating - economics of coating – physical vapor deposition - chemical vapor deposition- plasma spraying - ion implantation - diffusion coating - boriding and chromizing – cladding - laser gladding- friction stir processing – laser hard facing - micro arc oxidation process – shot peening and ultrasonic shot peening.

Total Hours: 45

Text Books:

1	Anand Pandey, “Modern Machining Processes”, Ane Books Pvt. Ltd., New Delhi, India, 2019.
2	P Pandey and H Shan, “Modern Machining Processes”, McGraw Hill Education, 2017.
3	Peter Martin, “Introduction to Surface Engineering and Functionally Engineered Materials”, Inter science Wiley, 2011.

Reference Books:

1	Golam Kibria, B. Bhattacharyya, J. Paulo Davim, “Non-traditional micro machining processes: Fundamentals and applications”, Springer International publishing, 2017.
2	H. El-Hofy, “Fundamentals of Machining Processes: conventional and non-conventional”, 2nd edition, CRC press, Taylor & Francis group, 2014.

3	Steven Abbott, Nigel Mac Dermid, “Nanocoatings: Principles and Practice: From Research to Production”, DEStech Publications, 2013.

Web References:

1	https://nptel.ac.in/courses/112/107/112107078/
2	https://nptel.ac.in/courses/113/105/113105086/

Online Resources:

1	https://www.udemy.com/course/non-conventional-machining-processes/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom’s Level	Assessment Component	FA (16%) [80 Marks]
C914.1	Remember	Quiz	20
C914.2	Analyse	Assignment	20
C914.3	Apply	Group Assignment	20
C914.4	Understand		
C914.5	Apply	Case Study	20

Assessment based on Summative and End Semester Examination

Bloom’s Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1: [60 Marks]	CIA2: [60 Marks]	
Remember	20	20	20
Understand	40	40	40
Apply	30	30	30
Analyse	10	10	10
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C914.1	3	3												1	
C914.2	3	3	3											3	
C914.3	3	3	2											2	
C914.4	3	3												1	
C914.5	3	3	3											3	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

23ME915	FAILURE ANALYSIS AND NDT TECHNIQUES	3/0/0/3
Nature of Course	Theory Application	
Pre-Requisites	Manufacturing Technology, Industrial Metallurgy, Mechanics of Deformable Solids	

Course Objectives:	
1	To introduce the scope of failure analysis and fundamental sources of failures.
2	To study the different types of failure analysis tool.
3	To examine the students to non-destructive testing methods and basic principles of visual inspection.
4	To examine the students to understand the principle of magnetic testing, radiography testing and inspection techniques.
5	To study the basic principles of ultrasonic and acoustic emission testing method.

Course Outcomes: Upon completion of the course, students shall have ability to		
C915.1	Recall the fundamental concepts of failures in engineering materials.	[R]
C915.2	Infer the types of engineering material failures and analyze its causes.	[An]
C915.3	Apply various failure analysis techniques / tools to appropriate scenario.	[Ap]
C915.4	Summarize the basic concepts of non-destructive testing methods.	[U]
C915.5	Identify and apply suitable non-destructive testing methods to predict surface and sub surface flaws.	[Ap]

Course Contents:

Introduction and need and scope of failure analysis. Engineering disasters and understanding failure analysis. Fundamental sources of failures. Deficient design. Improper manufacturing & assembly. Tree diagram and FMEA. Material failure modes and their identification. Tensile test, static loading, combined stress, principal stresses, theories of failure, fracture processes, meaning of ductile and brittle fracture, fracture mechanics and failure. **Failure Analysis & Tools**: Application of poisson, exponential and weibull distributions for reliability, bath tub curve, parallel and series systems, MTBF, MTTR, FMEA-design process, FMEA, analysis of causes of failure modes, ranks of failure modes; Fault tree analysis; Industrial case studies on FMEA.

Introduction to Non-Destructive Testing: Introduction, visual examination, Basic principle, applications. **Liquid Penetrant Testing**: Procedure for penetrant testing, penetrant testing materials, penetrant testing methods, applications, limitations and standards. **Magnetic Particle Testing:** Principle of magnetic particle testing, magnetizing techniques, procedure used for testing a component, limitations. **Eddy Current Testing:** Principles, instrumentation for eddy current testing techniques, applications, limitations. **Radiographic Testing**: Radiography, radiographic imaging, inspection techniques, applications of radiographic inspection, limitations, safety in industrial radiography, standards, neutron radiography.

Ultrasonic Testing: Basic principle, techniques for normal beam inspection, techniques for angle beam inspection, flaw characterization techniques, advantages, limitations. **Acoustic Emission Testing**: Principle of acoustic emission testing, technique, applications, standards. **Thermograph:** Basic principles, techniques, applications, codes and standards. **In Situ Metallographic Examination:** Approach to the selection of site for metallographic examination, significance of microstructure observation, applications, codes and standards (digital signal process)

Total Hours:	45

Text Books:

1	Fausto Pedro Garcia Marquez, “Non-Destructive Testing”, Intech, 2016.
2	Gilles Corneloup, Cécile Gueudré, Marie-Aude Ploix, “Non Destructive Testing and testability of materials and structures”, The university of chigaco press, 2022.

Reference Books:	
1	ASM Metals Handbook, Non-Destructive Evaluation and Quality Control, American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
2	ASNT, American Society for Non-Destructive Testing, Columbus, Ohio, NDT Handbook, Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol. 7, Ultrasonic Testing.
3	J. Prasad and C. G. K. Nair, "Non-Destructive Test and Evaluation of Materials", Tata McGraw-Hill Education, 2nd edition, 2011.
Web References:	
1	https://www.asminternational.org/learning/courses/online//journal_content/56/10192/1961171/CLASS/
2	https://www.intertek.com/non-destructive-testing/materials-testing/component-failure-analysis-engineering-manufacturing/
Online Resources:	
1	https://onlinecourses.nptel.ac.in/noc21_me14/preview
2	https://onlinecourses.nptel.ac.in/noc20_mm07/preview

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C915.1	Remember	Quiz	20
C915.2	Analyze	Assignment	20
C915.3	Apply	Case study	20
C915.4	Understand	Tutorial	20
C915.5	Apply		

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	10	10	10
Understand	20	20	20
Apply	30	30	30
Analyze	40	40	40
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C915.1	3	2	2	2										2	
C915.2	3	3	2	2										3	
C915.3	3	3	3											3	
C915.4	3	3	2	3										2	
C915.5	3	3	2	3										3	
	3 Strongly agreed						2 Moderately agreed						1 Reasonably agreed		

23ME916	GREEN AND SUSTAINABLE MANUFACTURING	3/0/0/3
Nature of Course	Theory	
Pre requisites	Environmental Science, Manufacturing Technology	
Course Objectives:		
1	To introduce the concept of green and sustainable manufacturing.	
2	To impart knowledge about air, noise and water pollution and its effects on the environment.	
3	To introduce the concept of green co-rating and its need.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C916.1	Elucidate the concept of green and sustainable manufacturing and applying metrics in manufacturing.	[R]
C916.2	Analyze the difficulties in the conventional machining process.	[A]
C916.3	Summarize the manufacturing processes in order to minimize the air, noise and water pollution.	[U]
C916.4	Evaluate green co-rating and its benefits.	[AP]
C916.5	Select the modern approach for sustainable manufacturing.	[R]

Course Contents:

INTRODUCTION TO SUSTAINABLE GREEN MANUFACTURING: Introduction of green factory, sustainability and its relevance, metrics for green manufacturing, modern approaches for sustainable manufacturing, toxic substances in industry and need of renewable sources. **DIFFICULTIES IN CONVENTIONAL MACHINING:** Importance of cutting fluids- health hazard and environmental issues using coolants-coolant selection criteria-motivations behind the use of green machining-concept for productivity improvement-typical measures of affecting productivity.

AIR POLLUTION SAMPLING AND MEASUREMENT: Primary and secondary pollutants- automobile pollutants- industrial pollution- ambient air quality standards-metrological aspects of air pollution. **NOISE POLLUTION AND CONTROL:** Frequency and sound levels-units of noise based power radio- contours of loudness. Effect of human-environment and properties- measuring instruments for frequency and noise levels. **WATER DEMAND AND WATER QUALITY**: Factors affecting consumption- variation- contaminants in water- taste and odour- radio activity in water-criteria for different impurities in water for portable and non-portable use.

GREEN CO-RATING: Ecological footprint - need for green co-rating – green co-rating system, assessment process – types of rating – green co-benefits – case studies of green co rating. **MODERN APPROACHES FOR SUSTAINABLE MANUFACTURING:** Green manufacturing techniques: dry and near-dry machining-edible oil based cutting fluids- cryogenic machining - energy efficiency characterization of manufacturing processes - various instruments used for green machining.

Total Hours:	**45**

Text Books:

1	T E H Graedel, “Industrial Ecology and Sustainable Engineering”, Pearson, 2015.
2	Tang, Sustainable Environmental Engineering”, Wiley, 2018.

Reference Books:

1	Ni-Bin Chang and Ana Pires, “Sustainable Solid Waste Management A Systems Engineering Approach”, Wiley, 2018.
2	Dr. K. Jagannadha Rao, Dr. Srinivas Vasam, “Sustainable Engineering”, S.K. Kataria & Sons, 2021.
3	Bali, Vikram, “Handbook of Sustainable Development Through Green Engineering and Technology”, Hardbound, Taylor and Francis Ltd, 2022.

Web References:	
1	https://www.teslamechanicaldesigns.com/blog/concept-of-green-design-and-manufacturing/
2	https://blog.hexagonmi.com/en/beyond-green-factories-the-power-of-eco-design/
Online Resources:	
1	https://study.com/learn/lesson/green-design-sourcing-manufacturing.html

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C916.1	Remember	Assignment	40
C916.2	Analyze		
C916.3	Understand	Assignment	40
C916.4	Apply		
C916.5	Remember		

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	40	30	30
Understand	40	20	20
Apply	20	20	30
Analyse	-	30	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]				End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks		CA 2 : 100 Marks		
SA 1 (60 Marks)	FA 1 (40 Marks) Component - I (40 Marks)	SA 2 (60 Marks)	FA 2 (40 Marks) Component - I (40 Marks)	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C916.1		2	3	1			3							2	
C916.2		2	3	1			3							2	
C916.3		2	3	1			3							2	
C916.4	1	2	3	1			3	3						2	
C916.5		2	3	1			3							2	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed	

23ME917	ADDITIVE MANUFACTURING	3/0/0/3

Nature of Course	Theory Application
Pre-Requisites	Manufacturing Technology I &II

Course Objectives:

1	To develop skills, ideas and knowledge about additive manufacturing process.
2	To demonstrate liquid, solid and powder based additive manufacturing process.
3	To impart knowledge about additive manufacturing and its wide applications

Course Outcomes:
Upon completion of the course, students shall have ability to

C917.1	Recall the concept of additive manufacturing and post processing	[R]
C917.2	Summarize the reverse engineering, data processing and AM design	[U]
C917.3	Apply the various types of additive manufacturing techniques	[Ap]
C917.4	Use the various AM process parameter effects on response	[Ap]
C917.5	Develop critical parts using various AM technology	[A]

Course Contents:

Introduction to Additive Manufacturing: Overview of AM - scope and need - survey of AM applications. Classification of AM process, AM process chain, reverse engineering – basic concepts, digitization techniques types. **Data Processing for AM:** Conceptualization to build model, AM software's – **AM Design:** Need for Design for Additive Manufacturing (DfAM), CAD tools vs. DfAM tools - generative design technology for developing critical parts - topology optimization. **Post-Processing Techniques:** Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, property enhancements using non-thermal and thermal techniques.

Liquid Based AM Process: Stereo lithography Apparatus, digital light processing, polyjet. **Solid Based AM Process:** Laminated object manufacturing, fused deposition modeling - principle of operation, machine details and variants, materials used, process details, process parameters effect on responses and applications, advantages and disadvantages, case studies.

Powder Based AM Process: Powder Bed Fusion: Selective laser sintering, selective laser melting, electron beam melting, **Directed Energy Deposition:** Laser metal deposition- laser engineered net shaping -direct metal deposition, electron beam based metal deposition, principle of operation, machine details and variants, materials used, process details, process parameters effect on responses and applications, advantages and disadvantages, case studies – research findings of binder jetting technique, friction stir additive manufacturing - wire arc additive manufacturing.

Self-study: Role of AM in I4.0, IIoT AI and ML for AM Systems (not for exam)

Total Hours:	**45**

Text Books:

1	3D Printing Technology, Applications, and Selection By Rafiq Noorani · 2017
2	Additive Manufacturing: Advanced Materials and Design Techniques by Pulak Mohan Pandey 2022.

Reference Books:

1	Duc Pham, S.S. Dimov, "Rapid Manufacturing Technologies and Applications of Rapid Prototyping and Rapid Tooling", 2012
2	Gibson, Ian, David W. Rosen, Brent Stucker, and Mahyar Khorasani, "Additive Manufacturing Technologies", Springer, 2021.

Web References:

1	https://www.youtube.com/watch?v=NkC8TNts4B4

2	https://www.youtube.com/watch?v=t7yv4gSnNkE&list=PLwdnzlV3ogoWI8QEu4hsT-n_r8UbWbquy
Online Resources:	
1	https://nptel.ac.in/courses/112107077/382
2	https://nptel.ac.in/courses/112107078/37
3	https://www.coursera.org/learn/additive-manufacturing-3d-printing

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C917.1	Remember	Assignment	40
C917.2	Understand		
C917.3	Apply	Hands on experience – AM process and Project Work (Print a Part and appraise the response)	40
C917.4	Apply		
C917.5	Analyze		

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	30	20	20
Understand	40	30	30
Apply	30	30	30
Analyze	-	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]				End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks		CA 2 : 100 Marks		
SA 1 (60 Marks)	FA 1 (40 Marks) Component - I (40 Marks)	SA 2 (60 Marks)	FA 2 (40 Marks) Component - I (40 Marks)	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

Cos	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C917.1	3	1	1		1										
C917.2	3	1	1		1										
C917.3	3	1	1		2									1	
C917.4	3	1	1		2									3	
C917.5	3	3	3		3								3	3	3

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

23ME918	DESIGN FOR MANUFACTURING AND ASSEMBLY	3/0/0/3

Nature of Course	Theory Application
Pre-Requisites	Manufacturing Technology II

Course Objectives:

1	To enable the students to understand the general design guidelines of design for manufacture and assembly.
2	To provide the knowledge on minimizing the design cost/time, maximizing the quality and improve ease of manufacture and assembly.
3	To enable the students to understand the principles and design rules pertaining to design for casting, welding, machining and assembly.
4	To outline the features of DFMA software.

Course Outcomes:
Upon completion of the course, students shall have ability to

C918.1	Summarize the design procedure of engineering products in order to minimize the cost/time.	[U]
C918.2	Analyse the importance of tolerance and process capability in promoting interchangeability and selective assembly.	[A]
C918.3	Analyze the design process of engineering products for ease of assembly.	[A]
C918.4	Apply the design concepts for engineering products for casting, welding and machining operations.	[Ap]
C918.5	Study the design parameters of a product using DFMA software.	[U]

Course Contents:

DFMA Introduction: Engineering design – kinds of design – design process steps – factors influencing design – concurrent engineering – manufacturing process and material selection – evaluation methods for material selection. Tolerance analysis: Process capability analysis – cumulative effect of tolerances – centrality analysis – compound assembly – selective and interchangeable assembly – grouped datum systems.

Design for casting, welding and machining: Design considerations for sand cast – die cast – permanent mold cast parts, arc welding – design considerations for cost reduction – minimizing distortion – weld strength – weldment & heat treatment. resistance welding – design considerations for spot – seam – projection – flash & upset weldment, design considerations for turned parts – drilled parts – milled, planed, shaped and slotted parts– ground parts.

Design for welding and DFMA software: Design for assembly – general assembly recommendations – minimizing the no. of parts – design considerations for: rivets – screw fasteners – gasket & seals – press fits – snap fits – automatic assembly, advances in DFMA-Design for robustness– computer aided DFA using software.

Total Hours:	45

Text Books:

1	Matousek, R. “Engineering Design” Blackie and Son Limited, Glasgow, 2018.
2	Dieter, G.E. “Engineering Design: A Materials and processing Approach”, McGraw Hill Co. Ltd, 5th edition, 2012.

Reference Books:

1	Eggert, R.J. “Engineering Design” Pearson Education, Inc. New Jersey, 2014.
2	Peck, H. “Designing for Manufacture”, Pitman Publications, London, 2013.
3	Kalandar Saheb, S.D and Prabhakar, O. “Engineering Design for Manufacture”, ISPE 2014.
4	Geoffrey Boothroyd, Peter Dewhurst and Winston Knight, “Product design for manufacture and assembly”, Second edition, Taylor and Francis, 2015.

Web References:

1	www.dfma.com

2	https://engineeringproductdesign.com/knowledge-base/design-for-manufacture-and-assembly/
Online Resources:	
1	www.nptel.ac.in/courses/107103012
2	www.mjme.ir-International journal of advanced design and manufacturing

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	**Bloom's Level**	**Assessment Component**	**FA (16%) [80 Marks]**
C918.1	Understand	Class presentation	20
C918.2	Analyze		
C918.3	Analyze	Assignment	40
C918.4	Apply		
C918.5	Understand	Case study using DFMA software	20

Assessment based on Summative and End Semester Examination

Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	20	20	20
Apply	30	30	30
Analyse	20	20	20
Evaluate	10	10	10
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]					**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**		
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**	
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (40 Marks)**	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C918.1	3	2	2	2										3	
C918.2	3	3	3	2										2	
C918.3	3	3	3	3										2	
C918.4	3	2	2	3										3	
C918.5	3	2	3	3	3							1		2	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

23ME919	POWER PLANT ENGINEERING	3/0/0/3

Nature of Course	Theory application
Pre-Requisites	Engineering thermodynamics and Thermal engineering

Course Objectives:

1	To provide a general perspective of power plant engineering, indicating the role of mechanical engineers in their operation and maintenance.
2	To understand the construction, working principles and advantages of thermal, gas turbine, steam turbine, hydro, diesel and nuclear power plants.
3	To create awareness about renewable energy, tariff calculation and economics of various power plants.

Course Outcomes:
Upon completion of the course, students shall have ability to

C919.1	Recall the various techniques used for power generation.	[R]
C919.2	Describe the functioning of components in steam power plant.	[U]
C919.3	Sketch the design layout and explain the working of diesel, gas turbine, hydroelectric and nuclear power plants.	[Ap]
C919.4	Identify the ways to extract power from renewable/ non-conventional energy sources.	[Ap]
C919.5	Analyze the economic feasibility and its implications on power generating units.	[A]

Course Contents:

Coal based thermal power plant: Components and layout, boiler classification – types of boiler – fire tube and water tube boilers - high pressure and supercritical boilers – positive circulation boilers - fluidized bed boilers – waste heat recovery boiler – feed water heaters – super heaters – reheaters – economiser – air heaters, coal handling and preparation – combustion equipment and firing methods – mechanical stokers – pulverized coal firing systems, ash handling systems, electrostatic precipitator, feed water treatment, forced draft and induced draught, surface condenser, cooling tower – types - induction technology.

Diesel power plant: Components and layout, selection of engine type, starting and stopping – heat balance – supercharging of diesel engines. **Nuclear power plant**: Principles of nuclear energy – energy from fission and fuel burnup – decay rates and half-lives – nuclear reactor – types – boiling water reactor – pressurized water reactor – fast breeder reactor – reactor materials – radiation shielding. **Gas turbine power plant**: Components and layout, open and closed cycles – intercooling – reheating and regenerating – combined cycle power plant.

Non-conventional energy based power plant: Hydro power plant: Classification of hydro-electric power plants – selection of prime movers – governing of turbines - construction and working of wind, tidal, solar photo voltaic, geothermal, biogas and ocean thermal energy conversion power plants. economics of power plant: actual load curves – cost of electric energy - fixed and operating costs - energy rates – types of tariffs – energy management and energy audit - economics of load sharing – variable load operation – comparison of economics of various power plants.

Total Hours:	45

Text Books:

1	Prof. Sudipta De, “Nag’s Power Plant Engineering”, McGraw Hill, 5th Edition, 2021.
2	P.K. Nag, “Power Plant Engineering”, McGraw – Hill Education, Fourth Edition, 2017.

Reference Books:

1	Dipak Kumar Mandal, Somnath Chakrabarti, Arup Kumar Das, Prasanta Kumar Das, “Power Plant Engineering: Theory and Practice”, Wiley, 2019.
2	R. Yadav, “Fundamentals of Power Plant Engineering (Conventional and Non-conventional) An Innovative Approach”, 2nd Edition, IK International Publishing House Pvt Ltd, 2022.

3	P.K Das, A.K Das, "An Introduction to Thermal Power Plant Engineering and Operation", 1st Edition, 2018.
Web References:	
1	https://www.academia.edu/28181314/Power_Plant_Engineering
2	https://link.springer.com/book/10.1007/978-1-4613-0427-2
Online Resources:	
1	https://archive.nptel.ac.in/courses/112/107/112107291/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C919.1	Remember	Quiz	20
C919.2	Understand	Assignment	20
C919.3	Apply	Group Assignment	20
C919.4	Apply	Case Study / Seminar	20
C919.5	Analyze		

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	20	20
Understand	30	30	30
Apply	40	40	40
Analyse	10	10	10
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C919.1	3	3	1											1	
C919.2	3	2	1											2	
C919.3	3	3	3											2	
C919.4	3	3	3			3	3	3						2	
C919.5	3	2	1								3				

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed	

23ME920	BIOENERGY CONVERSION TECHNOLOGIES	3/0/0/3
Nature of Course	Theory Technology	
Pre-Requisites	Engineering Thermodynamics Thermal Engineering	

Course Objectives:	
1	To understand the biomass, types, availability, and characteristics
2	To study the bio-methanation process.
3	To impart knowledge on combustion of biofuels
4	To describe the significance of equivalence ratio on thermochemical conversion of biomass
5	To provide insight on the possibilities of producing liquid fuels from biomass

Course Outcomes: **Upon completion of the course, students shall have ability to**		
C920.1	Study the surplus biomass availability of any given area.	[U]
C920.2	Analyze the biogas plant required for variety of biofuels.	[A]
C920.3	Determine and compare the cost of steam generation from biofuels with that of coal and petroleum fuels.	[U]
C920.4	Analyse the influence of governing parameters in thermochemical conversion of biomass.	[A]
C920.5	Evaluate the properties of Synthesize liquid biofuels used for power generation.	[Ap]

Course Contents:

Introduction and Biomethenation: Biomass types – advantages and drawbacks – typical characteristics – proximate & ultimate analysis – comparison with coal - Indian scenario - carbon neutrality – biomass assessment studies – typical conversion mechanisms - densification technologies, Biomethenation process – influencing parameters – typical feed stocks – biogas plants: types and design.

Combustion and Application: Perfect, complete and incomplete combustion – stoichiometric air requirement for biofuels - equivalence ratio – fixed Bed and fluid Bed combustion, Biogas appliances – burner, luminaries and power generation systems – Industrial effluent based biogas plants.

Gasification and Liquified Biofuels: Chemistry of gasification - types – comparison – typical application – performance evaluation – economics. Pyrolysis - Classification - process governing parameters – Typical yield rates. Carbonization – merits of carbonized fuels – techniques adopted for carbonisation-Straight Vegetable Oil (SVO) as fuel - Biodiesel production from oil seeds, waste oils and algae - Process and chemistry - Biodiesel Vs. Diesel – comparison on emission and performance fronts. Production of alcoholic fuels (methanol and ethanol) from biomass – engine modifications.

Total Hours:	45

Text Books:	
1	Nidhi Adlakha, Rakesh Bhatnagar, Syed Shams Yazdani, “Biomass for Bioenergy and Biomaterials”, CRC Press, 2021.
2	Augustine O. Ayeni, Samuel Eshorame Sanni, Solomon U. Oranusi, “Bioenergy and Biochemical Processing Technologies”, Springer, 2022.

Reference Books:	
1	M. Moo-Young, J. Lamptey, B. Glick, “Biomass Conversion Technology: Principles and Practice”, Pergamon 1st edition, 2013.
2	Iyer PVR et al, Thermochemical Characterization of Biomass, M N E S
3	Pratima Bajpai, “Biomass to Energy Conversion Technologies: The Road to Commercialization”, Elsevier Science, 2019.
4	Sergio Capareda, “Introduction to Biomass Energy Conversions”, CRC Press, 2013.

Web References:	
1	https://www.intechopen.com/chapters/73832
2	https://www.energy.gov/eere/bioenergy/conversion-technologies
Online Resources:	
1	https://onlinecourses.nptel.ac.in/noc22_ch28/preview
2	https://onlinecourses.nptel.ac.in/noc19_bt16/preview

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C920.1	Understand	Group Assignment	20
C920.2	Analyze	Presentation	20
C920.3	Understand		
C920.4	Analyze	Individual Assignment	20
C920.5	Appply	Case Study	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	20	20
Understand	40	40	40
Apply	30	30	30
Analyse	10	10	10
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]					End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks		
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)	
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C920.1	3						3		1						
C920.2	2	3	2			2	2								
C920.3	2	3	2	2			1							2	
C920.4	2	2	2	3			1							2	
C920.5	2	2	3	2										1	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

23ME921	GAS DYNAMICS AND JET PROPULSION	3/0/0/3
Nature of Course	Theory analytical	
Pre-Requisites	Engineering Thermodynamics and Thermal Engineering	

Course Objectives:

1	To understand the basic difference between incompressible and compressible flow.
2	To analyse the phenomenon of shock waves and its effect on flow.
3	To gain basic knowledge about jet propulsion.

Course Outcomes:
Upon completion of the course, students shall have ability to

C921.1	Study the behavior of various flow regimes.	[U]
C921.2	Assess the properties of fluid while the fluid flows under different conditions.	[Ap]
C921.3	Analyse the flow behavior and consequent loads due to flow.	[A]
C921.4	Analyse the shock in flows.	[A]
C921.5	Estimate propulsion efficiency and design inlets and nozzles.	[E]

Course Contents:

Compressible flow fundamentals: Energy and momentum equations for compressible fluid flows, various regions of flow, reference velocities, stagnation state, velocity of sound, critical states, Mach number, (significance and characteristics) critical Mach number, Types of waves, Mach cone, Mach angle, effect of Mach number on compressibility. **Flow through variable area ducts:** Isentropic flow through variable area ducts, T-s, h-s diagrams for nozzles & diffusers, Mach number variation, area ratio as a function of Mach number, mass flow rate through nozzles & diffusers, effect of friction in flow through nozzles, choking.

Fanno and Rayleigh flow: Flow in constant area ducts with friction (Fanno flow) - Fanno curves and Fanno flow equation, variation of flow properties, variation of Mach number with duct length. Isothermal flow with friction in constant area ducts, flow in constant area ducts with heat transfer (rayleigh flow), rayleigh line and rayleigh flow equation, variation of flow properties.

Normal shock: Governing equations, variation of flow parameters like static pressure, static temperature density, stagnation pressure and entropy across the normal shock, prandtl-meyer equation, impossibility of shock in subsonic flows, flow in convergent and divergent nozzles with shock, normal shock in fanno and rayleigh flows. flow with oblique shock (elementary treatment only), the shock tube. **Jet and Space propulsion:** Aircraft propulsion, types of jet engines, energy flow through jet engines, study of turbojet engine, performance of turbo jet engines thrust and thrust power, propulsive and overall efficiencies. Types of rocket engines and propellants.

Total Hours:	45

Text Books:

1	Yahya. S.M., “Fundamental of Compressible Flow”, New Age International (p) Ltd., New Delhi, 2018
2	Patrich.H. Oosthvizen, William E.Carscallen, “Compressible Fluid Flow”, McGrawHill Education, 2017.

Reference Books:

1	Cohen. H., Rogers R.E.C and Sravanamutoo, “Gas Turbine Theory”, Addison Wesley Ltd., 2016.
2	Ganesan. V., “Gas Turbines”, McGraw-Hill Education, New Delhi, 2015.
3	Balachandran.P, “Fundamentals of Compressible Fluid Dynamics”, Prentice Hall of India, New Delhi, 2018.

Web References:

1	http://www.grc.nasa.gov/WWW/K-12/airplane/bgp.html
2	https://ocw.mit.edu/search/ocwsearch.htm?q=gas%20dynamics

Online Resources:

1	https://nptel.ac.in/courses/112106166/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C921.1	Understand	Quiz	20
C921.2	Apply	Group Assignment	20
C921.3	Analyze	Case Study	20
C921.4			
C921.5	Evaluate	Assignment	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	10	10	10
Understand	20	10	10
Apply	40	40	40
Analyse	30	30	30
Evaluate	-	10	10
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%)[200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C921.1	2	3	1											1	
C921.2	3	3	2											2	
C921.3	3	3	2											2	
C921.4	3	3	3											2	
C921.5	3	3	3											3	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed	

23ME922	HEATING, VENTILATION AND AIR-CONDITIONING SYSTEMS	3/0/0/3

Nature of Course	Theory application
Pre-Requisites	Engineering thermodynamics and Thermal engineering

Course Objectives:

1	To provide a general perspective of heating, ventilation and air-conditioning system, indicating the role of mechanical engineers in their operation and maintenance.
2	To understand the construction and working principle of sensors and auxiliary devices, electric controls and pneumatic controls.
3	To create awareness about various control systems in sequence of operation of HVAC.

Course Outcomes:
Upon completion of the course, students shall have ability to

C922.1	Recall the various techniques used for air-conditioning systems.	[R]
C922.2	Describe the functioning of components in air-conditioning systems.	[U]
C922.3	Sketch the design layout and explain the working of AC circuits, variable speed drives, valves and dampers	[Ap]
C922.4	Identify the accuracy, range and reliability of various sensors used in the HVAC systems.	[Ap]
C922.5	Analyze the water vapor, relative humidity and temperatures in the HVAC system.	[A]

Course Contents:

Introduction to HVAC Control Systems: Need of controls, brief history of controls, control loops, control modes - two-position control, floating control, modulating control, pulse-width modulating, and time-proportioning control, gains and loop tuning, control actions and normal position, control range and sequencing, controls documentation, maintenance and operations.

Basics of Electricity: Simple circuits and ohm's law, ac circuits, transformers and power services, relays, motors and motor starters, variable speed drives. **Control Valves and Dampers:** Two-way control valves styles and principles of operation, three-way control valves, selecting and sizing valves, flow characteristic selection, close-off pressure, control dampers, styles and principles of operation, selecting and sizing dampers.

Sensors and Auxiliary Devices: Accuracy, range, reliability, repeatability, precision, transmitter, temperature sensors – bimetal, fluid expansion, electrical, self-powered, electrical resistance, humidity and the psychrometric chart, relative humidity, moisture sensors, relative humidity sensors, pressure sensors, flow sensors and meters, auxiliary devices. heating and cooling load calculation.

Total Hours:	45

Text Books:

1	Chris P. Underwood, "HVAC Control Systems: Modelling, Analysis and Design", Routledge Publisher, 2022.
2	N C Gupta, "Comprehensive HVAC System Design", Narosa Book Distributors Pvt Ltd, 2020.

Reference Books:

1	Shankar Kumar Chatterjee, "A Practical Approach to Air Conditioning and Refrigeration", Notion Press, 2022.
2	Carter Stanfield, David Skaves, "Fundamentals of HVACR", Pearson Education, 2021.
3	John W. Mitchell, James E. Braun, "Principles of Heating, Ventilation, and Air Conditioning in Buildings, Wiley, 2020.

Web References:

1	http://www.digimat.in/nptel/courses/video/112107208/L35.html
2	https://www.digimat.in/nptel/courses/video/112105128/L13.html

Online Resources:	
1	https://archive.nptel.ac.in/courses/112/105/112105129/
2	https://brennanheating.com/how-does-hvac-system-work/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C922.1	Remember	Quiz	20
C922.2	Understand	Assignment	20
C922.3	Apply	Group Assignment	20
C922.4	Apply	Case Study / Seminar	20
C922.5	Analyze		

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	20	20
Understand	30	30	30
Apply	40	40	40
Analyse	10	10	10
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C922.1	3	2	2											1	
C922.2	3	2	2											2	
C922.3	3	3	3											2	
C922.4	3	3	3											2	3
C922.5	3	3	3											2	

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed	

23ME923	RENEWABLE ENERGY TECHNOLOGIES	3/0/0/3

Nature of Course	Theory.
Pre Requisites	Thermodynamics, Fluid Mechanics, Heat and Mass Transfer.

Course Objectives:

1	To understand and analyze the patterns of renewable energy resources and its environmental merits
2	To discuss technologies for utilization of renewable energy sources.
3	To enable the students to understand the various economics involved in the utilization of renewable energy sources.

Course Outcomes:
Upon completion of the course, students shall have ability to

C923.1	Recall the various sources of energy.	[R]
C923.2	Elucidate the various means of utilizing the solar energy resources.	[U]
C923.3	Infer the impact of Wind energy resources on the environment.	[Ap]
C923.4	Analyze the scope of ocean energy, geothermal energy, Biomass and their application.	[A]
C923.5	Analyze the new energy sources like OTEC energy, MHD energy.	[A]

Course Contents:

Role and potential of renewable source , Renewable energy sources – types , energy the solar energy option– solar cells – pv systems, solar thermal collectors – flat plate and concentrating collectors – solar applications – fundamentals of photo voltaic conversion, **Solar radiation:** Availability, measurement and estimation, introduction to solar collectors flat, plate collectors, air heater and concentrating collectors and thermal storage, solar pond, solar refrigeration, solar water heating systems - active and passive, passive heating and cooling of buildings, solar distillation, solar drying.

Energy available from wind, Basis of wind energy conversion, general formula, lift and drag, effect of density, angle of attack, wind energy generators and its performance – wind energy storage – **Applications** – Hybrid systems – state of the art technology trends for offshore wind energy operation, biomass, biogas, source, composition, raw materials, properties of bio gas, bio diesel production and economics. principle of **ocean thermal energy conversion**, tidal energy – data, technology options, offshore and onshore wave energy conversion machines.

Power plants based on ocean energy, Problems associated with ocean thermal energy conversion systems – Open and closed OTEC Cycles – small hydro turbines, **Geothermal energy sources**, power plant and environmental issues – potential in India. **Hydrogen**, generation, storage, transport and utilization, Fuel cells – technologies, types – economics and the power generation - **Magneto-hydro-dynamic** (MHD) energy conversion. Fuel from sea – concept.

Total Hours: 45

Text Books:

1	S.P.Sukhatme-Solar Energy:Principles of Thermal Collection and Storage, Tata McGraw-Hill (2016).
2	A G.D. Rai, Non-Conventional Energy Sources, Khanna Publishers, New Delhi, 2011.

Reference Books:

1	F.A.Duffie and W.A.Beckman-Solar Engineering of Thermal Processes-John Wiley 2015.
2	E.G.N. Tiwari, Solar Energy – Fundamentals Design, Modelling& applications, Narosa Publishing House, New Delhi, 2012.
3	C. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K., 2012.

Web References:

1	https://www.nrdc.org/stories/renewable-energy-clean-facts#sec-whatis

2	https://www.energy.gov/eere/renewable-energy
Online Resources:	
1	https://www.coursera.org/courses?query=renewable%20energy
2	https://www.renewableinstitute.org/training-courses/

Formative Assessment	Summative Assessment	Total	Total Continuous Assessment	End Semester Examination	Total
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C923.1	Remember	Quiz.	20
C923.2	Understand	Assignment.	20
C923.3	Apply	Group Assignment.	20
C923.4 C923.5	Analyse	Case study.	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	10	20
Understand	20	30	20
Apply	30	30	30
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]					End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks		
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)	
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C923.1	3														
C923.2	3		2	2											
C923.3	3	2		3		3	3								
C923.4	3														
C923.5	3		2									3			

	3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed	

23ME924	ENERGY STORAGE DEVICES AND THERMAL MANAGEMENT OF BATTERIES	3/0/0/3

Nature of Course	THEORY
Pre Requisites	Heat Transfer and Thermal Machines

Course Objectives:

1	To study the various types of energy storage devices and technologies used for building them.
2	To have an insight about different types of batteries.
3	To learn the vital components of thermal management systems used in various Electric Vehicles.

Course Outcomes:
Upon completion of the course, students shall have ability to

C924.1	Paraphrase the working of various energy storage devices and their importance.	[U]
C924.2	Elucidate the basic characteristics of batteries for mobile and hybrid systems.	[U]
C924.3	Choose the different types of Batteries.	[AP]
C924.4	Evaluate a Battery pack with appropriate PCM.	[A]
C924.5	Analyze different thermal management systems used in E-vehicles.	[A]

Course Contents:

INTRODUCTION TO ENERGY STORAGE-Need for energy storage – types of energy storage – various forms of energy storage – mechanical–thermal - chemical– electrochemical – electrical. **ENERGY STORAGE SYSTEMS** Batteries – types-charging and discharging – battery testing and performance, batteries for electric vehicles - battery specifications for cars, superconducting magnetic energy storage (SMES), tesla model S- 18650 cell specifications, P85 battery pack, texas instruments battery management system, super capacitors, diamond battery concepts.

THERMAL MANAGEMENT IN BATTERIES- Thermal management systems- impact, types- air, liquid, direct refrigerant, heat pipe, thermo electric, phase change material cooling methods. solid-liquid PCM types- organic, inorganic, eutectics. PCM thermal properties and applications. Tesla model-S battery module- bonding techniques, thermal management.

BATTERY THERMAL MANAGEMENT CASE STUDIES- EV battery cooling- challenges and solutions. heat exchanger design and optimization model for EV Batteries using PCMs- system set up, selection of PCMs. chevrolet volt model battery thermal management system- case study. Modelling liquid cooling of a Li-Ion battery pack with COMSOL multiphysics- simulation concepts.

Total Hours:	**45**

Text Books:

1	Rober Huggins, “Energy Storage: Fundamentals, Materials and Applications”, 2nd Edition, Springer, 2015.
2	Ibrahim Dinçer, Halil S. Hamut, and Nader Javani, “Thermal Management of Electric Vehicle Battery Systems’’, Wiley, 2017.

Reference Books:

1	“Vehicle thermal Management Systems Conference Proceedings”, 1st Edition; 2013, Coventry Techno centre, UK.
2	Jerry Sergent, Al Krum, “Thermal Management Handbook: For Electronic Assemblies Hardcover”, 2007, Mc Graw- Hill.
3	Younes Shabany,” Heat Transfer: Thermal Management of Electronics Hardcover” 2010, CRC Press.

Web References:

1	https://energystorage.org/why-energy-storage/technologies/
2	https://www.techtarget.com/whatis/definition/battery-management-system-BMS

Online Resources:	
1	https://www.coursera.org/lecture/21st-century-energy-transition/energy-storage-U5WyJ
2	https://www.coursera.org/learn/battery-management-systems

Formative Assessment	Summative Assessment	Total	Total Continuous Assessment	End Semester Examination	Total
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C924.1	Understand	Assignment.	20
C924.2	Understand	Quiz.	20
C924.3	Apply	Group Assignment.	20
C924.4 C924.5	Analyse	Case study.	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	20	20
Understand	30	30	30
Apply	30	30	30
Analyse	20	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]					End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks		
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)	
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C924.1	3	3	2				3					1			
C924.2	3	1	1									1			
C924.3	3	3	1									2			
C924.4	3	2										3			3
C924.5	3	2	3									3			2

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed	

Open Elective

23ME001	INDUSTRIAL SAFETY	3/0/0/3
Nature of Course	Theory	
Pre-Requisites	Nil	
Course Objectives:		
1	To enable students to understand the basic Industrial safety engineering acts and rules.	
2	To impart knowledge on OSHAS (Occupational Safety and Health Assessment Series) in engineering Industry.	
3	To enable the students to identify the causes of accidents and its preventions.	
4	To train students to identify hazard and assess the risks using suitable techniques.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C001.1	Identify the evolution of industrial safety acts, rules and health standards.	[R]
C001.2	Summarize different safety management activities in industry.	[U]
C001.3	Prepare accident investigation report and preventive guidelines to industry.	[Ap]
C001.4	Analyze the process to avoid, prevent and control workplace hazards.	[A]
C001.5	Analyze the role of government agencies and private consulting agencies in safety training.	[A]

Course Contents:

BASICS OF SAFETY ENGINEERING & ACTS: Evolution of modern safety concept – safety audit; Acts– factories act– 1948–statutory authorities–inspecting staff–Tamil Nadu factories Rules 1950 under safety and health – environment act 1986 – air act 1981, water act 1974 – labour laws; safety in industries – general safety concepts, machine guarding, hazards in metal removing process, Hazardous Wastes (management, handling and Transboundary Movement) Rules 2016, check list for LPG installations, safety precautions using CNG. Introduction to OHSAS 18000 and 14000, National Disaster Management Act.

SAFETY MANAGEMENT: History of Safety movement – general concepts of management – planning for safety for optimization of productivity -productivity, quality and safety-line staff functions for safety -budgeting for safety - safety policy. Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling. Fire Explosion and toxicity Index. ACCIDENT INVESTIGATION AND REPORTING: Concept of an accident, reportable and non-reportable accidents, unsafe act and condition – principles of accident prevention, Supervisory role- Role of safety committee – Accident causation models - Cost of accident. Overall accident investigation process-Response to accidents, India reporting requirement, Planning document, Planning matrix, Investigators Kit, functions of investigator, four types of evidences, Records of accidents - Class exercise with case study.

SAFETY PERFORMANCE MONITORING: Reactive and proactive monitoring techniques - Permanent total disabilities, permanent partial disabilities, temporary total disabilities Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety “t” score, safety activity rate. SAFETY EDUCATION AND TRAINING: Importance of training – identification of training needs – training methods – programme, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training– creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training, Evaluating Employee’s training Performance.

Total Hours:	**45**

Text Books:	
1	Charles D. Reese “Occupational Health and Safety Management: A Practical Approach”, 3rd Edition CRC press 2017
2	Mark A. Friend, James P. Kohn “Fundamentals of Occupational Safety and Health” 6th Edition Bernan press, 2016.
3	Krishnan N.V., “Safety Management in Industry”, Jaico Publishing House, Bombay, 2016.
Reference Books:	
1	Joel M. Haight, “Principles of Industrial Safety”, ASSE publishers, 2017
2	R.K.Mishra, “Safety Management”, AITBS publishers,2022
3	Relevant India Acts and Rules, Government of India, 2020
4	C. Ray Asfahl, David W. Rieske “Industrial Safety and health management”, Practice,7th Edition, Pearson,2021
Web References:	
1	https://nptel.ac.in/courses/110105094
Online Resources:	
1	https://www.shiksha.com/online-courses/industrial-safety-courses-certification-training-st575-tg1307
2	https://alison.com/courses?query=industrial%20safety
3	http://dce.mst.edu/credit/certificates/safetyengineering

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom’s Level	Assessment Component	FA (16%) [80 Marks]
C001.1	Remember	Quiz	20
C001.2	Understand	Assignment	20
C001.3	Apply	Technical Seminar	20
C001.4	Analyze		
C001.5	Analyze	Case study	20

Assessment based on Summative and End Semester Examination

Bloom’s Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	30	10	30
Understand	40	40	30
Apply	30	40	30
Analyze	-	10	10
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination							
Continuous Assessment (40%) [200 Marks]							End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks				CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)			SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)			Component - I (20 Marks)	Component - II (20 Marks)	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)												
Cos	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
C001.1	3		2			2		2				
C001.2	3		2			2		1				
C001.3	3	2				3		3				
C001.4	3	2				3		3				
C001.5	3	2				3		3				

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

23ME002	FUNDAMENTALS OF MEMS/NEMS	3/0/0/3

Nature of Course	Theory
Pre requisites	Nil

Course Objectives:

1	To encourage the students to learn various techniques available to make micro shapes using various materials.
2	To impart the methodologies to be followed in micro fabrication and forming.
3	To enhance the students knowledge about MEMS / NEMS devices and their applications.

Course Outcomes:
Upon completion of the course, students shall have ability to

C002.1	Recall the basic concepts related to MEMS / NEMS.	[R]
C002.2	Interpret the various fabrication techniques and micro machining processes for MEMS / NEMS.	[U]
C002.3	Apply various fabrication techniques to develop a MEMS / NEMS System.	[Ap]
C002.4	Analyse the characteristics of MEMS and NEMS devices.	[A]
C002.5	Recall the principles and applications of MEOMS	[R]

Course Contents:

INTRODUCTION TO MEMS/NEMS: Introduction – MEMS vs NEMS - Evolution of Micro-sensors and MEMS - Mechanical, Inertial, Biological, Chemical, Acoustic, Microsystems Technology, Integrated Smart Sensors and MEMS, Interface Electronics for MEMS, MEMS Simulators, MEMS for RF Applications, Bonding & Packaging of MEMS. Introduction to NEMS – a journey from MEMS to NEMS - Nano-mechanical Resonators, Nano-mechanical Sensors. NEMS architecture, Surface Plasmon effects **LITHOGRAPHY:** Introduction - Photolithography-Overview to Critical Dimension and Lithographic Sensitivity Photolithography Resolution - Enhancement Technology Beyond Moore's Law Next Generation – Emerging Lithography Technologies.

ADDITIVE TECHNOLOGY: Introduction –Silicon Growth - Si Doping - Oxidation of Silicon-Physical Vapor Deposition - Chemical Vapor Deposition- Silk-Screening or Screen-Printing - Sol-Gel Deposition Technique. Plasma Spraying - Deposition and Arraying Methods of Organic Layers in BIOMEMS and BIONEMS - Thin versus Thick Film Deposition - Selection Criteria for Deposition Method. Nanofabrication with EBL & IBL.

MINIATURIZATION TECHNIQUES Introduction - Absolute and Relative Tolerance in Manufacturing - Introduction to Top-Down Manufacturing Methods and Bottom-Up Approaches, Silicon on Insulator Technology (SOI). Micromachining: Bulk Micromachining - Surface Micromachining - Dry Micromachining - New MEMS materials Introduction- Modelling, Brains in Miniaturization- Packaging, Substrate Choice. **MINIATURIZATION APPLICATIONS**: Introduction - Scaling, Actuators, Fluidics- Scaling in Analytical Separation Equipment- Other Actuators - Integrated Power miniaturization applications- Introduction - Definitions and Classification Method – MOEMS – Principles and Applications to Automotive, Telecom and Biomedical.

Total Hours:	**45**

Text Books:

1	Tai-Ran-Hsu, “MEMS & Microsystems: Design and Manufacture”, McGraw Hill, 17th Reprint, 2017.
2	Eun Sok Kim, “Fundamentals of Microelectromechanical Systems (MEMS)”, 1st Edition, 2021.

Reference Books:	
1	V.K. Jain, “Micromanufacturing Processes”, CRC Press, 2016.
2	Marc J Madou, “Fundamentals of Microfabrication and Nanotechnology”, CRC Press, 2011.
3	Chang Liu, “Foundations of MEMS”, Pearson education India limited, 2nd Edition, 2011.
Web References:	
1	https://youtu.be/ZcCXFrHQ7Ao/Introduction to Materials Science for MEMS and NEMS
Online Resources:	
1	MEMS and Microsystems - https://nptel.ac.in/courses/117105082/
2	https://www.coursera.org/learn/MEMS/NEMS

Summative assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%)						**End Semester Examination (60 %)**
CA 1 (20 Marks)			**CA 2 (20 Marks)**			**Theory Examination (60 Marks)**
SA 1 (12 Marks)	**FA 1**		**SA 2 (12 marks)**	**FA 2**		
	Component -I (20 marks)	**Component –II (20 marks)**		**Component -I (20 marks)**	**Component –II (20 marks)**	

Assessment Methods & Levels (based on Blooms’ Taxonomy)			
Formative assessment based on Capstone Model (16%)			
Course Outcome	**Bloom’s Level**	**Assessment Component**	**Marks**
C002.1	Remember	Assignment	20
C002.2/C002.5	Understand	Objective type Quiz	20
C002.3	Apply	Technical Presentation	20
C002.4	Analyse	Group Assignment	20

Summative assessment based on Continuous and End Semester Examination			
Bloom’s Level	**Continuous Assessment (24%)**		**End Semester Examination (60%) [60 Marks]**
	CIA1 [12 Marks]	**CIA2 [12 Marks]**	
Remember	20	30	20
Understand	40	30	40
Apply	40	30	30
Analyse	-	10	10
Evaluate	-	-	-
Create	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)												
COs	**POs**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
C002.1	3	2	1									
C002.2	3	3	3		2							
C002.3	3	3	3		3							
C002.4	3	3	3									
C002.5	3	2	2									

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

23ME003	TOTAL QUALITY MANAGEMENT	3/0/0/3
Nature of Course	D (Theory Application)	
Pre-Requisites	Nil	
Course Objectives:		
1	To recollect the engineering and management aspects of quality planning and control.	
2	Study the methodology of improving quality in manufacturing and service sectors.	
3	To implement the concepts of quality management system.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C003.1	Define the basic concepts of quality management.	[U]
C003.2	Recall the fundamentals of Total Quality Management and its tools.	[R]
C003.3	Examine the role of TQM tools and techniques in elimination of wastages and reduction of defects.	[A]
C003.4	Inculcate the concepts of quality and continuous improvement as a passion and habit.	[Ap]
C003.5	Analyze and understand the industrial problem and suggest process improvements.	[A]
Course Contents:		
QUALITY CONCEPTS: Definition of quality, dimensions of quality, quality planning, quality costs. Cost estimation and principles, leadership, quality council, quality statements, strategic, Quality Guru's, Criteria for Deming's Prize. PRODUCT DESIGN AND ANALYSIS: Basic Design Concepts and TQM Principles, Failure Mode Effect Analysis, Fault Tree Analysis, Design for Robustness, Value Analysis. **PROCESS IMPROVEMENT AND MODERN PRODUCTION MANAGEMENT TOOLS:** Six Sigma Approach, Total Productive Maintenance, Just-In-Time, Lean Manufacturing, Paradigms, Quality Improvement Tools and Continuous Improvement. Q-7Tools, New Q-7 Tools, Quality Function Deployment, Kaizen, 6S, 8D (Disciplines), Poka- Yoke. **QUALITY MANAGEMENT SYSTEMS:** Quality Management Systems, Introduction to ISO9000, Benefits of ISO Registration, TS16949: 2002 and EMS 14001certifications. OHSAS 18001 Occupational Health & Safety Assessment Series.		
	Total Hours:	**45**
Text Books:		
1	DaleH. Besterfield "Total Engineering Quality Management", 6thEdition, Pearson Education, 2021.	
2	Sunil Sharma, "Total Engineering Quality Management", 6thEdition, Mac Millan India Limited, 2019.	
Reference Books:		
1	Poornima M.Charantimath, "Total Quality Management", 5thEdition, Pearson Education, 2019.	
2	James R Evans, "Quality and Performance Excellence", 8thEdition, Cengage Learning, 2019.	
Web References:		
1	https://managementhelp.org/quality/total-quality-management.htm	
Online Resources:		
1	https://onlinecourses.nptel.ac.in/noc17_mg18/preview	
2	https://www.apnacourse.com/course/quality-management	

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C003.1	Understand	Quiz	20
C003.2	Remember	Assignment	20
C003.3	Analyze	Assignment	20
C003.4	Apply	Assignment/Tutorial	20
C003.5	Analyze		

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	40	40	30
Understand	40	30	40
Apply	10	10	20
Analyse	10	20	10
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
C003.1	3											3
C003.2	3	2				2						
C003.3	3	3	3									
C003.4	3	2	2			2						
C003.5	3					2						

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

23ME004	PRODUCT DEVELOPMENT	3/0/0/3
Nature of Course	**Theory**	
Pre requisites	Nil	

Course Objectives:

1	To describe the basic concept of product development
2	To learn the concepts and tools that is necessary for the product design and manufacturing.
3	To apply the new product development process by devising a new product or service and an introductory launch plan.

Course Outcomes:
Upon completion of the course, students shall have ability to

C004.1	Identify concept generation activities and summarize the methodology involved in concept selection and testing.	[R]
C004.2	Describe the different stages in product development.	[U]
C004.3	Analyse the relative importance of customer needs in establishing product specifications.	[A]
C004.4	Apply the design knowledge in design for manufacturing.	[Ap]
C004.5	Devise innovative product development plan with environmental and societal consideration.	[A]

Course Contents:

INTRODUCTION: Introduction: Importance of engineering design, characteristics of successful product development, New product development process, Identifying customer needs – Concept generation – Concept selection – Pugh matrix method – concept screening and scoring – concept testing.

DESIGN THINKING TECHNIQUES: Product Specifications - Product Architecture – Industrial Design - User Interface Design – Function based design – Designing to codes and standards. TRIZ – axiomatic design – Robust design.

DESIGN FOR THE MANUFACTURING: Design for Manufacturing – Design for Assembly – Factors affecting DFM. Prototyping - product validation and implementation. **DESIGN FOR ENVIRONMENT:** Design for the Environment - Product Lifecycle Management – Role of PLM in industries (Aero, Auto, and Electronics), Human factors in design.

Total Hours:	**45**

Text Books:

1	Karl T Ulrich & Steven D Eppinger, “Product design and development” New York, McGraw-Hill Education, 2020.
2	George E. Dieter, Linda C. Schmidt, “Engineering Design”, McGraHill International Edition, 4th edition, 2017

Reference Books:

1	Steven Selikoff “The complete book of Product Design, Development, Manufacturing and sales”, Product Development Academy; 2nd edition (2020)
2	Kevin N A Otto, Kristin, “Product Design”, Indian reprint, Pearson education 2014.

Web References:

1	www.nptel.ac.in/courses/112107217/
2	https://ocw.mit.edu/

Online Resources:

1	https://www.edx.org/learn/product-design

Continuous Assessment				End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C004.1	Remember	Quiz	20
C004.2	Understand	Assignment	20
C004.3	Analyze	Case Study	20
C004.4	Apply		
C004.5	Analyze	Assignment	20

Summative assessment based on Continuous and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	40	40	40
Apply	20	20	20
Analyse	20	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA1: 100 Marks			**CA2:100 Marks**			
SA 1 (60 Marks)	**FA1 (40 Marks)**		**SA 1 (60 Marks)**	**FA2 (40 Marks)**		
	Component – I (20 Marks)	**Component – II (20 Marks)**		**Component – I (20 Marks)**	**Component – II (20 Marks)**	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	**POs**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
C004.1	3											
C004.2	3											
C004.3	3	3										
C004.4	3		3						2			
C004.5	3						3	3	2			

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

23ME005	FUNDAMENTALS OF ADDITIVE MANUFACTURING	3/0/0/3
Nature of Course	Theory application	
Pre Requisites	-	

Course Objectives:

1	To provide a detailed insight on the additive manufacturing processes.
2	To help in understanding the need, types, application, method of operation and the future of AM system in industrial applications.
3	To enhance innovative thinking and solve business case studies in AM technique.

Course Outcomes:
Upon completion of the course, students shall have ability to

C005.1	Illustrate the basic concepts of additive manufacturing technologies along with recent trends in advanced manufacturing.	[U]
C005.2	Summarize the different methods used for pre-processing and post processing of additive manufactured products.	[U]
C005.3	Demonstrate the uses of additive manufacturing in automobile, aerospace and biomedical fields.	[Ap]
C005.4	Select the appropriate CAD formats in the manufacturing of 3D printed parts.	[Ap]
C005.5	Design the product using additive manufacturing techniques.	[E]

Course Contents:

INTRODUCTION TO RAPID MANUFACTURING:
Prototyping fundamentals - Historical development - Fundamentals of Additive Manufacturing (AM)- Advantages and Limitations of AM - Commonly used Terms - AM Process Chain: Fundamental Automated Processes - Process Chain - CAD Model - 3D modelling -3D solid modeling software and their role in AM –Input file formats - Classification of AM systems- AM Benefits.

TYPES OF ADDITIVE MANUFACTURING PROCESS:
Liquid based systems: Stereolithography – Solid Ground Curing – Polyjet printing –Applications. Solid based systems: Fusion Deposition Modeling – Laminated Object Manufacturing – Solid Deposition Manufacturing –Applications. Powder based systems: Selective Laser Sintering – 3-Dimensional Printers – Laser Engineered Net Shaping –Electron Beam Melting Process – Applications. Other Systems: Metal Additive Manufacturing (SLM, Inkjet, etc), Sand/Ceramics Printing. Advanced materials - Electronic
Materials, Bio printing - Food Printing.

APPLICATIONS OF ADDITIVE MANUFACTURING:
Rapid Tooling and Applications of AM: Direct Rapid Tooling, Indirect Rapid Tooling: Soft tooling and Hard tooling –Conversion of CT / MRI scan data –Customized implant -Reverse engineering –Case studies on current application of AM –Novel Application of AM systems –Future trends of AM system. Application of AM in Medical, Automotive, Aeronautical, Space and Construction Industries. Reverse Engineering -3D Scanner.

Total Hours:	**45**

Text Books:

1	C.K. Chua, K.F. Leong, C.S. Lim, "Rapid prototyping Principles & Application (3rd Edition), World Scientific Publication, 2018.
2	Additive Manufacturing Design, Methods & Processes, Steinarkilli, Taylor & Francis Publication, 2017.

Reference Books:

1	Liou, W.F., Rapid Prototyping and Engineering Applications, A toolbox for prototype development, CRC Press, Taylor & Francis Group LLC, USA, 2018.
2	Hopkinson, N., Hague, R.J.M, and Dickens, P.M., Rapid Manufacturing, An Industrial Revolution for the Digital Age, John Wiley & Sons, Ltd, UK, 2019.

Web References:

1	http://nptel.ac.in/courses/112107077/382
2	http://nptel.ac.in/courses/112107078/37

3	http://nptel.ac.in/courses/112102103/16
Online Resources:	
1	https://www.technosofteng.com
2	https://schooledbyscience.com
3	https://www.metal-am.com

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C005.1	Understand	Quiz	20
C005.2	Understand	Assignment	20
C005.3	Apply	Case Study	20
C005.4	Apply		
C005.5	Evaluate	Mini Project	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	30	20	20
Understand	50	40	40
Apply	20	40	40
Analyse	-	-	-
Evaluate		-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)												
COs	**POs**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
C005.1	3	2	2									
C005.2	3	2	2									
C005.3	3	2	3									
C005.4	3	2	3									
C005.5	3	3	3	3	3							
3	Strongly agreed		2	Moderately agreed				1	Reasonably agreed			

23ME006	TECHNOLOGY MANAGEMENT	3/0/0/3

Nature of Course	Theory
Pre Requisites	Nil

Course Objectives:

1	To understand about basic concepts of management and to get equipped with the nuances of management functions
2	To create an awareness about the impact of technology and innovation on business management.
3	To gain knowledge to build an effective communication model and to manage innovation

Course Outcomes:
Upon completion of the course, students shall have ability to

C006.1	Recognize the role and significance of technology management	[U]
C006.2	Interpret the human issues and ethics involved in the technology usage and implementation.	[U]
C006.3	Illustrate the environmental impact of technological change.	[A]
C006.4	Relate the issues in deployment of technology management concepts	[A]
C006.5	Develop strategies for business units to attain global recognition	[Ap]

Course Contents:

Introduction to Technology Management: Concept and Meaning of Technology and Technology Management; Technology management, Evolution and Growth of Technology, Role and Significance of Technology Management, Impact of Technology on Society and Business-components of technology management -Technology and competition; Forms of Technology-Process technology; Product technology, Case studies of Technological Futures

Managing Technology Based Innovation: Innovation and Technology- Role of technology in innovation; Technological innovation and management, Process of Technology – Based Innovation, IPR and Patents, Characteristics of Innovative Work Environment, Information Technology for Business Measures for Building High- Performing Innovative Technology- Based Organizations. International Business and Strategic Alliances, Management of R&D and Innovation

Social Issues in Technology Management: Social Issues, Technological Change and Industrial Relations; Technology Assessment and Environmental Impact Analysis-Environmental impact analysis process- Performance Appraisal and Counseling, Leadership and Change Management, Sustainable Technology Management

Total Hours:	**45**

Text Books:

1	Sanjiva Shankar, Technology and innovation management, Dubey publisher: PHI learning, 2020.
2	Margaret A. White, Garry D. Bruton, The Management of Technology and Innovation: A Strategic Approach, 2nd Edition, 2019.

Reference Books:

1	Joe Tidd, John Bessant, Managing Innovation: Integrating Technological, Market and Organizational Change, 6th Edition 2018.
2	Hellriegel, Jackson and Slocum, Management: A Competency-Based Approach, South Western, 11th edition, 2015.
3	Koontz, Essentials of Management, Tata McGraw-Hill, 10th Edition, 2015.

Web References:

1	https://professional.mit.edu/course-catalog/management-technology-roadmapping-development
2	https://www.referenceforbusiness.com/management/Str-Ti/Technology-Management.html

Online Resources:	
1	https://nptel.ac.in/courses/110107141
2	https://in.coursera.org/specializations/technology-management

Summative assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%)						End Semester Examination (60 %)
CA 1 (100 Marks)			CA 2 (100 Marks)			Theory Examination (60 Marks)
SA 1 (60 Marks)	FA 1		SA 2 (60 marks)	FA 2		
	Component -I (20 marks)	Component –II (20 marks)		Component -III (20 marks)	Component -IV (20 marks)	

Assessment Methods & Levels (based on Blooms'Taxonomy)			
Formative assessment based on Capstone Model (16%)			
Course Outcome	Bloom's Level	Assessment Component	Marks
C006.1	Understand	Quiz	20
C006.2	Understand	Assignment	20
C006.3	Analyze	Case Study	20
C006.4	Apply	Assignment	20
C006.5			

Summative assessment based on Continuous and End Semester Examination			
Bloom's Level	Continuous Assessment (24%)		End Semester Examination (60%) [100 Marks]
	CIA1 [60 Marks]	CIA2 [60 Marks]	
Remember	30	20	20
Understand	50	40	40
Apply	20	40	40
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
C006.1	3		1									
C006.2	3	2	2									
C006.3	3			2								
C006.4	3			2								
C006.5	3	2		3								

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

Mandatory Courses

23MC102	ENVIRONMENTAL SCIENCES	2 /0 /0 /0

Nature of Course	:C (Theory Concept)
Pre requisites	:Basics in Environmental Studies

Course Objectives:

1	To learn the integrated themes on various natural resources.
2	To gain knowledge on the type of pollution and its control methods.
3	To have an awareness about the current environmental issues and the social problems.

Course Outcomes:
Upon completion of the course, students shall have ability to

C102.1	Recall and play an important role in transferring a healthy environment for future generation.	[R]
C102.2	Illustrate the importance of natural resources and conservation of biodiversity.	[U]
C102.3	Interpret and analyze the impact of engineering solutions in a global and societal context.	[U]
C102.4	Apply the gained knowledge to overcome pollution problems.	[AP]
C102.5	Apply the gained knowledge in various environmental issues and sustainable development.	[AP]

Course Contents:

Natural Resources:
Introduction-Forest resources: Use and abuse, case study-Major activities in forest-Water resources-over utilization of water, dams-benefits and problems. Mineral resources-Use and exploitation, environmental effects of mining- case study–Food resources- World food problems, case study. Energy resources -Renewable and non-renewable energy sources Land resources-Soil erosion and desertification – Role of an individual in conservation of natural resources.

Environmental Pollutions:
Definition – causes, effects and control measures of: a. Air pollution-Acid rain - Greenhouse effect-Global warming- Ozone layer depletion – case study- Bhopal gas tragedy. Water pollution c. Soil pollution - Solid waste management-Recycling of plastics-Pyrolysis method- causes, effects and control measures of municipal solid wastes d. Noise pollution. e. Nuclear hazards-case study-Chernobyl nuclear disaster-Role of an individual in prevention of pollution.

Social issues and the Environment:
Sustainable development-water conservation, rain water harvesting, E-Waste Management – Environmental ethics: 12 Principles of green chemistry-Scheme of labelling of environmental friendly products (Eco mark) – Emission standards – ISO 14001 standard.

Total Hours:	**30**

Text Books:

1	AnubhaKaushik and C P Kaushik “Perspectives in Environmental Studies”4th Edition, Newage International (P) Limited, Publisher Reprint 2014. New Delhi
2	Rajagopalan, R, “Environmental Studies-From Crisis to Cure”, Oxford University Press 2015.

Reference Books:

1	Tyler Miller, Jr., “Environmental Science”, Brooks/Cole a part of Cengage Learning, 2014.
2	William Cunningham and Mary Cunningham, “Environmental Science”, 13th Edition, McGraw Hill,2015.
3	Gilbert M. Masters, “Introduction to Environmental Engineering and Science”, Third Edition, Pearson Education, 2014.

Web References:	
1	http://nptel.ac.in/courses/104103020/20
2	http://nptel.ac.in/courses/120108002
3	http://nptel.ac.in/courses/122106030
4	http://nptel.ac.in/courses/120108004/
5	http://nptel.ac.in/courses/122102006/20
Online Resources:	
1	https://www.edx.org/course/subject/environmental-studies
2	www.environmentalscience.org

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:40)

Course Outcome	Bloom's Level	Assessment Component	Marks
C201.1	Remember	Quiz	10
C201.2	Understand	Case study based on environmental aspect	10
C201.3	Understand	Class presentation	10
C201.4& C201.5	Apply	Assignment	10

Summative assessment based on Continuous Assessment

Bloom's Level	Continuous Assessment		
	CIA-I [0 marks]	CIA-II [0 marks]	Term End Assessment [60 marks]
Remember	-	-	30
Understand	-	-	40
Apply	-	-	30
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C102.1							3								
C102.2							3								
C102.3						2	3								
C102.4							3								
C102.5							3								

	3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

23MC103	SOFT SKILLS	2/0/0/0

Nature of Course: Theory Concept

Pre Requisites : Technical Communication Skills

Course Objectives:

1	To develop the students competency level and their capabilities.
2	To teach the students to be effective in workplace and social environments.
3	To create self confidence among the students and to resolve stress and conflict within themselves.
4	To help the students to enhance their career skills by increasing their productivity and performances.
5	To concentrate more on conversation skills, presentation skills, verbal ability, critical and creative thinking.

Course Outcomes:

Upon completion of the course, students shall have ability to

C103.1	Remember the principles of soft skills required for their profession.	[R]
C103.2	Understand the importance of Interpersonal communication Skills among individuals, groups and cultures.	[U]
C103.3	Apply verbal and non-verbal communication skills in corporate environment.	[AP]
C103.4	Analyse and apply creativity skills, critical thinking skills and problem-solving skills.	[AN]
C103.5	Articulate oral and written messages in an appropriate and persuasive manner to suit specific purposes, audiences and contexts at work place.	[AP]
C103.6	Apply good teamwork skills and Leadership Skills	[AP]

Course Contents:

Module 1: Professional Communication Skills

Introduction to the Soft Skills, Performance Evaluation 1 – Significance of Soft Skills - Understanding the basic Communication Principles –Listening Skills- Listening Exercises Speaking Skills- How to start and Sustain a Conversation- Speaking in Groups- Understanding self and Personal Branding, attitude, types of attitudes, Positive Attitude, Self Confidence and Self-Motivation - Personal Application/Action Taken. Advanced Writing Skills-Principles of Business Writing- E mails- Writing Reports- Types of Reports- Strategies for Report Writing-Personal Application/Action Taken. Verbal Ability- Analogy- Classification- Odd One Out-Idioms and Phrases- Sentence Correction- Empathy and its importance in career -Personal Application/Action Taken. **(10 Hours)**

Module 2: Interpersonal Communication

Nonverbal Communication- Individual, Groups and Cultures- Body Language- Attire and Etiquettes- Interpersonal Skills- dealing with diverse People- Networking- Emotional Intelligence and its importance. Personal Application/Action Taken. Developing Creativity-Critical Thinking and Problem-Solving Skills- Making the Right Choice- Never Give Up- Begin to Grow- Personal Application/Action Taken. Interviews- Facing Job Interviews - Planning and Preparing- Effective Resume along with Covering Letter- Planning and Preparing- Personal Application/Action Taken. Self-Discipline - Self Presentation - Personal Application/Action Taken.

(10 Hours)

Module 3: Teamwork and Leadership Skills

Industry Expectations- Universal Hiring Rule- Personal Application/Action Taken. Importance of Human Values-Importance of Team Work- Developing Key Traits in Motivation, Persuasion, Negotiation and Leadership Skills- Being an Effective Team Player- Personal Application/Action Taken. Planning- Prioritization - Delegation- Conflict Management-Decision and its necessity in crucial situations- Group Discussion- Personal Application/Action Taken. Essential Skills in working Strategies- Presentation and Interaction Skills- What to Present and How- Being Assertive-Multimedia Presentation-Making Effective Presentations. Interview Skills- Do's and Don'ts - Body Language – Answering the Common Questions of Interview- Performance Evaluation 2- Mock Interview **(10 Hours)**

Total Hours: 30

Text Books:	
1	Penrose, “Business Communication for managers: An advanced approach”, Cengage learning.
2	H.E. Sales, “Professional Communication in Engineering”, Palgrave Macmillan 2009.
3	W. P. Scott, Bertil Billing, “Communication for Professional Engineers”, Thomas Telford, 1998.
Reference Books:	
1	Peter Davson-Galle, “Reason and Professional Ethics”, Ashgate Publishing, Ltd., 2009.
2	William B. Gudykunst, “Cross Cultural and Inter Cultural Communication”, Sage Publications India Pvt Ltd, New Delhi, 2003.
3	Joep Cornelissen, “Corporate Communications: Theory and Practice”, Sage Publications India Pvt Ltd, New Delhi, 2004.
Web References:	
1	https://onlinecourses.nptel.ac.in/noc16_hs15/preview
2	https://www.getinternship.switchidea.com/NTAT/syllabus/InterpersonalCommunication
3	https://smude.edu.in/smude/programs/bca/soft-skills.html
4	https://swayam.gov.in/course/4047-developing-soft-skills-and-personality
5	https://www.clearias.com/interpersonal-skills-including-communication-skills-for-csat/
6	https://www.bizlibrary.com/soft-skills-training/

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:40)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C103.1	Remember	Group Discussion	10
C103.2 & C103.3	Understand	Listening Skills	10
C103.4	Analyze	Interview	10
C103.5 & C103.6	Apply	Formal Presentation	10

Summative assessment based on Continuous Assessment

Bloom’s Level	Term End Assessment [60 marks]
Remember	20
Understand	30
Apply	30
Analyze	20
Evaluate	-
Create	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C103.1						1	1	2	2	3	2	2			
C103.2							1	1	3	3	2	2			
C103.3									2	3	2	2			
C103.4						1	1	1	2	3	3	2			
C103.5						1	1		2	3	2	2			
C103.6							1	2	3	3	2	2			

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed	

23MC104	MANAGEMENT ORGANIZATIONAL BEHAVIOUR	2/0/0/0
Nature of Course	Theory Concept	
Pre requisites	Nil	
Course Objectives:		
1.	The objective of the course is to provide basic knowledge about management to familiarize the students with the management principles and organizational behavior.	
2.	The course is designed to enable the students to adapt & apply theoretical concepts in business	
3.	To know about the role of manager in the area of management.	
4.	To create and implement team building strategies for organization building.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C104.1	Identify and understand different management principles techniques in business environment.	[U]
C104.2	Apply management fundamentals and planning to solve organization problems and make effective decisions.	[AP]
C104.3	Understand and analyze the changes within an individual will change the group as well as the organization	[A]
C104.4	Understand and analyze the leadership style and organization theories to create a productive environment to workforce.	[A]
C104.5	Analyze the organizational climate and change management strategies and tactics	[A]
C104.6	Apply the empowerment strategy and tactics for productivity	[AP]

Course Contents:

Module 1: Fundamentals of Management, Planning and Decision Making (10 Hours)

Introduction to Management- Concept and functions- Thought Managerial roles and styles- Principles of Management - Levels of Management- Theories of Management - Classical, Scientific, Administrative, Behavioral, Management Sciences Theories. Organizational planning - Vision, Mission and goals, Types of plans, steps in planning process, Approaches to planning, Planning in Dynamic Environment. Decision making process, types of decisions, decision making styles, Behavioural influences on decision making - Group decision making - Vroom's Participative decision-making model.

Module 2: Individual, interpersonal and group behavior (10 Hours)

Definition, need and importance of Organizational behavior –Learning-Nature -Importance of Learning- Introduction and theories Motivation: Content and process theories-Leadership: Styles and Theories - Perception-Personality – Attitudes- Definition, need and importance -Nature and scope-Importance of Groups and Teams- Role relationships and conflict-Group dynamics- Work values. Organization Theories: Maslow's needs hierarchy theory, two factor theory of motivation, McGregor's theory, ERG theory, McClelland's needs theory, Valance Theory.

Module 3: Organizational Development (10 Hours)

Organizational culture: Elements - Organizational climate– Factors affecting organizational climate-Organizational Commitment, Organizational schange- Importance- Stability Vs Change-Proactive Vs Reaction change- Change process– Resistance to change- Managing changes-Managing International Workforce – Productivity- Alternative change management approaches and cultural contingencies - power to manage effectively; Empowerment and Participation strategies and tactics.

Total Hours:	**30 Hrs**

Text Books:	
1.	Nelson, Quick, Khandelwal, “Organizational Behavior”, 2nd Edition, Cengage Learning, 2016.
2.	Williams, Tripathy, “Principles of Management”, Cengage Learning, 2016.
3.	Aswathappa, K, “Organizational Behavior”, 12th Edition, Himalaya Publication, 2016.
4.	Stephen Robbins, Timothy A. Judge, “Organizational Behavior”, 16th Edition, Prentice Hall India Pvt. Ltd, 2014.
Reference Books:	
1.	Chandrani Singh, Aditi Khatri, “Principles and Practices of Management and Organizational Behavior”, Sage Publications, 2016.
2.	Richard L. Daft, “Understanding the Theory and Design of Organizations”, 11th Edition, Cengage Learning, 2013.
3.	John M Ivancevich and Robert Konopaske, “Organizational Behavior and Management”, McGraw-Hill Education, 2013.
4.	UdaiPareek, Sushama Khanna, “Organization Behavior”, 3rd Edition, Oxford Publishing, 2012.
Web References:	
1.	https://iedunote.com/fundamental-concepts-of-organizational-behavior
2.	https://nscpolteksby.ac.id/ebook/
3.	https://ebooks.lpude.in/management/mba/term_1/DMGT402_MANAGEMENT PRACTICES_AND_ORGANIZATIONAL_BEHAVIOUR.pdf
4.	https://www.studocu.com/in/document/vellore-institute-of-technology/organizational-behaviour/lecture-notes/ob-notes/3208134/view
Online Resources:	
1.	https://nptel.ac.in/syllabus/110105034/
2.	https://nptel.ac.in/courses/110/105/110105033/
3.	https://freevideolectures.com/course/3502/organizational-behaviour-i
4.	https://nptel.ac.in/courses/110/106/110106145/

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:40)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C104.1	Understand	Quiz	10
C104.2 C104.6	Apply	Online Course	10
C104.3	Analyze	Technical Presentation	10
C104.4 C104.5	Apply	Assignment	10

Summative assessment based on Continuous Assessment

Bloom’s Level	Term End Assessment [60 marks]
Remember	20
Understand	30
Apply	30
Analyze	20
Evaluate	-
Create	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C104.1						2	2	2	2		2				
C104.2						2	2	2	2		2				
C104.3						2	2	2	2		2				
C104.4						2	2	2	2		2				
C104.5						2	2	2	2		2				
C104.6						2	2	2	2		2				
	3 Strongly agreed					2 Moderately agreed						1 Reasonably agreed			

23MC105	GENERAL APTITUDE	2/0/0/0

Nature of Course: Problem analytical

Pre Requisites : Basic Mathematical calculations

Course Objectives:

1	To ensure that students learn to think critically about mathematical models for relationships between different quantities and use those models effectively to solve problems and reach conclusions about them.
2	To impart skills that enable students to effectively use and interpret data, formulas, and graphs in the workplace.
3	To instills confidence in facing technical aptitude questions interviewed by recruiters

Course Outcomes:

Upon completion of the course, students shall have ability to

C105.1	To teach the basics of Quantitative Techniques in a graded manner.	[R]
C105.2	Understand the verbal and non-verbal nature of problems in reality and know the shortcut methods of solving it.	[U]
C105.3	Solve problems using their general mental ability.	[AP]
C105.4	To give intense focus on improving and increasing the ability of solving real problems.	[AP]
C105.5	Think critically about mathematical models for relating different quantities to reach conclusion.	[AP]
C105.6	Enable effective use of data interpretation, formulas, graphs and assumptions.	[AP]

Course Contents:

Module 1: Number Theory and Statistics

Number Systems– HCF and LCM of Numbers – Decimal Fractions – Simplification – Square Root and Cube Root of a number – Surds and Indices – Problems on numbers – Percentage – Ratio and Proportion – Divisibility – Mixtures – Averages- Polynomials – Solving Equations and Inequalities – Discard's rule of signs – Problems on ages – Chain rule – Time and Work – Time and Distance – Problems on Trains – Problems on Boats and Streams- Measures of central tendency – Mean, Median and Mode – Variance and Standard deviation Logarithms – Profit and Loss – Simple Interest – Compound Interest. **(14 Hours)**

Module 2: Logic and Decision Making

Analogy – Classification – Series completion – Coding and Decoding – Blood Relations – Puzzle Test – Direction Sense test – Logical Venn Diagrams - Number Ranking and Time Sequence Test – Decision Making – Assertion and Reason– Inserting the missing one – Logical Sequence of words – Syllogisms. **(8 Hours)**

Module 3: Reasoning

Logic – Statement and Arguments – Statements and Assumptions – Statements and Course of Action – Statements and Conclusions – Deriving conclusions from passages – Functions – Different kinds of functions – Miscellaneous sets- Series – Analogy – Classifications – Analytical Reasoning – Problems on Cubes and Dice – Mirror Images – Water Images – Rule Detection.

(8 Hours)

Total Hours: 30

Text Books:

1	Aggarwal R. S, "Quantitative Aptitude" Revised Edition, S. Chand Publication.
2	Abhijit Guha, "Quantitative Aptitude" 5th Edition, McGraw Hill Education.

Reference Books:

1	Edgar Thorpe "Mental Ability & Quantitative Aptitude" 3rd Edition, McGraw Hill Education.

Web References:

1	https://www.wizig.com/tutorial/815468-quantitative-aptitude-reasoning-data-interpretation-video-lectures

2	https://learningpundits.com/contest?referrer=harsh.cse15@nituk.ac.in
3	https://nptel.ac.in/courses/114106041/8
4	https://nptel.ac.in/courses/111103020/2
5	http://aptitudetraining.in/home/index.php
6	https://www.udemy.com/vedicmaths/
7	https://www.youtube.com/channel/UCtmn-DsF4BhPug-ff9LiDAA?disable_polymer=true

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:40)

Course Outcome	Bloom's Level	Assessment Component	Marks
C105.1	Remember	Classroom or Online Quiz	10
C105.2 & C105.3	Understand	Formal presentation	10
C105.4, C105.5 & C105.6	Apply	Formal interview tests	20

Summative assessment based on Continuous Assessment

Bloom's Level	Term End Assessment [60 marks]
Remember	20
Understand	40
Apply	40
Analyse	-
Evaluate	-
Create	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C105.1	3	3	2												
C105.2	3	2	2												
C105.3	3	3	2												
C105.4	3	2	2												
C105.5	3	3	2												
C105.6	3	2	2												

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

23MC106	LIFE SKILLS AND ETHICS	2/0/0/0

Nature of Course: Theory Concept

Pre Requisites : Nil

Course Objectives:

1	To develop communication competence in prospective engineers.
2	To enable them to convey thoughts and ideas with clarity and focus.
3	To develop report writing skills.
4	To equip them to face interview & Group Discussion.
5	To inculcate critical thinking process.
6	To prepare them on problem solving skills.
7	To provide symbolic, verbal, and graphical interpretations of statements in a problem description.

Course Outcomes:
Upon completion of the course, students shall have ability to

C106.1	Define and Identify different life skills required in personal and professional life.	[U]
C106.2	Develop an awareness of the self and apply well-defined techniques to cope with emotions and stress.	[AP]
C106.3	Explain the basic mechanics of effective communication and demonstrate these through presentations.	[A]
C106.4	Use appropriate thinking and problem solving techniques to solve new problems.	[AP]
C106.5	Understand the basics of teamwork and leadership	[U]

Course Contents:

Communication Skill:
Introduction to Communication, The Process of Communication, Barriers to Communication, Listening Skills, Writing Skills, Technical Writing, Letter Writing, Job Application, Report Writing, Non-verbal Communication and Body Language, Interview Skills, Group Discussion, Presentation Skills, Technology-based Communication. **(10 Hours)**

Critical Thinking & Problem Solving:
Creativity, Lateral thinking, Critical thinking, Multiple Intelligence, Problem Solving, Six thinking hats Mind Mapping & Analytical Thinking. Teamwork: Groups, Teams, Group Vs Teams, Team formation process, Stages of Group, Group Dynamics, Managing Team Performance & Team Conflicts. **(10 Hours)**

Ethics, Moral & Professional Values:
Human Values, Civic Rights, Engineering Ethics, Engineering as Social Experimentation, Environmental Ethics, Global Issues, Code of Ethics like ASME, ASCE, IEEE. **Leadership Skills:** Leadership, Levels of Leadership, Making of a leader, Types of leadership, Transactions Vs Transformational Leadership, VUCA Leaders, DART Leadership, Leadership Grid & leadership Formulation **(10 Hours)**

Total Hours: 30

Text Books:

1	Barun K. Mitra, “Personality Development & Soft Skills”, First Edition, Oxford Publishers, 2011.
2	Kalyana, “Soft Skill for Managers”, 1st Edition, Wiley Publishing Ltd, 2015.
3	Larry James, “The First Book of Life Skills”, 1st Edition, Embassy Books, 2016
4	Shalini Verma, “Development of Life Skills and Professional Practice”, 1st Edition, Sultan Chand (G/L) & Company, 2014
5	John C. Maxwell, “The 5 Levels of Leadership”, Centre Street, A division of Hachette Book Group Inc, 2014.

Web References:	
1	https://www.coursera.org/courses?query=ethics

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:40)

Course Outcome	Bloom's Level	Assessment Component	Marks
C106.1	Understand	Quiz	10
C106.2	Apply	Assignment	10
C106.3	Analyse	Presentation	10
C106.4 & C106.5	Apply	Group Discussion	10

Summative assessment based on Continuous Assessment

Bloom's Level	Term End Assessment [60 marks]
Remember	20
Understand	30
Apply	30
Analyse	20
Evaluate	-
Create	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C106.1								2	2	2		2			
C106.2								2	2	2		2			
C106.3								2	2	3		2			
C106.4								2	2	2		2			
C106.5								2	3	2		2			

	3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed	

23MC107	STRESS MANAGEMENT	2/0/0/0

Nature of Course: Theory Concept

Pre Requisites : Nil

Course Objectives:

1	Understand the basic principles of stress management
2	Recognize your stress triggers and how to manage them
3	Develop proactive responses to stressful situations
4	Use coping tips for managing stress both on and off the job
5	Learn to manage stress through diet, sleep and other lifestyle factors
6	Develop a long term action plan to minimize and better manage stress
7	Understand the basic principles of stress management

Course Outcomes:

Upon completion of the course, students shall have ability to

C107.1	Understand the basic principles of stress management	[U]
C107.2	Apply the concept of recognizing your stress triggers and find was to manage them.	[AP]
C107.3	Develop proactive responses to stressful situations	[A]
C107.4	Develop a long term action plan to minimize and better manage stress	[AP]

Course Contents:

Scientific Foundations of Stress:

What is stress? – Sources of Stress – Types of Stress – Personality Factors and stress – Stress and the college student. Stress Psychophysiology: Stress and nervous system – Hypothalamic – Pituitary – Adrenal (HPA) Axis – Effect of Stress on Immune system – Health risk associated with chronic stress – Stress and Major Psychiatric disorders. **(10 Hours)**

Developing Resilience to Stress:

Understanding you stress level – Role of personality pattern, Self-esteem, Locus of control – Role of Thoughts Beliefs and Emotions – I & II – Life situation Intrapersonal: (Assertiveness, Time Management). **(10 Hours)**

Strategies for Relieving Stress:

Developing cognitive coping skills – Autogenic training, imagery and progressive relaxation – Other relaxation techniques – Exercise and Health – DIY strategies stress management.

(10 Hours)

Total Hours: 30

Reference Books:

1	Jonathan C. Smith, “Stress Management: A Comprehensive Handbook of Techniques and Strategies”, 1st Edition, Springer Publishing Company, 2011.
2	Bob Stahl, Elisha Goldstein, Jon Kabat-Zinn, “A Mindfulness–based Stress Reduction Workbook”, 2nd Edition, New Harbinger Publications, 2019.
3	Ryan M. Niemiec, “The Strengths-based Workbook for Stress Relief”, 1st Edition, New Harbinger Publications, 2019.

Web References:

1	https://thiswayup.org.au/courses/coping-with-stress-course/
2	https://www.classcentral.com/course/swayam-stress-management-14309

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:40)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C107.1	Understand	Quiz	10
C107.2	Apply	Group Discussion	10
C107.3	Analyse	Class Presentation	10
C107.4	Apply	Assignment	10

Summative assessment based on Continuous Assessment	
Bloom's Level	**Term End Assessment [60 marks]**
Remember	20
Understand	30
Apply	30
Analyse	20
Evaluate	-
Create	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C107.1								2	3	2		2			
C107.2								2	2	2		2			
C107.3								2	3	2		2			
C107.4								2	3	2		3			

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

23MC108	CONSTITUTION OF INDIA	2/0/0/0

Nature of Course: Theory

Pre Requisites : Nil

Course Objectives:

1	To familiarize with basic information about Indian constitution
2	To understand the fundamental rights and duties as citizens of India

Course Outcomes:

Upon completion of the course, students shall have ability to

C108.1	Explain the objectives of the Constitution of India and its formation	[U]
C108.2	Recall state and central policies (Union and State Executive), fundamental Rights and their duties.	[R]
C108.3	Make use of legal directions in developing solutions to societal issues	[AP]
C108.4	Solve for competitive exams that requires knowledge of Indian Constitution	[AP]

Course Contents:

Module I

Historical perspective, The making of the Constitution, The Role of the Constituent Assembly - Preamble and Salient features of the Constitution of India. Fundamental Rights, Directive Principles of State Policy, Fundamental Duties, Citizenship Article 5-11.

(10 Hours)

Module II

Federal structure, Powers of the Union and the states, Centre-State Relations, Union Executive – President, Prime Minister, Union Cabinet, Parliament, Supreme Court of India, State Executives – Governor, Chief Minister, State Cabinet, State Legislature, High Court and Subordinate Courts, Elections, Electoral Process, and Election Commission of India, Election Laws. Powers and Functions of Municipalities and Panchayat

(10 Hours)

Module II

Amendments - Methods, Emergency Provisions, National Emergency, President Rule, Financial Emergency, Provisions for SC & ST, OBC, women, children and backward classes, Right to Property, Freedom of Trade and Commerce. Agricultural Law

(10 Hours)

Total Hours: 30

Text Books:

1	D. D. Basu, “Introduction to the Constitution of India”, LexisNexis, New Delhi, 22nd edition, 2016.
2	“Bare act-constitution of India”, The universal Publications, LexisNexis 2020, New Delhi, India.

Reference Books:

1	Subhash. C. Kashyap, “Our Constitution: An Introduction to India’s Constitution and Constitutional Law”, National Book Trust, India, 5th edition, 2019.
2	M. Laxmikanth, “Constitution of India”, Cengage Learning India. 1st edition 2018.

Web References:

1	https://unacademy.com/course/the-indian-constitution/NSKQ8XXQ
2	https://unacademy.com/goal/upsc-civil-services-examination-ias-preparation/KSCGY

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:40)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C108.1	Understand	Case Study Assessment	10
C108.2	Remember	Assignment	10
C108.3	Apply	Online Quiz	10
C108.4	Apply	Presentation	10

Summative assessment based on Continuous Assessment	
Bloom's Level	**Term End Assessment [60 marks]**
Remember	20
Understand	40
Apply	40
Analyse	-
Evaluate	-
Create	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C108.1						3	3	3		1					
C108.2		2		3		3	3	3	3		3	3			
C108.3				3		3	3	3	3		3	3			
C108.4		2				3	3	3	3						

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed		

23MC109	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	2/0/0/0

Nature of Course: Theory

Pre Requisites : Nil

Course Objectives:

1	To make understand the contribution of Indian mind in various fields.
2	To cultivate critical appreciation of the thought content and provide insights relevant for promoting cognitive ability, health, good governance, aesthetic appreciation and right values.

Course Outcomes:
Upon completion of the course, students shall have ability to

C109.1	Relate classical Indian traditions with contemporary traditions and culture.	[U]
C109.2	Describe the thoughts of Indians in different disciplines.	[R]
C109.3	Apply the knowledge to the present context.	[AP]
C109.4	Discover a better appreciation and understanding of Indian traditions.	[AP]

Course Contents:

Indian Ethics: Individual and Social – Society state and Polity (Survey) - Education systems – Agriculture (Survey) – Early & Classical Architecture – Medieval & Colonial Architecture.

(10 hours)

Astronomy in India – Martial Arts Traditions (Survey) - Indian Literatures - Indian Philosophical Systems - Indian Traditional Knowledge on Environmental Conservation - Ayurveda for Life, Health and Well-being.

(10 hours)

The Historical Evolution of Medical Tradition in Ancient India - Music in India - Classical & Folk dance - Theatre and Drama in India.

(10 hours)

Total Hours: 30

Text Books:

1	Kapil Kapoor and Michel Danino, Textbook of “Knowledge Traditions and Practices of India”, Central Board of Secondary Education, 2017.
2	Yogesh Atal, “Indian Society: Continuity and Change”, Pearson Education India, 2016.

Reference Books:

1	Douglas Osto, “An Indian Tantric Tradition and Its Modern Global Revival”, Routledge publications, 2020.
2	Rao C.N. Shankar, “Sociology: Principles of Sociology with an Introduction to Social Thoughts”, S Chand Publisher, 2019.

Web References:

1	http://nopr.niscair.res.in/handle/123456789/43
2	https://nptel.ac.in/courses/109/104/109104102/

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:40)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C109.1	Understand	Assignment	10
C109.2	Remember	Online Quiz	10
C109.3	Apply	Presentation	10
C109.4	Apply	Case Study Assessment	10

Summative assessment based on Continuous Assessment	
Bloom's Level	**Term End Assessment [60 marks]**
Remember	20
Understand	40
Apply	40
Analyse	-
Evaluate	-
Create	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C109.1						3	3					3			
C109.2						3	3					3			
C109.3						3	3					3			
C109.4						3	3					3			

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed		

23MC110	BIOLOGY	2/0/0/0

Nature of Course : Theory

Pre requisites : Nil

Course Objectives:

1. To understand the basic biological concepts related to engineering systems.
2. To have adequate knowledge about the various human anatomy and physiological systems.
3. To impart the knowledge about biological systems in the environment.

Course Outcomes:

Upon completion of the course, students shall have ability to

C110.1	Relate the biological system with engineering concepts	[R]
C110.2	Understands the anatomy and physiology of human system.	[U]
C110.3	Understand the concept of plant, animal and microbial systems and growth in real life situations	[U]
C110.4	Apply the knowledge of applications of biological systems in relevant industries.	[AP]

Course Contents:

Introduction, Science and Engineering – Phylogeny, Motivation, Methods, Synthesis, Biological Classification, Biology as whole, Applications of Biology, Principles of biology – Genetic Basics, substance for life – Basic organic chemical structure, chemical bonding, acid, base reactions, physicochemical interactions. **(10 hours)**

Cell – prokaryotes and eukaryotes, biological membrane, membrane transport, eukaryotic cell structure and function. Plant – plant division, Animal – reproductive strategies, Human – Skin, skeletal system, muscular system, nervous system, cardiovascular system, respiratory system, digestion, nutrition, excretory system. **(10 hours)**

Industrial Microbiology and its Applications, Relationship between Engineering and Biology - Living things as solution, models, recipients, inadvertently affected. Biological solutions to Industrial Problems. Cell organization, signalling and deciphering human genetic variation **(10 hours)**

Total hours: 30

Text Books:

1.	A Text book of Biotechnology, R.C.Dubey, S. Chand Higher Academic Publications, 2015.
2.	ThyagaRajan.S., Selvamurugan. N., Rajesh.M.P., Nazeer.R.A., Richard W. Thilagaraj, Barathi.S., and Jaganthan.M.K., “Biology for Engineers”, Tata McGraw-Hill, New Delhi, 2017.

Reference Books:

1.	Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2014.
2.	David A. Vaccari, Peter F. Strom, James E. Alleman,” Environmental Biology for Engineers and Scientist”, A John Willey Inc. publications, 2018.

Web References:

1.	https://www.cellsalive.com/
2.	https://www.visiblebody.com/teaching-anatomy/courseware

Online Resources:

1.	https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology_(Boundless)/17%3A_Industrial_Microbiology/17.1%3A_Industrial_Microbiology
2.	http://sites.khas.edu.tr/bioinformatics/whats/bioinformatics-genetics/

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:40)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C110.1	Remember	Assignment	10
C110.2	Understand	Online Quiz	10
C110.3	Understand	Presentation	10
C110.4	Apply	Case Study Assessment	10

Summative assessment based on Continuous Assessment	
Bloom's Level	**Term End Assessment [60 marks]**
Remember	20
Understand	40
Apply	40
Analyse	-
Evaluate	-
Create	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C110.1	3	3	2			3	3				3	3			
C110.2	3	3	2	2	2	3	3				3	3			
C110.3	3	3	2	2	2	3	3				3	3			
C110.4	3	3	2	2	2	3	3				3	3			

	3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed	

23MC500	SPORTS AND YOGA	2/0/0/0
Nature of Course	Practical concepts	
Pre Requisites	NIL	
Course Objectives:		
1	Understand the importance of sound health and fitness principles as they relate to better health	
2	Stimulate their continued inquiry about Yoga, physical education, health and fitness.	
3	Create a safe, progressive, methodical and efficient activity based plan to enhance improvement and minimize risk of injury.	
4	Develop physical activities as a lifetime pursuit and a means to better health.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C500.1	Identify techniques for increasing concentration and decreasing anxiety which leads to stronger academic performance.	[U]
C500.2	Describe various combination and forms and assess current personal fitness levels	[U]
C500.3	Understanding of psychological problems associated with the age and lifestyle.	[U]
C500.4	Apply biomechanical and physiological principles related to exercise and training.	[Ap]
Course Contents:		
Introduction to Physical Education: Meaning and objectives of Physical Education, Changing trends in Physical Education. Ancient & Modern Olympics (Summer & Winter), Awards and Honours in the field of Sports in India. **Physical Fitness, Wellness & Lifestyle:** Components of Physical fitness, Health related fitness, Preventing Health Threats through Lifestyle Change, Concept of Positive Lifestyle. **Fundamentals of Anatomy:** Define Anatomy, Effect of exercise on the functioning of Various Body Systems. (Circulatory System, Respiratory System, Neuro-Muscular System etc.). **Postures:** Concept of Postures, Causes of Bad Posture, Common Postural Deformities and advantages of Correct Posture. **Yoga and Lifestyle:** Introduction - Asanas, Pranayama, Meditation & Yogic Kriyas. **Training and Psychology in Sports:** Meaning, Warming up, Skill, Technique & Style. Meaning, Concept & Types of Aggressions in Sports. Adolescent Problems and their Management, Psychological benefits of exercise. Anxiety & Fear and its effects on Sports Performance. **Doping:** Meaning, Side Effects of Prohibited Substances. **Sports Medicine:** First Aid, Sports injuries and Management of Injuries.		
	Total Hours:	**30**
Text Books:		
1	Modern Trends and Physical Education by Prof. Ajmer Singh.	
2	Light On Yoga by B.K.S. Iyengar.	
3	Health and Physical Education – NCERT (11th and 12th Classes).	

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:40)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C500.1	Understand	Quiz	10
C500.2	Understand	Assignment	10
C500.3	Understand	Presentation	10
C500.4	Apply	Group Discussion	10

Summative assessment based on Continuous Assessment	
Bloom's Level	**Term End Assessment [60 marks]**
Remember	20
Understand	40
Apply	40
Analyze	-
Evaluate	-
Create	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C500.1								2	2	2		2			
C500.2								2	2	2		2			
C500.3								2	2	3		2			
C500.4								2	2	2		2			

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

Value Added Courses

23VA502	PROJECT MANAGEMENT PROCESS	

Nature of Course: Theory

Pre Requisites : Nil

Course Objectives:

1	To understand about the basics of project management.
2	To successfully build and lead a team for successful project completion
3	To evaluate the risk factors involved in a project and to manage them effectively.
4	To align project plans with organization's goals and objectives

Course Outcomes:
Upon completion of the course, students shall have ability to

C502.1	Plan and execute a project in the projected timeline.	[U]
C502.2	Propose and control the overall cost and budget of the project.	[U]
C502.3	Network with different stakeholders and improvise the business model	[AP]
C502.4	Utilizing different communication models and business plans to accomplish the project.	[AP]

Course Contents:

Module I

Basics of Project Management Process: Objectives of a Project – Project Life Cycle – Project Charter – Project Management Plan – Building a team – Work Breakdown Structure – Requirement Planning – People – Process – Business Environment - Estimation tools and techniques – Overview of PMBOK

(12 Hours)

Module II

Planning and Execution: Cost management planning – Project Budgeting tools and techniques – Communications planning – Procurement Planning – Human Resource Planning – Quality Management Planning – Stakeholder Management Planning - Continuous improvement processes – Sequencing of Activities – Quality Assurance

(12 Hours)

Module II

Monitoring and Controlling: Performance management and tracking techniques (PERT, CPM, Trend Analysis) - Project monitoring tools and techniques - Project quality best practices and standards - Quality measurement tools (statistical sampling, control charts, flowcharting, inspection, assessment) – Risk Identification Techniques – Compliance and Review Techniques – Agile Project Management

(12 Hours)

Total Hours: 36

Reference

1	Project Management by Merrie Barron and Andrew Barron.

23VA503	QUALITY MANAGEMENT	

Nature of Course: Theory

Pre Requisites : Nil

Course Objectives:

1	To understand the engineering and management aspects of quality planning and control.
2	Study the methodology of improving quality in manufacturing process / products.
3	To understand the concepts of quality management system.

Course Outcomes:
Upon completion of the course, students shall have ability to

C503.1	Define the basic concepts of quality management.	[R]
C503.2	Understand the fundamentals of total quality management and its tools.	[U]
C503.3	Elaborate the role of TQM tools and techniques in elimination of wastes and reduction of defects.	[AP]
C503.4	Inculcate the concepts of quality and continuous improvement as a passion and habit.	[AP]

Course Contents:

Module I

TQM KITEMARKS – Evolution of TQM, Quality Guru's – Edward Deming, Joseph Juran. Product Design and Analysis: Basic design concepts and TQM, Failure Mode Effect Analysis, Fault Tree Analysis, Design for Robustness, Value Analysis.

(12 Hours)

Module II

Modern Production Management Tools – Q7 Tools, New Q7 Tools, Quality Function Deployment, Kaizen, 5S, Poka-Yoke, SMED

(12 Hours)

Module II

Quality Management Systems: Quality Management Systems, Introduction to ISO9000, TS16949:2002 and EMS14001 certifications. OHSAS 18001 Occupational Health & Safety Assessment Series.

(12 Hours)

Total Hours: 36

Reference

1	Dale H. Besterfiled, et al., "Total quality Management", Pearson Education Asia
2	Taha H.A, "Operation Research", Pearson Education

Service Courses

23ME111	ENGINEERING GRAPHICS	1/0/4/3
Nature of Course	Practical application	
Pre-Requisites	-	

Course Objectives:

1	To understand the method to construct the conic curves used in engineering applications.
2	To study the conversion of Isometric to orthographic views and vice versa.
3	To learn the basic projection of straight lines and plane surfaces.
4	To develop the imagination of solids inclined to one reference plane.
5	To understand the development of surfaces used in various fields.

Course Outcomes:
Upon completion of the course, students shall have ability to

C111.1	Describe the basic concepts of engineering graphics.	[U]
C111.2	Sketch isometric projections and orthographic projections from pictorial views	[Ap]
C111.3	Draw the projections of lines, planes and solids.	[Ap]
C111.4	Develop lateral surfaces of solids including prisms and pyramids	[A]
C111.5	Construct projections of lines, planes, solids and isometric views using modelling software.	[Ap]

Course Contents:

Concepts and conventions: Drafting instruments, BIS conventions, drawing sheets, general principles of projection in quadrants: First angle projection – Third angle projection - Layout of views- Lettering and Dimensioning.

S.No	List of Experiments	CO Mapping	RBT
1	Introduction to drafting software.	C111.1	U
2	Construction of conic curves (Ellipse, Parabola and Hyperbola)	C111.1	U
3	Construction of special curves (Cycloid and Involutes)	C111.1	U
4	Isometric to orthographic projections – manual sketches	C111.2	Ap
5	Isometric to orthographic projections – software sketches	C111.2	Ap
6	Projection of lines - inclined to HP, VP and Both HP & VP	C111.3	Ap
7	Projection of plane surfaces (Hexagon, Pentagon and circle) – inclined to any one of the principle planes	C111.3	Ap
8	Projection of solids (Prism and Pyramid) – inclined to HP	C111.4	Ap
9	Projection of solids (Cone and Cylinder) – inclined to VP	C111.4	Ap
10	Development of surfaces (Prism, Pyramid, Cone and Cylinder)	C111.5	A
11	Introduction to Perspective projection	C111.5	A
	Total Hours:		**75**

Reference Books:

1	Varghese P.I., “Engineering Drawing”, McGraw Hill Education Pvt. Ltd., 3e-2019.
2	K. V. Natarajan, “A Text Book of Engineering Graphics", Dhanalakshmi Publishers, 2018.
3	Basant Agarwal and C M Agarwal. “Engineering Drawing”, 2e, McGraw Hill Education, 2019.
4	Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2018.

Web References:

1	http://nptel.ac.in/courses/112102101/
2	www.solidworks.com

Continuous Assessment									End Semester Examination	Total
Theory				Practical			Total (A+B)	Total Continuous Assessment		
Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Total (B)				
80	120	200	100	75	25	100	200	50	50	100

Formative Assessment based on Capstone Model - Theory

Course Outcome	Bloom's Level	Assessment Component	FA (10%) [80 Marks]
C111.1	Understand	Assignment	20
C111.2	Apply	Assignment	20
C111.3	Apply	Assignment	20
C111.5	Apply		
C111.4	Analyze	Assignment	20

Assessment based on Summative and End Semester Examination - Theory

Bloom's Level	Summative Assessment (15%) [120 Marks]	
	CIA1: (60 Marks)	CIA2: (60 Marks)
Remember	30	30
Understand	30	30
Apply	20	20
Analyse	20	20
Evaluate	-	-
Create	-	-

Assessment based on Continuous and End Semester Examination - Practical

Bloom's Level	Continuous Assessment (25%) [100 Marks]		End Semester Examination (50%) [100 Marks]
	FA: (75 Marks)	SA: (25 Marks)	
Remember	30	30	30
Understand	30	30	30
Apply	20	20	20
Analyse	20	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination												
Continuous Assessment (50%)												End Semester Examination (50%)
CA 1 (100 Marks)				CA 2 (100 Marks)				Practical Exam (100 Marks)				Practical Examination (50%)
SA 1 (60M)	FA 1			SA 2 (60 M)	FA 2			FA (75 M)	SA (25 M)			
	Component -I (20 Marks)	Component -II (20 Marks)			Component -I (20 Marks)	Component -II (20 Marks)						

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)												
COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
C111.1	3		1							3		
C111.2	3		1							3		
C111.3	3		1							3		
C111.4	3		1							3		
C111.5	3		1		3					3		

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed