We Make You Shine

St. JOSEPH'S INSTITUTE OF TECHNOLOGY

(An Autonomous Institution)

St. Joseph's Group of Institutions

OMR, Chennai - 119

DEPARTMENT OF MECHANICAL ENGINEERING

B.E. MECHANCAL ENGINEERING

REGULATIONS -2022

(CHOICE BASED CREDIT SYSTEM)

CURRICULUM AND SYLLABI

I to VIII Semester

DEPARTMENT OF MECHANICAL ENGINEERING

Vision of the Program

- To provide knowledge centered education and prepare students for meeting global mechanical engineering challenges thereby enabling them to contribute for the prosperity of the society.

Mission of the Program

- To impart quality education in the field of mechanical engineering through teaching and learning process.
- To promote students awareness about the importance of professional ethical practices.
- To enrich the knowledge in mechanical engineering through research and innovation.
- To inculcate the spirit of entrepreneurship among students.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Graduates of Mechanical engineering program will have a successful career in Mechanical Engineering and allied industries.

PEO2: Graduates of Mechanical engineering program will have expertise in the areas of Design, Thermal, Materials and Manufacturing.

PEO3: Graduates of Mechanical engineering program will contribute towards technological development through academic research and industrial practices.

PEO4: Graduates of Mechanical engineering program will practice their profession with good communication, leadership, ethics and social responsibility.

PEO5: Graduates of Mechanical engineering program will adapt to evolving technologies through life-long learning.

PROGRAMME OUTCOMES (POs)

PO **GRADUATE ATTRIBUTES**

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 solution for complex engineering problems and design systems components or process 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. **Environmental 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 (PSOs)

PSO 1: Ability to implement new ideas in various fields such as thermal, industrial and product design & development while ensuring best manufacturing practices.

PSO 2: Ability to lead professional career in industries or an entrepreneur by applying engineering and management principles and practices.

PEO / PO MAPPING:

Programme Educational Objectives	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
PEO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PEO2	✓	✓	✓	✓	✓	✓	✓	✓	-	-	-	✓	✓	-
PEO3	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	✓	✓	✓
PEO4	-	-	✓	-	-	✓	✓	✓	✓	✓	✓	✓	-	✓
PEO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

DEPARTMENT MECHANICAL ENGINEERING
B.E. MECHANICAL ENGINEERING
REGULATIONS - 2022
(CHOICE BASED CREDIT SYSTEM)
CURRICULA AND SYLLABI
SEMESTER I

S. No.	Course Code	Subject Name	Category	Periods per week			Contact Periods	Credits
				L	T	P		
1	IP4151	Induction Programme	–	–	–	–	–	**0**
THEORY								
2	HS4101	Communicative English	HSMC	3	0	0	3	3
3	MA4102	Engineering Mathematics	BSC	3	1	0	4	4
4	PH4103	Engineering Physics	BSC	3	0	0	3	3
5	CY4104	Engineering Chemistry	BSC	3	0	0	3	3
6	GE4105	Problem Solving and Python Programming	ESC	3	0	0	3	3
7	GE4106	Engineering Graphics	ESC	2	0	4	6	4
8	GE4151	தமிழர் மரபு / Heritage of Tamils	HSMC	1	0	0	1	1
PRACTICALS								
9	GE4107	Python Programming Laboratory	ESC	0	0	4	4	2
10	BS4108	Physics and Chemistry Laboratory	BSC	0	0	4	4	2
			Total	**18**	**1**	**12**	**31**	**25**

SEMESTER II

S. No.	Course Code	Subject Name	Category	Periods per week			Contact Periods	Credits
				L	T	P		
THEORY								
1	HS4201	Professional English	HSMC	3	0	0	3	3
2	MA4202	Statistics and Numerical Methods	BSC	3	1	0	4	4
3	PH4253	Materials Science	BSC	3	0	0	3	3
4	GE4204	Environmental Science and Engineering	BSC	3	0	0	3	3
5	BE4251	Basic Electrical and Electronics Engineering	ESC	3	0	0	3	3
6	GE4206	Engineering Mechanics	ESC	3	1	0	4	4
7	GE4251	தமிழரும் தொழில் நுட்பமும்/ Tamils and Technology	HSMC	1	0	0	1	1
PRACTICALS								
8	GE4207	Engineering Practices Laboratory	ESC	0	0	4	4	2
9	BE4258	Basic Electrical and Electronics Engineering Laboratory	ESC	0	0	4	4	2
			Total	**19**	**2**	**8**	**29**	**25**

SEMESTER III

S. No.	Course Code	Subject Name	Category	Periods per week			Contact Periods	Credits
				L	T	P		
THEORY								
1	MA4352	Transforms and Complex functions	BSC	3	1	0	4	4
2	ME4301	Fluid Mechanics and Machinery	ESC	3	0	0	3	3
3	ME4302	Engineering Thermodynamics	PCC	3	1	0	4	4
4	ME4303	Manufacturing Processes	PCC	3	0	0	3	3
5	ME4304	Engineering Materials and Metallurgy	PCC	3	0	0	3	3
PRACTICALS								
6	ME4306	Computer Aided Machine Drawing Laboratory	ESC	0	0	4	4	2
7	ME4307	Manufacturing Processes Laboratory	PCC	0	0	4	4	2
8	HS4310	Professional Skills	HSMC	0	0	2	2	1
			Total	**15**	**2**	**10**	**27**	**22**

SEMESTER IV

S. No.	Course Code	Subject Name	Category	Periods per week			Contact Periods	Credits
				L	T	P		
THEORY								
1	MA4401	Probability and Statistics	BSC	3	1	0	4	4
2	ME4401	Strength of Materials	ESC	3	0	0	3	3
3	ME4402	Thermal Engineering	PCC	3	0	0	3	3
4	ME4403	Hydraulics and Pneumatics	PCC	3	0	0	3	3
5	ME4404	Metal Cutting and Machine Tools	PCC	3	0	0	3	3
6	ME4405	Metrology and Measurements	PCC	3	0	0	3	3
PRACTICALS								
7	ME4406	Strength of Materials and Fluid Machinery Laboratory	ESC	0	0	4	4	2
8	ME4407	Internal Combustion Engineering Laboratory	PCC	0	0	4	4	2
9	ME4408	Machine Tools Laboratory	PCC	0	0	4	4	2
			Total	**18**	**1**	**12**	**31**	**25**

SEMESTER V								
S. No.	**Course Code**	**Subject Name**	**Category**	**Periods per week**			**Contact Periods**	**Credits**
				L	**T**	**P**		
THEORY								
1	ME4501	Design of Machine Elements	PCC	3	1	0	4	4
2	ME4502	Theory of Machines	PCC	3	0	0	3	3
3		Professional Elective Course – I	PEC	3	0	0	3	3
4		Professional Elective Course – II	PEC	3	0	0	3	3
5		Professional Elective Course – III	PEC	3	0	0	3	3
6		Mandatory Course - I	MC	3	0	0	3	0
PRACTICALS								
7	ME4507	Metrology and Dynamics Laboratory	PCC	0	0	4	4	2
8	ME4508	CAD/CAM Laboratory	PCC	0	0	4	4	2
9	ME4509	Summer Internship*	EEC	0	0	0	0	1
			Total	**18**	**1**	**8**	**27**	**21**

**Summer Internship carries one credit and it will be done during IV semester summer vacation and same will be evaluated in V semester.*

SEMESTER VI								
S. No.	**Course Code**	**Subject Name**	**Category**	**Periods per week**			**Contact Periods**	**Credits**
				L	**T**	**P**		
THEORY								
1	ME4601	Heat and Mass Transfer	PCC	3	1	0	4	4
2	CS4655	C Programming and Basics of Data Structures	ESC	3	0	0	3	3
3		Professional Elective Course – IV	PEC	3	0	0	3	3
4		Professional Elective Course – V	PEC	3	0	0	3	3
5		Professional Elective Course – VI	PEC	3	0	0	3	3
6		Mandatory Course - II	MC	3	0	0	3	0
PRACTICALS								
7	CS4657	C Programming and Data Structures Laboratory	ESC	0	0	4	4	2
8	ME4608	Heat Transfer, Refrigeration and Air-Conditioning Laboratory	PCC	0	0	4	4	2
9	ME4609	Design and Fabrication Project	EEC	0	0	4	4	2
			Total	**18**	**1**	**12**	**31**	**22**

SEMESTER VII								
S. No.	**Course Code**	**Subject Name**	**Category**	**Periods per week**			**Contact Periods**	**Credits**
				L	**T**	**P**		
THEORY								
1	ME4701	Mechatronics	PCC	3	0	0	3	3
2	ME4702	Computer Integrated Manufacturing	PCC	3	0	0	3	3
3	GE4791	Human Values and Ethics	HSMC	3	0	0	3	3
4		Professional Elective Course – VII	PEC	3	0	0	3	3
5		Open Elective Course – I	OEC	3	0	0	3	3
PRACTICALS								
6	ME4707	Simulation and Analysis Laboratory	PCC	0	0	4	4	2
7	ME4708	Mechatronics Laboratory	PCC	0	0	4	4	2
			Total	**15**	**0**	**8**	**23**	**19**

SEMESTER VIII								
S. No.	**Course Code**	**Subject Name**	**Category**	**Periods per week**			**Contact Periods**	**Credits**
				L	**T**	**P**		
THEORY								
1	GE4792	Industrial Management	HSMC	3	0	0	3	3
2		Open Elective Course – II	OEC	0	0	0	3	3
PRACTICALS								
3	ME4807	Project Work	EEC	0	0	20	20	10
			Total	**3**	**0**	**20**	**26**	**16**

TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE = 175

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES (HSMC)								
S. No.	**Course Code**	**Subject Name**	**Category**	**Periods per week**			**Contact Periods**	**Credits**
				L	**T**	**P**		
1	HS4101	Communicative English	HSMC	3	0	0	3	3
2	HS4201	Professional English	HSMC	3	0	0	3	3
3	HS4310	Professional Skills	HSMC	0	0	2	2	1
4	GE4791	Human Values and Ethics	HSMC	3	0	0	3	3
5	GE4204	Environmental Science and Engineering	HSMC	3	0	0	3	3
6	GE4792	Industrial Management	HSMC	3	0	0	3	3
7	MB4741	Total Quality Management	HSMC	3	0	0	3	3
8	GE4151	தமிழர் மரபு / Heritage of Tamils	HSMC	1	0	0	1	1
9	GE4251	தமிழரும் தொழில் நுட்பமும்/ Tamils and Technology	HSMC	1	0	0	1	1

BASIC SCIENCE COURSES (BSC)								
S. No.	**Course Code**	**Subject Name**	**Category**	**Periods per week**			**Contact Periods**	**Credits**
				L	**T**	**P**		
1	MA4102	Engineering Mathematics	BSC	4	0	0	4	4
2	PH4103	Engineering Physics	BSC	3	0	0	3	3
3	CY4104	Engineering Chemistry	BSC	3	0	0	3	3
4	BS4108	Physics and Chemistry Laboratory	BSC	0	0	4	4	2
5	MA4202	Statistics and Numerical Methods	BSC	4	0	0	4	4
6	PH4253	Materials Science	BSC	3	0	0	3	3
7	MA4352	Transforms and Complex functions	BSC	4	0	0	4	4
8	MA4401	Probability and Statistics	BSC	4	0	0	4	4

ENGINEERING SCIENCE COURSES (ESC)								
S. No.	Course Code	Subject Name	Category	Periods per week			Contact Periods	Credits
				L	T	P		
1	GE4105	Problem Solving and Python Programming	ESC	3	0	0	3	3
2	GE4106	Engineering Graphics	ESC	2	0	4	6	4
3	GE4107	Python Programming Laboratory	ESC	0	0	4	4	2
4	BE4251	Basic Electrical, Electronics Engineering	ESC	0	0	4	2	2
5	GE4206	Engineering Mechanics	ESC	3	1	0	4	4
6	GE4207	Engineering Practices Laboratory	ESC	0	0	4	4	2
7	BE4258	Basic Electrical, Electronics Engineering Laboratory	ESC	0	0	4	2	2
8	ME4301	Fluid Mechanics and Machinery	ESC	3	0	0	3	3
9	ME4306	Computer Aided Machine Drawing Laboratory	ESC	0	0	4	4	2
10	ME4401	Strength of Materials	ESC	3	0	0	3	3
11	ME4406	Strength of Materials and Fluid Machinery Laboratory	ESC	0	0	4	4	2
12	CS4655	C Programming and Basics of Data Structures	ESC	3	0	0	3	3
13	CS4657	C Programming and Data Structures Laboratory	ESC	0	0	4	4	2

PROFESSIONAL CORE COURSES (PCC)								
S. No.	Course Code	Subject Name	Category	Periods per week			Contact Periods	Credits
				L	T	P		
1	ME4302	Engineering Thermodynamics	PCC	3	1	0	4	3
2	ME4303	Manufacturing Processes	PCC	3	0	0	3	3
3	ME4304	Engineering Materials and Metallurgy	PCC	3	0	0	3	3
4	ME4307	Manufacturing Processes Laboratory	PCC	0	0	4	4	2
5	ME4402	Thermal Engineering	PCC	3	0	0	3	3
6	ME4403	Hydraulics and Pneumatics	PCC	3	0	0	3	3
7	ME4404	Metal Cutting and Machine Tools	PCC	3	0	0	3	3
8	ME4405	Metrology and Measurements	PCC	3	0	0	3	3

9	ME4407	Internal Combustion Engineering Laboratory	PCC	0	0	4	4	2
10	ME4408	Machine Tools Laboratory	PCC	0	0	4	4	2
11	ME4501	Design of Machine Elements	PCC	3	1	0	4	4
12	ME4502	Theory of Machines	PCC	3	0	0	3	3
13	ME4507	Metrology and Dynamics Laboratory	PCC	0	0	4	4	2
14	ME4508	CAD/CAM Laboratory	PCC	0	0	4	4	2
15	ME4601	Heat and Mass Transfer	PCC	3	1	0	4	4
16	ME4608	Heat Transfer, Refrigeration and Air-Conditioning Laboratory	PCC	0	0	4	4	2
17	ME4701	Mechatronics	PCC	3	0	0	3	3
18	ME4702	Computer Integrated Manufacturing	PCC	3	0	0	3	3
19	ME4707	Simulation and Analysis Laboratory	PCC	0	0	4	4	2
20	ME4708	Mechatronics Laboratory	PCC	0	0	4	4	2

EMPLOYABILITY ENHANCEMENT COURSES (EEC)								
S. No.	**Course Code**	**Subject Name**	**Category**	**Periods per week**			**Contact Periods**	**Credits**
				L	**T**	**P**		
1	ME4509	Summer Internship*	EEC	0	0	0	0	1
2	ME4609	Design and Fabrication Project	EEC	0	0	3	4	2
3	ME4807	Project Work	EEC	0	0	20	20	10

SEMESTER V **MANDATORY COURSES I**								
S. No.	**Course Code**	**Subject Name**	**Category**	**Periods per week**			**Contact Periods**	**Credits**
				L	**T**	**P**		
1	MX4001	Introduction to Women and Gender Studies	MC	3	0	0	3	0
2	MX4002	Elements of Literature	MC	3	0	0	3	0
3	MX4003	Personality Development through Life Enlightment Skills	MC	3	0	0	3	0
4	MX4004	Disaster Management	MC	3	0	0	3	0

SEMESTER VI								
MANDATORY COURSES II								
S. No.	**Course Code**	**Subject Name**	**Category**	**Periods per week**			**Contact Periods**	**Credits**
				L	**T**	**P**		
1	MX4005	Well Being with Traditional Practices	MC	3	0	0	3	0
2	MX4006	History of Science and Technology in India	MC	3	0	0	3	0
3	MX4007	Political and Economic Thought for a Humane Society	MC	3	0	0	3	0
4	MX4008	Industrial Safety	MC	3	0	0	3	0

PROFESSIONAL ELECTIVE COURSES (PEC) :VERTICALS								
VERTICAL 1 : PRODUCT AND PROCESS DEVELOPMENT								
S. No.	**Course Code**	**Subject Name**	**Category**	**Periods per week**			**Contact Periods**	**Credits**
				L	**T**	**P**		
1	ME4511	Value Engineering	PEC	3	0	0	3	3
2	ME4512	CAD/CAM	PEC	3	0	0	3	3
3	ME4513	Ergonomics in Design	PEC	3	0	0	3	3
4	ME4514	New Product Development	PEC	3	0	0	3	3
5	ME4515	Product Life Cycle Management	PEC	3	0	0	3	3

VERTICAL 2 : ROBOTICS AND AUTOMATION								
S. No.	**Course Code**	**Subject Name**	**Category**	**Periods per week**			**Contact Periods**	**Credits**
				L	**T**	**P**		
1	ME4521	Sensors and Instrumentation	PEC	3	0	0	3	3
2	ME4522	Electrical Drives and Actuators	PEC	3	0	0	3	3
3	ME4523	Embedded Systems and Programming	PEC	3	0	0	3	3
4	ME4524	Robotics	PEC	3	0	0	3	3
5	ME4525	Automation in Manufacturing	PEC	3	0	0	3	3

VERTICAL 3 : PROCESS EQUIPMENT AND PIPING DESIGN								
S. No.	**Course Code**	**Subject Name**	**Category**	**Periods per week**			**Contact Periods**	**Credits**
				L	**T**	**P**		
1	ME4531	Non-Destructive Testing Techniques	PEC	3	0	0	3	3
2	ME4532	Plant Layout and Materials Handling	PEC	3	0	0	3	3
3	ME4533	Safety In Material Handling	PEC	3	0	0	3	3
4	ME4534	Process Equipment Design	PEC	3	0	0	3	3
5	ME4535	Design of Pressure Vessels	PEC	3	0	0	3	3

VERTICAL 4 : DIVERSIFIED COURSES GROUP 1								
S. No.	**Course Code**	**Subject Name**	**Category**	**Periods per week**			**Contact Periods**	**Credits**
				L	**T**	**P**		
1	ME4541	Automobile Engineering	PEC	3	0	0	3	3
2	ME4542	Automotive Materials, Components, Design and Testing	PEC	3	0	0	3	3
3	ME4543	Power Plant Engineering	PEC	3	0	0	3	3
4	ME4544	Refrigeration and Air Conditioning	PEC	3	0	0	3	3
5	ME4545	Power Generation Equipment Design	PEC	3	0	0	3	3

VERTICAL 5 : DIVERSIFIED COURSES GROUP II								
S. No.	**Course Code**	**Subject Name**	**Category**	**Periods per week**			**Contact Periods**	**Credits**
				L	**T**	**P**		
1	ME4551	Electrical Drives and Control	PEC	3	0	0	3	3
2	ME4552	Turbo Machines	PEC	3	0	0	3	3
3	ME4553	Design of Transmission Systems	PEC	3	0	0	3	3
4	ME4554	Finite Element Analysis	PEC	3	0	0	3	3
5	ME4555	Design for Manufacturing	PEC	3	0	0	3	3

VERTICAL 6 : DIVERSIFIED COURSES GROUP III								
S. No.	**Course Code**	**Subject Name**	**Category**	**Periods per week**			**Contact Periods**	**Credits**
				L	**T**	**P**		
1	ME4561	Advanced Internal Combustion Engines	PEC	3	0	0	3	3
2	ME4562	Process Planning and Cost Estimation	PEC	3	0	0	3	3
3	ME4563	Gas Dynamics and Jet Propulsion	PEC	3	0	0	3	3
4	ME4564	Operational Research	PEC	3	0	0	3	3
5	ME4565	Casting and Welding Processes	PEC	3	0	0	3	3

VERTICAL 7 : DIVERSIFIED COURSES GROUP IV								
S. No.	**Course Code**	**Subject Name**	**Category**	**Periods per week**			**Contact Periods**	**Credits**
				L	**T**	**P**		
1	ME4571	Measurements and Controls	PEC	3	0	0	3	3
2	ME4572	Environment Sustainability and Impact Assessment	PEC	3	0	0	3	3
3	ME4573	Lean Manufacturing	PEC	3	0	0	3	3
4	ME4574	Composite Materials and Mechanics	PEC	3	0	0	3	3
5	ME4551	Non-traditional Machining Processes	PEC	3	0	0	3	3

OPEN ELECTIVE COURSES (OEC)								
SEMESTER VII								
OPEN ELECTIVE I								
S. No.	**Course Code**	**Subject Name**	**Category**	**Periods per week**			**Contact Periods**	**Credits**
				L	**T**	**P**		
1	OEC414	Basics of Biomedical Instrumentation	OEC	3	0	0	3	3
2	OEC412	Foundation of Robotics	OEC	3	0	0	3	3
3	OIT411	Fundamentals of Database Design	OEC	3	0	0	3	3
4	OMA426	Resource Management Techniques	OEC	3	0	0	3	3
5	OEE411	Renewable Energy Systems	OEC	3	0	0	3	3
6	OMA411	Graph Theory and Its Application	OEC	3	0	0	3	3
7	OAD432	Deep Learning	OEC	3	0	0	3	3
8	OEC411	IoT Concepts and Applications	OEC	3	0	0	3	3
9	OCS422	Machine Learning Techniques	OEC	3	0	0	3	3

SEMESTER VIII OPEN ELECTIVE II								
S. No.	**Course Code**	**Subject Name**	**Category**	**Periods per week**			**Contact Periods**	**Credits**
				L	**T**	**P**		
1	OEE423	Control Systems	OEC	3	0	0	3	3
2	OEE421	Electric and Hybrid Vehicle	OEC	3	0	0	3	3
3	OME423	Additive Manufacturing	OEC	3	0	0	3	3
4	OME427	Reverse Engineering	OEC	3	0	0	3	3
5	OMB413	Digital Marketing	OEC	3	0	0	3	3
6	OAD414	Artificial Intelligence and Machine Learning	OEC	3	0	0	3	3
7	OCS423	Augmented and Virtual Reality	OEC	3	0	0	3	3
8	OAD422	Data Science Fundamentals	OEC	3	0	0	3	3
9	OME416	Testing of Materials	OEC	3	0	0	3	3

Credits Distribution

S. No.	Subject Area	Credits Per Semester								Total Credits	Percentage %
		I	II	III	IV	V	VI	VII	VIII		
1	**Humanities, Science & Management Courses (HSMC)**	4	4	1	-	-	-	3	3	15	**8.57**
2	**Basic Science Courses (BSC)**	12	10	4	4	-	-	-	-	30	**17.14**
3	**Engineering Science Courses (ESC)**	9	11	5	5	-	5	-	-	35	**20.00**
4	**Professional Cores Courses (PCC)**	-	-	12	16	11	6	10	-	55	**31.43**
5	**Professional Elective Courses (PEC)**	-	-	-	-	9	9	3	-	21	**12.00**
6	**Open Elective Courses (OEC)**	-	-	-	-	-	-	3	3	6	**3.43**
7	**Employability Enhancement Courses (EEC)**	-	-	-	-	1	2	-	10	13	**7.43**
8	**Mandatory (MC) / Summer Internship (SI)**	-	-	-	√	√	√	-	-	-	-
	Total	**25**	**25**	**22**	**25**	**21**	**22**	**19**	**16**	**175**	**100**

Semester Wise Course Details

S. No.	Semester	Theory	Laboratory	Mini Project	Project	MC	SI	Total
1	**I**	7	2	-	-	-	-	9
2	**II**	7	2	-	-	-	-	9
3	**III**	5	3	-	-	-	-	8
4	**IV**	6	3	-	-	-	-	9
5	**V**	5	2	-	-	1	1	9
6	**VI**	5	2	1	-	1	-	9
7	**VII**	5	2	-	-	-	-	7
8	**VIII**	2	-	-	1	-	-	3
Total		**42**	**16**	**1**	**1**	**2**	**1**	**63**

ENROLLMENT FOR B.E. / B. TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree.

For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only.

For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes, Moreover, for minor degree the student can register for courses from any one of the following verticals also.

VERTICALS FOR MINOR DEGREE

(In addition to all the verticals of other programmes)

Vertical I	**Vertical II**	**Vertical III**	**Vertical IV**	**Vertical V**
Fintech and Block Chain	**Entrepreneurship**	**Public Administration**	**Business Data Analytics**	**Environment and Sustainability**
Financial Management	Foundations of Entrepreneurship	Principles of Public Administration	Statistics for Management	infrastructure Development
Fundamentals of Investment	Team Building and Leadership Management for Business	Constitution of India	Datamining for Business Intelligence	Sustainable Agriculture and Environmental Management
Banking, Financial Services and Insurance	Creativity and Innovation in Entrepreneurship	Insurance Public Personnel Administration	Human Resource Analytics	Sustainable Bio Materials
Introduction to Blockchain and its Applications	Principles of Marketing Management for Business	Administrative Theories	Marketing and Social Media Web Analytics	Materials for Energy Sustainability
Fintech Personal Finance and Payments	Human Resource Management for Entrepreneurs	Indian Administrative System	Operation and Supply Chain Analytics	Green Technology
Introduction to Fintech	Financing New Business Ventures	Public Policy Administration	Financial Analytics	Environmental Quality Monitoring and Analysis
				Integrated Energy Planning for Sustainable Development
				Energy Efficiency for Sustainable Development

Department of Mechanical Engineering

LIST OF VALUE ADDED COURSES

S No	Sub Code	Title	Credits
1	MVA001	Small Unmanned Aerial Vehicle (SUAV) - Drone	2
2	MVA002	3D Printing	2
3	MVA003	Elements of Automation and Process Control	1
4	MVA004	Geometric Dimensioning and Tolerancing	2
5	MVA005	Smart Materials and Structures	2
6	MVA006	Green Energy Technologies and Management	2
7	MVA007	Automation Suite for Smart Systems	2
8	MVA008	IoT Applications in Mechanical Engineering	1
9	MVA009	Surface Coating Technology	2
10	MVA010	Energy Resources and Management	2
11	MVA011	Modeling for Design Engineers	2
12	MVA012	Basic Concept of HVAC Designing and Drafting	2
13	MVA013	Robotics Process Automation	2
14	MVA014	Welding and Inspection Techniques	2
15	MVA015	Modern Trends in Refrigeration and Air Conditioning	2
16	MVA016	Finite Element Meshing Techniques	2
17	MVA017	Nanoscience and Technology	2
18	MVA018	Plant Design Management System	2
19	MVA019	Technology for Energy Storage	2
20	MVA020	Modeling Practice for Automotive Assemblies	2
21	MVA021	Modeling and Machining Practice for CNC Machines	2
22	MVA022	Introduction to Multi Body Dynamics	2
23	MVA023	IoT and Augmented Reality Applications in Mechanical Engineering	2

HS4101	COMMUNICATIVE ENGLISH	L	T	P	C
		3	0	0	3

OBJECTIVES

- To develop listening skills to comprehend lectures, ask questions and seek clarifications
- To improve speaking skills to speak fluently in real contexts
- To hone reading skills to comprehend different types of texts
- To enhance writing skills to convey their ideas effectively
- To strengthen the grammar and general vocabulary

UNIT I	LISTENING TO CONVERSATIONS AND SPEECHES	9
Listening – short texts – short formal and informal conversations; Speaking – basics of speaking – introducing oneself – exchanging information – speaking on given topics & situations; Reading – critical reading – finding key information in a given text – sifting facts from opinions; Writing – autobiographical writing – developing hints; Language development – Parts of speech – articles – voices – Question types: wh- and yes/no; Vocabulary development – prefixes – suffixes – Polite Expressions.		CO1
UNIT II	**SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS**	**9**
Listening – TED talks – extensive speech on current affairs and discussions; Speaking – describing a simple process – asking and answering questions; Reading – short narratives and descriptions from newspapers –Reading comprehension texts with varied question types – Writing – paragraph writing – topic sentence – main ideas– free writing, short narrative descriptions using suggested vocabulary and structures – Language development – prepositions, clauses; Vocabulary development– guessing meanings of words in context – use of sequence words.		CO2
UNIT III	**READING FOR COMPREHENSION**	**9**
Listening – Listening to TED talks and long speeches for comprehension; Speaking – roleplay – asking about routine actions and expressing opinions; Reading– short texts and longer passages (cloze reading) & critical analysis of a text; Writing – types of paragraphs and writing essays – rearrangement of jumbled sentences; Language development – degrees of comparison – pronouns – Direct vs; Indirect Questions; Vocabulary development – idioms and phrases– cause & effect expressions, adverbs.		CO3
UNIT IV	**FREE WRITING AND EXTENDED WRITING**	**9**
Listening – Listening comprehension for English proficiency tests; Speaking –describing friends/places/hobbies; Reading – comprehension – reading longer texts – reading different types of texts – magazines; Writing – informal letter writing – e–mails – conventions of personal email; Language development – Tenses – Simple present – simple past– present continuous and past continuous – conditionals; Vocabulary development– synonyms – antonyms – single word substitutes – Collocations.		CO4
UNIT V	**GRAMMAR AND LANGUAGE DEVELOPMENT**	**9**
Listening – popular speeches and presentations; Speaking – impromptu speeches & debates; Reading – comparisons and contrast; Writing – brainstorming – writing short essays – developing an outline – identifying main and subordinate ideas – dialogue writing; Language development – modal verbs – present/ past perfect tense; Vocabulary development – Phrasal verbs– fixed and semi–fixed expressions.		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Sanjay Kumar & Pushp Lata Communication Skills Second Edition, Oxford University Press: 2015.
2. Board of Editors. Using English, A Coursebook for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2020
3. Richards, C. Jack. Interchange Students 'Book–2 New Delhi: CUP, 2015.

REFERENCE BOOKS

1. Bailey, Stephen. Academic Writing: A Practical Guide for Students. New York: Rutledge,2011.
2. Means, L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage Learning, USA: 2007
3. Redston, Chris & Gillies Cunningham Face 2 Face (Pre–intermediate Student's Book & Workbook) Cambridge University Press, New Delhi: 2005
4. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
5. Dutt P. Kiranmai and Rajeevan Geeta Basic Communication Skills, Foundation Books: 2013
6. John Eastwood et al: Be Grammar Ready: The Ultimate Guide to English Grammar, Oxford University Press: 2020. .

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Listen and comprehend different spoken discourses/excerpts
CO2	Speak clearly and confidently with one or many listeners using appropriate communicative strategies
CO3	Read different genres of texts adopting various reading strategies
CO4	Write coherently and flawlessly on different topics
CO5	Communicate using a wide vocabulary without grammatical errors

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	–	–	–	–	–	–	–	–	2	3	–	–	2	2
CO2	–	1	–	2	–	–	–	–	–	3	–	–	2	2
CO3	–	2	–	3	–	–	–	–	–	2	–	–	2	2
CO4	–	–	–	–	–	–	–	–	2	2	–	–	2	2
CO5	–	2	1	1	2	–	2	–	–	3	–	–	3	3

MA4102	ENGINEERING MATHEMATICS	L	T	P	C
		3	1	0	4

OBJECTIVES

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

UNIT I	**MATRICES**	**9+3**
Characteristic equation - Cayley-Hamilton theorem (without proof) - Eigenvalues and Eigenvectors of a real matrix – Properties of Eigenvalues and Eigenvectors – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.		**CO1**
UNIT II	**DIFFERENTIAL CALCULUS**	**9+3**
Limit of a function - Continuity - Derivatives - Differentiation rules – Interval of increasing and decreasing functions – Maxima and Minima - Intervals of concavity and convexity.		**CO2**
UNIT III	**FUNCTIONS OF SEVERAL VARIABLES**	**9+3**
Partial differentiation – Homogeneous functions and Euler's theorem – Total derivatives – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Maxima and Minima of functions of two variables – Lagrange's method of undetermined multipliers.		**CO3**
UNIT IV	**INTEGRAL CALCULUS**	**9+3**
Definite and Indefinite integrals – Substitution rule – Techniques of Integration – Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.		**CO4**
UNIT V	**MULTIPLE INTEGRALS**	**9+3**
Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Change of variables from cartesian to polar co-ordinates in double integrals – Triple integrals – Volume of solids.		**CO5**
		TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendental", Cengage Learning, 7th Edition, New Delhi,2015. [For Units I & III - Sections 2.2, 2.3, 2.5, 2.7(Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.2 - 7.4 and 7.8].

REFERENCE BOOKS

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., “Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
5. T. Veerarajan, “Engineering Mathematics – I”, McGraw Hill Education; First edition 2017.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the concepts of matrix algebra for analysing practical problems.
CO2	Apply differential calculus tools in solving various application problems.
CO3	Use differential calculus ideas on several variable functions.
CO4	Apply different methods of integration in solving practical problems.
CO5	Evaluate area, volume and other practical problems by multiple integrals.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	1	-	3	-	-	-	-	-	-	2	1	1
CO2	3	3	1	-	3	-	-	-	-	-	-	2	3	2
CO3	3	3	1	-	3	-	-	-	-	-	-	2	3	2
CO4	3	3	1	-	3	-	-	-	-	-	-	2	2	2
CO5	3	3	1	-	3	-	-	-	-	-	-	2	2	1

PH4103	ENGINEERING PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To make the students to understand about the elastic property and stress strain diagram.
- To educate the students about principle of laser and its role in optical fibers and its applicationsas sensors and communication.
- To teach the students about the heat transfer through solids and liquids.
- To educate the students about the quantum concepts and its use to explain black bodyradiation, Compton effect, tunnelling electron microscopy and its applications.
- To make the students to understand the importance of various crystal structures and various growth techniques.

UNIT I	PROPERTIES OF MATTER	9
Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensilestrength – torsional stress and deformations – twisting couple - torsion pendulum: theory andexperiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment – Practical applications of modulus of elasticity-I-shaped girders - stress due to bending in beams.		CO1
UNIT II	**LASER AND FIBER OPTICS**	**9**
Lasers : population of energy levels, Einstein's A and B coefficients derivation — resonant cavity, optical amplification (qualitative) – Nd-YAG Laser-Semiconductor lasers: homojunction and heterojunction — Industrial and medical applications of Laser– Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index,mode) — losses associated with optical fibers — Fabrication of Optical fiber-Double crucible method-fibre optic sensors: pressure and displacement-Industrial and medical applications of optical fiber- Endoscopy-Fiber optic communication system.		CO2
UNIT III	**THERMAL PHYSICS**	**9**
Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation – heat conductions in solids – thermal conductivity – Rectilinear flow of heat- Lee's disc method: theory and experiment - conductionthrough compound media (series and parallel)-Radial flow of heat– thermal insulation – applications: heat exchangers, refrigerators, oven, Induction furnace and solar water heaters.		CO3
UNIT IV	**QUANTUM PHYSICS**	**9**
Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependentequations – particle in a one-dimensional rigid box – Electron microscope-tunnelling (qualitative) - scanning tunnelling microscope-Applications of electron microscopy.		CO4
UNIT V	**CRYSTAL PHYSICS**	**9**
Single crystalline, polycrystalline and amorphous materials — single crystals: unit cell, crystalsystems, Bravais lattices, directions and planes in a crystal, Miller indices — inter-planar distances coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures — Graphite structure-crystal imperfections: point defects, line defects — Burger vectors, stacking faults – growth of single crystals: solution and melt growth techniques- Epitaxial growth-Applications of Single crystal (Qualitative). Crystal structure determination – Laue and powder diffraction method.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS
1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2019. 2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2017. 3. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
REFERENCE BOOKS
1. Tipler, P.A. & Mosca, G. "Physics for Scientists and Engineers with Modern Physics'.W.H.Freeman, 2007. 2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2019. 3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2019.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Gain knowledge on the basics of properties of matter and its applications,
CO2	Acquire knowledge on the concepts of waves and optical devices and their applications in fibreoptics.
CO3	Have adequate knowledge on the concepts of thermal properties of materials and theirapplications in expansion joints and heat exchangers.
CO4	Get knowledge on advanced physics concepts of quantum theory and its applications intunneling microscopes, and
CO5	Understand the basics of crystals, their structures and different crystal growth techniques.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	2	2	1	3	2	1	2	2	2
CO2	3	3	3	2	3	2	2	1	2	2	2	1	3	3
CO3	3	3	2	2	2	1	2	1	2	1	1	2	2	2
CO4	3	3	2	2	2	1	1	1	1	1	1	3	3	3
CO5	3	3	3	3	2	1	2	1	3	1	1	3	3	3

CY4104	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To Study the principles of water characterization and treatment for industrial purposes.
- To apply the principles and applications of surface chemistry and catalysis.
- To learn about Phase rule and various types of alloys.
- To analysis Various types of fuels, applications and combustion.
- To understand Conventional and non–conventional energy sources and energy storage device.

UNIT I	WATER AND ITS TREATMENT	9
Hardness of water– Types – Expression of hardness–Units–Estimation of hardness by EDTA method – Numerical problems on EDTA method – Boiler troubles (scale and sludge, caustic embrittlement, boiler corrosion, priming and foaming)–Treatment of boiler feed water–Internal treatment (carbonate, phosphate, colloidal, sodium aluminate and calgon conditioning)–External treatment–Ion exchange process, Zeolite process–Desalination of brackish water by reverse Osmosis.		CO1
UNIT II	SURFACE CHEMISTRY AND CATALYSIS	9
Surface chemistry: Types of adsorption – Adsorption of gases on solids – Adsorption of solute from solutions– Adsorption isotherms – Freundlich's adsorption isotherm–Langmuir's adsorption isotherm — Kinetics of uni-molecular surface reactions —Adsorption in chromatography – Applications of adsorption in pollution abatement using PAC. **Catalysis**: Catalyst – Types of catalysis – Criteria – Contact theory – Catalytic poisoning and Catalytic promoters – Industrial applications of catalysts – Catalytic convertor – Auto catalysis – Enzyme catalysis – Michaelis – Menten equation.		CO2
UNITIII	PHASE RULE AND ALLOYS	9
Phase rule: Introduction – Definition of terms with examples – One component system–Water system – Reduced phase rule – Thermal analysis and cooling curves – Two component systems–Lead-silver system – Pattinson process. **Alloys**: Introduction– Definition – Properties of alloys – Significance of alloying – Functions and effect of alloying elements – Nichrome , Alnico , Stainless steel (18/8)-Heat treatment of steel – Non-ferrous alloys – Brass and bronze.		CO3
UNIT IV	FUELS AND COMBUSTION	9
Fuels : Introduction – classification of fuels – Comparison of solid, liquid, gaseous fuels – Coal– Analysis of coal (proximate and ultimate). – Carbonization – Manufacture of metallurgical coke (Otto Hoffmann method) – Petroleum – Cracking – Manufacture of synthetic petrol (Bergius process, Fischer Tropsch Process) — Knocking — Octane number — Diesel oil–Cetane number– Compressed natural gas (CNG) – Liquefied petroleum gases (LPG) –Power alcohol and biodiesel. **Combustion of fuels**: Introduction – Calorific value – Higher and lower calorific values –Theoretical calculation of calorific value – Ignition temperature – Spontaneous ignition temperature – Explosive range – Flue gas analysis by Orsat Method.		CO4
UNIT V	NON – CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES	9
Nuclear energy – Fission and fusion reactions – Differences – Chain reactions – Nuclearreactors – Classification of reactors – Light water nuclear reactor for power generation –Breeder reactor — Solar energy conversion — Solar cells — Wind energy — Fuel cells —Hydrogen - oxygen fuel cell. Batteries – Types of batteries – Alkaline batteries – Lead - acid, Nickel – cadmium and Lithium batteries.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. P.C.Jain, Monica Jain, Engineering Chemistry ‖17thEd.DhanpatRaiPub.Co.,New Delhi,(2015).
2. S.S. Dara, S.S. Umare, A text book of Engineering Chemistry ‖ S. Chand &Co. Ltd., New Delhi(2020).
3. P. Kannan , A. Ravi krishnan, Engineering Chemistry ‖,Sri Krishna Hi-tech Publishing Company (P) Ltd. Chennai,(2009).

REFERENCE BOOKS

1. B.K. Sharma – Engineering chemistry ‖ Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. B. Sivasankar – Engineering Chemistry ‖ Tata Mc Graw – Hill Pub. Co .Ltd , New Delhi(2008).
3. Prasanta Rath- Engineering Chemistry ‖ Cengage Learning India (P) Ltd ., Delhi, (2015).
4. Shikha Agarwal – Engineering Chemistry– Fundamentals andApplications ‖ ,Cambridge University press, Delhi,(2015)
5. A. Pahari, B. Chauhan- Engineering Chemistry ‖,Fire wall Media., New Delhi., (2010).
6. Sheik Mideen ., Engineering Chemistry , Airwalk Publications ,Chennai (2018).

COURSE OUT COMES

Upon completion of the course , students will be able to

CO1	Able to understand impurities in industrial water, boiler troubles, internal and external treatment methods of purifying water.
CO2	Able to understand concepts of absorption, adsorption, adsorption isotherms, application of adsorption for pollution abatement, catalysis and enzyme kinetics.
CO3	Able to recognize significance of alloying , functions of alloying elements and types of alloys ,uses of alloys .They should be acquainted with phase rule and reduced phase and its Applications in alloying.
CO4	Able to identify various types of fuels, properties,uses and analysis of fuels. They should be able to understand combustion of fuels, method of preparation of bio-diesel, synthetic petrol.
CO5	Able to understand conventional , non–conventional energy sources , nuclear fission and fusion, power generation by nuclear reactor, wind, solar energy and preparation, uses of various batteries.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAMOUTCOMES(POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	2	3	2	2	2	2	2	2	2
CO2	3	3	2	2	2	2	2	1	1	1	1	2	2	1
CO3	3	3	3	3	3	2	2	1	2	2	2	2	2	2
CO4	3	3	3	2	2	3	3	2	2	3	2	2	3	1
CO5	3	2	3	3	3	3	3	2	2	2	2	2	3	2

GE4105	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To know the basics of algorithmic problem solving
- To write simple python programs
- To develop python program by using control structures and functions
- To use python predefined data structures
- To write file-based program

UNIT I	ALGORITHMIC PROBLEM SOLVING	9
Algorithms, Building blocks of algorithms: statements, state, control flow, functions, Notation: pseudo code, flow chart, programming language, Algorithmic problem solving: Basic algorithms, flowcharts and pseudocode for sequential, decision processing and iterative processing strategies, Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.		**CO1**

UNIT II	INTRODUCTION TO PYTHON	9
Python Introduction, Technical Strength of Python, Python interpreter and interactive mode, Introduction to colab , pycharm and jupyter idle(s) ,Values and types: int, float, boolean, string, and list; Built-in data types, variables, Literals, Constants, statements, Operators: Assignment, Arithmetic, Relational, Logical, Bitwise operators and their precedence, Expressions, tuple assignment, Accepting input from Console, printing statements, Simple Python programs.		**CO2**

UNIT III	CONTROL FLOW, FUNCTIONS AND STRINGS	9
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: while, for; Loop manipulation using pass, break, continue,and else; Modules and Functions: function definition and use, flow of execution, parameters and arguments, local and global scope, return values, function composition, recursion. Strings: string slices, immutability, string functions and methods, string module; Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.		**CO3**

UNIT IV	LISTS, TUPLES, DICTIONARIES	9
Lists: Defining list and list slicing, list operations, list slices, list methods, list loop, list Manipulation, mutability, aliasing, cloning lists, list parameters, lists as arrays. Tuples: tuple assignment, tuple as return value, tuple Manipulation; Dictionaries: operations and methods; advanced list processing — list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.		**CO4**

UNIT V	FILES, MODULES, PACKAGES	9
Files and exception: Concept of Files, Text Files; File opening in various modes and closing of a file, Format Operators, Reading from a file, Writing onto a file, File functions- open(), close(), read(),readline(), readlines(),write(), writelines(),tell(),seek(), Command Line arguments; Errorsand exceptions: handling exceptions; modules, packages; introduction to numpy, matplotlib. Illustrative programs: word count, copy a file.		**CO5**

TOTAL : 45 PERIODS

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/thinkpython/)
2. Guido van Rossum and Fred L. Drake Jr, - An Introduction to Python – Revised andupdated for Python 3.2, Network Theory Ltd., 2011.
3. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford UniversityPress, 2019.

REFERENCE BOOKS

1. John V Guttag, ―Introduction to Computation and Programming Using Python‖, Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, ―Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop algorithmic solutions to simple computational problems
CO2	Develop simple console application in python
CO3	Develop python program by applying control structure and decompose program into functions.
CO4	Represent compound data using python lists, tuples, and dictionaries.
CO5	Read and write data from/to files in Python.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAMOUTCOMES(POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	3	3	3	3	3	2	2	2	3	2	1
CO2	3	2	3	3	2	3	3	3	3	2	2	3	2	2
CO3	3	3	2	2	3	3	2	2	1	2	1	3	2	2
CO4	3	3	3	3	1	2	3	3	2	2	2	2	2	1
CO5	3	2	3	2	3	3	3	2	2	2	2	3	3	2

GE4106	ENGINEERING GRAPHICS	L	T	P	C
		2	0	4	4

OBJECTIVES

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination)		**1**
Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.		
UNIT I	**PLANE CURVES AND FREEHAND SKETCHING**	**7+12**
Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction of involutes of square and circle – Drawing of tangents and normal to the abovecurves. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three-Dimensional objects — Layout of views- Freehand sketching of multiple views from pictorial views of objects		**CO1**
UNIT II	**PROJECTION OF POINTS, LINES AND PLANE SURFACE**	**6+12**
Orthographic projection- principles-Principal Planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.		**CO2**
UNIT III	**PROJECTION OF SOLIDS**	**5+12**
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when theaxis is inclined to one of the principal planes by rotating object method.		**CO3**
UNIT IV	**PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OFSURFACES**	**6+12**
Sectioning of above solids in simple vertical position when the cutting plane is inclined to theone of the principal planes and perpendicular to the other — obtaining true shape of section.Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.		**CO4**
UNIT V	**ISOMETRIC AND PERSPECTIVE PROJECTIONS**	**6+12**
Principles of isometric projection — isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.		**CO5**
		TOTAL : 90 PERIODS

TEXT BOOKS

1. Natarajan K.V., ―A text book of Engineering Graphics‖, Dhanalakshmi Publishers, Chennai,Twenty Ninth Edition 2016
2. Venugopal K. and Prabhu Raja V., ―Engineering Graphics‖, New Age International (P) Limited, 2011.

REFERENCE BOOKS

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2019.
2. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2018.
4. Luzzader, Warren.J. and Duff,John M., ―Fundamentals of Engineering Drawing with an introduction to Interactive Comput er Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N S Parthasarathy and Vela Murali, "Engineering Graphic", Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the fundamentals and standards of Engineering graphics
CO2	Perform freehand sketching of basic geometrical constructions and multiple views of objects
CO3	Understand the concept of orthographic projections of lines and plane surfaces
CO4	Draw the projections of section of solids and development of surfaces
CO5	Visualize and to project isometric and perspective sections of simple solids

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	-	-	-	-	-	-	-	1	1	1	3	2
CO2	3	3	-	-	-	-	-	-	-	1	1	1	3	2
CO3	3	3	-	-	-	-	-	-	-	1	1	1	3	2
CO4	3	3	-	-	-	-	-	-	-	1	1	1	3	2
CO5	3	3	-	-	-	-	-	-	-	1	1	1	3	2

GE4151	தமிழர் மரபு	L	T	P	C
		1	0	0	1

அலகு I	மொழி மற்றும் இலக்கியம்	3

இந்திய மொழிக் குடும்பங்கள் திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி தமிழ் செவ்விலக்கியங்கள்- சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை- சங்க இலக்கியத்தில் பகிர்தல் அறம்- திருக்குறளில் மேலாண்மைக் கருத்துக்கள் தமிழ்க் காப்பியங்கள்- தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம- பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் -தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II	மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை- சிற்பக் கலை	3

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள்- பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள் பொம்மைகள் - தேர் செய்யும் கலை சுடுமண் சிற்பங்கள் நாட்டுப்புறத் தெய்வங்கள்- குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள் - மிருதங்கம். பறை, வீணை, யாழ். நாதஸ்வரம் தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III	நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்: தெருக்கூத்து,	3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம்,. தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV	தமிழர்களின் திணைக் கோட்பாடுகள்	3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் -தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் -தமிழர்கள் போற்றிய அறக்கோட்பாடு -சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி -கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி

அலகு V	இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு	3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம்- சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிகள் தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு

TOTAL: 15 PERIODS

TEXT-CUM REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).

2. கணினித்தமிழ் - முனைவர் இல சுந்தரம் (விகடன் பிரசுரம்).

3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)

4. பொருநை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

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 C ivilization 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

GE4151	HERITAGE OF TAMILS	L	T	P	C
		1	0	0	1

UNIT I	LANGUAGE AND LITERATURE	3

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.

UNIT II	HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE	3

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.

UNIT III	FOLK AND MARTIAL ARTS	3

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV	THINAI CONCEPT OF TAMILS	3

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.

UNIT V	CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIANCULTURE	3

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: 15 PERIODS

TEXT-CUM REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித்தமிழ் - முனைவர் இல சுந்தரம் (விகடன் பிரசுரம்).
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

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 C ivilization 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

GE4107	PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, and dictionaries.
- Read and write data from/to files in Python.

LIST OF EXPERIMENTS

1. Write an algorithm and draw flowchart illustrating mail merge concept.	**CO1**
2. Write an algorithm, draw flowchart and write pseudo code for a real life or scientific ortechnical problems	
3. Scientific problem-solving using decision making and looping. • Armstrong number, palindrome of a number, Perfect number.	
4. Simple programming for one dimensional and two-dimensional arrays. • Transpose, addition, multiplication, scalar, determinant of a matrix	
5. Program to explore string functions and recursive functions.	**CO2**
6. Utilizing ‗Functions' in Python • Find mean, median, mode for the given set of numbers in a list. • Write a function dups to find all duplicates in the list. • Write a function unique to find all the unique elements of a list. • Write function to compute gcd, lcm of two numbers.	
7. Demonstrate the use of Dictionaries and tuples with sample programs.	
8. Implement Searching Operations: Linear and Binary Search.	
9. To sort the ‗n' numbers using: Selection, Merge sort and Insertion Sort.	
10. Find the most frequent words in a text of file using command line arguments.	**CO3**
11. Demonstrate Exceptions in Python.	
12. Applications**:** Implementing GUI using turtle, pygame.	
TOTAL: 60 PERIODS	

REFERENCE BOOKS

1. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford UniversityPress, 2019
2. Allen B. Downey , ― Think Python: How to Think Like a Computer Scientist‖, Second Edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016.
3. Shroff ―Learning Python: Powerful Object-Oriented Programming; Fifth edition, 2013.
4. David M.Baezly ―Python Essential Reference‖. Addison-Wesley Professional; Fourth edition,2009.
5. David M. Baezly ―Python Cookbook‖ O'Reilly Media; Third edition (June 1, 2013)

WEB REFERENCES	
1. http://www.edx.org	
COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Develop simple console applications through python with control structure and functions
CO2	Use python built in data structures like lists, tuples, and dictionaries for representing compound data.
CO3	Read and write data from / to files in Python and applications of python.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAMOUTCOMES(POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	3	3	-	-	-	-	2	2	3	2	1
CO2	3	2	3	3	2	-	-	-	-	2	2	3	2	2
CO3	3	3	2	2	3	-	-	-	-	2	1	3	2	2

BS4108	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

The students will be trained to perform experiments to study the following.

- ❖ The Properties of Matter
- ❖ The Optical properties, Characteristics of Lasers & Optical Fibre
- ❖ Electrical & Thermal properties of Materials
- ❖ Enable the students to enhance accuracy in experimental measurements.
- ❖ To make the student to acquire practical skills in the determination of water quality parametersthrough volumetric analysis
- ❖ Instrumental method of analysis such as potentiometry, conductometry and PH metry

LIST OF EXPERIMENTS – PHYSICS (A minimum of 5 experiments to be performed from the given list)	
1. Determination of Young's modulus of the material of the given beam by Non-uniform bending method. 2. Determination of Young's modulus of the material of the given beam by uniform bending method. 3. Determination of rigidity modulus of the material of the given wire using torsion pendulum.	**CO1**
4. Determination of wavelength of mercury spectra using Spectrometer and grating. 5. Determination of dispersive power of prism using Spectrometer. 6. (a) Determination of wavelength and particle size using a laser. (b) Determination of Numerical and acceptance angle of an optical fibre. 7. Determination of energy band gap of the semiconductor. 8. Determination of coefficient of thermal conductivity of the given bad conductor using Lee's disc. 9. Determination of Hysteresis loss in a ferromagnetic materials.	**CO2**
DEMONSTRATION EXPERIMENT	
1. Determination of thickness of a thin sheet / wire – Air wedge method	**CO1**
LIST OF EXPERIMENTS – CHEMISTRY (A minimum of 6 experiments to be performed from the given list)	
1. Determination of chloride content of water sample by argentometric method. 2. Estimation of copper content of the given solution by Iodometry. 3. Determination of strength of given hydrochloric acid using pH meter.	**CO3**
4. Determination of strength of acids in a mixture of acids using conductivity meter. 5. Estimation of iron content of the given solution using potentiometer. 6. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer. 7. Conductometric titration of strong acid vs strong base.	**CO4**
8. Estimation of HCl using Na_2CO_3 as primary standard and determination of alkalinity in water sample.	**CO5**
9. Determination of total, temporary & permanent hardness of water by EDTA method.	
10. Determination of DO content of water sample by Winkler's method.	
DEMONSTRATION EXPERIMENTS	
1. Estimation of iron content of the water sample using spectrophotometer (1,10-Phenanthroline / thiocyanate method).	**CO3**
2. Estimation of sodium and potassium present in water using flame photometer.	**CO5**
TOTAL: 60 PERIODS	

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Able to understand the concept about the basic properties of matter like stress, strain and typesof moduli. Able to understand the concept of optics like reflection, refraction, diffraction by using spectrometer grating.
CO2	Able to understand the thermal properties of solids, specific heat and some models for specificheat calculation. Able to understand the working principle of laser components and working of different lasersystem. Able to understand the phenomenon of light, applications of fibre optics.
CO3	Able to understand the concept of determining the pH value by using pH meter. Able to understand the concept about the amount of chloride present in the given sample ofwater.
CO4	Able to understand the concept of determining the emf values by using potentiometer Able to understand the concept about the measurement of conductance of strong acid andstrong base by using conductivity meter.
CO5	Able to understand the amount of dissolved oxygen present in the water. Able to understand the concept of estimation of hardness of water by EDTA method.Able to understand the concept of estimation of alkalinity in water sample.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	2	2	2	1	1	1	3	2	2	3	2	2
CO2	3	1	2	1	1	1	1	1	2	1	1	2	2	2
CO3	3	1	2	1	2	2	2	1	2	1	1	1	2	1
CO4	3	2	1	1	2	1	1	1	2	1	1	2	2	1
CO5	3	2	1	1	1	2	2	1	2	1	2	1	2	2

HS4201	PROFESSIONAL ENGLISH	L	T	P	C
		3	0	0	3

OBJECTIVES

- To engage learners in meaningful language activities to improve their LSRW skills
- To enhance learners' awareness of general rules of writing for a specific purpose
- To develop analytical thinking skills for problem solving in communicative contexts
- To help learners understand the purpose, audience, contexts of different types of writing
- To demonstrate an understanding of job applications and interviews for internship and placements

UNIT I	MAKING COMPARISONS	9
Listening – Evaluative Listening: Advertisements, Product Descriptions – Audio / video – Listening and filling a Graphic Organiser – Choosing a product or service by comparison; Speaking – Marketing a product, Persuasive Speech Techniques; Reading – Reading advertisements, user manuals, brochures; Writing – Professional emails, Email etiquette – Compare and Contrast Essay - Writing definitions; Grammar – Prepositional phrases; Vocabulary – Contextual meaning of words.		CO1

UNIT II	EXPRESSING CASUAL RELATIONS IN SPEAKING AND WRITING	9
Listening – Listening to longer technical talks and completing gap filling exercises – Listening to technical information from podcasts – Listening to process/event descriptions to identify cause & effects – Speaking – Describing and discussing the reasons of accidents or disasters based on news reports; Reading – Reading longer technical texts – Cause and Effect Essays – Letters/ emails of complaint; Writing – Purpose statements – Writing responses to complaints; Grammar – Impersonal passive, Infinitive and Gerunds; Vocabulary – Word Formation (Noun-Verb-Adj-Adv).		CO2

UNIT III	PROBLEM SOLVING	9
Listening – Listening to / Watching movie scenes/ documentaries depicting a technical problem and suggesting solutions; Speaking – Group Discussion (based on case studies) – techniques and strategies, Reading – Case Studies, excerpts from literary texts, news reports etc; Writing – Letter to the Editor, Checklists, Problem solution essay – Argumentative Essay; Grammar – Error correction – If conditional sentences; Vocabulary - Compound Words, Sentence Completion.		CO3

UNIT IV	REPORTING OF EVENTS AND RESEARCH	9
Listening – Listening comprehension based on news reports and documentaries – paraphrasing and summarising; Speaking – Interviewing, presenting an oral report, Mini presentations on select topics; Reading – Newspaper articles; Writing – Recommendations, Transcoding charts and graphs Transcoding Accident Report, Survey Report Grammar – Reported Speech, Subject-verb agreement, Vocabulary – Conjunctions – use of prepositions.		CO4

UNIT V	PRESENTING IDEAS OR INFORMATION COGENTLY	9
Listening – Listening to technical talks, Presentations, Formal job interviews, analysis of the interview performance; Speaking – Participating in a Role play, (interview/telephone interview), virtual interviews, making presentations with visual aids; Reading – Company profiles, Statement of Purpose (SOP), an excerpt of interview with professionals; Writing – Job / Internship application – Cover letter & Resume; Grammar – Numerical adjectives, Relative Clauses; Vocabulary – Easily confused words.		CO5

TOTAL: 45 PERIODS

TEXT BOOKS

1. English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd. Department of English, Anna University.
2. English for Science & Technology Cambridge University Press 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.
3. Raman. Meenakshi, Sharma. Sangeeta (2022). Technical Communication. Oxford University Press. New Delhi.

REFERENCE BOOKS

1. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, New Delhi.
2. Learning to Communicate – Dr. V. Chellammal. Allied Publishers, New Delhi, 2003
3. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
4. Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd. 1990, Delhi.
5. Raman. Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford University Press. New Delhi.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To compare and contrast products and ideas in technical texts.
CO2	To identify cause and effects in events, industrial processes through technical texts.
CO3	To analyse problems in order to arrive at feasible solutions and communicate them orally and in the written format.
CO4	To report events and the processes of technical and industrial nature.
CO5	To present opinions in a planned and logical manner, and draft effective resumes in context of job search.

MAPPING OF COs WITH POs

Cos	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUT COMES (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	1	1	-	1	1	-	1	2	2	2	2	2
CO2	-	-	1	1	-	1	1	-	1	2	2	2	2	2
CO3	-	-	2	1	-	-	1	-	1	3	2	2	2	2
CO4	-	-	2	1	-	2	2	1	2	3	2	3	2	2
CO5	-	-	1	2	-	2	2	1	1	3	2	3	1	1

MA4202	STATISTICS AND NUMERICAL METHODS	L	T	P	C
		3	1	0	4

OBJECTIVES

- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT I	TESTING OF HYPOTHESIS	9+3
Sampling distributions – Tests for single mean, proportion and difference of means (Large and small samples) – Tests for single variance and equality of variances – Chi-square test for goodness of fit – Independence of attributes.		CO1
UNIT II	**DESIGN OF EXPERIMENTS**	**9+3**
One-way and two-way classifications – Completely randomized design – Randomized block design –Latin square design – 2^2 factorial design.		CO2
UNIT III	**SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS**	**9+3**
Solution of algebraic and transcendental equations by Newton Raphson method – Solution of linear system of equations – Gauss elimination method – Pivoting – Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel – Eigenvalue of a matrix by Power method.		CO3
UNIT IV	**INTERPOLATION AND NUMERICAL CALCULUS**	**9+3**
Interpolations – Lagrange's, Newton's forward and backward Interpolations – Approximation of derivatives using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.		CO4
UNIT V	**NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS**	**9+3**
Single step methods: Taylor's series method – Euler's method - Modified Euler's method – Fourth order Runge-Kutta method for solving first order differential equations - Multi step method: Milne's predictor corrector method for solving first order differential equations.		CO5
		TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal. B.S. and Grewal. J.S., "Numerical Methods in Engineering and Science" , 10th Edition, Khanna Publishers, New Delhi, 2015.
2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
3. Kandasamy P., Thilagavathi K and Gunavathi K., "Statistical and numerical methods", S. Chand & Company Ltd. Sultan Chand & Company, 2001.

REFERENCE BOOKS

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 2006.
4. Gupta S.C. and Kapoor V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020.
5. Spiegel. M.R., Schiller. J. and Srinivasan. R.A.,"Schaum's Outlines on Probability and Statistics", Tata McGraw Hill Edition, 4th Edition, 2012.
6. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2010.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Apply the concept of testing of hypothesis for small and large samples in real life problems.
CO2	Apply the basic concepts of classifications of design of experiments in the field of agriculture.
CO3	Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.
CO4	Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
CO5	Solve the ordinary differential equations with initial conditions by using certain techniques with engineering applications.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	2	3	-	-	3	2	3	3	2	1
CO2	3	3	3	2	2	1	-	-	-	-	1	2	1	0
CO3	3	3	3	2	2	1	-	-	-	-	1	2	2	1
CO4	3	3	3	2	2	1	-	-	-	-	1	2	1	0
CO5	3	3	3	2	1	1	-	-	-	-	1	2	1	0

PH4253	MATERIALS SCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the essential principles of materials science for mechanical and related engineering applications.

UNIT I	PHASE DIAGRAMS	9
Solid solutions - Hume Rothery's rules - the phase rule - single component system - one- component system of iron - binary phase diagrams - isomorphous systems - the tie-line rule -the lever rule - application to isomorphous system - eutectic phase diagram - peritectic phase diagram - other invariant reactions - free energy composition curves for binary systems - microstructural change during cooling.		CO1
UNIT II	**FERROUS ALLOYS**	**9**
The iron-carbon equilibrium diagram - phases, invariant reactions - microstructure of slowly cooled steels - eutectoid steel, hypo and hypereutectoid steels - effect of alloying elements on the Fe-C system - diffusion in solids - Fick's laws of diffusion- mechanisms of diffusion, temperature dependence of diffusivity - steady and non-steady state diffusion - factors that influence diffusion - Properties and applications of copper alloys, aluminium alloys and titanium alloys. Phase transformations - T-T-T-diagram for eutectoid steel - pearlitic, baintic and martensitic transformations - tempering of martensite		CO2
UNIT III	**MECHANICAL PROPERTIES**	**9**
Tensile test - plastic deformation mechanisms - slip and twinning - role of dislocations in slip - strengthening methods - strain hardening - refinement of the grain size - solid solution strengthening - precipitation hardening - creep resistance - creep curves - mechanisms of creep- creep-resistant materials - fracture - the Griffith criterion - critical stress intensity factor and its determination- Fatigue failure - fatigue tests - hardness - Rockwell and Brinell hardness - Knoop and Vickers micro hardness. Steps in materials selection process, Factors influencing materials selection, Case studies.		CO3
UNIT IV	**MAGNETIC, DIELECTRIC AND SUPERCONDUCTING MATERIALS**	**9**
Ferromagnetism - domain theory - types of energy - hysteresis - hard and soft magnetic materials - ferrites - dielectric materials - types of polarization – Langevin - Debye equation - frequency effects on polarization - dielectric breakdown - insulating materials - Ferroelectric materials - superconducting materials and their properties.		CO4
UNIT V	**NEW MATERIALS**	**9**
Historical perspective- Material properties and qualities, Classification of Materials - Ceramics - types and applications - composites: classification, role of matrix and reinforcement, processing of fibre reinforced plastics - metallic glasses: types , glass forming ability of alloys, melt spinning process, applications - shape memory alloys: phases, shape memory effect, pseudo elastic effect, NiTi alloy, applications – nano materials: preparation (bottom up and top down approaches), properties and applications.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Balasubramaniam, R. Callister's Materials Science and Engineering. Wiley India Pvt. Ltd., 2014.
2. Raghavan, V. Physical Metallurgy: Principles and Practice. PHI Learning, 2015.
3. Raghavan, V. Materials Science and Engineering: A First course. PHI Learning, 2015.

REFERENCE BOOKS

1. Askeland, D. Materials Science and Engineering. Brooks/Cole, 2010.
2. Smith, W.F., Hashemi, J. & Prakash, R. Materials Science and Engineering. Tata McGraw Hill Education Pvt. Ltd., 2014.
3. Wahab, M.A. Solid State Physics: Structure and Properties of Materials. Narosa Publishing House,2009.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the various forms of solid solutions, equilibrium, and different phase diagrams and their applications in materials system.
CO2	Understand the Fe - Fe_3C phase diagram, invariant reactions, diffusion of solids, mechanism, factors that influence diffusion, properties of copper, aluminium and titanium alloys and various microstructures of ferrous and their alloys.
CO3	Understand the mechanical properties of materials, measurement and materials selections process and their case studies.
CO4	Understand the properties of different types of magnetic materials - Ferromagnetic, Anti ferro magnetic, Ferrites. Understand the phenomenon of superconductivity, and its properties of superconductors and the properties of dielectric materials, various types of polarization and loss in dielectric materials.
CO5	Understand the importance of various newer materials, like ceramics, composite materials, metallic glass, SMA, Nano materials. Their historical perspective, properties, classification and fabrication and apply to develop alloys of various composition with desirable properties.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	-	-	-	-	3	3	-	-	-	-	3	3	3
CO2	-	-	-	-	-	3	3	-	-	-	-	3	3	3
CO3	-	-	-	-	-	3	3	-	-	-	-	3	3	3
CO4	-	-	-	-	-	3	3	-	-	-	-	3	3	3
CO5	-	-	-	-	-	3	3	-	-	-	-	3	3	3

GE4204	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the inter relationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world;envision the surrounding environment, its functions and its value.
- To find and implement scientific, technological, economic and political solutions to environmental problems.
- To apply the integrated themes and biodiversity, natural resources, pollution control and waste management.
- To analyse the dynamic processes and understand the features of the earth‘s interior and surface.

UNIT I	ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY	9
Definition, scope and importance of environment – Need for public awareness – Role of Individual in Environmental protection – Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Foodchains, food webs and ecological pyramids – Ecological succession – Types, characteristic features, structure and function of forest, grass land, desert and aquatic (ponds, lakes, rivers,oceans, estuaries) ecosystem. Biodiversity – Definition – Genetic, species and ecosystem diversity – Value of biodiversity – Consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity atglobal, national and local levels – India as a mega diversity nation – Hot spots of biodiversity –Threats to biodiversity– Habitat loss, poaching of wild life, human-wildlife conflicts – Wildlife protection act and forest conservation act – Endangered and endemic species – Conservation of biodiversity – In-situ and ex-situ conservation of biodiversity.		CO1

UNIT II	ENVIRONMENTAL POLLUTION	9
Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – Solid waste management: causes, effects and control measures of municipal solidwastes – Problems of e-waste – Role of an individual in prevention of pollution – Pollution casestudies – Disaster management – Floods, earthquake, cyclone, tsunami and landslides – Field study of local polluted site – Urban / Rural / Industrial / Agricultural.		CO2

UNIT III	NATURAL RESOURCES	9
Forest resources: Uses and over-exploitation — Deforestation — Case studies — Timber extraction, mining, dams and their effects on forests and tribal people – Water resources – Use and overutilization of surface and ground water, floods, drought, conflicts over water – Dams:benefits and problems – Mineral resources: Uses and exploitation – Environmental effects ofextracting and using mineral resources– Food resources: World food problems – Changes caused by agriculture and overgrazing – Effects of modern agriculture: fertilizer– pesticide problems, water logging, salinity – Energy resources: Growing energy needs – Renewable and non-renewable energy sources – Use of alternate energy sources– Land resources: Land as a resource – Land degradation, man induced landslides, soil erosion and desertification – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles – Field study of local area to document environmental assets – River / Forest / Grassland / Hill / Mountain – case studies		CO3

UNIT IV	SOCIAL ISSUES AND THE ENVIRONMENT	9
From unsustainable to sustainable development – Urban problems related to energy – Waterconservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns, case studies – Role of non-governmental organization –Environmental ethics – Issues and possible solutions – Climate change – Global warming – Acid rain, Ozone layer depletion –Nuclear accidents and holocaust – Case studies – Wasteland reclamation — Consumerism and waste products — Principles of Green Chemistry — Environment protection act – Air (Prevention and Control of Pollution) Act – Water (Preventionand control of Pollution) Act – Wildlife protection Act – Forest conservation Act – Enforcementmachinery involved in environmental legislation– Central and state pollution control boards– National Green Tribunal – Public awareness.		

UNIT V	HUMAN POPULATION AND THE ENVIRONMENT	9
Population growth – Variation among nations – Population explosion – Family welfare programme – Environment and human health – Human rights – Value education – HIV / AIDS – COVID 19 – Women and child welfare – Role of information technology in environment and human health – Case studies		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Benny Joseph, ‗Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2014).
2. Gilbert M.Masters, ‗Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, (2004).
3. Dr. A. Sheik Mideen and S.Izzat Fathima, Environmental Science and Engineering, Airwalk Publications, Chennai, (2018).

REFERENCE BOOKS

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India Pvt Ltd, New Delhi, (2007).
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press (I) Pvt, Ltd,Hydrabad, (2015).
3. G. Tyler Miller,Scott E. Spoolman, "Environmental Science", Cengage Learning India Pvt.Ltd,Delhi, (2014).
4. R. Rajagopalan, ‗Environmental Studies-From Crisis to Cure', Oxford University Press, (2005).
5. Anubha Kaushik , C.P. Kaushik, "Perspectives in Environmental Studies", New AgeInternational Pvt. Ltd, New Delhi, (2004).
6. Frank R. Spellman, "Handbook of Environmental Engineering", CRC Press, (2015).

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	To obtain knowledge about environment, ecosystems and biodiversity.
CO2	To take measures to control environmental pollution.
CO3	To gain knowledge about natural resources and energy sources.
CO4	To find and implement scientific, technological, economic and political solutions to environmental problems.
CO5	To understand the impact of environment on human population.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMOUTCOMES(POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	3	3	3	3	2	2	2	3	2	1
CO2	3	2	3	3	2	3	3	3	3	2	2	3	2	2
CO3	3	3	2	2	3	3	2	2	1	2	1	3	2	2
CO4	3	3	3	3	1	2	3	3	2	2	2	2	2	1
CO5	3	2	3	2	3	3	3	2	2	2	2	3	3	2

BE4251	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the basics of electric circuits and analysis
- To impart knowledge in the basics of working principles and application of electrical machines
- To introduce analog devices and their characteristics
- To educate on the fundamental concepts of digital electronics
- To introduce the functional elements and working of measuring instruments

UNIT I	ELECTRICAL CIRCUITS	9
DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws –Independent and Dependent Sources – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state) . Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only).		CO1
UNIT II	**ELECTRICAL MACHINES**	**9**
Construction and Working principle- DC Separately and Self excited Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications. Construction, Working principle and Applications of Transformer, Three phase Alternator, Synchronous motor and Three Phase Induction Motor.		CO2
UNIT III	**ANALOG ELECTRONICS**	**9**
Resistor, Inductor and Capacitor in Electronic Circuits- Semiconductor Materials: Silicon &Germanium – PN Junction Diodes, Zener Diode –Characteristics Applications – Bipolar Junction Transistor-Biasing, JFET, SCR, MOSFET,IGBT – Types, I-V Characteristics and Applications, Rectifier and Inverters		CO3
UNIT IV	**DIGITAL ELECTRONICS**	**9**
Review of number systems, binary codes, error detection and correction codes, Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps (Simple Problems only)		CO4
UNIT V	**MEASUREMENTS& INSTRUMENTATION**	**9**
Functional elements of an instrument, Standards and calibration, Operating Principle, types - Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter, Instrument Transformers- CT and PT, DSO- Block diagram- Data acquisition.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. D.P. Kotharti and I.J Nagarath, Basic Electrical and Electronics Engineering, McGraw Hill, 2016, Third Edition.
2. S.K.Bhattacharya "Basic Electrical and Electronics Engineering", Pearson Education, Second Edition, 2017.
3. Sedha R.S., "A textbook book of Applied Electronics", S. Chand & Co., 2008
4. James A .Svoboda, Richard C. Dorf, "Dorf's Introduction to Electric Circuits", Wiley,.
5. A.K. Sawhney, PuneetSawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', DhanpatRai and Co, 2015.

REFERENCE BOOKS

1. Kothari DP and I.J Nagrath, "Basic Electrical Engineering", Fourth Edition, McGraw Hill Education, 2019
2. Thomas L. Floyd, 'Digital Fundamentals', 11th Edition, Pearson Education, 2017.
3. Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education; 7th edition, 2017.
4. MahmoodNahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw Hill, 2002.
5. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Compute the electric circuit parameters for simple problems
CO2	Explain the working principle and applications of electrical machines
CO3	Analyze the characteristics of analog electronic devices
CO4	Explain the basic concepts of digital electronics
CO5	Explain the operating principles of measuring instruments

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	-	-	-	-	-	-	-	-	2	3	3
CO2	3	3	3	-	-	-	-	-	-	-	-	2	3	3
CO3	3	3	3	-	-	-	-	-	-	-	-	2	3	3
CO4	3	3	3	-	-	-	-	-	-	-	-	2	3	3
CO5	3	3	3	-	-	-	-	-	-	-	-	2	3	3

GE4206	ENGINEERING MECHANICS	L	T	P	C
		3	2	0	4

OBJECTIVES

- To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.

UNIT I	STATICS OF PARTICLES	9+6
Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces – Vectorial representation of forces – Vector operations of forces - additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility.		CO1
UNIT II	**EQUILIBRIUM OF RIGID BODIES**	**9+6**
Free body diagram – Types of supports –Action and reaction forces – stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions.		CO2
UNIT III	**PROPERTIES OF SURFACES AND SOLIDS**	**9+6**
Centroids and centre of mass – Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula –Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula –Parallel axis theorem and perpendicular axis theorem – Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.		CO3
UNIT IV	**DYNAMICS OF PARTICLES AND RIGID BODIES**	**9+6**
Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion - Newton's laws of motion – Work Energy Equation.		CO4
UNIT V	**FRICTION AND RIGID BODY DYNAMICS**	**9+6**
Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8 Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
2. Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.

REFERENCE BOOKS

1. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 1998.
2. Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and Dynamics", 4 Edition, Pearson Education 2006.
3. Meriam J.L. and Kraige L.G., " Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2", Third Edition, John Wiley & Sons,1993.
4. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3 Edition, Vikas Publishing House Pvt. Ltd., 2005.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Illustrate the vectorial and scalar representation of forces and moments
CO2	Analyse the rigid body in equilibrium
CO3	Evaluate the properties of surfaces and solids
CO4	Calculate dynamic forces exerted in rigid body
CO5	Determine the friction and the effects by the laws of friction

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	-	-	-	-	-	3	3	3	3	3	3
CO2	3	3	3	-	-	-	-	-	3	3	3	3	3	3
CO3	3	3	3	-	-	-	-	-	3	3	3	3	3	3
CO4	3	3	3	-	-	-	-	-	3	3	3	3	3	3
CO5	3	3	3	-	-	-	-	-	3	3	3	3	3	3

GE4251	தமிழரும் தொழில் நுட்பமும்	L	T	P	C
		1	0	0	1

அலகு I	நெசவு மற்றும் பானைத்தொழில்நுட்பம்	3

சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள்- பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II	வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்	3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு -சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் -மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் - நாயக்கர் காலக் கோயில்கள் -மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள்- பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ- சாரோசெனிக் கட்டிடக் கலை.

அலகு III	உற்பத்தித் தொழில் நுட்பம்	3

கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை -இரும்பை உருக்குதல், எஃகு வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் -- நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத்துண்டுகள் - தொல்வியல் சான்றுகள்- சிலப்பதிகாரத்தில் மணிகளின் வகைகள்,

அலகு IV	வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்:	3

அணை ஏரி, குளங்கள். மதகு - சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள்- வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு- மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்:

அலகு V	அறிவியல் தமிழ் மற்றும் கணித்தமிழ்	3

அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

TOTAL: 15 PERIODS

TEXT-CUM REFERENCE BOOKS

1.தமிழக வரலாறு -மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)

2. கணினித் தமிழ் - முனைவர் இல சுந்தரம். (விகடன் பிரசுரம்).

3. கீழடி -வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)

4. பொருநை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)

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 C ivilization 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.

GE4251	TAMILS AND TECHNOLOGY	L	T	P	C
		1	0	0	1

UNIT I	WEAVING AND CERAMIC TECHNOLOGY	3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II	DESIGN AND CONSTRUCTION TECHNOLOGY	3

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.

UNIT III	MANUFACTURING TECHNOLOGY	3

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.

UNIT IV	AGRICULTURE AND IRRIGATION TECHNOLOGY	3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu 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.

UNIT V	SCIENTIFIC TAMIL & TAMIL COMPUTING	3

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: 15 PERIODS

TEXT-CUM REFERENCE BOOKS

1.தமிழக வரலாறு -மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)

2. கணினித் தமிழ் - முனைவர் இல சுந்தரம். (விகடன் பிரசுரம்).

3. கீழடி -வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)

4. பொருநை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)

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 C ivilization 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.

GE4207	ENGINEERING PRACTICES LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering

LIST OF EXPERIMENTS

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE — **CO1**

Buildings:

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.

(b) Study of pipe connections requirements for pumps and turbines.

(c) Preparation of plumbing line sketches for water supply and sewage works.

(d) **Hands-on-exercise:**

Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.

(b) Hands-on-exercise:

Wood work, joints by sawing, planning and cutting.

II MECHANICAL ENGINEERING PRACTICE — **CO2**

Welding:

(a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.

(b) Gas welding practice

Basic Machining:

(a) Simple Turning and Taper turning

(b) Drilling Practice

Sheet Metal Work:

(a) Forming & Bending:

(b) Model making – Trays and funnels.

(c) Different type of joints.

Machine assembly practice:

(a) Study of centrifugal pump

(b) Study of air conditioner

Demonstration on:

(a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.

(b) Foundry operations like mould preparation for gear and step cone pulley.

(c) Fitting – Exercises – Preparation of square fitting and V – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter. — **CO3**
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit. — **CO4**
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

IV ELECTRONICS ENGINEERING PRACTICE	
1. Study of electronic components and equipment's – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR. 2. Study of logic gates AND, OR, EX-OR and NOT. 3. Generation of Clock Signal. 4. Soldering practice – Components Devices and Circuits – Using general purpose PCB. Measurement of ripple factor of HWR and FWR.	**CO5**
TOTAL: 60 PERIODS	

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	DESCRIPTION OF EQUIPMENT	Quantity required
	CIVIL	
1.	Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	**15 sets**
2.	Carpentry vice (fitted to work bench)	**15 Nos**
3.	Standard woodworking tools 15 Sets.	**15 Sets.**
4.	Models of industrial trusses, door joints, furniture joints	**5 each**
5.	**Power Tools:** (a) Rotary Hammer (b) Demolition Hammer (c) Circular Saw (d) Planer (e) Hand Drilling Machine (f) Jigsaw	**2 Nos**
	MECHANICAL	
1.	Arc welding transformer with cables and holders.	**5 Nos**
2.	Welding booth with exhaust facility.	**5 Nos**
3.	Welding accessories like welding shield, chipping hammer, wire brush, etc.	**5 Sets**
4.	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	**2 Nos**
5.	Centre lathe.	**2 Nos**
6.	Hearth furnace, anvil and smithy tools.	**2 Sets**
7.	Moulding table, foundry tools.	**2 Sets**
8.	Power Tool: Angle Grinder.	**2 Nos**
9.	Study-purpose items: centrifugal pump, air-conditioner.	**1 Each**
	ELECTRICAL	
1.	Assorted electrical components for house wiring.	**15 Sets**
2.	Electrical measuring instruments.	**10 Sets**
3.	Study purpose items: Iron box, fan and regulator, emergency lamp.	**1 each**
4.	Megger (250V/500V).	**1 No.**
5.	Power Tools: (a) Range Finder (b) Digital Live-wire detector	**2 Nos**
	ELECTRONICS	
1.	Soldering guns 10 Nos.	**10 Nos.**
2.	Assorted electronic components for making circuits 50 Nos.	**50 Nos.**
3.	Small PCBs.	**10 Nos.**
4.	Multimeters	**10 Nos.**
5.	Study purpose items: Telephone, FM radio, low-voltage power supply	**1 each**

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Fabricate carpentry components and pipe connections including plumbing works. Use welding equipment's to join the structures.
CO2	Carry out the basic machining operations Make the models using sheet metal works
CO3	Carry out basic home electrical works and appliances.
CO4	Measure the electrical quantities
CO5	Elaborate on the components, gates, soldering practices

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	3	-	-	3	-	-	-	-	-	3	1	2
CO2	3	2	3	-	-	3	-	-	-	-	-	3	1	2
CO3	3	1	2	-	-	2	-	-	-	-	-	3	1	2
CO4	3	2	3	3	1	3	1	1	1	1	2	3	1	2
CO5	3	2	3	3	1	2	1	1	1	1	2	3	1	2

BE4258	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To validate the principles studied in theory by performing experiments in the laboratory

LIST OF EXPERIMENTS

1. Verification of Kirchhoff's voltage and current laws	**CO1**
2. Verification of Thevenin's and Norton's theorem.	**CO2**
3. Load Test on DC Shunt Motor	
4. Speed Control of DC Shunt Motor	
5. Load Test on single phase transformer	**CO3**
6. Load test on three phase squirrel cage induction motor.	
7. Transistor based application circuits	**CO4**
8. Half wave rectifier with capacitive filter.	
9. Characteristics of PN Diode.	
10. Characteristics of BJT	
11. RTD and Thermistor	**CO5**
12. Characteristics of LVDT	

TOTAL : 60 PERIODS

COURSE OUTCOMES

Upon completion of the course, students will be able toR

CO1	Understand and experimentally verify the basics of electric circuit laws
CO2	Understand and apply circuit theorems and concepts in engineering applications
CO3	Analyze and understand the working of AC machines.
CO4	Understand and analyze the characteristics of diode, transistor and implement transistor based application.
CO5	Understand and analyze the characteristics of different transducers.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMOUTCOMES(POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	1	1	1	2	1	3	3	1	2
CO2	3	3	3	3	3	2	1	1	2	1	3	3	1	2
CO3	3	3	3	3	3	1	2	1	2	1	3	3	1	2
CO4	3	3	3	3	3	1	1	1	2	1	3	3	1	2
CO5	3	3	3	3	3	2	1	1	2	1	3	3	1	2

MA4352	TRANSFORMS AND COMPLEX FUNCTIONS	L	T	P	C
		3	1	0	4

OBJECTIVES

- This course is designed to cover topics such as Complex Analysis, Ordinary Differential Equations, Z-Transforms and Laplace Transform.
- To develop an understanding of the standard techniques analytic function and its mapping property.
- To familiarize the students with complex integration and contour integration techniques which can be used in real integrals.
- To acquaint the students with Differential Equations which are significantly used in engineering problems.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z-transform techniques for discrete time systems
- To apply Laplace transforms for solving the problems that occur in various branches of engineering disciplines.

UNIT I	ANALYTIC FUNCTIONS	9+3
Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function – Conformal mapping – Mapping by functions w = Z + C, CZ, 1/Z - Bilinear transformation		CO1
UNIT II	**COMPLEX INTEGRATION**	**9+3**
Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semi-circular contour(excluding poles on the real line)		CO2
UNIT III	**ORDINARY DIFFERENTIAL EQUATIONS**	**9+3**
Higher order linear differential equations with constant coefficients - Method of variation of parameters– Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients		CO3
UNIT IV	**Z – TRANSFORMS AND DIFFERENCE EQUATIONS**	**9+3**
Z-transforms – Elementary properties – Inverse Z-transform (using partial fraction and residues) –Initial and final value theorems – Convolution theorem – Formation of difference equations – Solution of difference equations using Z – transform.		CO4
UNIT V	**LAPLACE TRANSFORMS**	**9+3**
Existence conditions – Transforms of elementary functions –Basic properties - Shifting theorems - transforms of derivatives and integrals — Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.		CO5
		TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.

REFERENCE BOOKS

1. G Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., — Advanced Engineering Mathematics, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. O Neil, P.V. —Advanced Engineering Mathematics, Cengage Learning India Pvt., Ltd, New Delhi, 2007.
4. Sastry, S.S, "Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014
5. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics" Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand Analytic functions, conformal mapping & Bilinear transformation.
CO2	Evaluate real integration by Complex integration techniques.
CO3	Apply various techniques in solving ordinary differential equations.
CO4	Use the effective mathematical tools for the solutions of partial differential equations by using Z-transform techniques for discrete time systems.
CO5	Apply Laplace transform and inverse transform of simple functions, properties and various related theorems in solving differential equations with constant coefficients.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	2	1	1	-	-	-	-	1	3	-
CO2	3	3	3	2	2	2	1	-	-	-	-	1	3	-
CO3	3	3	3	2	3	3	2	-	-	1	1	3	2	-
CO4	3	1	1	1	2	1	1	1	2	2	1	0	2	-
CO5	3	3	3	2	2	2	1	-	-	-	-	1	2	-

ME4301	FLUID MECHANICS AND MACHINERY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the students about properties of the fluids, behavior of fluids under static conditions.
- To impart basic knowledge of the dynamics of fluids and boundary layer concept.
- To expose to the applications of the conservation laws to a) flow measurements b) flow through pipes (both laminar and turbulent) and c) forces on pipe bends.
- To exposure to the significance of boundary layer theory and its thicknesses.
- To expose the students to basic principles of working of hydraulic machineries and to design Pelton wheel, Francis and Kaplan turbine, centrifugal and reciprocating pumps.

UNIT I	FLUID PROPERTIES AND FLOW CHARACTERISTICS	9
Properties of fluids – Fluid statics - Pressure Measurements - Buoyancy and floatation – Flow characteristics - Eulerian and Lagrangian approach - Concept of control volume and system - Reynold's transportation theorem - Continuity equation, energy equation and momentum equation - Applications.		CO1
UNIT II	**FLOW THROUGH PIPES AND BOUNDARY LAYER**	**9**
Reynold's Experiment - Laminar flow through circular conduits - Darcy Weisbach equation – friction factor - Moody diagram - Major and minor losses - Hydraulic and energy gradient lines - Pipes in series and parallel - Boundary layer concepts - Types of boundary layer thickness.		CO2
UNIT III	**DIMENSIONAL ANALYSIS AND MODEL STUDIES**	**9**
Fundamental dimensions - Dimensional homogeneity - Rayleigh's method and Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.		CO3
UNIT IV	**TURBINES**	**9**
Impact of jets - Velocity triangles - Theory of rotodynamic machines - Classification of turbines - Working Principles - Pelton wheel - Modern Francis turbine - Kaplan turbine - Work done - Efficiencies – Draft tube - Specific speed - Performance curves for turbines - Governing of turbines.		CO4
UNIT V	**PUMPS**	**9**
Classification of pumps - Centrifugal pumps - Working principle - Heads and efficiencies– Velocity triangles - Work done by the impeller - Performance curves - Reciprocating pump working principle - Indicator diagram and it's variations - Work saved by fitting air vessels - Rotary pumps.		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Dr. R. K. Bansal., A Textbook of Fluid Mechanics and Hydraulic Machines. Laxmi Publications, New Delhi, 2017
2. S. Ramamrutham, R. Narayan · Hydraulics, Fluid Mechanics And Fluid Machines, Dhanpat Rai Books 2014
3. Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014.

REFERENCE BOOKS

1. Modi P.N. and Seth, S.M. Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, 22nd edition (2019)
2. Kumar K. L., Engineering Fluid Mechanics, Eurasia Publishing House(p) Ltd. New Delhi, 2016.
3. Fox W.R. and McDonald A.T., Introduction to Fluid Mechanics John-Wiley and Sons, Singapore,2011.
4. Pani B S, Fluid Mechanics: A Concise Introduction, Prentice Hall of India Private Ltd, 2016.

COURSE OUTCOMES **Upon completion of the course, students will be able to:**	
CO1	Understand the properties and behaviour in static conditions. Also, to understand the conservation laws applicable to fluids and its application through fluid kinematics and dynamics
CO2	Estimate losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel. Also, to understand the concept of boundary layer and its thickness on the flat solid surface.
CO3	Formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performances of prototype by model studies
CO4	Explain the working principles of various turbines and design the various types of turbines.
CO5	Explain the working principles of centrifugal, reciprocating and rotary pumps and design the centrifugal and reciprocating pumps

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	1	2	2	1	2	1	1	2	3	2
CO2	3	3	3	2	1	2	2	1	2	1	1	2	3	2
CO3	3	3	3	3	1	2	2	1	2	1	1	2	3	2
CO4	3	3	3	3	1	2	2	1	2	1	1	2	3	2
CO5	3	3	3	3	1	2	2	1	2	1	1	2	3	2

ME4302	ENGINEERING THERMODYNAMICS	L	T	P	C
		3	1	0	4

OBJECTIVES

- Impart knowledge on the basics and application of zeroth and first law of thermodynamics.
- Impart knowledge on the second law of thermodynamics in analysing the performance of thermal devices.
- Impart knowledge on availability and applications of second law of thermodynamics
- Teach the various properties of steam through steam tables and Mollier chart.
- Impart knowledge on the macroscopic properties of ideal and real gases.

UNIT I	BASICS, ZEROTH AND FIRST LAW	9+3
Review of Basics – Thermodynamic systems, Properties and processes Thermodynamic Equilibrium - Displacement work - P-V diagram. Thermal equilibrium - Zeroth law – Concept of temperature and Temperature Scales. First law – application to closed and open systems – steady and unsteady flow processes.		CO1
UNIT II	**SECOND LAW AND ENTROPY**	**9+3**
Heat Engine – Refrigerator - Heat pump. Statements of second law and their equivalence & corollaries. Carnot cycle - Reversed Carnot cycle - Performance - Clausius inequality. Concept of entropy - T-s diagram - Tds Equations - Entropy change for a pure substance.		CO2
UNIT III	**AVAILABILITY AND APPLICATIONS OF II LAW**	**9+3**
Ideal gases undergoing different processes - principle of increase in entropy. Applications of II Law. Highand low-grade energy. Availability and Irreversibility for open and closed system processes - I and II law Efficiency		CO3
UNIT IV	**PROPERTIES OF PURE SUBSTANCES**	**9+3**
Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. p-v-T surface. Use of Steam Table and Mollier Chart. Determination of dryness fraction. Application of I and II law for pure substances. Ideal and actual Rankine cycles, Cycle Improvement Methods - Reheat and Regenerative cycles,		CO4
UNIT V	**IDEAL AND REAL GASES, THERMODYNAMIC RELATION**	**9+3**
Properties of Ideal gas, real gas - comparison. Equations of state for ideal and real gases. vander Waal's relation - Reduced properties - Compressibility factor - Principle of Corresponding states - Generalized Compressibility Chart. Maxwell relations - TdS Equations - heat capacities relations - Energy equation, JouleThomson experiment - Clausius-Clapeyron equation.		CO5
		TOTAL: 60 PERIODS

TEXTBOOKS

1. Nag.P.K., "Engineering Thermodynamics", 6th Edition, Tata McGraw Hill (2017), New Delhi.
2. Natarajan, E., "Engineering Thermodynamics: Fundamentals and Applications", 2nd Edition (2014), Anuragam Publications, Chennai.

REFERENCE BOOKS

1. Cengel, Y and M. Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill,9th Edition, 2019.
2. Chattopadhyay, P, "Engineering Thermodynamics", 2nd Edition Oxford University Press, 2016.
3. Rathakrishnan, E., "Fundamentals of Engineering Thermodynamics", 2nd Edition, Prentice Hall of India Pvt. Ltd, 2006.
4. Claus Borgnakke and Richard E. Sonntag, "Fundamentals of Thermodynamics", 10th Edition, Wiley Eastern, 2019.
5. Venkatesh. A, "Basic Engineering Thermodynamics", Universities Press (India) Limited, 2007

COURSE OUTCOMES Upon completion of the course, students will be able to:	
CO1	Understand the Forecasting methods and planning procedure.
CO2	Explain the concepts of general management, financial management, human resources, production management, and marketing management.
CO3	Illustrate the application with to identify solutions to industry problems
CO4	Implement the Principles of Scientific and personnel Management
CO5	Identify the optimum solutions with system approach to both industry and service sector.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	1	-	-	-	-	-	-	-	2	3	2
CO2	3	3	2	1	-	-	-	-	-	-	-	2	3	2
CO3	3	3	2	1	-	-	-	-	1	-	1	2	3	2
CO4	3	3	2	1	-	1	-	-	2	-	1	2	3	2
CO5	3	3	2	1	-	1	-	-	2	-	1	2	3	2

ME4303	MANUFACTURING PROCESSES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To illustrate the working principles of various metal casting processes.
- To learn and apply the working principles of various metal joining processes.
- To analyse the working principles of bulk deformation of metals.
- To learn the working principles of sheet metal forming process.
- To study and practice the working principles of plastics molding.

UNIT I	METAL CASTING PROCESSES	9
Sand Casting – Sand Mould – Type of patterns - Pattern Materials – Pattern allowances – Molding sand Properties and testing – Cores –Types and applications –Principle of special casting processes- Shell, investment – Ceramic mould – Pressure die casting – low pressure, gravity- Tilt pouring, high pressure die casting- Centrifugal Casting – CO2 casting –- Defects in Sand casting process-remedies		CO1

UNIT II	METAL JOINING PROCESSES	9
Fusion welding processes – Oxy fuel welding – Filler and Flux materials-–Arc welding, Gas Tungsten arc welding – Gas metal arc welding - Submerged arc welding – Electro slag welding– Plasma arc welding — Resistance welding Processes -Electron beam welding –Laser beam Welding Friction welding – Friction stir welding – Diffusion welding – Thermit Welding, Brazing - soldering – Adhesive bonding.		CO2

UNIT III	BULK DEFORMATION PROCESSES	9
Hot working and cold working of metals – Forging processes – Open, impression and closed die forging – cold forging- Characteristics of the processes – Typical forging operations – rolling of metals – Types of Rolling – Flat strip rolling – shape rolling operations – Defects in rolled parts – Principle of rod and wire drawing – Tube drawing – Principles of Extrusion – Types – Hot and Cold extrusion. Introduction to shaping operations.		CO3

UNIT IV	SHEET METAL PROCESSES	9
Sheet metal characteristics – Typical shearing, bending and drawing operations – Stretch forming operations – Formability of sheet metal – Test methods –special forming processes - Working principle and applications – Hydro forming – Rubber pad forming – Metal spinning – Introduction of Explosive forming, magnetic pulse forming, peen forming, Super plastic forming – Micro forming – Incremental forming.		CO4

UNIT V	MANUFACTURE OF PLASTIC COMPONENTS	9
Types and characteristics of plastics – Molding of thermoplastics & Thermosetting polymers– working principles and typical applications – injection molding – Plunger and screw machines – Compression molding, Transfer Molding – Typical industrial applications – introduction to blow molding – Rotational molding – Filmblowing – Extrusion – Thermoforming – Bonding of Thermoplastics- duff moulding.		CO5

TOTAL: 45 PERIODS

TEXTBOOKS

1. C.Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India,4th Edition, 2013
2. P.N.Rao Manufacturing Technology Volume 1 Mc Grawhill Education 5th edition, 2018.

REFERENCE BOOKS

1. Roy. A. Lindberg, Processes and materials of manufacture, PHI / Pearson education, 2006.
2. S. Gowri P. Hariharan, A.Suresh Babu, Manufacturing Technology I, Pearson Education, 2008.
3. Paul Degarma E, Black J.T and Ronald A. Kosher, Eligth Edition, Materials and Processes, in Manufacturing, Eight Edition, Prentice – Hall of India, 1997.
4. Hajra Chouldhary S.K and Hajra Choudhury. AK., Elements of workshop Technology, volume I and II, Media promoters and Publishers Private Limited, Mumbai, 1997
5. Sharma, P.C., A Text book of production Technology, S.Chand and Co. Ltd., 2004

COURSE OUTCOMES **Upon completion of the course, students will be able to:**	
CO1	Explain the principle of different metal casting processes.
CO2	Describe the various metal joining processes.
CO3	Illustrate the different bulk deformation processes.
CO4	Apply the various sheet metal forming process.
CO5	Apply suitable molding technique for manufacturing of plastics components.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	2	-	-	2	3	1	1	-	-	1	3	1
CO2	3	-	2	-	-	2	3	1	1	-	-	1	3	1
CO3	3	-	2	-	-	2	2	1	1	-	-	1	3	1
CO4	3	-	2	-	-	2	2	1	1	-	-	1	3	1
CO5	3	-	2	-	2	2	2	1	1	-	-	1	3	1

ME4304	ENGINEERING MATERIALS AND METALLURGY	L	T	P	C
		3	0	0	3

OBJECTIVES

- 1 To learn the constructing the phase diagram and using of iron-iron carbide phase diagram for microstructure formation.
- 2. To learn selecting and applying various heat treatment processes and its microstructure formation.
- 3. To illustrate the different types of ferrous and non-ferrous alloys and their uses in engineering field.
- 4. To illustrate the different polymer, ceramics and composites and their uses in engineering field.
- 5. To learn the various testing procedures and failure mechanism in engineering field.

UNIT I	CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS	9
Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, Iron – Iron carbide equilibrium diagram. Classification of steel and cast-Iron microstructure, properties and application.		CO1

UNIT II	HEAT TREATMENT	9
Definition – Full annealing, stress relief, recrystallisation and spheroidising –normalizing, hardening and tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram – continuous cooling Transformation (CCT) diagram – Austempering, Martempering – Hardenability, Jominy end quench test -case hardening, carburizing, Nitriding, cyaniding, carbonitriding – Flame and Induction hardening – Vacuum and Plasma hardening – Thermo-mechanical treatments- elementary ideas on sintering.		CO2

UNIT III	FERROUS AND NON-FERROUS METALS	9
Effect of alloying additions on steel (Mn, Si, Cr, Mo, Ni, V,Ti& W) – stainless and tool steels – HSLA - Maraging steels – Grey, white, malleable, spheroidal – alloy cast irons, Copper and its alloys – Brass, Bronze and Cupronickel – Aluminium and its alloys; Al-Cu – precipitation strengthening treatment – Titanium alloys, Mg-alloys, Ni-based super alloys – shape memory alloys- Properties and Applications overview of materials standards		CO3

UNIT IV	NON-METALLIC MATERIALS	9
Polymers – types of polymers, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PAI, PPO, PPS, PEEK, PTFE, Thermoset polymers – Urea and Phenol formaldehydes – Nylon, Engineering Ceramics – Properties and applications of Al2O3, SiC, Si3N4, PSZ and SIALON – intermetallics- Composites- Matrix and reinforcement Materials applications of Composites - Nano composites.		CO4

UNIT V	MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS	9
Mechanisms of plastic deformation, slip and twinning – Types of fracture – Griffith's theory- Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), Micro and nano-hardness tests, Impact test lzod and charpy, fatigue and creep failure mechanisms.		CO5

TOTAL: 45 PERIODS

TEXTBOOKS

1. Kenneth G.Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 9th edition ,2018.
2. Sydney H.Avner, "Introduction to Physical Metallurgy", McGraw Hill Book Company, 199

REFERENCE BOOKS

1. A. Alavudeen, N. Venkateshwaran, and J. T.WinowlinJappes, A Textbook of Engineering Materials and Metallurgy, Laxmi Publications, 2006.
2. Amandeep Singh Wadhwa, andHarvinder Singh Dhaliwal, A Textbook of Engineering Material and Metallurgy, University Sciences Press, 2008
3. G.S. Upadhyay and Anish Upadhyay, "Materials Science and Engineering", Viva Books Pvt.Ltd, New Delhi, 2020.
4. Raghavan.V, "Materials Science and Engineering", Prentice Hall of India Pvt.Ltd. 6th edition, 2019.
5. Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, 2nd edition Re print 2019.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Explain alloys and phase diagram, Iron-Iron carbon diagram and steel classification.
CO2	Explain isothermal transformation, continuous cooling diagrams and different heat treatment processes.
CO3	Clarify the effect of alloying elements on ferrous and non-ferrous metals.
CO4	Summarize the properties and applications of non-metallic materials.
CO5	Explain the testing of mechanical properties.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	3	2	-	-	-	-	-	-	-	2	3	-
CO2	3	1	3	2	-	-	-	-	-	-	-	2	3	-
CO3	3	1	3	2	-	-	-	-	-	-	-	2	3	-
CO4	3	1	3	2	-	-	-	-	-	-	-	2	3	-
CO5	3	1	3	2	-	-	-	-	-	-	-	2	3	-

ME4306	COMPUTER AIDED MACHINE DRAWING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- ❖ To apply Indian Standards in drawing practices of machine components.
- ❖ To use hand books for the selection of the standard components like bolts, nuts, screws, keys etc.
- ❖ To show the limits, fits and tolerances in the production drawings of machine components.
- ❖ To prepare assembly drawings both manually and using standard CAD packages.
- ❖ To add the knowledge on 3D Modelling with the detailing features available in the standard CAD packages for converting 3D models into 2D drawings.

DRAWING STANDARDS & FITS AND TOLERANCES	**12**
Code of practice for Engineering Drawing, BIS specifications – Welding symbols, riveted joints, keys, fasteners – Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc. - Limits, Fits – Tolerancing of individual dimensions – Specification of Fits – Preparation of production drawings and reading of part and assembly drawings, basic principles of geometric dimensioning & Tolerance.	**CO1**
INTRODUCTION TO 2D DRAFTING	**16**
• Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailing, Detailed drawing. • Bearings - Bush bearing, Plummer block • Valves – Safety and non-return valves.	**CO2**
3D GEOMETRIC MODELING AND ASSEMBLY	**32**
Sketcher - Datum planes – Protrusion – Holes - Part modeling – Extrusion – Revolve – Sweep – Loft – Blend – Fillet - Pattern – Chamfer - Round - Mirror – Section – Assembly - Detailing for production drawing. • Couplings – Flange, Universal, Oldham's, Muff, Gear couplings • Joints – Knuckle, Gib & cotter, strap, sleeve & cotter joints • Engine parts – Piston, connecting rod, cross-head (vertical and horizontal), stuffing box, multi-plate clutch • • Miscellaneous machine components – Screw jack, machine vice, tail stock, chuck, vane and gear pump	**CO3**
	TOTAL: 60 PERIODS

Note: 25% of assembly drawings must be done manually and the remaining 75% of assembly drawings must be done by using any CAD software. The above tasks can be performed manually and using standard commercial 2D / 3D CAD software

TEXTBOOKS

1. Gopalakrishna K.R., ―Machine Drawing‖, 22nd Edition, Subhas Stores Books Corner, Bangalore, 2017

REFERENCE BOOKS

1. N. D. Bhatt and V.M. Panchal, ―Machine Drawing‖, 48th Edition, Charotar Publishers,2016
2. K.L. Narayana, P. Kannaiam and K. Venkata Reddy,‖ Machine Drawing‖, published by New Age International Publishers,2019.
3. N. Siddeshwar, P. Kanniah, V.V.S. Sastri,‖ Machine Drawing‖, published by Mc GrawHill, 2017
4. Engineering Drawing Practice for Schools and Colleges BIS SP46:2003 (R2008), Published by Bureau of Indian Standards (BIS), 2008.

COURSE OUTCOMES **Upon completion of the course, students will be able to:**	
CO1	Apply the knowledge on standards in drawing practices to prepare the production drawings.
CO2	Use the hand books for selecting the standard components in the drafting of Machine components.
CO3	Distinguish between the 2D drafting and 3D modeling processes available in the standard CAD packages.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. NO	Description of the Equipment	Quantity
1.	Computer nodes or systems with suitable graphics facility	30 Nos
2.	Licensed software for Drafting and Modeling	30 Nos
3.	Laser Printer or Plotter to print / plot drawings	1 No

ME4307	MANUFACTURING PROCESSES LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To study and practice the various operations that can be performed in lathe, shaper, drilling, milling machines etc. and to equip with the practical knowledge required in the core industries.

LIST OF EXPERIMENTS

Machining and Machining time estimations for:

1. Taper Turning
2. External Thread cutting
3. Internal Thread Cutting
4. Eccentric Turning
5. Knurling

Casting and Joining processes

6. Joining of plates by horizontal, vertical and overhead welding (Arc Welding)
7. Joining of plates and pipes using Gas Metal Arc Welding/ Arc Welding /Submerged arc welding
8. Preparation of green sand moulds for various patterns
9. Manufacturing of simple sheet metal components using shearing and bending operations.
10. Manufacturing of sheet metal components using metal spinning on a lathe.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Demonstrate the safety precautions exercised in the mechanical workshop.
CO2	Make the workpiece as per given dimensions and calculate machining time for different operations in Lathe.
CO3	Join two metals using arc welding
CO4	Use sheet metal fabrication tools and make simple tray and funnel
CO5	Use different moulding tools, patterns and prepare sand moulds

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (Pos)												PROGRAM SPECIFIC OUTCOMES (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	2	3	3	3	3	3	3	3	3	3	1
CO2	3	1	3	2	3	3	3	3	3	3	3	3	3	1
CO3	3	1	2	2	3	3	3	3	3	3	3	3	3	1
CO4	3	1	2	2	3	3	3	3	3	3	3	3	3	1
CO5	3	1	2	2	3	3	3	3	3	3	3	3	3	1

HS4310	PROFESSIONAL SKILLS LAB	L	T	P	C
		0	0	2	1

OBJECTIVES

- Enhance the employability and career skills of students
- Orient the students towards grooming as a professional
- Make them employable graduates
- To acquaint themselves with the major generic divisions in English literature
- Develop their confidence and help them attend interviews successfully

LIST OF EXPERIMENTS

UNIT I	**6**
Introduction to soft skills – Hard skills & Soft skills – employability and career skills – grooming as a professional with values – making an oral presentation – planning and preparing a model presentation – organizing the presentation to suit the audience and context; connecting with the audience with the presentation; projecting a positive image while speaking; emphasis on effective body language – general awareness of current affairs	**CO1**
UNIT II	**6**
Self-Introduction – organizing the material – introducing oneself to the audience introducing the topic answering questions individual presentation practice – making a power point presentation – structure and format; covering elements of an effective presentation; body language dynamics – making an oral presentation–planning and preparing a model presentation – organizing the presentation to suit the audience and context; connecting with the audience with the presentation; projecting a positive image while speaking; emphasis on effective body language	**CO2**
UNIT III	**6**
Introduction to group discussion – participating in group discussions – understanding group dynamics – brain storming the topic – questioning and clarifying – GD strategies – structure and dynamics of a GD; techniques of effective presentation in group discussion; preparing for group discussion; accepting others' views /ideas; arguing against others' views or ideas etc	**CO3**
UNIT IV	**6**
Basics of public speaking; preparing for a speech; features of a good speech; speaking with a microphone. (Famous speeches maybe played as model speeches for learning the art of public speaking). Interview etiquette – dress code – body language – attending interviews – telephone/skype interview – one-to-one & a panel interview job interviews purpose and process; how to prepare for an interview; language and style to be used in an interview types of interview questions and how to answer them	**CO4**
UNIT V	**6**
Recognizing differences between groups and teams – managing time – managing stress – networking professionally – respecting social protocols – understanding career management – developing a long-term career plan making career change	**CO5**
	TOTAL: 30 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

- One Server
- 30 Desktop Computers
- One Hand Mike
- One LCD Projector

TEXT BOOKS

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi,2015
2. E. Suresh Kumar et al, Communication for Professional Success. Orient Blackswan: Hyderabad, 2015
3. Raman, Meenakshi and Sangeetha Sharma. Professional Communication. Oxford University Press: Oxford 2014
4. S. Hariharan et al. Soft Skills. MJP Publishers: Chennai, 2010
5. Interact English Lab Manual for Undergraduate Students, Orient BlackSwan: Hyderabad, 2016.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop adequate Soft Skills required for the workplace
CO2	Make effective presentations
CO3	Participate confidently in Group discussions
CO4	Attend job interviews and be successful in them
CO5	Hone their communications skills for their career

MAPPING OF COs WITH POs ANPSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	2	-	2	1	-	-	-	2	3	-	-	2	2
CO2	-	2	-	2	-	-	-	-	2	3	-	-	2	2
CO3	-	-	-	-	-	-	-	-	2	2	-	-	2	2
CO4	-	-	-	-	-	-	-	-	2	2	-	2	1	1
CO5	-	2	1	1	2	-	2	-	2	3	-	2	3	3

MA4401	PROBABILITY AND STATISTICS	L	T	P	C
		3	1	0	4

OBJECTIVES

- ❖ This course aims at providing the required skill to apply the statistical tools in engineering problems.
- ❖ To introduce the basic concepts of probability and random variables.
- ❖ To introduce the basic concepts of two dimensional random variables.
- ❖ To provide necessary basic concepts of probability and random processes for applications in engineering.
- ❖ To introduce the basic concepts and important roles in the statistical quality control.

UNIT I	PROBABILITY AND RANDOM VARIABLES	9+3
Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.		CO1
UNIT II	**TWO - DIMENSIONAL RANDOM VARIABLES**	**9+3**
Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables.		CO2
UNIT III	**RANDOM PROCESSES**	**9+3**
Classification – Stationary process – Markov process – Poisson process – Discrete parameter Markov chain – Chapman Kolmogorov equations (Statement only) – Limiting distributions.		CO3
UNIT IV	**NON-PARAMETRIC TESTS**	**9+3**
Introduction – The Sign test – The Signed – Rank test – Rank – sum tests – The U test – The H test – Tests based on Runs – Test of randomness – The Kolmogorov Test.		CO4
UNIT V	**STATISTICAL QUALITY CONTROL**	**9+3**
Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.		CO5
		TOTAL : 60 PERIODS

TEXT BOOKS

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund‘s Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
2. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.
3. Ibe, O.C., “Fundamentals of Applied Probability and Random Processes", Elsevier,1st Indian Reprint, 2007.

REFERENCE BOOKS

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences‖, Cengage Learning, New Delhi, 8th Edition, 2014.
2. Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Edition, New Delhi, 2004.
3. Papoulis,A. and Unnikrishnapillai, S.,"Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi, 2010.
4. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.
5. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.
6. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2007.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1	Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon
CO2	Understand the basic concepts of one and two dimensional random variables and apply in engineering Applications.
CO3	Apply the concept of random processes in engineering disciplines.
CO4	Apply the basic concepts of statistical quality control.
CO5	Have the notion of sampling distributions and statistical techniques used in engineering and management problems.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	-	-	-	-	-	2	3	-	1	3	-
CO2	3	2	2	-	-	-	-	-	1	2	-	1	3	-
CO3	3	3	3	-	-	-	-	-	2	2	-	1	3	-
CO4	3	2	2	-	-	-	-	-	2	1	-	2	2	-
CO5	3	3	2	-	-	-	-	-	2	2	-	2	3	-

ME4401	STRENGTH OF MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the concepts of stress, strain, principal stresses and principal planes.
- To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
- To determine stresses and deformation in circular shafts and helical spring due to torsion.
- To compute slopes and deflections in determinate beams by various methods.
- To study the stresses and deformations induced in thin and thick shells.

UNIT I	STRESS, STRAIN AND DEFORMATION OF SOLIDS	9
Rigid bodies and deformable solids – Tension, Compression and Shear Stresses - Deformation of simple and compound bars – Thermal stresses – Elastic constants - Volumetric strains – Stresses on inclined planes.		CO1
UNIT II	**TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM**	**9**
Beams – Types - Transverse loading on beams – Shear force and Bending moment in beams – Cantilever, Simply supported and over hanging beams. Theory of simple bending – Bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stress distribution.		CO2
UNIT III	**TORSION**	**9**
Theory of Torsion – Stresses and Deformations in Solid and Hollow Circular Shafts – Combined bending moment and torsion of shafts - Power transmitted to shaft – Shaft in series and parallel – Closed and Open Coiled helical springs – springs in series and parallel.		CO3
UNIT IV	**DEFLECTION OF BEAMS**	**9**
Elastic curve – Governing differential equation - Double integration method - Macaulay's method – Area moment method - Conjugate beam method for computation of slope and deflection of determinant beams. Principal stresses and principal planes – Mohr's circle of stress.		CO4
UNIT V	**THIN CYLINDERS, SPHERES AND THICK CYLINDERS**	**9**
Stresses in thin cylindrical shell due to internal pressure - circumferential and longitudinal stresses - Deformation in thin cylinders – Spherical shells subjected to internal pressure – Deformation in spherical shells – Thick cylinders - Lame's theory.		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Rajput R.K. “Strength of Materials (Mechanics of Solids)", S.Chand & company Ltd., New Delhi, 7th edition, 2018.
2. R. C. Hibbeler, Kai Beng Yap , Mechanics of Materials , The Tenth SI Edition Pearson Education Limited · 2018

REFERENCE BOOKS

1. Rattan S.S., “Strength of Materials", Tata McGraw Hill Education Pvt .Ltd., New Delhi, 2017.
2. Singh. D.K., “Strength of Materials”, Ane Books Pvt Ltd., New Delhi, 2021.
3. Egor P Popov, “Engineering Mechanics of Solids”, 2nd edition, PHI Learning Pvt. Ltd., New Delhi, 2015.
4. Beer. F.P. & Johnston. E.R. “Mechanics of Materials”, Tata McGraw Hill, 8th Edition, New Delhi 2019.
5. Vazirani. V.N, Ratwani. M.M, Duggal .S.K “Analysis of Structures: Analysis, Design and
6. Detailing of Structures-Vol.1”, Khanna Publishers, New Delhi 2014.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1	Understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.
CO2	Understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.
CO3	Apply basic equation of torsion in designing of shafts and helical springs
CO4	Calculate slope and deflection in beams using different methods.
CO5	Analyze thin and thick shells for applied pressures.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	2	3	1	3	2	3	1	3	3	2
CO2	3	3	3	3	2	3	1	3	2	3	1	3	3	2
CO3	3	3	3	3	2	3	1	3	2	3	1	3	3	2
CO4	3	3	3	3	2	3	1	3	2	3	1	3	3	2
CO5	3	3	3	3	2	3	1	3	2	3	1	3	3	2

ME4402	THERMAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the concepts and laws of thermodynamics to predict the operation of thermodynamic cycles and performance of Internal Combustion(IC) engines and Gas Turbines.
- To analyzing the performance of steam nozzle, calculate critical pressure ratio
- To Evaluating the performance of steam turbines through velocity triangles, understand the need for governing and compounding of turbines
- To analyzing the working of IC engines and various auxiliary systems present in IC engines
- To evaluating the various performance parameters of IC engines

UNIT I	THERMODYNAMIC CYCLES	9
Air Standard Cycles – Carnot, Otto, Diesel, Dual, Brayton – Cycle Analysis and its Performance Calculations		CO1
UNIT II	**STEAM NOZZLES AND INJECTOR**	**9**
Types and Shapes of nozzles, Flow of steam through nozzles, Critical pressure ratio, Variation of mass flow rate with pressure ratio. Effect of friction. Metastable flow.		CO2
UNIT III	**STEAM AND GAS TURBINES**	**9**
Types, Impulse and reaction principles, Velocity diagrams, Work done and efficiency – optimal operating conditions. Multi-staging, compounding and governing. Gas turbine cycle analysis – open and closed cycle. Performance and its improvement - Regenerative, Intercooled, Reheated cycles and their combination.		CO3
UNIT IV	**INTERNAL COMBUSTION ENGINES – FEATURES AND COMBUSTION**	**9**
IC engine – Classification, working, components and their functions. Ideal and actual : Valve and port timing diagrams, p-v diagrams- two stroke & four stroke, and SI & CI engines – comparison. Geometric, operating, and performance comparison of SI and CI engines. Desirable properties and qualities of fuels. Air-fuel ratio calculation – lean and rich mixtures. Combustion in SI & CI Engines – Knocking – phenomena and control.		CO4
UNIT V	**INTERNAL COMBUSTION ENGINE PERFORMANCE AND AUXILIARY SYSTEMS**	**9**
Performance and Emission Testing, Performance parameters and calculations. Morse and Heat Balance tests. Multipoint Fuel Injection system and Common rail direct injection systems. Ignition systems – Magneto, Battery and Electronic. Lubrication and Cooling systems. Concepts of Supercharging and Turbocharging – Emission Norms		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1.Mahesh. M. Rathore, “Thermal Engineering”, 1st Edition, Tata McGraw Hill, 2010.

2. Ganesan.V, " Internal Combustion Engines" 4th Edition, Tata McGraw Hill, 2012.

REFERENCE BOOKS

1. Ballaney. P, “Thermal Engineering”, 25th Edition, Khanna Publishers, 2017.
2. Domkundwar, Kothandaraman, &Domkundwar, “A Course in Thermal Engineering”, 6th Edition, Dhanpat Rai& Sons, 2011.
3. Gupta H.N, “Fundamentals of Internal Combustion Engines”, 2nd Edition Prentice Hall of India, 2013.
4. Mathur M.L and Mehta F.S., “Thermal Science and Engineering”, 3rd Edition, Jain Brothers Pvt. Ltd, 2017.
5. Soman. K, “Thermal Engineering”, 2nd Edition, Prentice Hall of India, 2011

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Apply thermodynamic concepts to different air standard cycles and solve problems
CO2	To solve problems in steam nozzle and calculate critical pressure ratio.
CO3	Explain the flow in steam turbines, draw velocity diagrams, flow in Gas turbines and solve problems.
CO4	Explain the functioning and features of IC engine, components and auxiliaries.
CO5	Calculate the various performance parameters of IC engines

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1	-	-	-	-	-	-	-	1	2	2
CO2	3	2	2	1	-	-	-	-	-	-	-	1	2	2
CO3	3	2	2	1	-	-	-	-	-	-	-	1	2	2
CO4	3	2	1	1	-	-	-	-	-	-	-	1	2	2
CO5	3	2	1	1	-	-	-	-	-	-	-	1	2	2

ME4403	HYDRAULICS AND PNEUMATICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- 1. To provide the knowledge on the working principles of fluid power systems.
- 2. To study the fluids and components used in modern industrial fluid power system.
- 3. To develop the design, construction and operation of fluid power circuits.
- 4. To learn the working principles of pneumatic power system and its components.
- 5. To provide the knowledge of trouble shooting methods in fluid power systems.

UNIT I	FLUID POWER PRINICIPLES AND HYDRAULIC PUMP	9
Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of Hydraulics – Pascal's Law – Principles of flow - Friction loss – Work, Power and Torque- Problems, Sources of Hydraulic power: Pumping Theory-– Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of pumps – Fixed and Variable displacement pumps – Problems.		CO1
UNIT II	**HYDRAULIC ACTUATORS AND CONTROL COMPONENTS**	**9**
Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Rotary Actuators-Hydraulic motors - Control Components: Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Accessories: Reservoirs, Pressure Switches – Filters –types and selection- Applications – Fluid Power ANSI Symbols – Problems		CO2
UNIT III	**HYDRAULIC CIRCUITS AND SYSTEMS**	**9**
Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double-Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Deceleration circuits, Sizing of hydraulic systems, Hydrostatic transmission, Electro hydraulic circuits, – Servo and Proportional valves – Applications- Mechanical, hydraulic servo systems.		CO3
UNIT IV	**PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS**	**9**
Properties of air –Air preparation and distribution – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit –classification- single cylinder and multi cylinder circuits-Cascade method –Integration of fringe circuits, Electro Pneumatic System – Elements – Ladder diagram – timer circuits-Problems, Introduction to fluidics and pneumatic logic circuits.		CO4
UNIT V	**TROUBLE SHOOTING AND APPLICATIONS**	**9**
Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Conditioning of hydraulic fluids Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications- mobile hydraulics; Design of Pneumatic circuits for metal working, handling, clamping counter and timer circuits. – Low-cost Automation – Hydraulic and Pneumatic power packs, IOT in Hydraulics and pneumatics Note: (Use of standard Design Data Book is permitted in the University examination)		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Anthony Esposito, "Fluid Power with Applications", Prentice Hall, 2009.
2. Shanmugasundaram.K, "Hydraulic and Pneumatic Controls". Chand & Co, 2006.

REFERENCE BOOKS

1. James A. Sullivan, "Fluid Power Theory and Applications", Fourth Edition, Prentice Hall, 199
2. Jagadeesha. T., "Pneumatics Concepts, Design and Applications ", Universities Press, 2015.
3. Joshi.P., Pneumatic Control", Wiley India, 2008.
4. Majumdar, S.R., "Oil Hydraulics Systems – Principles and Maintenance",TataMcGraw Hill, 2001.
5. Shanmugasundaram.K., "Hydraulic and Pneumatic Controls". Chand & Co, 2006.
6. Srinivasan.R., "Hydraulic and Pneumatic Controls", Vijay Nicole Imprints, 3rd edition,2019.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Apply the working principles of fluid power systems and hydraulic pumps.
CO2	Apply the working principles of hydraulic actuators and control components.
CO3	Design and develop hydraulic circuits and systems.
CO4	Apply the working principles of pneumatic circuits and power system and its components.
CO5	Identify various troubles shooting methods in fluid power systems

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	3	2	-	-	-	-	-	-	-	2	2	-
CO2	2	2	3	2	-	-	-	-	-	-	-	2	2	-
CO3	2	2	3	2	-	-	-	-	-	-	-	2	2	-
CO4	2	2	3	2	-	-	-	-	-	-	-	2	2	-
CO5	2	2	3	2	-	-	-	-	-	-	-	2	2	-

ME4404	METAL CUTTING AND MACHINE TOOLS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the concepts and basic mechanics of metal cutting and the factors affecting machinability
- To learn working of basic and advanced turning machines.
- To teach the basics of machine tools with reciprocating and rotating motions and abrasive finishing processes.
- To study the basic concepts of CNC of machine tools and constructional features of CNC.
- To learn the basics of CNC programming concepts to develop the part programme for Machine centre and turning centre.

UNIT I	MECHANICS OF METAL CUTTING	9
Mechanics of chip formation, forces in machining, Types of chip, cutting tools – single point cutting tool nomenclature, orthogonal and oblique metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability.		CO1
UNIT II	**TURNING MACHINES**	**9**
Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, surface roughness in turning, machining time and power estimation. Special lathes - Capstan and turret lathes- tool layout – automatic lathes: semi-automatic – single spindle: Swiss type, automatic screw type – multi spindle		CO2
UNIT III	**RECIPROCATING MACHINE TOOLS**	**9**
Reciprocating machine tools: shaper, planer, slotter: Types and operations- Hole making: Drilling, reaming, boring, tapping, type of milling operations-attachments- types of milling cutters– machining time calculation - Gear cutting, gear hobbing and gear shaping – gear finishing methods Abrasive processes: grinding wheel – specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centreless grinding, internal grinding - micro finishing methods		CO3
UNIT IV	**CNC MACHINES**	**9**
Computer Numerical Control (CNC) machine tools, constructional details, special features – Drives, Recirculating ball screws, tool changers; CNC Control systems – Open/closed, point-to-point/continuous - Turning and machining centres – Work holding methods in Turning and machining centres, Coolant systems, Safety features.		CO4
UNIT V	**PROGRAMMING OF CNC MACHINE TOOLS**	**9**
Coordinates, axis and motion, Absolute vs Incremental, Interpolators, Polar coordinates, Program planning, G and M codes, Manual part programming for CNC machining centers and Turning centers – Fixed cycles, Loops and subroutines, Setting up a CNC machine for machining.		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India,7th Edition, 2018.
2. Michael Fitzpatrick, Machining and CNC Technology, McGraw-Hill Education; 4th edition, 2018.

REFERENCE BOOKS

1. Roy. A. Lindberg, Processes and materials of manufacture, PHI / Pearson education, 2006.
2. Geofrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", McGraw Hill, 1984.
3. Rao. P.N "Manufacturing Technology," Tata McGraw- Hill, New Delhi, 2009.
4. A. B. Chattopadhyay, Machining and Machine Tools, Wiley, 2nd edition, 2017.

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Apply the mechanism of metal removal process and to identify the factors involved in improving machinability.
CO2	Describe the constructional and operational features of centre lathe and other special purpose lathes.
CO3	Describe the constructional and operational features of reciprocating machine tools.
CO4	Apply the constructional features and working principles of CNC machine tools.
CO5	Demonstrate the Program CNC machine tools through planning, writing codes and setting up CNC machine tools to manufacture a given component.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	1	1	1	3	-	-	3	-	2	2	1
CO2	3	3	3	1	1	1	3	-	-	3	-	2	2	1
CO3	3	3	3	1	1	1	3	-	-	3	-	2	2	1
CO4	3	3	3	1	1	1	3	-	-	3	-	2	2	1
CO5	3	3	3	1	1	1	3	-	-	3	-	2	2	1

ME4405	METROLOGY AND MEASUREMENTS	L	T	P	C
		3	0	0	3

OBJECTIVES

- 1 To learn basic concepts of the metrology and importance of measurements.
- 2 To teach measurement of linear and angular dimensions assembly and transmission elements.
- 3 To study the tolerance analysis in manufacturing.
- 4 To develop the fundamentals of GD & T and surface metrology.
- 5 To provide the knowledge of the advanced measurements for quality control in manufacturing industries.

UNIT I	BASICS OF METROLOGY	9
Measurement – Need, Process, Role in quality control; Factors affecting measurement - SWIPE; Errors in Measurements – Types – Control – Measurement uncertainty – Types, Estimation, Problems on Estimation of Uncertainty, Statistical analysis of measurement data, Measurement system analysis, Calibration of measuring instruments, Principle of air gauging- ISO standards.		CO1

UNIT II	MEASUREMENT OF LINEAR, ANGULAR DIMENSIONS, ASSEMBLY AND TRANSMISSION ELEMENTS	9
Linear Measuring Instruments – Gauge blocks – Use and precautions, Comparators – Working and advantages; Opto-mechanical measurements using measuring microscope and Profile projector - Angular measuring instruments – Measurement of Screw threads - Single element measurements – Pitch Diameter, Lead, Pitch. Measurement of Gears – purpose – Analytical measurement – Runout, Pitch variation, Tooth profile, Tooth thickness, Lead – Functional checking – Rolling gear test.		CO2

UNIT III	TOLERANCE ANALYSIS	9
Tolerancing– Interchangeability, Selective assembly, Tolerance representation, Terminology, Limits and Fits, Problems (using tables IS919); Design of Limit gauges, Problems. Tolerance analysis in manufacturing, Process capability, tolerance stackup, tolerance charting.		CO3

UNIT IV	METROLOGY OF SURFACES	9
Fundamentals of GD & T- Conventional vs Geometric tolerance, Datums, Inspection of geometric deviations like straightness, flatness, roundness deviations; Simple problems – Measurement of Surface finish – Functionality of surfaces, Parameters, Comparative, Stylus based and Optical Measurement techniques, Filters, Introduction to 3D surface metrology- Parameters.		CO4

UNIT V	ADVANCES IN METROLOGY	9
Lasers in metrology - Advantages of lasers – Laser scan micrometers; Laser interferometers –Applications – Straightness, Alignment; Ball bar tests, Computer Aided Metrology - Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Multi-sensor CMMs. Machine Vision - Basic concepts of Machine Vision System – Elements – Applications - On-line and in-process monitoring in production – Computed tomography – White light Scanners.		CO5

TOTAL: 45 PERIODS

TEXTBOOKS

1. Gupta. I.C., "Engineering Metrology", Dhanpatrai Publications, 2005.
2. Jain R.K. "Engineering Metrology", Khanna Publishers, 2009.

REFERENCE BOOKS

1. Dotson Connie, "Dimensional Metrology", Cengage Learning, First edition, 2012.
2. Mark Curtis, Francis T. Farago, "Handbook of Dimensional Measurement", Industrial Press, Fifth Edition 2013.
3. AmmarGrous, J "Applied Metrology for Manufacturing Engineering", Wiley-ISTE, 2011.
4. Galyer, J.F.W. Charles Reginald Shotbolt, "Metrology for Engineers", Cengage Learning EMEA; 5th revised edition, 1990.
5. Raghavendra N.V. and Krishnamurthy. L., Engineering Metrology and Measurements, Oxford University Press, 2013.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Discuss the concepts of measurements to apply in various metrological instruments.
CO2	Apply the principle and applications of linear and angular measuring instruments, assembly and transmission elements.
CO3	Apply the tolerance symbols and tolerance analysis for industrial applications.
CO4	Apply the principles and methods of form and surface metrology.
CO5	Apply the advances in measurements for quality control in manufacturing Industries.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	-	2	-	-	-	-	-	3	3	-
CO2	3	2	2	2	-	2	-	-	-	-	-	3	3	-
CO3	3	2	2	2	-	2	-	-	-	-	-	3	3	-
CO4	3	2	2	2	-	2	-	-	-	-	-	3	3	-
CO5	3	2	2	2	-	2	-	-	-	-	-	3	3	-

ME4406	STRENGTH OF MATERIALS AND FLUID MECHANICS AND MACHINERY LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To study the mechanical properties of materials when subjected to different types of loading.
- To verify the principles studied in Fluid Mechanics theory by performing experiments in lab.

STRENGTH OF MATERIALS LABORATORY

LIST OF EXPERIMENTS

1. Tension test on a mild steel rod	CO1
2. Double shear test on Mild steel and Aluminium rods	
3. Torsion test on mild steel rod	
4. Impact test on metal specimen	CO2
5. Hardness test on metals - Brinnell and Rockwell Hardness Number	
6. Deflection test on beams	
7. Compression test on helical springs	CO3
8. Strain Measurement using Rosette strain gauge	
9. Effect of hardening- Improvement in hardness and impact resistance of steels.	CO2
10. Microscopic Examination of • Hardened samples and • Hardened and tempered samples.	CO3
TOTAL: 30 PERIODS	

FLUID MECHANICS AND MACHINES LABORATORY

LIST OF EXPERIMENTS

1. Determination of the Coefficient of discharge of given Orifice meter.	CO4
2. Determination of the Coefficient of discharge of given Venturi meter	
3. Calculation of the rate of flow using Rota meter.	
4. Determination of friction factor for a given set of pipes.	
5. Conducting experiments and drawing the characteristic curves of centrifugal pump / submergible pump	CO5
6. Conducting experiments and drawing the characteristic curves of reciprocating pump.	
7. Conducting experiments and drawing the characteristic curves of Gear pump.	
8. Conducting experiments and drawing the characteristic curves of Pelton wheel.	
9. Conducting experiments and drawing the characteristics curves of Francis turbine.	
10. Conducting experiments and drawing the characteristic curves of Kaplan turbine.	
TOTAL: 30 PERIODS	

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Determine the tensile, torsion and shear properties of metals by testing
CO2	Determine the impact, hardness and deflection properties of metals by testing
CO3	Determine the stiffness properties of helical spring, strain measurement and microscopic analysis of metal samples.
CO4	Apply the conservation laws to determine the coefficient of discharge of a venturimeter, Orifice meter, Rotameter and finding the friction factor of given pipe
CO5	Determine the performance characteristics of turbine, roto-dynamic pump and positive displacement pump.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	-	-	-	1	2	2	3	3	-	2	3	2
CO2	3	1	-	-	-	1	2	2	3	3	-	2	3	2
CO3	3	1	-	-	-	1	2	2	3	3	-	2	3	2
CO4	3	1	-	-	-	1	2	2	3	3	-	2	3	2
CO5	3	1	-	-	-	1	2	2	3	3	-	2	3	2

ME4407	INTERNAL COMBUSTION ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To study the value timing-V diagram and performance of IC Engines
- To Study the characteristics of fuels/Lubricates used in IC Engines
- To study the Performance of steam generator/ turbine

LIST OF EXPERIMENTS I.C. ENGINE LAB

1. Valve Timing and Port Timing diagrams.
2. Actual p-v diagrams of IC engines.
3. Performance Test on 4 – stroke Diesel Engine.
4. Heat Balance Test on 4 – stroke Diesel Engine
5. Morse Test on Multi-cylinder Petrol Engine.
7. Retardation Test on a Diesel Engine.
8. Determination of Flash Point and Fire Point of various fuels / lubricants.
9. Performance test on a two stage Reciprocating Air compressor

STEAM LAB

1. Study on Steam Generators and Turbines.
2. Performance and Energy Balance Test on a Steam Generator.
3. Performance and Energy Balance Test on Steam Turbine.

TOTAL: 60 PERIODS

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

S. No	Name of the Equipment	Qty
1	I.C Engine – 2 stroke and 4 stroke model	1 Set
2	Apparatus for Flash and Fire point	1 No.
3	4-stroke Diesel Engine with mechanical loading	1 No.
4	4-stroke Diesel Engine with hydraulic loading	1 No.
5	4-stroke Diesel Engine with electrical loading	1 No.
6	Multi-Cylinder Petrol Engine	1 No.
7	Single Cylinder Petrol Engine	1 No.
8	Data Acquisition system with any one of the above engines	1 No.
9	Steam Boiler with turbine setup	1 No.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Conduct tests to evaluate performance characteristics of IC engines
CO2	Conduct tests to evaluate the performance of refrigeration cycle
CO3	Conduct tests to evaluate Performance and Energy Balance on a Steam Generator.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	-	1	-	-	1	1	1
CO2	2	2	1	1	-	-	-	-	1	-	-	1	1	1
CO3	2	2	1	1	-	-	-	-	1	-	-	1	1	1

ME4408	MACHINE TOOLS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To Study and acquire knowledge on various basic Machining Operations in special purpose machines and its applications in real life manufacture of components in the industry.

List of Experiments

1. Contour milling using vertical milling machine
2. Spur gear cutting in milling machine
3. Helical Gear Cutting in milling machine
4. Gear generation in hobbing machine
5. Gear cutting in gear shaping machine
6. Square Head shaping
7. Plain Surface grinding
8. Cylindrical grinding
9. Centreless grinding
10. Tool angle grinding with tool and Cutter Grinder
11. Measurement of cutting forces in Milling / Turning Process
12. CNC Part Programming

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

Sl. No.	Name of the Equipment	Qty.
1.	Centre Lathes	7 Nos
2.	Turret and Capstan Lathes	1 Nos
3.	Horizontal Milling Machine	2 Nos
4.	Vertical Milling Machine	2 Nos
5.	Surface Grinding Machine	1 Nos
6.	Cylindrical Grinding Machine	1 Nos
7.	Centreless Grinding Machine	1 Nos
8.	Tool and Cutter Grinder	1 Nos
9.	Lathe tool Dynamometer	1 Nos
10.	Milling tool Dynamometer	1 Nos
11.	Gear Hobbing Machine	1 Nos
12.	Tool Makers Microscope	1 Nos
13.	CNC Lathe	1 Nos
14.	CNC Milling	1 Nos
15.	Gear Shapping Machine	1 Nos

TOTAL: 60 PERIODS

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	The students will be able to use different machine tools used in the process of milling, finishing operations, manufacture of Gears and to manufacture tools using cutter grinder
CO2	Develop CNC part programming

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**Program SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	-	-	3	-	1	-	-	-	-	1	2	2	-
CO2	-	-	-	3	-	1	-	-	-	-	1	2	2	-
CO3	-	-	-	3	-	1	-	-	-	-	1	2	2	-
CO4	-	-	-	3	-	1	-	-	-	-	1	2	2	-
CO5	-	-	-	3	-	1	-	-	-	-	1	2	2	-

ME4501	DESIGN OF MACHINE ELEMENTS	L	T	P	C
		3	1	0	4

OBJECTIVES

- To learn the various steps involved in the Design Process.
- To learn designing shafts and couplings for various applications.
- To learn the design of temporary and permanent Joints.
- To learn designing helical, leaf springs, flywheels, connecting rods and crank shafts for various applications.
- To learn designing and select sliding and rolling contact bearings, seals and gaskets.

(Use of PSG Design Data book is permitted)

UNIT I	FUNDAMENTAL CONCEPTS IN DESIGN	12
Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers - Direct, Bending and torsional loading- Modes of failure - Factor of safety - Combined loads - Principal stresses - Eccentric loading - curved beams - crane hook and 'C' frame - theories of failure - Design based on strength and stiffness - stress concentration - Fluctuating stresses - Endurance limit - Design for finite and infinite life under variable loading - Exposure to standards.		CO1
UNIT II	**DESIGN OF SHAFTS AND COUPLINGS**	**12**
Shafts and Axles - Design of solid and hollow shafts based on strength, rigidity and critical speed - Keys and splines - Rigid and flexible couplings.		CO2
UNIT III	**DESIGN OF TEMPORARY AND PERMANENT JOINTS**	**12**
Threaded fasteners - Bolted joints including eccentric loading, Knuckle joints, Cotter joints - Welded joints. Butt, Fillet and parallel transverse fillet welds - welded joints subjected to bending, torsional and eccentric loads, riveted joints for structures - theory of bonded joints.		CO3
UNIT IV	**DESIGN OF ENERGY STORING ELEMENTS AND ENGINE COMPONENTS**	**12**
Types of springs, design of helical and concentric springs- surge in springs, Design of laminated springs - rubber springs - Flywheels considering stresses in rims and arms for engines and punching machines - Solid and Rimmed flywheels - connecting rods and crank shafts.		CO4
UNIT V	**DESIGN OF BEARINGS AND MISCELLANEOUS ELEMENTS**	**12**
Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number, Raimondi & Boyd graphs, Selection of Rolling Contact bearings - Design of Seals and Gaskets.		CO5
		TOTAL: 60 PERIODS

TEXTBOOKS

1. Bhandari V B, "Design of Machine Elements", 4th Edition, Tata McGraw-Hill Book Co, 2016.
2. Joseph Shigley, Richard G. Budynas and J. Keith Nisbett "Mechanical Engineering Design", 10th Edition, Tata McGraw-Hill, 2015.

REFERENCE BOOKS

1. Ansel C Ugural, "Mechanical Design – An Integral Approach", 1st Edition, Tata McGraw-Hill Book Co, 2004.
2. Merhyle Franklin Spotts, Terry E. Shoup, and Lee Emrey Hornberger, "Design of Machine Elements" 8th Edition, Printice Hall, 2004.
3. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine component Design", 6th Edition, Wiley, 2017.
4. Sundararajamoorthy T. V. and Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.
5. Design of Machine Elements | SI Edition | Eighth Edition | By Pearson by M. F. Spotts, Terry E. Shoup, et al. | 25 March 2019

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Explain the design machine members subjected to static and variable loads.
CO2	Apply the concepts design to shafts, key and couplings.
CO3	Apply the concepts of design to bolted, Knuckle, Cotter, riveted and welded joints.
CO4	Apply the concept of design helical, leaf springs, flywheels, connecting rods and crank shafts.
CO5	Apply the concepts of design and select sliding and rolling contact bearings, seals and gaskets.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	3	-	-	-	-	1	1	-	-	2	3	2
CO2	2	2	3	-	-	-	-	1	1	-	-	2	3	2
CO3	2	2	3	-	-	-	-	1	1	-	-	2	3	2
CO4	2	2	3	-	-	-	-	1	1	-	-	2	3	2
CO5	2	2	3	-	-	-	-	1	1	-	-	2	3	2

ME4502	THEORY OF MACHINES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide the knowledge of basics of mechanism, machines and its velocity and acceleration analysis
- To provide the knowledge of kinematics of cam and gear mechanism
- To provide the knowledge of force analysis and balancing
- To provide the knowledge of basics of vibration and forced vibration and its control

UNIT I	**BASICS OF MECHANICSM AND KINEMATIC ANALYSIS**	**9**
Basics of Mechanisms – Terminology and definitions – Degrees of freedom – Kinematics Inversions of four bar and slide crank chain – Kinematics analysis in simple mechanisms using relative velocity method – Velocity and Acceleration polygons– Graphical Method.		**CO1**
UNIT II	**KINEMATICS OF CAMS, GEARS & GEAR TRAINS**	**9**
Cams – Classifications – Displacement diagrams - Layout of plate cam profiles – Derivatives of follower motion. Spur gear – Law of toothed gearing – Involute gearing – Gear Tooth action - Interference and undercutting in Involute Gears - Gear trains – Parallel axis gears trains – Simple Epicyclic gear trains		**CO2**
UNIT III	**DYNAMIC FORCE ANALYSIS AND BALANCING OF ROTATING MASS**	**9**
Dynamic force analysis – Inertia force - D Alembert's principle –Dynamic Analysis in reciprocating engines – Gas forces - Bearing loads – Crank shaft torque - Balancing of Rotating masses – Balancing of Several mass rotating in different planes – Applications – Balancing machines		**CO3**
UNIT IV	**FREE VIBRATION ANALYSIS**	**9**
Free vibrations – Equations of motion – Natural Frequency – Free Vibration analysis of beams subjected to multiple loading - Bending - Critical speed of simple shaft - Damped Vibration –Torsional vibration – Torsional vibration of geared system.		**CO4**
UNIT V	**FORCED VIBRATION AND GYROSCOPIC COUPLE**	**9**
Response of one degree freedom systems to periodic forcing – Harmonic disturbances –Disturbance caused by unbalance – Support motion –transmissibility – Vibration isolation vibration measurement. Gyroscopes – Gyroscopic forces and torques – Gyroscopic stabilization – Gyroscopic effects in Automobiles, ships and airplanes.		**CO5**
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Rattan, S.S, "Theory of Machines", 4th Edition, Tata McGraw-Hill, 2014.
2. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", 4th Edition, Oxford University Press, 2014.

REFERENCE BOOKS

1. Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2014.
2. Khurmi, R.S.,"Theory of Machines", 14th Edition, S Chand Publications, 2005.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To study the basic components of mechanisms, analyzing the simple mechanism with respect to velocity and acceleration at any point in a link of a mechanism.
CO2	To study the basic kinematics of cam and gear mechanism
CO3	To study the force analysis on engine mechanism and balancing of rotating mass
CO4	To study the free vibration analysis of various mechanical systems
CO5	To study the forced vibration caused and to study the gyroscopic effects.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	2	-	2	-	-	-	2	-	2	3	3
CO2	3	3	3	2	-	2	-	-	-	2	-	2	3	3
CO3	3	3	3	2	-	2	-	-	-	-	-	2	3	3
CO4	3	3	3	2	-	2	-	-	-	-	-	2	3	3
CO5	3	3	3	2	-	2	-	-	-	1	-	2	3	3

ME4507	METROLOGY AND DYNAMICS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- 1. To study the different measurement equipment and use of this industry for quality inspection.
- 2. To supplements the principles learnt in dynamics of machinery.
- 3 .To understand how certain measuring devices are used for dynamic testing.

METROLOGY LABORATORY	**30**
LIST OF EXPERIMENTS 1. Calibration and use of linear measuring instruments – Vernier caliper, micrometer, Vernier height gauge, depth micrometer, bore gauge, telescopic gauge, Comparators. 2. Measurement of angles using bevel protractor, sine bar, autocollimator, precision level. 3. Measurement of assembly and transmission elements - screw thread parameters – Screw thread Micrometers, Three wire method, Toolmaker's microscope. 4. Measurement of gear parameters – Micrometers, Vernier caliper, Gear tester. 5. Measurement of features in a prismatic component using Coordinate Measuring Machine (CMM), Programming of CNC Coordinate Measuring Machines for repeated measurements of identical components. 6. Non-contact (Optical) measurement using Measuring microscope / Profile projector and Video measurement system. 7. Surface metrology - Measurement of form parameters – Straightness, Flatness, Roundness, Cylindricity, Perpendicularity, Runout, Concentricity – in the given component using Roundness tester. 8. Measurement of Surface finish in components manufactured using various processes (turning, milling, grinding, etc.,) using stylus based instruments.	**CO1**
DYNAMICS LABORATORY	**30**
LIST OF EXPERIMENTS 1. Study of gear parameters. 2. Epicycle gear Train. 3. Determination of moment of inertia of flywheel and axle system. 4. Determination of mass moment of inertia of a body about its axis of symmetry. 5. Undamped free vibrations of a single degree freedom spring-mass system. 6. Torsional Vibration (Undamped) of single rotor shaft system. 7. Dynamic analysis of cam mechanism. 8. Experiment on Watts Governor. 9. Experiment on Porter Governor. 10. Experiment on Proell Governor. 11. Experiment on motorized gyroscope. 12. Determination of critical speed of shafts.	**CO2**

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

METROLOGY LABORATORY

Sl. No.	Name of the Equipment	Qty.
1.	Micrometer	5 Nos
2.	Vernier Caliper	5 Nos
3.	Vernier Height Gauge	2 Nos
4.	Vernier Depth Gauge	2 Nos
5.	Slip Gauge Set	1 Nos
6.	Gear Tooth Vernier	1 Nos
7.	Sine Bar	1 Nos
8.	Floating Carriage Micrometer	1 Nos
9.	Profile Projector / Tool Makers Microscope	1 Nos
10.	Mechanical / Electrical / Pneumatic Comparator	1 Nos
11.	Autocollimator	1 Nos
12.	Surface finish Measuring Equipment	1 Nos
13.	Bore Gauge	1 Nos
14.	Telescope Gauge	1 Nos

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

DYNAMICS LABORATORY

Sl. No.	Name of the Equipment	Qty.
1.	Cam follower setup	1No.
2.	Motorised gyroscope	1No.
3.	Governor apparatus – Watt, Porter, Proell and Hartnell governors	1No.
4.	Whirling of shaft apparatus	1No.
5.	Dynamic balancing machine	1No.
6.	Spring mass vibration system	1No.
7.	Torsional Vibration of single rotor system setup	1No.
8.	Gear Models	1No.
9.	Kinematic Models to study various mechanisms	1No.
10.	Turn table apparatus	1No.
11.	Transverse vibration setup of a) cantilever beam b)Simply supported beam	1No.

TOTAL: 60 PERIODS

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	The students able to calibrate instruments and to measure the gear tooth dimensions, angle using sine bar and straightness.
CO2	Determine mass moment of inertia of mechanical element, governor effort and range of Sensitivity, the natural frequency and damping coefficient, critical speeds of shafts.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOS)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	2	2	3	-	2	2	-	-	-	2	2	3	2
CO2	-	2	2	3	-	2	2	-	-	-	2	2	3	2

ME4508	CAD CAM LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To show the practical knowledge in handling 2D drafting and 3D modelling software systems.
- To design the 3 - Dimensional geometric model of parts, sub-assemblies, assemblies and exporting it to drawing.
- To explore to the features of CNC Machine Tools.
- To use the various types of to modern control systems (Fanuc)
- To know the application of various CNC machines like CNC lathe, CNC Vertical Machining centre.

3D GEOMETRIC MODELLING	**30**
1. Introduction of 3D Modelling software **Creation of 3D assembly model of following machine elements using 3D Modelling software** 2. Flange Coupling 3. Plummer Block 4. Screw Jack 5. Universal Joint 6. Machine Vice 7. Stuffing box 8. Connecting rod 9. Piston 10. Crankshaft	**CO1** **CO2**
MANUAL PART PROGRAMMING.	**20**
(i) Part Programming - CNC Machining Centre (a) Linear Cutting. (b) Circular cutting (c) Cutter Radius Compensation. (d) Canned Cycle Operations. (ii) Part Programming - CNC Turning Centre (a) Straight, Taper and Radius Turning. (b) Thread Cutting. (c) Rough and Finish Turning Cycle. (d) Drilling and Tapping Cycle	**CO3** **CO4**
STUDY ON COMPUTER AIDED PART PROGRAMMING	**10**
(a) CL Data and Post process generation using CAM packages. (b) Application of CAPP in Machining and Turning Centre.	**CO5**
	TOTAL: 60 PERIODS

TEXTBOOKS

1. Gopalakrishna K.R., ―Machine Drawing‖, 22nd Edition, Subhas Stores Books Corner, Bangalore, 2017

REFERENCE BOOKS

1. N. D. Bhatt and V.M. Panchal, ―Machine Drawing‖, 48th Edition, Charotar Publishers,2016
2. 2. K.L. Narayana, P. Kannaiam and K. Venkata Reddy,‖ Machine Drawing‖, published by New Age International Publishers,2019.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Explore to the different 3D modelling features available in the CAD System.
CO2	Design the 3 - Dimensional geometric part and assembly models.
CO3	Detail the 3 - Dimensional geometric model of parts, sub-assemblies, assemblies into to production drawings.
CO4	Apply the fundamental working principle of CNC machine tools.
CO5	Program using G & M Codes and simulate the CNC program. CO6 Generate part programming data through CAM software

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No	Description of the Equipment	Quantity
	Hardware	
1.	Computer Server	1 No
2.	Computer nodes or systems s (High end CPU with at least 1 2. GB main memory) networked to the server	30 Nos
3.	A3 size plotter	1 No
4.	Laser Printer	1 No
5.	CNC Lathe	1 No
6.	CNC milling machine	1 No
	Software	
7.	Any High-end integrated modeling and manufacturing CAD / CAM software	30 Nos
8.	CAM Software for machining centre and turning centre (CNC Programming and tool path simulation for FANUC)	30 Nos
9.	Licensed operating system	30

ME4601	HEAT AND MASS TRANSFER	L	T	P	C
		3	1	0	4

OBJECTIVES

- Understanding the steady and transient heat conduction.
- Comprehending the principles of convective heat transfer.
- Outlining the facets of heat transfer for designing a heat exchanger
- Inferring the fundamental concepts of radiation heat transfer.
- Analyzing the relation between heat and mass transfer

UNIT I	CONDUCTION	9+3
General Differential equation – Cartesian, Cylindrical and Spherical Coordinates – One Dimensional Steady State Heat Conduction — plane and Composite Systems – Conduction with Internal Heat Generation Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infinite and Infinite Solids –Use of Heisler's charts.		CO1
UNIT II	**CONVECTION**	**9+3**
Conservation Equations, Boundary Layer Concept – Forced Convection: External Flow – Flow over Plates, Cylinders Spheres and Bank of tubes. Internal Flow – Entrance effects. Free Convection –Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres.		CO2
UNIT III	**PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS**	**9+3**
Nusselt's theory of condensation- Regimes of Pool boiling and Flow boiling, correlations in boiling and condensation. Heat Exchanger Types - Overall Heat Transfer Coefficient – Fouling Factors. LMTD and NTU methods. Introduction to TEMA Standards.		CO3
UNIT IV	**RADIATION**	**9+3**
Radiation laws, Black Body and Gray body Radiation. Shape Factor. Electrical Analogy. Radiation shields.		CO4
UNIT V	**MASS TRANSFER**	**9+3**
Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion. Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations.		CO5
		TOTAL: 60 PERIODS

TEXTBOOKS

1. R.C. Sachdeva, "Fundamentals of Engineering Heat & Mass transfer", New Age International Publishers, 2009
2. Yunus A. Cengel, "Heat Transfer A Practical Approach" – Tata McGraw Hill, 5thEdition –2013

REFERENCE BOOKS

1. Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2010
2. Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 2012

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Summarize the mechanism of heat conduction under steady and transient conditions.
CO2	Elucidate the principles of convective heat transfer.
CO3	Design a heat exchanger for any specific application
CO4	Adopt the concept of radiation heat transfer in real time systems
CO5	Develop solutions to problems involving combined heat and mass transfer

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	-	-	-	-	-	-	3	-	-
CO2	3	3	3	3	-	-	-	-	-	-	-	3	-	-
CO3	3	3	3	3	3	-	-	-	-	-	-	3	-	-
CO4	3	3	3	3	-	-	-	-	-	-	-	3	-	-
CO5	3	3	3	3	-	-	-	-	-	-	-	3	-	-

CS4655	C PROGRAMMING AND BASICS OF DATA STRUCTURES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the basics of C programming language.
- To learn the concepts of advanced features of C.
- To learn the concepts of advanced features of C.
- To know the concepts of non-linear data structure and hashing.
- To familiarize the concepts of sorting and searching techniques

UNIT I	BASICS OF C PROGRAMMING	9
Introduction to programming paradigms – Applications of C Language - Structure of C program - C programming: Data Types - Constants – Enumeration Constants - Keywords – Operators: Precedence and Associativity - Expressions – Input /Output statements, Assignment statements – Decision making statements - Switch statement - Looping statements – Preprocessor directives - Compilation process.		CO1
UNIT II	**ARRAYS, STRINGS AND FUNCTIONS**	**9**
Introduction to Arrays: Declaration, Initialization – One dimensional array – Two dimensional arrays - String operations: length, compare, concatenate, copy – linear and binary search. Modular programming - Function prototype, function definition, function call, Built-in functions (string functions, math functions) – Recursion, Binary Search using recursive functions.		CO2
UNIT III	**POINTERS**	**9**
Pointers – Pointer operators – Arrays and pointers – Array of pointers – Parameter passing: Pass by value, Pass by reference. Pointer and Structures-Dynamic memory allocation-Files – Types of file processing: Sequential access, Random access – Sequential access file - Random access file - Command line arguments.		CO3
UNIT IV	**STACKS, QUEUES AND LISTS**	**9**
Linked list implementation – Singly linked lists – Circularly linked lists – Doubly-linked lists –Stack ADT – Operations – Applications – Infix to Postfix conversion – Function Calls – Queue ADT – Operations – Circular Queue – Dequeue.		CO4
UNIT V	**SEARCH TREES, SEARCHING, SORTING AND HASHING TECHNIQUES**	**9**
B-Tree – B+ Tree – Types of Graphs – Breadth-first traversal – Depth-first traversal -Dijkstra's algorithm – Minimum Spanning Tree – Prim's algorithm – Kruskal's algorithm- Sorting – Selection sort – Insertion sort –. Merge Sort – Hashing – Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Reema Thareja, "Programming C", Second Edition, Oxford University Press, 2016.
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education, 1997.

REFERENCE BOOKS

1. "Fundamentals of data structure in C" Horowitz, Sahani & Freed, Computer Science Press.
2. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education,1983

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop C programs for any real world/technical application.
CO2	Apply advanced features of C in solving problems.
CO3	Write functions to implement linear and non–linear data structure operations.
CO4	Suggest and use appropriate linear/non–linear data structure operations for solving a given problem.
CO5	Appropriately use sort and search algorithms for a given application. And apply appropriate hash functions that result in a collision free scenario for data storage and retrieval.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	2	3	3	1	1	3	0	0	2	1	-	-
CO2	2	1	1	1	1	0	3	3	1	1	2	1	-	-
CO3	1	2	2	0	0	3	1	0	3	1	1	3	-	-
CO4	3	1	2	2	0	0	1	3	1	3	1	1	-	-
CO5	2	1	1	1	2	0	3	0	1	1	3	1	-	-

CS4657	C PROGRAMMING AND DATA STRUCTURES LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To introduce the basics of C programming language.
- Implement various basic data structures and its operations.
- Implement various sorting and searching algorithms.

LIST OF EXPERIMENTS

1. Basics a. Write a program to print sample strings like "hello world", "Welcome to C Programming" with different formats using escape sequences. b. Write a Program to demonstrate arithmetic operators. (+,-,*,/,%) c. Write a Program to demonstrate logical operators. (logical AND, logical OR).	CO1
2. Decision Statements a. Write a Program to read marks of a student in six subjects and print whether pass or fail (using if-else). b. Write a Program to calculate electricity bill. c. Write a Program to display names of days in a Week using switch case. d. Write a program to display multiplication tables from 1 to 10 except 3 and 5 using loops.	
3. Arrays a. Write a program to store 10 elements in the 1-D array and print sum of the array. b. Write a program to count no. of positive numbers, negative numbers and zeros in the array. c. Write a program to search the given element by using linear search. d. Write a program to perform matrix multiplication by checking the compatibility.	CO2
4. Strings a. Write a program to verify the given string is palindrome or not (without built-in functions, with using built-in functions). b. Write a program to concatenate two strings using arrays.	
5. Function a. Write a program to read values from keyboard and find the values using abs(),sqrt(),floor(),ceil()and pow(). b. Write a program to find difference of two numbers using functions without arguments, with return type. c. Write a program to calculate factorial, gcd using recursion and non-recursion functions. d. Write a program which copies the contents of one file to another file using command line arguments.	
6. Implementation of stacks using linked lists.	CO3
7. Implement stacks and queue.	
8. Graph traversal 1. DFS 2. BFS	
9. Implementation of minimum spanning tree	
10. Sorting Algorithm a. Selection sort b. Insertion sort c. Merge sort	
TOTAL: 60 PERIODS	

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Able to implement concepts of C programming
CO2	Ability to perform the basic data structure and its operations
CO3	Ability to solve minimum spanning tree

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	3	0	3	3	2	3	3	2	0	1	-	-
CO2	3	2	3	1	2	3	0	3	2	3	0	1	-	-
CO3	2	3	0	0	3	0	1	2	3	0	0	0	-	-

ME4608	HEAT TRANSFER AND REFRIGERATION AND AIR-CONDITIONING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To study the heat transfer phenomena, predict the relevant coefficient using implementation
- To study the performance of refrigeration cycle / components

LIST OF EXPERIMENTS - HEAT TRANSFER LAB

1. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
2. Determination of heat transfer coefficient under natural convection from a vertical cylinder.
3. Determination of heat transfer coefficient under forced convection from a tube.
4. Determination of Thermal conductivity of composite wall.
5. Heat transfer from pin-fin apparatus (natural & forced convection modes)
6. Determination of Stefan – Boltzmann constant.
7. Determination of emissivity of a grey surface.
8. Effectiveness of Parallel / counter flow heat exchanger.

REFRIGERATION AND AIR CONDITIONING LAB

1. Determination of COP of a refrigeration system
2. Performance test on a reciprocating air compressor
3. Performance test in Cooling Tower

TOTAL: 60 PERIODS

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

S. No	Name of the Equipment	Qty
1	Lagged pipe apparatus	1 Set
2	Natural convection-vertical cylinder apparatus	1 No.
3	Forced convection inside tube apparatus	1 No.
4	Composite wall apparatus	1 No.
5	Pin-fin apparatus	1 No.
6	Stefan-Boltzmann apparatus	1 No.
7	Emissivity measurement apparatus	1 No.
8	Parallel/counter flow heat exchanger apparatus	1 No.
9	Refrigeration test rig	1 No
10	Air-conditioning test rig	1 No
11	HC Refrigeration System	1 No.
12	Fluidized Bed Cooling Tower	1 No

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Ability to determine the thermal conductivity, heat transfer coefficient, Stefan Boltzmann constant and emissivity of a grey surface
CO2	Ability to determine the effectiveness of a heat exchanger
CO3	Ability to determine the COP of an AC and refrigeration system

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	1	-	-	1	2	1
CO2	3	2	1	1	-	-	-	-	1	-	-	1	2	1
CO3	3	2	1	1	-	-	-	-	1	-	-	1	2	1

ME4609	DESIGN AND FABRICATION PROJECT	L	T	P	C
		0	0	4	2

OBJECTIVES

- To give an opportunity to the student to get hands on training in the fabrication of one or more components of a complete working model, which is designed by them.

The students in a group of 2 to 4 works on a topic approved by the Head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Use of design principles and develop conceptual and engineering design of any components.
CO2	Fabricate any components using different manufacturing tools and demonstrate the working model of the machine element or the mechanical product.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	-	-	-	3	-	2	2	-	3	3
CO2	3	3	2	1	-	-	-	3	-	2	2	-	3	3

ME4701	MECHATRONICS	L	T	P	C
		3	0	0	3

OBJECTIVE

- To impart knowledge about the elements and techniques involved in Mechatronics systems which are very much essential to understand the emerging field of automation.

UNIT I	INTRODUCTION	12
Introduction to Mechatronics – Systems – Concepts of Mechatronics approach – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance sensors – Strain gauges – Eddy current sensor – Hall effect sensor – Temperature sensors – Light sensors		CO1
UNIT II	**8085 MICROPROCESSOR AND 8051 MICROCONTROLLER**	**10**
Introduction – Architecture of 8085 – Pin Configuration – Addressing Modes –Instruction set, Timing diagram of 8085 – Concepts of 8051 microcontroller – Block diagram		CO2
UNIT III	**PROGRAMMABLE PERIPHERAL INTERFACE**	**8**
Introduction – Architecture of 8255, Keyboard interfacing, LED display –interfacing, ADC and DAC interface, Temperature Control – Stepper Motor Control – Traffic Control interface.		CO3
UNIT IV	**PROGRAMMABLE LOGIC CONTROLLER**	**7**
Introduction – Basic structure – Input and output processing – Programming – Mnemonics – Timers, counters and internal relays – Data handling – Selection of PLC.		CO4
UNIT V	**ACTUATORS AND MECHATRONIC SYSTEM DESIGN**	**8**
Types of Stepper and Servo motors – Construction – Working Principle – Advantages and Disadvantages. Design process-stages of design process – Traditional and Mechatronics design concepts – Case studies of Mechatronics systems – Pick and place Robot – Engine Management system – Automatic car park barrier.		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Bolton, “Mechatronics”, Printice Hall, 2019, 6th Edition.
2. Ramesh S Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085” 5th Edition, Prentice Hall, 2008.

REFERENCE BOOKS

1. Michael B.Histand and Davis G.Alciatore, “Introduction to Mechatronics and Measurement systems”, McGraw Hill International edition, 2007.
2. Bradley D.A, Dawson D, Buru N.C and Loader A.J, “Mechatronics”, Chapman and Hall, 1993.
3. Smaili.A and Mrad.F , “Mechatronics Integrated Technologies for Intelligent Machines”, Oxford University Press, 2007.
4. Devadas Shetty and Richard A. Kolk, “Mechatronics Systems Design”, PWS publishing company, 2007.
5. Krishna Kant, “Microprocessors & Microcontrollers”, Prentice Hall of India, 2007. 6. Clarence W, de Silva, "Mechatronics" CRC Press, First Indian Re-print, 2013

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1	Discuss the interdisciplinary application of Electronics, Electrical, Mechanical and Computer systems for the control of Mechanical, Electronic Systems and Sensor technology
CO2	Discuss the architecture of Microcontroller and Microprocessor, Pin diagram, Addressing modes of Microcontroller and Microprocessor.
CO3	Discuss programmable peripheral Interface Architecture of 8255 PPI and various device interfacing.
CO4	Explain the architecture, programming and application of Programmable Logic controllers to problems and challenges in area of mechatronics Engineering.
CO5	Discuss various actuators and mechatronics systems using the knowledge and skills acquired through the course and also from given case studies.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	3	-	-	-	-	-	-	-	-	2	2	3
CO2	3	-	3	-	-	-	-	-	-	-	-	1	2	3
CO3	3	-	3	-	-	-	-	-	-	-	-	1	2	3
CO4	3	2	3	-	3	-	-	-	-	2	-	2	2	3
CO5	3	-	3	-	3	-	-	-	-	3	-	2	2	3

ME4702	COMPUTER INTEGRATED MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

UNIT I	INTRODUCTION	9
Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerized elements of CIM system –Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In-Time Production. Introduction to 3D printing and smart manufacturing.		CO1
UNIT II	PRODUCTION PLANNING AND CONTROL AND COMPUTERISED PROCESS PLANNING	9
Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control-Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) - Simple Problems.		CO2
UNIT III	CELLULAR MANUFACTURING	9
Group Technology(GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method - Arranging Machines in a GT cell – Hollier Method – Simple Problems.		CO3
UNIT IV	FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS)	9
Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety.		CO4
UNIT V	INDUSTRIAL ROBOTICS	9
Robot Anatomy and Related Attributes – Classification of Robots- Robot Control systems – End Effectors – Sensors in Robotics – Robot Accuracy and Repeatability - Industrial Robot Applications – Robot Part Programming – Robot Accuracy and Repeatability – Simple Problems.		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Mikell.P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008.
2. Radhakrishnan P, Subramanyan S.and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.

REFERENCE BOOKS

1. Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India, 2003.
2. Gideon Halevi and Roland Weill, "Principles of Process Planning – A Logical Approach" Chapman & Hall, London, 1995.
3. Rao. P, N Tewari &T.K. Kundra, "Computer Aided Manufacturing", Tata McGraw Hill Publishing Company, 2000.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1	Understand the elements of CIM and CIM Concept
CO2	Understand Computers in process planning and use in CIM
CO3	Understand the uses of Cellular Manufacturing in CIM
CO4	Understand the purpose of FMS and AGV in CIM
CO5	Understand the Robotic fundamentals in CIM

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	-	-	-	-	2	-	-	3	3	3	2	1	2
CO2	-	-	-	-	-	2	-	-	3	3	3	2	1	0
CO3	-	-	-	-	-	2	-	-	3	3	3	2	1	0
CO4	-	-	-	-	-	2	-	-	3	3	3	2	1	2
CO5	-	-	-	-	-	2	-	-	3	3	3	2	1	2

GE4791	HUMAN VALUES AND ETHICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I	HUMAN VALUES	10
Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.		CO1
UNIT II	**ENGINEERING ETHICS**	**9**
Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.		CO2
UNIT III	**ENGINEERING AS SOCIAL EXPERIMENTATION**	**9**
Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.		CO3
UNIT IV	**SAFETY, RESPONSIBILITIES AND RIGHTS**	**9**
Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.		CO4
UNIT V	**GLOBAL ISSUES**	**8**
Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Code of Conduct – Corporate Social Responsibility.		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

REFERENCE BOOKS

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd.,New Delhi, 2013.
6. World Community Service Centre, ' Value Education', Vethathiri publications, Erode, 2011.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Students should be able to apply ethics in society, and realize the responsibilities and rights in the society.
CO2	Students should be able to discuss the ethical issues related to engineering
CO3	Understood the core values that shape the ethical behaviour of an engineer
CO4	Exposed awareness on professional ethics and human values
CO5	Known their role in technological development

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	-	-	-	-	2	2	3	2	-	-	2	-	-
CO2	-	-	-	-	-	2	2	3	2	-	-	2	-	-
CO3	-	-	-	-	-	2	2	3	2	-	-	2	-	-
CO4	-	-	-	-	-	2	2	3	2	-	-	2	-	-
CO5	-	-	-	-	-	2	2	3	2	-	-	2	-	-

ME4707	SIMULATION AND ANALYSIS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To develop the student's skills in proper modeling, meshing, and setting up material properties, loads, and constraints for computer simulation and analysis
- To give exposure to software tools needed to analyze engineering problems
- To expose the students to different applications of simulation and analysis tools
- To provide the analysis skills to interpret and draw conclusion the results of computer analysis

LIST OF EXPERIMENTS

1. Analysis of bar element under axial loads and thermal loads.	CO2
2. Analysis of truss structure.	
3. Analysis of beams with point load, UDL, UVL, plotting shear force and bending moment diagrams.	
4. Analysis of a Plate with various Boundary conditions.	CO1
5. Stress analysis of an Axi-symmetric component.	
6. Modal Analysis of Beam and Plate Elements.	
7. Harmonic Analysis of Beam and Plate Elements.	CO2
8. Analysis of Column with Buckling Loads.	
9. Steady state heat transfer analysis of composite wall.	
10. Vibration analysis of spring-mass systems.	
11. Coupled field analysis of a solid object.	
12. Fluid flow analysis on circular pipe.	
13. Analysis of Joints and Springs.	CO1
14. Case Study - Structural/Thermal Analysis.	
15. Case Study – Fluid Analysis.	

TOTAL: 60 PERIODS

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Analyze and simulate the static solid and structural mechanics problems using FEA software
CO2	Understand heat transfer and dynamic analysis.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	2	2	-	-	1	-	-	2	3	2
CO2	2	3	2	-	2	2	-	-	2	-	-	2	3	2

ME4708	MECHATRONICS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To know the method of programming the microprocessor and also the design, modeling & analysis of basic electrical, hydraulic & pneumatic Systems which enable the students to understand the concept of mechatronics.

LIST OF EXPERIMENTS

1. Assembly language programming of 8085 – Addition – Subtraction – Multiplication – Division – Sorting – Code Conversion.	CO2
2. Stepper motor interface.	
3. Traffic light interface	
4. Speed control of DC motor.	
5. Study of various types of transducers.	CO1
6. Study of hydraulic, pneumatic and electro-pneumatic circuits.	
7. Modelling and analysis of basic hydraulic, pneumatic and electrical circuits using Software.	
8. Study of PLC and its applications.	CO2
9. Study of image processing technique.	
TOTAL: 60 PERIODS	

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1	Demonstrate the functioning of mechatronics system with various pneumatic, hydraulic and electrical systems.
CO2	Demonstrate the functioning of control systems with the help of PLC and microcontrollers.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	3	-	-	-	-	-	-	-	2	3
CO2	2	-	-	-	3	-	-	-	-	-	-	-	2	3

GE4792	INDUSTRIAL MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To enable the students to study the evolution of Management, to study the functions and principles of management and to learn the application of the principles in an organization.

UNIT I	INTRODUCTION	9
Management - Definition – Functions – Evolution of Modern Management – Scientific Management Development of Management Thought. Approaches to the study of Management, Forms of Organization – Individual Ownership – Partnership – Joint Stock Companies – Co- operative Enterprises – Public Sector Undertakings, Corporate Frame Work – Share Holders – Board of Directors – Committees – Chief Executive –Trade Union		CO1

UNIT II	FUNCTIONS OF MANAGEMENT	9
Planning – Nature and Purpose – Objectives – Strategies – Policies and Planning Premises – Decision Making – Organizing – Nature and Process – Premises – Departmentalization – Line and staff – Decentralization – Organizational culture, Staffing - selection and training – Placement – Performance appraisal – Career Strategy – Organizational Development. Leading – Managing human factor – Leadership – Communication, Controlling - Process of Controlling – Controlling techniques, productivity and operations management – Preventive control, Industrial Safety.		CO2

UNIT III	ORGANIZATIONAL BEHAVIOUR	9
Definition – Organization – Managerial Role and functions – Organizational approaches, Individual behaviour – causes – Environmental Effect – Behavior and Performance, Perception – Organizational Implications. Personality – Contributing factors - Dimension – Need Theories – Process Theories – Job Satisfaction, Learning and Behavior – Learning Curves, Work Design and approaches.		CO3

UNIT IV	GROUP DYNAMICS	9
Group Behavior – Groups – Contributing factors – Group Norms, Communication – Process – Barriers to communication – Effective communication, leadership – formal and informal characteristics – Managerial Grid – Leadership styles – Group Decision Making – Leadership Role in Group Decision, Group Conflicts – Types – Causes – Conflict Resolution – Inter group relations and conflict, Organization centralization and decentralization – Formal and informal – Organizational Structures – Organizational Change and Development – Change Process – Resistance to Change – Culture and Ethics.		CO4

UNIT V	MODERN CONCEPTS	9
Management by Objectives (MBO), Management by Exception (MBE), Strategic Management - Planning for Future direction – SWOT Analysis – Information technology in management – Decisions support system – Business Process Re-engineering (BPR) – Enterprises Resource Planning (ERP) – Supply Chain Management (SCM) – Activity Based Management (ABM).		CO5

TOTAL: 45 PERIODS

TEXTBOOKS

1. Herald Knottz and Heinz Weihrich, "Essentials of Management", Tata McGraw Hill Education Pvt. Ltd., 2010.
2. Stephen P. Robbins, "Organization Behaviour", Pearson Education Inc., 13 edition, 2010.

REFERENCE BOOKS

1. Joseph J, Massie, "Essentials of Management" Prentice Hall of India Pvt. Ltd. 1985.
2. Ties, AF, Stoner and R.Edward Freeman, "Management" Prentice Hall of India Pvt. Ltd. New Delhi 110 011, 1992
3. Tripathi. P.C. & P.N. Reddy, "Principles of Management", Tata McGraw Hill, 2006.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Know about Evolution of Modern Management and Forms of Organization.
CO2	Understand the need for planning and controlling activities in the organisation
CO3	Learn about the individuals and group behaviours in the organisation
CO4	Know about the effect Leadership roles and Organizational Structures
CO5	Understand the different modern concepts to evaluate the management activities.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	-	-	-	-	2	-	-	3	3	3	2	-	-
CO2	-	-	-	-	-	2	-	-	3	3	3	2	-	-
CO3	-	-	-	-	-	2	-	-	3	3	3	2	-	-
CO4	-	-	-	-	-	2	-	-	3	3	3	2	-	-
CO5	-	-	-	-	-	2	-	-	3	3	3	2	-	-

ME4807	PROJECT WORK	L	T	P	C
		0	0	20	10

OBJECTIVES

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination.

The students in a group of 2 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Take up any challenging practical problems and find solution by formulating proper methodology.
CO2	Design engineering solutions to complex problems utilizing a systems approach and conduct an engineering project and communicate with engineers and the community at large in written and oral forms.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	-	-	-	3	-	2	2	1	3	3
CO2	3	3	3	3	-	-	-	3	-	2	2	1	3	3

MX4001	INTRODUCTION TO WOMEN AND GENDER STUDIES	L	T	P	C
		3	0	0	0

OBJECTIVES

- To enhance social sensitivity, sensibility and responsibility thereby instilling the life skills among students, through applied learning.
- To upgrade knowledge and comprehension of gender issues for attitudinal and behavioural changes among marginalized groups to claim the right to life with dignity and equality through extension and collaborative activities.
- To evolve inclusive approach for holistic development in order to promote women empowerment

UNIT I	INTRODUCTION TO WOMEN'S STUDIES	9
Key concepts in Gender studies - Need, Scope and challenges of Women's Studies – Women's Studies as an academicdiscipline - Women's Studies to Gender Studies - Need for Gender Sensitization - Women's Movements – global and local: Pre-independence - Post-independence and Contemporary Debates - National Committees and Commissions for Women.		CO1
UNIT II	**FEMINIST THINKERS AND THEORIES**	**9**
Liberal Feminism - Marxist Feminism - Radical Feminism - Socialist Feminism - Indian Feminism - Black Feminism - Eco-Feminism - New Feminist Debates- Post Colonial /Post Modern - Masculinity Studies - Contemporary Contestations – Intersex and Transgender Movements. Feminist thinkers in 18^{th},19^{th}, 20^{th} and 21^{st} Century.		CO2
UNIT III	**GENDER AND EDUCATION**	**9**
Women's Education – Gender diversities and disparities in enrolment, Curriculumcontent, Dropouts, profession and Gender - Gendered Education- Family, Culture, Gender roles, Gender Identities -Education for the Marginalized Women - Recent Trends in Women's Education – Committees and Commissions on Education - Vocational education and skill Development for women.		CO3
UNIT IV	**WOMEN, WORK AND EMPLOYMENT**	**9**
Theoretical Perspective: Fredrick Engels, Rosa Luxemburg, Sandra Whiteworth, BoserupEsther -Concept of Work – Productive and non – productive work – Use value and market value - Gender Division of Labour – Mode of Production – Women in organized andunorganized sector - New Economic Policy and its impact on Women's Employment – Globalization –Structural Adjustment Programs.		CO4
UNIT V	**GENDER AND ENTREPRENEURSHIP**	**9**
Concept and meaning, Importance of Entrepreneurship, Entrepreneurial traits, Factors contributing to Entrepreneurship, enabling environment, small Enterprises, women in agri-business - Gender and emerging Technology – Impact - Self-help Groups and Micro Credit - Gender mainstreaming, Gender budgeting, planning and Analysis.		CO5
		TOTAL: 45 PERIODS

TEXT BOOKS

1. Jaya Kothari Pillai- 1995, Women and Empowerment, New Delhi: Gyan Publishing House
2. JoRoland–: 1997, Questioning Empowerment, Oxfam Oxford.
3. Janet Townsend etal-: 1999, Women and Power, Fighting Patriarchy and Poverty. Zed Books, London.
4. Naila Kabeer: 1996, Reversed Realities, Kali for women, New Delhi.

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	To enhance the social sensitivity, sensibility and responsibility thereby instilling the life skills among students.
CO2	To upgrade knowledge and comprehension of gender issues for attitudinal and behavioural change among men, women and transgender etc. to claim the right to life with dignity and equality.
CO3	To bring social, economic, political and cultural empowerment and gender equality in personal as well Professional life.
CO4	To crystallize the teaching of Women's Studies in term of teaching, research and extension. in order
CO5	To create more gender equality and equity world by education, sensitization and empowerment.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	-	-	-	-	1	-	1	-	-	-	1	-	-
CO2	-	-	-	-	-	1	-	1	-	-	-	1	-	-
CO3	-	-	-	-	-	1	-	1	-	-	-	1	-	-
CO4	-	-	-	-	-	1	-	1	-	-	-	1	-	-
CO5	-	-	-	-	-	1	-	1	-	-	-	1	-	-

MX4002	ELEMENTS OF LITERATURE	L	T	P	C
		3	0	0	0

OBJECTIVES

1. To understand the recent contexts, concepts and ideologies.
2. To acquaint themselves with the major generic divisions in English literature.
3. To acknowledge the conventions of literary research and documentation.

UNIT I	KEY ELEMENTS OF LITERATURE	9
Language - Plot - Setting/Milieu - Character - Theme - Point of View - Tone/Mood.		CO1
UNIT II	**PROSE**	**9**
The form of prose - written and spoken prose - individual and common style - simplicity and ornamentation - abstract and concrete - realism, romance and unreality - the science of rhetoric.		CO2
UNIT III	**POETRY**	**9**
The importance of form - the physical form of poetry - metre - variation - rhyme - internal pattern - logical sequence - the use of associations - patterns of imagery the main types of poetry.		CO3
UNIT IV	**NOVEL**	**9**
The concept of fiction - verisimilitude - the point of view - plot - character - character revealed - conversation - scene and background - dominant themes - the experimental novel.		CO4
UNIT V	**DRAMA**	**9**
Live literature - action - plots - conventional divisions - direct experience of characters - dialogue and conversation - verse and prose - types of drama - drama and history - use of notes – interpretation.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Barnet Sylvan, Types of Drama; Plays and Essays, Boston, Little Brown, 1981.
2. Brooks, Peter, Reading for the Plot; Design and Intention in Narrative, Oxford, Clarendon Press, 1984.
3. Hardings D.W., Words Into Rhythm; English Speech, OUP, New Delhi, 1976.
4. Murfin, Ross, and Supriya M. Ray. The Bedford Glossary of Critical and Literary Terms. New York: Macmillan Press Ltd., 1997.
5. Paul, Poplawski, ed. English Literature in Context. London: CUP,2008.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Comprehend various forms of literature like prose, poetry, drama and fiction.
CO2	Interpret and appreciate the didactic purpose in literature.
CO3	Identify the poetic devices to the connection of poems.
CO4	Describe the process and origin of the development of drama in its structure with the text.
CO5	Define the various types of novels with their structure

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	1	-	1	-	-	-	1	-	1
CO2	-	-	-	-	-	1	-	1	-	-	-	1	-	1
CO3	-	-	-	-	-	1	-	1	-	-	-	1	-	1
CO4	-	-	-	-	-	1	-	1	-	-	-	1	-	1
CO5	-	-	-	-	-	1	-	1	-	-	-	1	-	1

MX4003	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
		3	0	0	0

OBJECTIVES

- To develop inter personal skills and be an effective goal-oriented team player.
- To develop professionals with idealistic, practical and moral values.
- To develop communication and problem-solving skills.
- To re-engineer attitude and understand its influence on behavior

UNIT I		**9**
Neetisatakam-Holistic development of personality I Verses- 19,20,21,22 (wisdom), Verses- 29,31,32 (pride & heroism), Verses- 26,28,63,65 (virtue)		**CO1**
UNIT II		**9**
Neetisatakam-Holistic development of personality II Verses- 52,53,59 (don'ts), Verses- 71,73,75,78 (do's)		**CO1**
UNIT III		**9**
Approach to day-to-day work and duties. Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48, Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35, Chapter 18-Verses 45, 46, 48.		**CO2**
UNIT IV		**9**
Statements of basic knowledge. Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68, Chapter 12 -Verses 13, 14, 15, 16,17, 18		**CO2**
UNIT V		**9**
Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, Chapter 4-Verses 18, 38,39, Chapter18 – Verses 37,38,63.		**CO3**
		TOTAL PERIODS: 45

TEXT BOOKS

1. "Srimad Bhagavad Gita" by Swami Swarupananda, Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Study of Shrimad Bhagwad Geeta will help the student in developing his personality and achieve the highest goal in life.
CO2	The person who has studied Geeta will lead the nation and mankind to peace and prosperity.
CO3	Study of Neetishatakam will help in developing versatile personality.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	1	-	1	-	-	-	1	-	1
CO2	-	-	-	-	-	1	-	1	-	-	-	1	-	1
CO3	-	-	-	-	-	1	-	1	-	-	-	1	-	1

MX4004	DISASTER MANAGEMENT	L	T	P	C
		3	0	0	0

OBJECTIVES

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction.
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I	INTRODUCTION TO DISASTERS	9
Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters..		CO1
UNIT II	**APPROACHES TO DISASTER RISK REDUCTION (DRR)**	**9**
Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake- holders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.		CO2
UNIT III	**INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT**	**9**
Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.		CO3
UNIT IV	**DISASTER RISK MANAGEMENT IN INDIA**	**9**
Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment		CO4
UNIT V	**DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS**	**9**
Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.		CO5
	TOTAL: 45 PERIODS	

TEXTBOOKS

1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, NewDelhi, 2010.

REFERENCE BOOKS

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Differentiate the types of disasters, causes and their impact on environment and society
CO2	Assess vulnerability and various methods of risk reduction measures as well as mitigation
CO3	Draw the hazard and vulnerability profile of India, Scenarios in the Indian context,
CO4	Know about the relief measures, Disaster damage assessment and management.
CO5	Learn through case studies about the damages caused due to various disasters.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	-	3	-	-	3	3	-	-	-	-	2	-	2
CO2	-	-	3	-	-	3	3	-	-	-	-	2	-	2
CO3	-	-	3	-	-	3	3	-	-	-	-	2	-	2
CO4	-	-	3	-	-	3	3	-	-	-	-	2	-	2
CO5	-	-	3	-	-	3	3	-	-	-	-	2	-	2

MX4005	WELL BEING WITH TRADITIONAL PRACTICES	L	T	P	C
		3	0	0	0

OBJECTIVES

- Explaining the purpose of well being and impact it has on their work and life
- To teach basic methods used in the systems of Ayurveda, Siddha and Yoga
- Identify key factors that contribute to work place burnout and sustainability.

UNIT I	HEALTH AND HAPPINESS	9
Mental and physical health, physical and emotional safety, and a feeling of belonging, sense of purpose, achievement and success. Need for Managing Self, Positive Psychology and Yoga.		CO1
UNIT II	**WELL BEING**	**9**
Health and Wellbeing: Perspectives from Positive Psychology, Yoga and Ayurveda, Attaining Wellbeing – Methods, Obstacles, Realms and Types of Interventions for Managing Self and Career		CO2
UNIT III	**YOGA PRACTICES**	**9**
Definitions of Eight parts of yoga.(Ashtanga). Asan and Pranayam - Various yoga poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayam		CO3
UNIT IV	**AYURVEDA PRACTICS**	**9**
Health Benefits of Ayurveda, Ayurvedic techniques: Diet, Herbal, Acupuncture, Massage and Meditation. Ayurveda and allied disciplines –Approach to health disease in Ayurveda		CO4
UNIT V	**BASIC CONCEPTS AND PRINCIPLES OF SIDDHA MEDICINE**	**9**
Principles of Siddha- the five natural elements and three humours, Physical constituents.		CO5
		TOTAL:45 PERIODS

TEXT BOOKS

1. Mental health and well being in workplace by Gillhassan and Donna Butler.
2. Yogic Asanas for Group Training - Part- I": Janardan Swami Yogabhyasi Mandal, Nagpur.
3. Textbook of Ayurveda: Volume 1 - Fundamental Principles of Ayurveda by Dr Vasant Lad.
4. Siddha medicine handbook of raditional remedies by Paul Joseph

REFERENCE BOOKS

1.The Social Psychology of Mental Health: Basic Mechanisms and Applications by Diane N Ruble

2."Raja yoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama Publication Department), Kolkata.

COURSE OUTCOME

Upon completion of the course, students will be able

CO1	To create awareness about health and happiness
CO2	To develop healthy mind in a healthy body thus improving social health also
CO3	To educate the importance of various yoga asanas
CO4	To know the values of ayurveda system
CO5	To understand the importance of siddha medicine.

MAPPING OF COs WITH POs

COs	PROGRAM OUTCOMES (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	2	2	-	-	-	-	1
CO2	-	-	-	-	-	2	2	-	-	-	-	1
CO3	-	-	-	-	-	2	2	-	-	-	-	1
CO4	-	-	-	-	-	2	2	-	-	-	-	1
CO5	-	-	-	-	-	2	2	-	-	-	-	1

MX4006	HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA	L	T	P	C
		3	0	0	0

OBJECTIVES

- To provide an exposure to the development of science and technology in India
- To impart authentic knowledge of India's scientific and technological traditions.
- To provide an understanding of the socio-cultural and philosophical context in which science and technology developed.
- To help in repositioning India's contributions in science and technology

UNIT I	INTRODUCTION	9
Logic and methodology of Indian sciences - An overview of Indian contributions to sciences - An overview of Indian contributions to technology		CO1
UNIT II	**ASTRONOMY**	**9**
Development of astronomy in India- Pancanga: Indian calendrical computations- The distinctfeatures of Indian planetary models- Computation of eclipses: Its simplicity- elegance and efficiency- Observational astronomy in India		CO2
UNIT III	**MATHEMATICS**	**9**
An overview of the development of mathematics in India – Mathematics contained in Sulbasutras – combinatorial aspects of the Chandassastra – Solutions to the first and second order indeterminate equations- Weaving mathematics into beautiful poetry: Bhaskaracarya – The evolution of sine function in India – The discovery of calculus by Kerala astronomers.		CO3
UNIT IV	**AYURVEDA**	**9**
History of Ayurveda – Rational foundations of Ayurveda – Textual sources in Ayurveda – Ayurveda and allied disciplines –Approach to health disease in Ayurveda – Approach to diet and nutrition in Ayurveda – Ayurveda and modern medicine – Ayurveda and Yoga		CO4
UNIT V	**TECHNOLOGICAL DEVELOPMENT IN INDIA**	**9**
Agriculture: Origin and development- Ancient crops- Traditional practices Water management: Overview- Harappan water management- Other case studies- Medieval Water structures Pottery: Overview- Technical aspects Silpasastra: Architecture and Construction: An introduction to Silpasastra- Construction Technology Metallurgy: Copper/Bronze/Zinc- Iron and Steel Technology in India		CO5
		TOTAL: 45PERIODS

TEXT BOOKS

1. Suvobrata Sarkar, History of Science, Technology, Environment, and Medicine in India, Taylor & Francis, London
2. NeeraMisra, Sabareesh P.a. 2022, A Brief History of Science in India, Garuda Prakashan Private Limited.
3. Prittam Dutta 2021, WHAT IS ASTRONOMY ?, Notion Press

REFERENCE BOOKS

1. D. P. Chatpathayaya, History of science, philosophy, and culture in India civilization, Uma das Gupta, Pearson Education.
2. Bryan Bunch, Bryan H. Bunch, Alexander Hellemans, The History of Science and Technology, Houghton Mifflin.
3. Projit Bihari Mukharji · 2016, Doctoring Traditions-Ayurveda, Small Technologies, and Braided Sciences, University of Chicago Press

COURSE OUTCOME **Upon completion of the course, students will be able to:**	
CO1	Gain knowledge on Indian sciences
CO2	Able to understand the evolution of stars as well as of the large scale structure of the Universe
CO3	Can use to solve problems involved in arithmetic, algebra, geometry, and other fields of mathematics
CO4	Helps in understanding each individual at a very subtle, personal level and gives a detailed protocol for diet, daily routines and activities to be followed.
CO5	Gain knowledge on origin of agriculture, technical aspects of pottery and silpasastra

MAPPING OF COs WITH POs

COs	**PROGRAM OUTCOMES (POs)**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	-	-	1	-	-	2	2	-	-	-	2
CO2	2	2	1	1	1	2	2	1	-	-	1	3
CO3	3	3	2	1	1	-	-	-	1	-	1	2
CO4	1	-	-	-	-	3	3	1	-	-	-	3
CO5	2	2	1	1	2	3	3	1	-	-	-	2

MX4007	POLITICAL AND ECONOMIC THOUGHT FOR HUMANE SOCIETY	L	P	T	C
		3	0	0	0

OBJECTIVES

- To understand the concept of political science and theories of political science.
- To know the types of political socialization and their role.
- To explore various theories of economic thought.
- To learn the importance of human values of life.

UNIT I	POLITICAL THOUGHTS	9
Political science: Definition, Nature & Scope; Relation of Political Science with other Social Sciences; Traditional approaches to the study of Political Science: Normative, Empirical and Feminist-State: Definition; Elements; Relation with other organizations; Theories of origin of state (Theory of Divine, Force, and Evolutionary); Sovereignty- definition and characteristics.		CO1
UNIT II	**POLITICAL CULTURE AND POLITICAL SOCIALIZATION**	**9**
Meaning and dimensions of political culture, meaning and types of political socialization agencies of political socialization and their role-Meaning and types of political participation, political apathy – reasons for political apathy, Determinants of political participation – psychological, social and political.		CO2
UNIT III	**HISTORY OF ECONOMIC THOUGHT**	**9**
Nature and Importance of Economic thought – Approaches of Economic Thought – Scholastics – Mercantilism, French and English – Thomas Munn – Scientific Method and the French Physiocrats – Quesnay – The Classical School – Adam Smith – Division of Labour – Ricardo and Theory of Rent – Comparative Cost Theory – Stationary State – Malthus and Theory of Population and Theory of Gluts.		CO3
UNIT IV	**ECONOMIC BEHAVIOUR AND MORAL SENTIMENTS**	**9**
Importance of ethics in economics; Outcomes of ethical analysis; Duties, rules and virtues; Economic behaviour: Self-interest and rational behaviour- Adam Smith and self-interest - Social Philosophy (Naturalism, Optimism, Self Interest, Invisible hand, Laisseze faire); Economic ideas: Wealth, Labour & Division of labour, Value, Distribution.		CO4
UNIT V	**HUMAN VALUES**	**9**
Value Education, Self-Exploration - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship - the basic requirements for fulfillment of aspirations of every human being with their correct priority, Method to fulfill the human Values, understanding and living in harmony at various levels.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Bhargava, R. (2008) 'What is Political Theory', in Bhargava, R and Acharya, A. (eds.) Political Theory: An Introduction. New Delhi: Pearson Longman.
2. Olivier Blanchard and David R. Johnson, Macroeconomics, Sixth Edition, Pearson, 2017.
3. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.

REFERENCE BOOKS

1. O.P.Gauba, (2015) An Introduction to Political Theory, New Delhi: Mayur Publishers.
2. Ashaf, Ali and Sharma B.N. 2001.Political Sociology, University Press, Hyderabad .
3. Jonathan Conlin, Great Economic Thinkers: From Adam Smith to Amartya Sen, Speaking Tiger Publishing, 2018.
4. Linda Yueh, The Great Economists: How Their Ideas Can Help Us Today, Viking, 2018.
5. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Book.
6. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.
7. Irene van Staveren, The Values of Economics: An Aristotelian Perspective, London: Routledge, 2001

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	To explain the traditional approached of political science and theories of state.
CO2	To identify the political culture, socialization, participation and apathy.
CO3	To understand the importance of economic thought and their approaches.
CO4	To explore the economic behaviour and moral sentiments of the individuals.
CO5	To learn the human values for harmony and to build better relationships.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	-	-	-	-	1	1	1	2	2	1	2
CO2	-	-	-	-	-	2	1	1	2	2	1	2
CO3	-	-	-	-	-	2	1	2	2	2	1	2
CO4	-	-	-	-	-	2	3	2	2	3	1	2
CO5	-	-	-	-	-	1	3	3	3	3	1	2

MX4008	INDUSTRIAL SAFTEY	L	T	P	C
		3	0	0	0

OBJECTIVE

- To impart knowledge on safety engineering fundamentals and safety management practices.

UNIT I	**INTRODUCTION**	**9**
Evolution of modern safety concepts – Fire prevention – Mechanical hazards – Boilers, Pressure vessels, Electrical Exposure.		**CO1**
UNIT II	**CHEMICAL HAZARDS**	**9**
Chemical exposure – Toxic materials – Ionizing Radiation and Non-ionizing Radiation - Industrial Hygiene – Industrial Toxicology.		**CO2**
UNIT III	**ENVIRONMENTAL CONTROL**	**9**
Industrial Health Hazards – Environmental Control – Industrial Noise - Noise measuring instruments, Control of Noise, Vibration, - Personal Protection.		**CO3**
UNIT IV	**HAZARD ANALYSIS**	**9**
System Safety Analysis –Techniques – Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP analysis and Risk Assessment		**CO4**
UNIT V	**INDUSTRIAL SAFETY**	**9**
Explosions – Disaster management – catastrophe control, hazard control, Safety education and training - Factories Act, Safety regulations Product safety – case studies.		**CO5**
		TOTAL: 45 PERIODS

TEXTBOOKS

1. John V.Grimaldi, "Safety Management", AITB S Publishers, 2003.

REFERENCE BOOKS

1. Safety Manual, "EDEL Engineering Consultancy", 2000.
2. David L.Goetsch, "Occupational Safety and Health for Technologists", 5th Edition, Engineers and Managers, Pearson Education Ltd., 2005

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1	Understand the modern safety concepts and Mechanical hazards
CO2	Identify the effects of Chemical exposure and Toxic materials
CO3	Understand the Industrial Health Hazards due to environment
CO4	Understand the System Safety Analysis Techniques
CO5	Understand the Factories Act, Safety regulations

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	3	-	-	3	2	2	-	-	-	3	2	2
CO2	-	-	3	-	-	3	2	2	-	-	-	3	2	2
CO3	-	-	3	-	-	3	2	2	-	-	-	3	2	2
CO4	-	-	3	-	-	3	2	2	-	-	-	3	2	2
CO5	-	-	3	-	-	3	2	2	-	-	-	3	2	2

ME4511	VALUE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To Know the concepts of value engineering, operation in maintenance , repair activities and to identify the advantages, applications

UNITI	INTRODUCTION	9
Value engineering concepts, advantages, applications, problemrecognition, and role in productivity, criteria for comparison, elementof choice. Level of value engineering in the organization, size and skill of VEstaff, small plant, VE activity, unique and quantitative evaluation of		CO1
UNITII	**VALUE ENGINEERING JOB PLAN**	**9**
Introduction, orientation, information phase, speculation phase, analysis phase. Selection and Evaluation of value engineering Projects, Project selection, methods selection, value standards, application of value engineering methodology. Anatomy of the function, use esteem and exchange values, basic vs. secondary vs. unnecessary functions. Approach of function, Evaluation of function, determining function, classifying function, evaluation ofcosts, evaluation of worth, determining worth, evaluation of value.		CO2
UNITIII	**VALUE ENGINEERING TECHNIQUES**	**9**
Selecting products and operation for value engineering action, value engineering programmes, determining and evaluating function(s) assigning rupee equivalents, developing alternate means to required functions, decision making for optimum alternative, use of decision matrix, queuing theory and Monte Carlo method make or buy, measuring profits, reporting results, Follow up, Use of advanced technique like Function Analysis System		CO3
UNITIV	**VERSATILITY OF VALUE ENGINEERING**	**9**
Value engineering operation in maintenance and repair activities,value engineering in non-hardware projects. Initiating a valueengineering programme Introduction, training plan, careerdevelopment for value engineering specialties.		CO4
UNITV	**VALUE ENGINEERING LEVEL OF EFFORT**	**9**
Value engineering team, co-coordinator, designer, different services, definitions, construction management contracts, value engineering case studies.		CO5
		TOTAL:45PERIODS

TEXTBOOKS

1. Anil Kumar Mukhopadhyaya, "Value Engineering: Concepts Techniques and applications", SAGE Publications2010.
2. Alphonse Dell'Isola, "Value Engineering: PracticalApplications for Design, Construction, Maintenance & Operations", R S Means Co., 1997.

REFERENCEBOOKS

1. Richard Park, "Value Engineering: A Plan for Invention",St. Lucie Press, 1999.
2. Del L. Younker, "Value Engineering analysis andmethodology", Marcel Dekker Inc, New York, 2004.
3. Miles, L.D., "Techniques of Value Analysis andEngineering", McGraw Hill second Edition, 1989.

COURSEOUTCOMES

Uponcompletionof thecourse,studentswill beable to

CO1	Discuss the concepts of value engineering, identify the advantages, applications.
CO2	Discuss various phases of value engineering. Analyze the function, approach of function and evaluation of function. Determine the worth and value.
CO3	Discuss queuing theory.
CO4	Appraise the value engineering operation in maintenance and repair activities
CO5	Create the value engineering team and discuss the value engineering case studies

MAPPINGOFCOsWITHPOsANDPSOs

COs	**PROGRAMOUTCOMES(POs)**												**PROGRAM SPECIFIC OUTCOMES(PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	-	-	-	-	-	-	-	2	-	2
CO2	3	2	2	2	-	-	-	-	-	-	-	2	-	2
CO3	3	2	2	2	-	-	-	-	-	-	-	2	-	2
CO4	3	2	2	2	-	-	-	-	-	-	-	2	-	2
CO5	3	2	2	2	-	-	-	-	-	-	-	2	-	2

ME4512	CAD/CAM	L	T	P	C
		3	0	0	3

OBJECTIVES

- To Introduce and understand the Basic of Design.
- To study the two dimensional drafting and bill of material creation
- To learn three dimensional modelling and its advantages.
- To study the basic and purpose of assembling modeling.
- To study the basics of computer aided machining and part programming.

UNIT I	BASICS OF DESIGNS	9
Understanding of Projections, Scales, units, GD & T; its 14 symbols, Special characteristics Title Block readings. Revision / ECN status of drawings – Customer Specific requirements Drawing Grid reading		CO1
UNIT II	**2D DRAFTING**	**9**
Projection views – Orthographic view, Auxiliary view, Full & Half Section views, Broken Section view, Offset Section view – Title Block creation – BOM Creation – Notes creation – Ballooning of 2D drawing and its features for Inspection reporting		CO2
UNIT III	**3D MODELING**	**9**
Conversion of Views – 2D to 3D & 3D to 2D – Parametric and Non-Parametric Modeling – Tree features of 3D Modeling and its advantages – Surface Modeling – BIW (Body In White) – Solid Modeling, Boolean operations like Unites, Subtraction, Intersect, etc.		CO3
UNIT IV	**ASSEMBLY MODELING**	**9**
Basics of Assembly modeling, Purpose of Assembly modeling & its advantages – Top to Down & Bottom Up modeling approaches – Analysis of Clearances – Undercuts – Interferences – Stack up analysis –Cumulative effect of Tolerances in after assembly conditions - motion analysis		CO4
UNIT V	**CAM**	**9**
Basics of CNC Machining – 3, 4 & 5 Axis machines - CNC and Part Programing, CAM programing 2D & 3D. Elements of CAM Orientation, Boundary Creation, Cutter Path Selection, Cutter Compensation – Machining Stocks, Roughing, Re-roughing, Semi Finishing & Finishing – Tool Path Generation, Isl and Milling Programing. Machining program simulation, integration of program with machine; Estimation of CNC Cycle time. – Post Process NC Code conversion and Setup Sheet Preparation.		CO5
		TOTAL:45PERIODS

TEXT BOOKS

1. Ibrahim Zeid "CAD/CAM – Theory and Practice" Tata McGraw-Hill Publishing Co.2007
2. Mikell.P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008.

REFERENCE BOOKS

1. Donald Hearn and M. Pauline Baker "Computer Graphics"'. Prentice Hall, Inc., 1992.
2. Foley, Wan Dam, Feiner and Hughes - "Computer graphics principles & practice" Pearson Edu. -2003
3. William M Neumann and Robert F.Sproul "Principles of Computer Graphics", McGraw Hill Book Co. Singapore, 1989.
4.Radhakrishnan P, Subramanyan S., Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi,2000.

COURSEOUTCOMES **Upon completion of the course, students will be able to**	
CO1	Discuss the basics of the design and concepts.
CO2	Develop the two dimensional drafting and projection views.
CO3	Discuss the three dimensional modeling, parametric and Non-parametric modeling
CO4	Discuss the assembly modeling and top down, bottom up approaches.
CO5	Develop the computer aided machining and writing part programming.

MAPPING OF Cos WITH Pos AND PSOs

COs	**PROGRAM OUTCOMES(POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	2	-	-	-	1	-	-	1	3	3
CO2	3	2	2	2	2	-	-	-	1	-	-	1	3	3
CO3	3	2	2	2	2	-	-	-	1	-	-	1	3	3
CO4	3	2	2	2	2	-	-	-	1	-	-	1	3	3
CO5	3	2	2	2	2	-	-	-	1	-	-	1	3	3

ME4513	ERGONOMICS IN DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES

- To exposed the principles of ergonomics.
- To learn the mechanics of muscle physiology.
- To bee familiar with the mathematical models, analysis and design of biomedical devices using case studies.

UNITI	VISUAL AND AUDITORY ERGONOMICS	9
Process of seeing - visual capabilities-factors affecting visual acuity and contrast sensitivity - human factor aspects of hard copy text and computer screen text, factors in selecting graphic representations symbols, qualitative visual display - process of hearing-principles of auditory display.		CO1
UNITII	**ANTHROPOMETRY**	**9**
Anthropometry - anthropometric design principles - work space envelope- factors in design of work space surfaces - principles of seat design - principles of control panel. Organization classification of human errors theories of accident causation - reducing accidents by altering behavior.		CO2
UNITIII	**CONTROLS AND DISPLAYS**	**9**
Spatial compatibility physical arrangement of displays and controls- movement capability- rotary controls and rotar displays movement of displays orientation of the operator and movement relationships control orders and control responses- human limitations in tracking task.		CO3
UNITIV	**MUSCLE PHYSIOLOGY**	**9**
Muscle physiology -muscle metabolism-respiratory response-joint motion study- measure of physiological in-efficiency and energy consumption-work rest cycles-aspects of manual and posture study, materialhandling (MMH) Bio-mechanical recommended limits of MMH.		CO4
UNITV	**CASE STUDIES**	**9**
Case Study 1: computer design, control panel design of an electronic instrument, computer key board, hand drill etc. Case Study 2: Biomedical Application, Design optimization of Medical Equipment.		CO5
		TOTAL:45PERIODS

TEXT BOOKS

1. Pascale Carayon, Handbook of Human Factors and Engineering, Second Edition, CRC Press, 2011

2. Robert.N. Bailey, Human Performance Engineering, Third Edition, 1996

REFERENCEBOOKS

1. Shrawan Kumar, Biomechanics in Ergonomics, Second Edition, CRC Press 2007.

2. Stephen Pheasant, Christine M. Haslegrave, Bodyspace: Anthropometry, Ergonomics and the Design of Work, CRC Press, Third Edition, 2016.

3. Martin Helander, Guide to Human Factors and Ergonomics, Second Edition, CRC Press, 2005

COURSEOUTCOMES

Uponcompletionof thecourse,studentswill beable to

CO1	Understand the principles of ergonomics.
CO2	Understand the muscle physiology.
CO3	Understand the displays and controls ofphysical arrangement.
CO4	Understand the anthropometry.
CO5	Design biomedical devices.

MAPPINGOFCOsWITHPOsANDPSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES(PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	1
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	1
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	1
CO4	3	3	-	-	-	-	-	-	-	-	-	-	3	1
CO5	3	3	-	-	-	-	-	-	-	-	-	-	3	1

ME4514	NEW PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- This course aims at introducing the students to the basic concepts of engineering design and product development with focus on the front end processes.
- At the end of this course the student is expected to demonstrate an understanding of the overview of all the product development processes and knowledge of concept generation and selection tools.

UNITI	**INTRODUCTION**	**9**
Need for developing products – the importance of engineering design – types of design –the design process – relevance of product lifecycle issues in design –designing to codes and standards- societal considerations in engineering design –generic product development process – various phases of product development-planning for products –establishing markets- market segments- relevance of market research.		**CO1**
UNITII	**CUSTOMER NEEDS**	**9**
Identifying customer needs –voice of customer –customer populations- hierarchy of human needs- need gathering methods – affinity diagrams – needs importance- establishing engineering characteristics-competitive benchmarking- quality function deployment- house of quality- product design specification-case studies		**CO2**
UNITIII	**CREATIVE THINKING**	**9**
Creative thinking –creativity and problem solving- creative thinking methods- generating design concepts-systematic methods for designing –functional decomposition – physical decomposition – functional representation –morphological methods-TRIZ- axiomatic design		**CO3**
UNITIV	**DECISION MAKING AND PRODUCT ARCHITECTURE**	**9**
Decision making –decision theory –utility theory –decision trees –concept evaluation methods –Pugh concept selection method- weighted decision matrix –analytic hierarchy process – introduction to embodiment design – product architecture – types of modular architecture –steps in developing product architecture& sketching.		**CO4**
UNITV	**DESIGN AND COST ANALYSIS**	**9**
Industrial design – human factors design –user friendly design – design for serviceability – design for environment – prototyping and testing – cost evaluation –categories of cost – overhead costs – activity based costing –methods of developing cost estimates – manufacturing cost –value analysis in costing		**CO5**
		TOTAL:45PERIODS

TEXTBOOKS

1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, "Product Design and Development ", 7th Edition, 2020, Tata McGraw-Hill Education, ISBN-10-007-14679-9

2. Kevin Otto, Kristin Wood, "Product Design", Indian Reprint 2015, Pearson Education,ISBN9788177588217

REFERENCEBOOKS

1. Clive L.Dym, Patrick Little, "Engineering Design: A Project-based Introduction", 3rd Edition, JohnWiley & Sons, 2009, ISBN 978-0-470-22596-7.

2. George E.Dieter, Linda C.Schmidt, "Engineering Design", McGraw-Hill International Edition, 4thEdition, 2009, ISBN 978-007-127189-9.

3. Yousef Haik, T. M. M. Shahin, "Engineering Design Process", 2nd Edition Reprint, CengageLearning, 2010, ISBN 0495668141

4. Donald A. Norman, "The Design of Everyday Things"MIT Press, 2013

COURSEOUTCOMES Uponcompletionof thecourse,studentswill beable to	
CO1	Understand and discuss key concepts and principles concerning the role of product and service innovation and their contribution to generate competitive advantage in firms.
CO2	Understand and discuss key concepts and principles concerning the activities and competencies involved in new product development.
CO3	Understand and discuss key concepts and principles concerning- the range of tools and methods that are used to manage new product development.
CO4	Analyze the set of potential innovation triggers and strategically select those opportunities that fit with the organizational resources and strategies.
CO5	Critically evaluate the role of design in product development, and the ability to address costs issues through better design decisions.

MAPPINGOFCOsWITHPOsANDPSOs

COs	**PROGRAMOUTCOMES(POs)**												**PROGRAM SPECIFIC OUTCOMES(PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	3
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	2
CO3	3	3	-	-	-	-	-	-	-	-	-	1	3	2
CO4	3	3	-	-	-	-	-	-	-	-	-	1	3	3
CO5	3	2	-	-	-	-	-	-	-	-	-	-	2	2

ME4515	PRODUCT LIFECYCLE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn about increasing product revenues, reducing product-relatedcosts, maximizing the value of the product portfolio
- To maximize the value of current and future products for both customersand shareholders
- To reduce time to market, improve product quality, reduce prototypingcosts, identify potential sales opportunities
- To maintain and sustain operational serviceability, and reduceenvironmental impacts at end-of-life.

UNITI	INTRODUCTION TO PLM	9
Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM - Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (CPDM), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM). PLM/PDM Infrastructure – Network and Communications, Data Management, Heterogeneous data sources and applications.		CO1
UNITII	**PLM/PDM FUNCTIONS AND FEATURES**	**9**
User Functions – Data Vault and Document Management, Workflow and Process Management, Product Structure Management, Product Classification and Programme Management. Utility Functions – Communication and Notification, data transport, data translation, image services, system administration and application integration.		CO2
UNITIII	**ROLE OF PLM IN INDUSTRIES**	**9**
Case studies on PLM selection and implementation (like auto: aero, electronic) - other possible sectors, PLM visioning, PLM strategy, PLM feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for–business, organization, users, product or service, process performance		CO3
UNITIV	**DETAILS OF MODULES IN A PDM/PLM SOFTWARE**	**9**
Case studies based on top few commercial PLM/PDM tools – Teamcenter, Windchill, ENOVIA, Aras PLM, SAP PLM, Arena, Oracle Agile PLM and Autodesk Vault.		CO4
UNITV	**BASICS ON CUSTOMISATION/INTEGRATION OF PDM/PLM SOFTWARE**	**9**
PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLM and ERP		CO5
		TOTAL:45PERIODS

TEXTBOOKS

1.AnttiSaaksvuori and AnselmiImmonen, “Product Lifecycle Management”, Springer Publisher, 2008.

2. Michael Grieves, “Product Life Cycle Management”, Tata McGraw Hill, 2006.

2.ArieKarniel and Yoram Reich, Managing the Dynamics of New Product Development Processes: A New Product Lifecycle Management Paradigm, Springer,2011.

REFERENCEBOOKS

3. IvicaCrnkovic, Ulf Asklund and AnnitaPerssonDahlqvist, “Implementingand Integrating Product Data Management and Software ConfigurationManagement”, Artech House Publishers,2003.

4. JohnStark,“GlobalProduct:Strategy,Product LifecycleManagementandtheBillionCustomer Question”, Springer Publisher,2007.

5. JohnStark,“ProductLifecycleManagement:21stCenturyParadigmforProductRealisation”, Springer Publisher,2011.

COURSEOUTCOMES Uponcompletionof thecourse,studentswill beable to	
CO1	Explain the history, concepts and terminology of PLM.
CO2	Apply the functions and features of PLM/PDM.
CO3	Apply different modules offered in commercial PLM/PDM tools.
CO4	Implement PLM/PDM approaches for industrial applications.
CO5	Integrate PLM/PDM with legacy data bases, CAx& ERP systems.

MAPPINGOFCOsWITHPOsANDPSOs

COs	**PROGRAMOUTCOMES(POs)**												**PROGRAM SPECIFIC OUTCOMES(PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	3	2	3	3	3	2	2	3	3	3	3
CO2	2	2	3	3	3	3	3	2	2	2	2	2	3	3
CO3	2	3	3	2	3	3	3	3	2	2	2	2	3	3
CO4	3	3	2	3	3	2	3	3	2	3	3	3	3	3
CO5	2	3	3	2	3	2	2	3	2	3	3	3	3	3

ME4521	SENSORS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of measurement technology.
- To learn the various sensors used to measure various physical parameters.
- To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development
- To learn about the optical, pressure and temperature sensor
- To understand the signal conditioning and DAQ systems

UNIT I	INTRODUCTION	9
Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.		CO1

UNIT II	MOTION, PROXIMITY AND RANGING SENSORS	9
Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).		CO2

UNIT III	FORCE, MAGNETIC AND HEADING SENSORS	9
Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.		CO3

UNIT IV	OPTICAL, PRESSURE AND TEMPERATURE SENSORS	9
Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.		CO4

UNIT V	SIGNAL CONDITIONING AND DAQ SYSTEMS	9
Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi-channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring		CO5

TOTAL: 45 PERIODS

TEXT BOOKS

1. C. Sujatha ... Dyer, S.A., Survey of Instrumentation and Measurement, John Wiley & Sons, Canada, 2001.
2. Hans Kurt Tönshoff (Editor), Ichiro, "Sensors in Manufacturing" Volume 1, Wiley-VCH April 2001.

REFERENCE BOOKS

1. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications,1999.
2. Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2011.
3. Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press, 2015.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Recognize with various calibration techniques and signal types for sensors.
CO2	Describe the working principle and characteristics of force, magnetic, heading, pressure and temperature, smart and other sensors and transducers.
CO3	Apply the various sensors and transducers in various applications.
CO4	Select the appropriate sensor for different applications.
CO5	Acquire the signals from different sensors using Data acquisition systems

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	-	-	-	-	-	-	-	-	3	3	-
CO2	3	2	2	-	-	-	-	-	-	-	-	3	3	-
CO3	3	2	2	-	-	-	-	-	-	-	-	3	3	-
CO4	3	2	2	-	-	-	-	-	-	-	-	3	3	-
CO5	3	2	2	-	-	-	-	-	-	-	-	3	3	-

ME4522	ELECTRICAL DRIVES AND ACTUATORS	L	T	P	C
		3	0	0	3

OBJECTIVES

- 1. To familiarize a relay and power semiconductor devices
- 2. To get a knowledge on drive characteristics
- 3. To obtain the knowledge on DC motors and drives.
- 4. To obtain the knowledge on AC motors and drives.
- 5. To obtain the knowledge on Stepper and Servo motor

UNIT I	RELAY AND POWER SEMI-CONDUCTOR DEVICES	9
Study of Switching Devices – Relay and Types, Switching characteristics -BJT, SCR, TRIAC, GTO, MOSFET, IGBT and IGCT-: SCR, MOSFET and IGBT - Triggering and commutation circuit - Introduction to Driver and snubber circuits		CO1
UNIT II	**DRIVE CHARACTERISTICS**	**9**
Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, torque, and Direction starting & stopping – Selection of motor.		CO2
UNIT III	**DC MOTORS AND DRIVES**	**9**
DC Servomotor - Types of PMDC & BLDC motors - principle of operation- emf and torque equations - characteristics and control – Drives- H bridge - Single and Three Phases – 4 quadrant operation – Applications		CO3
UNIT IV	**AC MOTORS AND DRIVES**	**9**
Introduction – Induction motor drives – Speed control of 3-phase induction motor – Stator voltage control – Stator frequency control – Stator voltage and frequency control – Stator current control – Static rotor resistance control – Slip power recovery control.		CO4
UNIT V	**STEPPER AND SERVO MOTOR**	**9**
Stepper Motor: Classifications- Construction and Principle of Operation – Modes of Excitation-Drive System Logic Sequencer - Applications. Servo Mechanism – DC Servo motor-AC Servo motor – Applications.		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Bimbhra B.S., "Power Electronics", 5th Edition, Kanna Publishers, New Delhi, 2012.
2. Mehta V.K. & Rohit Mehta, "Principles of Electrical Machines", 2nd Edition, S.Chand& Co. Ltd., New Delhi, 2016.

REFERENCE BOOKS

1. Gobal K. Dubey, "Fundamentals of Electrical Drives", 2nd Edition, Narosal Publishing House, New Delhi, 2001.
2. Theraja B.L. &Theraja A.K., "A Text Book of Electrical Technology", 2nd Edition, S.Chand& Co. Ltd., New Delhi, 2012.
3. Singh M.D. &Kanchandhani K.B., "Power Electronics", McGraw Hill, New Delhi, 2007

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Recognize the principles and working of relays, drives and motors.
CO2	Explain the working and characteristics of various drives and motors.
CO3	Apply the solid state switching circuits to operate various types of Motors and Driver
CO4	Interpret the performance of Motors and Drives.
CO5	Suggest the Motors and Drivers for given applications.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	2	2	2	-	-	-	-	-	-	2	2	-
CO2	3	1	2	2	2	-	-	-	-	-	-	2	2	-
CO3	3	1	2	2	2	-	-	-	-	-	-	2	2	-
CO4	3	1	2	2	2	-	-	-	-	-	-	2	2	-
CO5	3	1	2	2	2	-	-	-	-	-	-	2	2	-

ME4523	EMBEDDED SYSTEMS & PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES

- Building Blocks of Embedded System
- Various Embedded Development Strategies
- Bus Communication in processors, Input/output interfacing.
- Various processor scheduling algorithms.
- Basics of Real time operating system and example tutorials to discuss on one real time operating system tool

UNIT I	INTRODUCTION TO EMBEDDED SYSTEMS	9
Introduction to Embedded Systems –Structural units in Embedded processor, selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging.		CO1
UNIT II	**EMBEDDED NETWORKING**	**9**
Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols RS232 standard – RS422 – RS 485 - CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) –need for device drivers.		CO2
UNIT III	**EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT**	**9**
Embedded Product Development Life Cycle- objectives, different phases of EDLC, Modelling of EDLC; issues in Hardware-software Co-design, Data Flow Graph, state machine model, Sequential Program Model, concurrent Model, object oriented Model.		CO3
UNIT IV	**RTOS BASED EMBEDDED SYSTEM DESIGN**	**9**
Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication shared memory, message passing-, Inter process Communication – synchronization between processes- semaphores, Mailbox, pipes, priority inversion, priority inheritance.		CO4
UNIT V	**EMBEDDED C PROGRAMMING**	**9**
Introduction-Creating hardware delays using Timer 0 and Timer 1-Reading switches-Adding Structure to the code-Generating a minimum and maximum delay-Example: Creating a portable hardware delay- Timeout mechanisms-Creating loop timeouts-Testing loop timeouts- hardware timeouts-Testing a hardware timeout.		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS
1. Peckol, "Embedded system Design", John Wiley & Sons,2010
2. Lyla B Das," Embedded Systems-An Integrated Approach", Pearson, 2013
REFERENCE BOOKS
1. Raj Kamal, 'Embedded System-Architecture, Programming, Design', Mc Graw Hill, 2013.
2. C.R.Sarma, "Embedded Systems Engineering", University Press (India) Pvt. Ltd, 2013.
3. Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2006.
4. Han-Way Huang, "Embedded system Design Using C8051", Cengage Learning, 2009.
5. Shibu. K.V, "Introduction to Embedded Systems", 2e, Mcgraw Hill, 2017

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand and analyze Embedded systems.
CO2	Suggest an embedded system for a given application.
CO3	Operate various Embedded Development Strategies.
CO4	Study about the bus Communication in processors.
CO5	Acquire knowledge on various processor scheduling algorithms & programming.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	-	2	-	-	1	2	-	3	-	1	2	2	2
CO2	1	-	2	-	-	1	2	-	3	-	1	2	2	2
CO3	1	-	2	-	-	1	2	-	3	-	1	2	2	2
CO4	1	-	2	-	-	1	2	-	3	-	1	2	2	2
CO5	1	-	2	-	-	1	2	-	3	-	1	2	2	2

ME4524	ROBOTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the functions of the basic components of a Robot.
- To study the use of various types of End of Effectors and Sensors
- To impart knowledge in Robot Kinematics and Programming
- To learn Robot safety issues and economics.

UNIT I	FUNDAMENTALS OF ROBOT	9
Robot - Definition - Robot Anatomy - Coordinate Systems, Work Envelope Types and Classification-Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load- Robot Parts and their Functions-Need for Robots-Different Applications.		CO1
UNIT II	**ROBOT DRIVE SYSTEMS AND END EFFECTORS**	**9**
Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.		CO2
UNIT III	**SENSORS AND MACHINE VISION**	**9**
Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data- Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms, Applications- Inspection, Identification, Visual Serving and Navigation.		CO3
UNIT IV	**ROBOT KINEMATICS AND ROBOT PROGRAMMING**	**9**
Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.		CO4
UNIT V	**IMPLEMENTATION AND ROBOT ECONOMICS**	**9**
RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Groover M.P., "Industrial Robotics -Technology Programming and Applications", McGraw Hill, 2012.
2. Klafter R.D., Chmielewski T.A and Negin M., "Robotic Engineering - An Integrated Approach",Prentice Hall, 2003.

REFERENCE BOOKS

1. Craig J.J., "Introduction to Robotics Mechanics and Control", Pearson Education, 2008.
2. Deb S.R., "Robotics Technology and Flexible Automation" Tata McGraw Hill Book Co., 2013.
3. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill Book Co., 1987.
4. Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill, 1995.
5. Koren Y., "Robotics for Engineers", Mc Graw Hill Book Co., 1992.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Explain the concepts of industrial robots, classification, specifications and coordinate systems. Also summarize the need and application of robots in different sectors.
CO2	Illustrate the different types of robot drive systems as well as robot end effectors.
CO3	Apply the different sensors and image processing techniques in robotics to improve the ability of robots.
CO4	Develop robotic programs for different tasks and familiarize with the kinematics motions of robot.
CO5	Examine the implementation of robots in various industrial sectors and interpolate the economic analysis of robots.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	-	-	-	-	-	-	-	-	3	3	-
CO2	3	2	2	-	-	-	-	-	-	-	-	3	3	-
CO3	3	2	2	-	-	-	-	-	-	-	-	3	3	-
CO4	3	2	2	-	-	-	-	-	-	-	-	3	3	-
CO5	3	2	2	-	-	-	-	-	-	-	-	3	3	-

ME4525	AUTOMATION IN MANUFACTURING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To give a brief exposure to automation principles and control technologies.
- To introduce the concept of fixed automation using transfer lines.
- To train the students in the programmable automation such as CNC and industrial robotics.
- To provide knowledge on the use of automated material handling, storage and data captures.

UNIT I	MANUFACTURING OPERATIONS	9
Automation in production systems, principles and strategies, Product/production relationships, Production concepts and mathematical models, manufacturing economics.		CO1
UNIT II	**CONTROL TECHNOLOGIES**	**9**
Automated systems – elements, functions, levels, Continuous Vs discrete control, Computer process control, Sensors, Actuators, ADC, DAC, Programmable logic controllers – ladder logic diagrams.		CO2
UNIT III	**TRANSFER LINES**	**9**
Automated production lines – applications, Analysis – with and without buffers, automated assembly systems, line unbalancing concept.		CO3
UNIT IV	**NUMERICAL CONTROL AND ROBOTICS**	**9**
NC - CNC – Part programming – DNC – Adaptive control – Robot anatomy – Specifications –End effectors – Industrial applications.		CO4
UNIT V	**AUTOMATED HANDLING AND STORAGE**	**9**
Automated guided vehicle systems, AS/RS, Carousel storage, Automatic data capture - Bar code technology.		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1.Mikell P.Groover, Automation, "Production Systems and Computer Integrated Manufacturing" PHI, 2008.
2.Automation, Production Systems and Computer Integrated Manufacturing by Mikell P. Groover, P.H.I. Learning Private Limited.

REFERENCE BOOKS

1.Mikell P.Groover, Emory W. Zimmers, Jr., "CAD/CAM: Computer - Aided Design and Manufacturing", PHI, 2007
2.Industrial Automation and Robotics by Er. A. K. Gupta and S. K. Arora, University Science Press, Laxmi Publishing Pvt. Ltd.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Ability to understand the requirements of automation in manufacturing systems.
CO2	Knowledge in the techniques of machinery automation, shop floor automation.
CO3	Gaining Knowledge about the Automation production lines and Automated Assembly system
CO4	Gaining basic knowledge in CAD systems, NC and CNC part Programming.
CO5	Selection of material handling systems for automated industries.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	3	2	-	-	-	-	-	-	3	3	2	2
CO2	3	2	3	2	-	-	-	-	-	-	3	3	2	2
CO3	3	2	3	2	-	-	-	-	-	-	2	3	2	2
CO4	3	2	3	2	-	-	-	-	-	-	2	3	2	2
CO5	3	2	3	2	-	-	-	-	-	-	2	3	2	2

ME4531	NON-DESTRUCTIVE TESTING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce need and scope of failure analysis and fundamental sources of failures.
- To learn about non-destructive testing and basic principles of visual inspection.
- To study about magnetic testing and principles, techniques.
- To learn the principle of radiography testing and its inspection techniques and methods.
- To study the acoustic testing principle and technique and instrumentation.

UNIT I	INTRODUCTION	9
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.		CO1
UNIT II	**VISUAL INSPECTION**	**9**
Introduction to Non-Destructive Testing: An Introduction, Visual examination, Basic Principle, The Eye, Optical aids used for visual inspection, Applications. Liquid Penetrant Testing: Physical principles, Procedure for penetrant testing, Penetrant testing materials, Penetrant testing methods, Sensitivity, Applications, Limitations and Standards		CO2
UNIT III	**MAGNETIC TESTING**	**9**
Magnetic Particle Testing, Eddy Current Testing: Magnetism-basic definitions and principle of. magnetic particle testing, Magnetizing techniques, induced current flow, Procedure used for testing a component, Equipment Used for magnetic particle testing, Sensitivity, Limitations. Eddy Current Testing: Principles, Instrumentation for eddy current testing Techniques. Sensitivity Advanced Eddy Current Test Methods, Applications, Limitations.		CO3
UNIT IV	**RADIOGRAPHY TESTING**	**9**
Radiography, Ultrasonic Testing: Basic principle, Electromagnetic radiation, Sources, Radiation attenuation in the specimen. Effect of radiation in film, Radiographic imaging, Inspection techniques, Applications of radiographic inspection, Limitations, Safety in Industrial Radiography, Standards, Neutron radiography. Ultrasonic Testing: Basic properties of sound beam, Ultrasonic transducers, Inspection methods, Techniques for Normal Beam Inspection, Techniques for Angle Beam Inspection, Flaw characterization techniques, Ultrasonic flaw detection equipment, Modes of Display, Immersion Testing, Applications of Ultrasonic Testing, Advantages, Limitations		CO4
UNIT V	**ACOUTISTIC TESTING**	**9**
Acoustic Emission Testing: Principle of Acoustic Emission Testing, Technique, Instrumentation, Sensitivity, Applications, Standards. Thermograph: Basic Principles, Detectors and Equipment, Techniques, Applications, Codes and Standards. In Situ Metallographic Examination: Approach to the Selection of Site for Metallographic examination, Replication process, Significance of Microstructure observation, Decision making, Applications, Codes and Standards.(digital signal process)		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2014.
2. Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010

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. Charles, J. Hellier," Handbook of Nondestructive evaluation", McGraw Hill, New York 2001.
4. 4. Paul E Mix, "Introduction to Non-destructive testing: a training guide", Wiley, 2 nd Edition New Jersey, 2005

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Discuss the need and scope of failure analysis and fundamental sources of failures.
CO2	Describe about non-destructive testing and basic principles of visual inspection.
CO3	Explain about magnetic testing and principles, techniques.
CO4	Explain the principle of radiography testing and its inspection techniques and methods
CO5	Describe the acoustic testing principle and technique and instrumentation.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	2	-	1	-	-	-	-	2	2	-
CO2	3	3	2	2	2	-	1	-	-	-	-	2	2	-
CO3	3	2	2	2	2	-	1	-	-	-	-	2	2	-
CO4	3	2	2	2	2	-	1	-	-	-	-	2	2	-
CO5	3	2	2	2	2	-	1	-	-	-	-	2	2	-

ME4532	PLANT LAYOUT AND MATERIAL HANDLING	L	T	P	C
		3	0	0	3

OBJECTIVE

- To explain the basic principles in facilities planning, location, layout designs and material handling systems

UNIT I	**PLANT LOCATION**	**9**
Introduction, Factors affecting location decisions , Location theory , Qualitative models , Semi- Quantitative models -Composite measure , Brown & Gibbs model , Break-Even analysis model, Single facility location problems – Median model, Gravity location model, Mini-Max model, Multifacility location problems, Network and warehouse location problems.		**CO1**
UNIT II	**PLANT LAYOUT DESIGN**	**9**
Need for Layout study, Factors influencing plant layout, Objectives of a good facility layout, Classification of layout, Layout procedure – Nadler's ideal system approach, Immer's basic steps, Apple's layout procedure, Reed's layout procedure –Layout planning – Systematic Layout Planning – Information gathering, flow analysis and activity analysis, relationship diagram, space requirements and availability, designing the layout. Utilities planning		**CO2**
UNIT III	**COMPUTERIZED LAYOUT PLANNING**	**9**
Concepts, Designing process layout – CRAFT, ALDEP, CORELAP – Trends in computerized layout, Algorithms and models for Group Technology.		**CO3**
UNIT IV	**DESIGN PRODUCT LAYOUT**	**9**
Line balancing - Objectives, Line balancing techniques – Largest Candidate rule- Kilbridge and Wester method- RPW method- COMSOAL.,		**CO4**
UNIT V	**MATERIAL HANDLING AND PACKAGING**	**9**
Objectives and benefits of Material handling, Relationship between layout and Material handling, Principles of material handling, Unit load concept, Classification of material handling equipments, Equipment selection, Packaging.		**CO5**
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Francis, R.L., and White, J.A, "Facilities layout and Location", Prentice Hall of India, 2002.
2. Tompkins, White et al., "Facilities planning", John Wiley & Sons, inc. 2003.

REFERENCE BOOKS

1. Pannerselvam.R, "Production and Operations Management", PHI, 2nd Edition, 2005
2. James, Apple, "Material Handling System design", Ronald Press, 1980.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Apply and evaluate appropriate location models for various facility types
CO2	Effectively design and analyze various facility layouts
CO3	Apply and analyze various computerized techniques while designing a layout
CO4	Effectively design and analyze a layout using grouping techniques
CO5	Implement smooth and cost effective system in the material handling process

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	3	3	3	3	-	-	-	-	-	-	-	-	-
CO2	-	3	3	3	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	3	3	3	-	-	-	-	3	-	-	-
CO4	-	-	3	3	3	-	-	-	-	-	3	-	-	-
CO5	-	-	3	3	-	-	-	-	-	-	-	-	-	-

ME4533	SAFETY IN MATERIAL HANDLING	L	T	P	C
		3	0	0	3

OBJECTIVE

- To learn about the safety handling of ropes, hoops etc.
- To gain the knowledge about the conveying mechanisms.
- To gain the knowledge about hoisting mechanism.
- To learn about the heavy equipment.
- To gain the knowledge about goods and equipment.

UNIT I	**MATERIAL HANDLING**	**9**
General safety consideration in material handling - Ropes, Chains, Sling, Hoops, Clamps, Arresting gears – Prime movers.		**CO1**
UNIT II	**ERGONOMICS OF CONVEYING MECHANISMS**	**9**
Ergonomic consideration in material handling, design, installation, operation and maintenance of Conveying equipment, hoisting, traveling and slewing mechanisms.		**CO2**
UNIT III	**ERGONOMICS OF HOISTING MECHANISMS**	**9**
Ergonomic consideration in material handling, design, installation, operation and maintenance of driving gear for hoisting mechanism – Traveling mechanism.		**CO3**
UNIT IV	**HANDLING OF HEAVY EQUIPMENTS**	**9**
Selection, operation and maintenance of Industrial Trucks – Mobile Cranes – Tower crane – Checklist - Competent persons.		**CO4**
UNIT V	**STORAGE OF GOODS AND EQUIPMENTS**	**9**
Storage and Retrieval of common goods of various shapes and sizes in a general store of a big industry. Safety in Manual Material Handling – Ergonomics consideration in manual material handling -OSHA Lifting Equation.		**CO5**
		TOTAL: 45 PERIODS

TEXTBOOKS

1. "Handbook of industrial and system engineering", 2nd edition, Adedeji B. Badiru – 2017.
2. Material Handling Handbook, volume 1 – Raymond - 2009.

REFERENCE BOOKS

1. Accident Prevention Manual for Industrial Operations, NSC, Chicago.
2. James, Apple, "Material Handling System design", Ronald Press, 1980.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Know about the general safety in material handling.
CO2	Obtain knowledge about the ergonomic hazards due to conveyer machines
CO3	Obtain knowledge about the ergonomic hazards due to hoisting.
CO4	Understand the operations of handling equipment.
CO5	Know about the storage and safe handling of goods.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	3	3	3	3	-	-	-	-	-	-	-	-	-
CO2	-	3	3	3	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	3	3	3	-	-	-	-	3	-	-	-
CO4	-	-	3	3	3	-	-	-	-	-	3	-	-	-
CO5	-	-	3	3	-	-	-	-	-	-	-	-	-	-

ME4534	PROCESS EQUIPMENT DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn about the procedure for design of piping,
- To know the relevant process design for application for Flow meters and Thermal equipment.

UNIT I	PROCESS DESIGN OF PIPING, FLUID MOVING DEVICES AND FLOW METERS	9
Introduction, Process design of piping, NPSHA &NPSHR, Power required by pump, evaluation of Centrifugal pump performance when handling viscous liquids, Power required in Fan, Blower and adiabatic compressor, flow meters, Process design of Orifice meter, Rotameter etc.		CO1
UNIT II	**PROCESS DESIGN OF HEAT EXCHANGERS**	**9**
Shell & Tube heat exchangers, Functions of various parts of shell & Tube Heat exchanger, General design method of shell & tube heat exchanger, Criteria of selection among Fixed Tube sheet, U Tube & Floating Head heat exchanger, Process design of without phase change heat exchanger, Process design of condenser, Criteria of selection for Horizontal and vertical condenser, Process design of Kettle type &Thermosyphon Reboilers and vaporizes, Tinker's flow model, Air cooled heat exchangers and air heaters, plate heat exchangers, etc.		CO2
UNIT III	**PROCESS DESIGN OF DISTILLATION COLUMN**	**9**
Introduction, Criteria of selection, Selection of equipment for distillation, Distillation column design, Selection of key components for multicomponent distillation, Determination of operating pressure for distillation column, Advantages & disadvantages of vacuum distillation, Determination of nos. of theoretical stages for binary distillation by McCabe Thiele method Determination of nos. of theoretical stages for multi-component distillation by Fenskey- Underwood-Gilliland's method, Selection of trays, Calculations for tower diameter & pressure drop of sieve tray tower, Checking of conditions for weeping, down comer flooding, liquid entrainment, etc, tray efficiency, Jet Flooding & down comer Flooding, Different types of weirs & down comers of tray tower, their selection criteria		CO3
UNIT IV	**PROCESS DESIGN OF ABSORBERS**	**9**
Introduction, Criteria for selection among different types of absorption equipment, Process Design of packed tower type absorber: Determination of actual amount of solvent, Selection of packing, Determination of tower diameter & pressure drop, Determination of NtoG, HtoG & height of packing, Process design & selection criteria of liquid distributors, redistributors & packing support, Process design of Spray chamber or spray tower type absorber, Venturi Scrubber.		CO4
UNIT V	**PROCESS DESIGN OF EXTRACTOR**	**9**
Industrial applications of liquid-liquid extraction, choice of solvent, Process design of counter current multistage extractor, Selection criteria among different types of extractor, Process design of mixer-settler type extractor & packed tower type extractor, Guidelines for the design of other types of extractors		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Ray Sinnott, Gavin Towler, Chemical Engineering Design - Principles, Practice and Economics of Plant and Process Design, Butterworth - Heinemann, 2008.
2. Introduction to Process Engineering and Design by S B Thakore and B I Bhatt, Tata McGraw Hill, 1st Edition, 2007.

REFERENCE BOOKS

1. Brownell and Young, Process Vessel Design, Wiley Eastern, 1977.

2. M. S. Peters and K. D. Timmerhaus, Plant Design and Economics for Chemical Engineers, 4th ed., McGraw - Hill, New York, 1991.

3. Ludwig, E. E., Applied process design for chemical and petrochemical plants , volume 1,2 & 3, Third Edition, Butterworth- Heinemam,1997

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Design process equipment and modify the design of existing equipment to new process conditions or new required capacity.
CO2	Build a bridge between theoretical and practical concepts used for designing the equipment in any process industry.
CO3	Create understanding of equipment design.
CO4	Review the importance of design concepts in process industry.
CO5	Design Calculation related to heat exchange equipment and their performance criteria.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	-	-	-	-	-	2	-	2	2	-
CO2	3	2	2	2	-	-	-	-	-	2	-	2	2	-
CO3	3	2	2	2	-	-	-	-	-	2	-	2	2	-
CO4	3	2	2	2	-	-	-	-	-	2	-	2	2	-
CO5	3	2	2	2	-	-	-	-	-	2	-	2	2	-

ME4535	DESIGN OF PRESSURE VESSELS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the Mathematical knowledge to design pressure vessels and piping
- To understand the ability to carry of stress analysis in pressure vessels and piping

UNIT I	**INTRODUCTION**	**3**
Methods for determining stresses - Terminology and Ligament Efficiency - Applications.		**CO1**
UNIT II	**STRESSES IN PRESSURE VESSELS**	**15**
Introduction - Stresses in a circular ring, cylinder - Dilation of pressure vessels, Membrane stress Analysis of Vessel - Cylindrical, spherical and, conical heads - Thermal Stresses - Discontinuity stresses in pressure vessels.		**CO2**
UNIT III	**DESIGN OF VESSELS**	**15**
Design of Tall cylindrical self-supporting process columns - Supports for short vertical vessels - Stress concentration at a variable Thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of Reinforcement - Pressure Vessel Design.		**CO3**
UNIT IV	**BUCKLING AND FRACTURE ANALYSIS IN VESSELS**	**8**
Buckling phenomenon - Elastic Buckling of circular ring and cylinders under external pressure - collapse of thick walled cylinders or tubes under external pressure - Effect of supports on Elastic Buckling of Cylinders - Buckling under combined External pressure and axial loading.		**CO4**
UNIT V	**PIPING**	**4**
Introduction - Flow diagram - piping layout and piping stress Analysis.		**CO5**
		TOTAL: 45 PERIODS

TEXTBOOKS

1. John F. Harvey, "Theory and Design of Pressure Vessels", CBS Publishers and Distributors, 1987.
2. Henry H. Bedner, “Pressure Vessels, Design Hand Book", CBS publishers and Distributors, 1987.

REFERENCE BOOKS

1. Stanley, M. Wales, “Chemical process equipment, selection and Design". Buterworths series in Chemical Engineering, 1988.
2. William. J., Bees, “Approximate Methods in the Design and Analysis of Pressure Vessels and Piping”, Pre ASME Pressure Vessels and Piping Conference, 1997.
3. Sam Kannapan, “Introduction to Pipe Stress Analysis”. John Wiley and Sons, 1985.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Know the methods to determine stresses.
CO2	Determine the stresses in the pressure vessels and pipes.
CO3	Apply the mathematical fundamental for the design of pressure vessels and pipes.
CO4	Analyse and design of pressure vessels and piping.
CO5	Know about the stress analysis of pipings.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	1
CO2	3	3	2	-	-	-	-	-	-	-	-	-	3	1
CO3	3	3	2	-	-	-	-	-	-	-	-	-	3	1
CO4	3	3	2	-	-	-	-	-	-	-	-	-	3	1
CO5	3	3	2	-	-	-	-	-	-	-	-	-	3	1

ME4541	AUTOMOBILE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the construction and working principle of various parts of an automobile.
- To have the practice for assembling and dismantling of engine parts and transmission system.

UNIT I	VEHICLE STRUCTURE AND ENGINES	9
Types of automobiles, vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC engines –components functions and materials, variable valve timing (VVT).		CO1
UNIT II	**ENGINE AUXILIARY SYSTEMS**	**9**
Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system, Emission norms (Euro and BS).		CO2
UNIT III	**TRANSMISSION SYSTEMS**	**9**
Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.		CO3
UNIT IV	**STEERING, BRAKES AND SUSPENSION SYSTEMS**	**9**
Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control.		CO4
UNIT V	**ALTERNATIVE ENERGY SOURCES**	**9**
Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Kirpal Singh, "Automobile Engineering", Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 1997.
2. Jain K.K. and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002.

REFERENCE BOOKS

1. Newton ,Steeds and Garet, "Motor Vehicles", Butterworth Publishers,1989.
2. Martin W, Stockel and Martin T Stockle , "Automotive Mechanics Fundamentals," The Good heart –Will Cox Company Inc, USA ,1978.
3. Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA, 1998.
4. Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2007.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the various vehicle structure and Components of IC engine.
CO2	Gain Knowledge in various auxiliary systems used in an automobile.
CO3	Understand the principle and application of Transmission systems in an automobile.
CO4	Demonstrate the use of steering, braking and suspension systems in an automobile
CO5	Apply the advantages of various alternative energy sources.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	1	-	-	-	-	-	-	-	-	2	-	-
CO2	3	-	1	-	-	-	-	-	-	-	-	2	-	-
CO3	3	-	1	-	-	-	-	-	-	-	-	2	-	-
CO4	3	-	1	-	-	-	-	-	-	-	-	2	-	-
CO5	3	-	1	-	-	2	3	-	-	-	-	2	-	-

ME4542	AUTOMOTIVE MATERIALS, COMPONENTS, DESIGN AND TESTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand basics of automotive components and automotive materials.
- To understand the automotive design, testing and validation

UNIT I	ENGINEERING MATERIALS AND MATERIALS FOR ENGINE AND TRANSMISSION	9
Classes of engineering materials – the evolution of engineering materials, Definition of materials properties, displaying material properties using materials selection charts, Forces for change in materials selection and design, Materials and the environment-selection of materials for automotive applications. Materials selection for IC engines: Piston, piston rings, cylinder, Engine block, Connecting rod, Crank shaft, Fly wheels, Gear box, Gears, Splines, Clutches.		CO1
UNIT II	**ELECTRONIC MATERIALS FOR AUTOMOTIVE APPLICATION**	**9**
Materials for sensors and electronic devices meant for Engine Speed and Crank Position, Throttle position sensor, Manifold Absolute Pressure, Temperature Sensor, Oxygen Sensor, Piezoelectric Sensor, Ultrasonic Sensor and Dew Sensor. Sensor Materials and Technologies.		CO2
UNIT III	**AUTOMOTIVE COMPONENTS**	**9**
Engine block - Cylinder head Crank shaft, Connecting rod, Camshaft, Cylinder Liners, Piston ring - Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints - Differential - Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force		CO3
UNIT IV	**VEHICLE BODY DESIGN**	**9**
Types of Car body – Saloon, convertibles, Limousine, Estate Van, Racing and Sports car -car body terminology – Visibility- regulations, driver's visibility, improvement in visibility and tests for visibility. Driver seat design -Car Body Construction – Various panels in car bodies. Safety: Safety design, safety equipment for cars. Types of commercial vehicle bodies – Light commercial vehicle body. Construction details of Flat platform body, Tipper body and Tanker body – Dimensions of driver's seat in relation to controls -Drivers cab design.		CO4
UNIT V	**VEHICLE TESTING**	**9**
Wind tunnel test requirements - Ground boundary simulation - wind tunnel selection and Reynolds number capability, model details, mounting of model, Test procedure. Body test - Dynamics simulation sled testing - Dolly roll over test - Dolly roll over fixture - vehicle roof strength test - Door system crash test.		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1.W.H. course& D.L. Anglin, "Automotive Mechanics" TMG publishing company, 2004
2.Gladius Lewis, "Selection of Engineering Materials", Prentice Hall Inc. New Jersey USA, 1995.

REFERENCE BOOKS

1.Automotive Handbook, Bosch. Website: www.mainindia.com/Draft, AIS standards.
2.ASM Handbook. "Materials Selection and Design", Vol. 20- ASM Metals Park Ohio.USA, 1997.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To understand the basics of materials and materials for engine and transmission
CO2	To understand the electronic materials used in automotive applications
CO3	To understand the basic automotive components
CO4	To understand the basic design on vehicle body and interiors
CO5	To understand the vehicle testing and validation

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	2	1	-	-	-	-	1	-	1	3	2	3
CO2	3	1	2	2	2	2	2	-	1	-	1	3	2	3
CO3	3	1	2	1	-	-	-	-	-	-	1	3	2	3
CO4	3	1	2	1	-	-	-	-	-	-	1	3	2	3
CO5	3	1	2	2	1	2	3	-	1	-	1	3	2	3

ME4543	POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- Providing an overview of Power Plants and detailing the role of Mechanical Engineers in their operation and maintenance

UNIT I	COAL BASED THERMAL POWER PLANTS	9
Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems		CO1
UNIT II	**DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS**	**9**
Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimization. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.		CO2
UNIT III	**NUCLEAR POWER PLANTS**	**9**
Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.		CO3
UNIT IV	**POWER FROM RENEWABLE ENERGY**	**9**
Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power system.		CO4
UNIT V	**ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS**	**9**
Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.
2. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998.

REFERENCE BOOKS

1. Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Ability to comprehend the Layout of modern coal power plant and its major components, Binary Cycles and Cogeneration systems.
CO2	Able to understand the concept of Otto, Diesel, Dual & Brayton Cycle - Analysis &optimization and Components of Diesel and Gas Turbine power plants
CO3	Ability to know the Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : BWR, PWR, CANDU, Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants
CO4	Ability to comprehend the concept of Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, SPV, Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.
CO5	To understand the concept of Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	-	-	-	3	-	1	1	2	3	2
CO2	3	3	3	3	-	-	-	3	-	1	1	2	3	2
CO3	3	3	3	3	-	-	-	3	-	1	1	2	3	2
CO4	3	3	3	3	-	-	-	3	-	1	1	2	2	3
CO5	3	3	3	3	-	-	-	3	-	1	1	2	3	3

ME4544	REFRIGERATION AND AIR CONDITIONING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the underlying principles of operations in different Refrigeration & Air conditioning systems and components.
- To provide knowledge on design aspects of Refrigeration & Air conditioning systems

UNIT I	INTRODUCTION	9
Introduction to Refrigeration - Unit of Refrigeration and C.O.P.– Ideal cycles- Refrigerants Desirable properties – Classification - Nomenclature - ODP & GWP.		CO1
UNIT II	**VAPOUR COMPRESSION REFRIGERATION SYSTEM**	**9**
Vapor compression cycle: p-h and T-s diagrams - deviations from theoretical cycle – subcooling and super heating- effects of condenser and evaporator pressure on COP- multipressure system - low temperature refrigeration - Cascade systems – problems. Equipment's: Type of Compressors, Condensers, Expansion devices, Evaporators		CO2
UNIT III	**OTHER REFRIGERATION SYSTEMS**	**9**
Working principles of Vapour absorption systems and adsorption cooling systems – Steam jet refrigeration- Ejector refrigeration systems- Thermoelectric refrigeration- Air refrigeration - Magnetic - Vortex and Pulse tube refrigeration systems.		CO3
UNIT IV	**PSYCHROMETRIC PROPERTIES AND PROCESSES**	**9**
Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychrometric chart; Psychrometric of air-conditioning processes, mixing of air streams.		CO4
UNIT V	**AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION**	**9**
Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection; fresh air load, human comfort & IAQ principles, effective temperature & chart, calculation of summer & winter air conditioning load; Classifications, Layout of plants; Air distribution system; Filters; Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors, Actuators & Safety controls.		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Arora, C.P., "Refrigeration and Air Conditioning", 3rd edition, McGraw Hill, New Delhi, 2010.
2. Stoecker, W.F. and Jones J. W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi, 1986.

REFERENCE BOOKS

1. ASHRAE Hand book,
2. Fundamentals, 2010 2. Jones W.P., "Air conditioning engineering", 5th edition, Elsevier Butterworth-Heinemann, 2007
3. Roy J. Dossat, "Principles of Refrigeration", 4th edition, Pearson Education Asia, 2009.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1	Explain the basic concepts of Refrigeration
CO2	Explain the Vapor compression Refrigeration systems and to solve problems
CO3	Discuss the various types of Refrigeration systems.
CO4	Calculate the Psychrometric properties and its use in Psychrometric processes
CO5	Explain the concepts of Air conditioning and to solve problems

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1	-	-	-	-	-	-	-	1	2	1
CO2	3	2	1	1	-	-	-	-	-	-	-	1	2	1
CO3	3	2	1	1	-	-	-	-	-	-	-	1	2	1
CO4	3	2	1	1	-	-	-	-	-	-	-	1	2	1
CO5	3	2	1	1	-	-	-	-	-	-	-	1	2	1

ME4545	MEASUREMENTS AND CONTROLS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the concepts of measurement technology
- To understand the concept of mathematical modeling using block diagram and signal flow graph techniques
- To study time response and frequency response of closed loop control systems
- To learn operating principle of mechanical sensors and transducers used to measure mechanical parameters
- To familiarize with the principle of various temperature and pressure measurement techniques

UNIT I	INTRODUCTION	9
Static and dynamic characteristics of measurement systems - standards and calibration - error and uncertainty analysis-statistical analysis of data-and curve fitting		CO1
UNIT II	**SYSTEMS AND REPRESENTATION**	**9**
Basic elements in control systems: – Open and closed loop systems – Electrical analogy of mechanical systems – Transfer function – AC and DC servomotors – Block diagram reduction techniques – Signal flow graphs.		CO2
UNIT III	**TIME AND FREQUENCY RESPONSE**	**9**
Time response: – Time domain specifications – Types of test input -I and II order system response – Error coefficients – Generalized error series – Steady state error – Correlation between frequency domain and time domain specifications- Frequency response: – Bode plot – Polar plot – Determination of closed loop response from open loop response		CO3
UNIT IV	**MECHANICAL MEASUREMENTS**	**9**
Measurement of displacement-Resistive-Inductive-Capacitive Methods Velocity Measurement-Contact type and Non-contact type Acceleration measurement-Potentiometric type-LVDT type-Piezoelectric type – Force measurement-Hydraulic-Pneumatic-Strain gauge- Magnetostrictive Load Cell Measurement of Torque-Inline rotating-Inline stationary-Proximity type.		CO4
UNIT V	**MEASUREMENT OF TEMPERATURE AND PRESSURE**	**9**
Temperature measurement-Bimetallic thermometer-Filled system thermometer-Resistance temperature detector-Thermistor-Thermocouple .Radiation fundamentals-Pyrometers Pressure measurement-Pressure fundamentals-Manometer and its types-Elastic and Electrical pressure transducers-Vacuum pressure measurement-McLeod gauge-Thermal conductivity gauge-Pressure gauge calibration-Dead weight tester		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Ernest O Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill, 2009.
2. Sawhney A K and Puneet Sawhney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th edition, Dhanpat Rai& Co, New Delhi, 2013.
3. Nagarath, I.J. and Gopal, M., "Control Systems Engineering", New Age International Publishers, 2017.
4. Benjamin C. Kuo, "Automatic Control Systems", Wiley, 2014.

REFERENCE BOOKS

1. Patranabis. D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2010.
2. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Explain various characteristics, standards, calibration and types of errors in measurement systems.
CO2	Develop mathematical models for different types of system by using block diagram and signal flow graph.
CO3	Determine the time response specifications along with error coefficients for closed loop control system.
CO4	Illustrate the working principle and applications of different types of Mechanical sensors and transducers.
CO5	Illustrate the working principle and applications of different types of instruments for measurement of temperature and pressure.

MAPPING OF COs WITH POs AND PSOs														
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	-	-	-	-	-	-	-	2	3	-
CO2	3	3	2	2	-	-	-	-	-	-	-	2	3	-
CO3	3	3	2	2	-	-	-	-	-	-	-	2	3	-
CO4	3	3	2	2	-	-	-	-	-	-	-	2	3	-
CO5	3	3	2	2	-	-	-	-	-	-	-	2	3	-

ME4551	NON-TRADITIONAL MACHINING PROCESSES	L	T	P	C
		3	0	0	3

OBJECTIVES

- ❖ To learn about various Non-traditional Machining processes, their process parameters and influence on the performance of end components
- ❖ To select appropriate machining technique for machining advanced materials
- ❖ To select appropriate machining technique for machining components with very tight tolerances
- ❖ To update the students with latest technological developments and research trends in the field of Non-traditional Machining.

UNIT I	INTRODUCTION AND MECHANICAL ENERGY BASED PROCESSES	9
Unconventional machining Process – Need – classification – merits, demerits and applications. Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining - Ultrasonic Machining. (AJM, WJM, AWJM and USM). Working Principles – equipment used – Process parameters – MRR Applications. Numerical Problems		CO1
UNIT II	**THERMAL AND ELECTRICAL ENERGY BASED PROCESSES**	**9**
Electric Discharge Machining (EDM) – Wire cut EDM – Working Principleequipments- Process parameters-Surface Finish and MRR- electrode / Tool – Power and control Circuits-Tool Wear – Dielectric – Flushing — Applications. Laser beam machining and drilling, Plasma arc machining (PAM), Electron Beam Machining (EBM) and Ion Beam Machining (IBM). Principles –Equipment – Types - Beam control techniques – Applications. Numerical Problems		CO2
UNIT III	**CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES**	**9**
Chemical machining - Etchants – Maskant - techniques of applying maskants - Principles of Electro Chemical Machining (ECM) - equipments – Process Parameters, MRR and Surface Finish. Electro Chemical Grinding (ECG) and Electro Chemical Honing (ECH), Electro Stem Drilling (ESD) - Applications. Numerical Problems		CO3
UNIT IV	**ADVANCED SURFACE FINISHING PROCESSES**	**9**
Abrasive flow machining, chemo-mechanical polishing, magnetic abrasive finishing, magneto rheological finishing, magneto rheological abrasive flow finishing, plasma assisted polishing: their working principles, equipments, effect of process parameters, applications, advantages and limitations- Recent developments in finishing process.		CO4
UNIT V	**RECENT TRENDS IN NON-TRADITIONAL MACHINING PROCESSES**	**9**
Recent developments in non-traditional machining processes, their working principles, equipments, effect of process parameters, applications, advantages and limitations. Comparison of non-traditional machining processes, Bio Machining, Ice Jet Machining, Elastic Emission Machining (EEM), Hybrid Machining Process – Micromachining and Nano machining, Non Traditional Machining in Industry 4.0.		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Vijay.K. Jain "Advanced Machining Processes" Allied Publishers Pvt. Ltd. New Delhi, 2009
2. Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw Hill, New Delhi, 2017.

REFERENCE BOOKS

1. Benedict. G.F. "Nontraditional Manufacturing Processes", Marcel Dekke Inc., New York, 2019.
2. Mc Geough, "Advanced Methods of Machining", Chapman and Hall, London 1998.
3. Paul De Garmo, J.T.Black, and Ronald. A.Kohser, "Material and Processes I Manufacturing", Prentice Hall of India Pvt. Ltd., 8thEdition, New Delhi, 2001.

COURSE OUTCOMES

Upon completion of the course, students will be able to	
CO1	Classify various Mechanical Energy based Non Traditional Machining processes.
CO2	Compare various Thermal energy and Electrical energy based Non Traditional Machining processes.
CO3	Summarize various chemical and electro-chemical energy based Non Traditional Machining processes.
CO4	Explain various Nano Finishing processes.
CO5	Gain knowledge about recent trends and developments in Non Traditional Machining

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	2	1	1	-	-	-	-	-	2	3	2
CO2	2	2	2	2	1	1	-	-	-	-	-	2	3	2
CO3	2	2	2	2	1	1	-	-	-	-	-	2	3	2
CO4	2	2	2	2	1	1	-	-	-	-	-	2	3	2
CO5	2	2	2	2	1	1	-	-	-	-	-	2	3	2

ME4552	TURBO MACHINES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the various systems, principles, operations and applications of different types of turbo machinery components.

UNIT I	**PRINCIPLES**	**9**
Energy transfer between fluid and rotor-classification of fluid machinery,-dimensionless parameters- specific speed-applications-stage velocity triangles-work and efficiency.		**CO1**
UNIT II	**CENTRIFUGAL FANS AND BLOWERS**	**9**
Types- stage and design parameters-flow analysis in impeller blades-volute and diffusers, losses, characteristic curves and selection, fan drives and fan noise.		**CO2**
UNIT III	**CENTRIFUGAL COMPRESSOR**	**9**
Construction details, impeller flow losses, slip factor, diffuser analysis, losses and performance curves.		**CO3**
UNIT IV	**AXIAL FLOW COMPRESSOR**	**9**
Stage velocity diagrams, enthalpy-entropy diagrams, stage losses and efficiency, work done simple stage design problems and performance characteristics.		**CO4**
UNIT V	**AXIAL AND RADIAL FLOW TURBINES**	**9**
Stage velocity diagrams, reaction stages, losses and coefficients, blade design principles, testing and performance characteristics.		**CO5**
		TOTAL: 45 PERIODS

TEXTBOOKS

1.Yahya, S.M., Turbines, Compressor and Fans, Tata McGraw Hill Publishing Company, 1996.
2.Bruneck, Fans, Fans; design and operation of centrifugal, axial-flow, and cross-flow fansPergamom Press, 1973.

REFERENCE BOOKS

1. Earl Logan, Jr., Hand book of Turbomachinery, Marcel Dekker Inc., 1992.
2. Dixon, S.I., "Fluid Mechanics and Thermodynamics of Turbomachinery", Pergamon Press, 1990.
3. Shepherd, D.G., "Principles of Turbomachinery", Macmillan, 1969.
4. Ganesan, V., "Gas Turbines", Tata McGraw Hill Pub. Co., 1999.
5. Gopalakrishnan .G and Prithvi Raj .D, "A Treatise on Turbo machines", Scifech Publications (India) Pvt. Ltd., 2002

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the principles of Energy transfer and velocity triangles.
CO2	Draw the characteristic curves of centrifugal fans and blowers
CO3	Analyse the performance curves of centrifugal compressor
CO4	Analyse the performance curves of centrifugal compressor axial flow compressor
CO5	Learn about blade design principles and performance curves of axial and radial flow turbines

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	-	-	-	-	-	-	-	2	3	-
CO2	3	2	3	2	-	-	-	-	-	-	-	2	3	-
CO3	3	2	3	2	-	-	-	-	-	-	-	2	3	-
CO4	3	2	3	2	-	-	-	-	-	-	-	2	3	-
CO5	3	2	3	2	-	-	-	-	-	-	-	2	3	-

ME4553	DESIGN OF TRANSMISSION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To gain knowledge on the principles and procedure for the design of Mechanical power Transmission components.
- To understand the standard procedure available for Design of Transmission of Mechanical elements
- To learn to use standard data and catalogues

(Use of P S G Design Data Book permitted)

UNIT I	DESIGN OF FLEXIBLE ELEMENTS	9
Design of Flat belts and pulleys - Selection of V belts and pulleys - Selection of hoisting wire ropes and pulleys - Design of Transmission chains and Sprockets.		CO1
UNIT II	**SPUR GEARS AND PARALLEL AXIS HELICAL GEARS**	**9**
Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects - Fatigue strength - Factor of safety - Gear materials - Design of straight tooth spur & helical gears based on strength and wear considerations - Pressure angle in the normal and transverse plane - Equivalent number of teeth - forces for helical gears.		CO2
UNIT III	**BEVEL, WORM AND CROSS HELICAL GEARS**	**9**
Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits, terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair. Cross helical: Terminology-helix angles-Estimating the size of the pair of cross helical gears.		CO3
UNIT IV	**GEAR BOXES**	**9**
Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box - Design of multi speed gear box for machine tool applications - Constant mesh gear box - Speed reducer unit. Variable speed gear box, Fluid Couplings, Torque Converters for automotive applications.		CO4
UNIT V	**CAMS, CLUTCHES AND BRAKES**	**9**
Cam Design: Types-pressure angle and under cutting base circle determination-forces and surface stresses. Design of plate clutches - axial clutches-cone clutches - internal expanding rim clutches - Electromagnetic clutches. Band and Block brakes - external shoe brakes - Internal expanding shoe brake.		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Bhandari V B, "Design of Machine Elements", 4th Edition, Tata McGraw-Hill Book Co, 2016.
2. Joseph Shigley, Richard G. Budynas and J. Keith Nisbett "Mechanical Engineering Design", 10th Edition, Tata McGraw-Hill, 2015.

REFERENCE BOOKS

1. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, "Design of Machine Elements" 8th Edition, Printice Hall, 2003.
2. Orthwein W, "Machine Component Design", Jaico Publishing Co, 2003. 3. Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2000.
4. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", 4th Edition, Wiley, 2005
5. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Apply the concepts of design to belts, chains and rope drives.
CO2	Apply the concepts of design to spur, helical gears.
CO3	Apply the concepts of design to worm and bevel gears.
CO4	Apply the concepts of design to gear boxes.
CO5	Apply the concepts of design to cams, brakes and clutches.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	3	-	-	-	-	-	-	-	-	3	3	1
CO2	3	2	3	-	-	-	-	-	-	-	-	3	3	1
CO3	3	2	3	-	-	-	-	-	-	-	-	3	3	1
CO4	3	2	3	-	-	-	-	-	-	-	-	3	3	1
CO5	3	2	3	-	-	-	-	-	-	-	-	3	3	1

ME4554	FINITE ELEMENT ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the concepts of Mathematical Modeling of Engineering Problems.
- To appreciate the use of FEM to a range of Engineering Problems.

UNIT I	**INTRODUCTION**	**9**
Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.		**CO1**
UNIT II	**ONE-DIMENSIONAL PROBLEMS**	**9**
One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices – Solution of problems from solid mechanics and heat transfer. Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation –Transverse deflections and Natural frequencies of beams.		**CO2**
UNIT III	**TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS**	**9**
Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems – Thermal problems – Torsion of Non circular shafts –Quadrilateral elements – Higher Order Elements.		**CO3**
UNIT IV	**TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS**	**9**
Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations – Plate and shell elements.		**CO4**
UNIT V	**ISOPARAMETRIC FORMULATION**	**9**
Natural co-ordinate systems – Isoparametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems – Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software		**CO5**
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Reddy. J.N., “An Introduction to the Finite Element Method”, 3rd Edition, Tata McGraw-Hill, 2005
2. Seshu, P, “Text Book of Finite Element Analysis”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.

REFERENCE BOOKS

1. Bhatti Asghar M, "Fundamental Finite Element Analysis and Applications", John Wiley & Sons, 2005 (Indian Reprint 2013)*
2. Chandrupatla & Belagundu, “Introduction to Finite Elements in Engineering”, 3rd Edition, Prentice Hall College Div, 1990
3. Logan, D.L., “A first course in Finite Element Method”, Thomson Asia Pvt. Ltd., 2002
4. Rao, S.S., “The Finite Element Method in Engineering”, 3rd Edition, Butterworth Heinemann, 2004

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1	Summarize the basics of finite element formulation.
CO2	Apply finite element formulations to solve one dimensional Problems.
CO3	Apply finite element formulations to solve two dimensional scalar Problems
CO4	Apply finite element method to solve two dimensional Vector problems
CO5	Apply finite element method to solve problems on iso parametric elements and dynamic Problems.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	-	-	-	-	-	-	-	1	1	3	3
CO2	3	3	2	-	-	-	-	-	-	-	1	1	3	3
CO3	3	3	2	-	-	-	-	-	-	-	1	1	3	3
CO4	3	3	2	-	-	-	-	-	-	-	1	1	3	3
CO5	3	3	2	-	-	-	-	-	-	-	1	1	3	3

ME4555	DESIGN FOR MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the principles of design such the manufacturing of the product is possible.
- Various design aspects to be considered for manufacturing the products using different processes

UNIT I	DESIGN FOR MANUFACTURING APPROACH AND PROCESS	9
Methodologies and tools, design axioms, design for assembly and evaluation, minimum part assessment. Taguchi method, robustness assessment, manufacturing process rules, designer's tool kit, Computer Aided group Technology, failure mode effective analysis, Value Analysis. Design for minimum number of parts, development of modular design, minimizing part variations, design of parts to be multi-functional, multi-use, ease of fabrication, Poka Yoke principles.		CO1
UNIT II	**GEOMETRIC ANALYSIS**	**9**
Surface finish, review of relationship between attainable tolerance grades and difference machining processes. Analysis of tapers, screw threads, applying probability to tolerances.		CO2
UNIT III	**FORM DESIGN OF CASTINGS AND WELDMENTS**	**9**
Redesign of castings based on parting line considerations, Minimizing core requirements, redesigning cast members using weldments, use of welding symbols.		CO3
UNIT IV	**MECHANICAL ASSEMBLY**	**9**
Selective assembly, deciding the number of groups, control of axial play, examples, grouped datum systems - different types, geometric analysis and applications - design features to facilitate automated assembly.		CO4
UNIT V	**TRUE POSITION THEORY**	**9**
Virtual size concept, floating and fixed fasteners, projected tolerance zone, assembly with gasket, zero true position tolerance, functional gauges, paper layout gauging, examples. Operation sequence for typical shaft type of components. Preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples.		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Corrado Poli, “Design for Manufacturing: A Structured Approach” Elsevier, 2001

2. G. K. Lal, Nallagundla Venkata Reddy, and Vijay Gupta,” Fundamentals of Design and Manufacturing” alpha Science International, 2005

REFERENCE BOOKS

1. A. K. Chitale, R. C. Gupta, “Product Design And Manufacturing” PHI Learning Pvt. Ltd. 2013

2. James G. Bralla, "Hand Book of Product Design for Manufacturing" McGraw Hill Publications, 1983.

3. Oliver R. Wade, "Tolerance Control in Design and Manufacturing", Industrial Press Inc. New York Publications, 1967.

4. Harry Peck, "Designing for Manufacture", Pitman Publications, 1983.

5. Matousek, "Engineering Design, - A Systematic Approach" - Blackie & Son Ltd., London, 1974.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Perform designing of components considering manufacture ability.
CO2	Understand the need and the usage of tolerances.
CO3	Design casting and weld structures.
CO4	Use principles of design for assembly.
CO5	Understand true position theory.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	3	1	-	-	-	-	-	-	1	1	3	1
CO2	3	2	3	1	-	-	-	-	-	-	1	1	3	1
CO3	3	2	3	1	-	-	-	-	-	-	1	1	3	1
CO4	3	2	3	1	-	-	-	-	-	-	1	1	3	1
CO5	3	2	3	1	-	-	-	-	-	-	1	1	3	1

ME4561	ADVANCED INTERNAL COMBUSTION ENGINES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the underlying principles of operation of different IC Engines and components.
- To provide knowledge on pollutant formation, control, alternate fuel etc.

UNIT I	**SPARK IGNITION ENGINES**	**9**
Mixture requirements – Fuel injection systems – Mono point, Multipoint & Direct injection - Stages of Combustion – Normal and Abnormal combustion – Knock - Factors affecting knock – Combustion chambers.		**CO1**
UNIT II	**COMPRESSION IGNITION ENGINES**	**9**
Diesel Fuel Injection Systems - Stages of combustion – Knocking – Factors affecting knock – Direct and Indirect injection systems – Combustion chambers – Fuel Spray behavior – Spray structure and spray penetration – Air motion - Introduction to Turbo-charging.		**CO2**
UNIT III	**POLLUTANT FORMATION AND CONTROL**	**9**
Pollutant – Sources – Formation of Carbon Monoxide, Un burnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling Emissions – Catalytic converters, Selective Catalytic Reduction and Particulate Traps – Methods of measurement – Emission norms and Driving cycles.		**CO3**
UNIT IV	**ALTERNATIVE FUELS**	**9**
Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel - Properties, Suitability, Merits and Demerits - Engine Modifications		**CO4**
UNIT V	**RECENT TRENDS**	**9**
Air assisted Combustion, Homogeneous charge compression ignition engines – Variable Geometry turbochargers – Common Rail Direct Injection Systems - Hybrid Electric Vehicles – NOx Adsorbers - Onboard Diagnostics.		**CO5**
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Ganesan,V., "Internal combustion engines", Tata McGraw Hill Publishing Co., 2007
2. Ramalingam. K.K., "Internal combustion engine", scitech publications, Chennai, 2003

REFERENCE BOOKS

1. Ganesan,V., "Compute Simulation of Compression Ignition engine process", Universities Press (India) Ltd., Hyderabad, 1996.
2. John,B., Heywood, "Internal Combustion Engine Fundamentals", McGraw Hill Publishing Co., New York, 1990
3. Benson,R.S., Whitehouse,N.D., "Internal Combustion Engines", Pergamon Press, Oxford, 1979.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1	Ability to understand the performance & characteristics a S.I Engine
CO2	Ability to understand about various injection systems, Fuel Spray behavior, Stages of combustion, Turbo charging, Combustion chambers and Knocking in C.I Engine
CO3	Ability to understand various pollutants and its formations, method of controlling Emissions, methods of measurement, Emission norms and Driving cycles
CO4	Ability to understand various alternative fuels, their suitability and corresponding Engine modifications
CO5	Ability to understand about the recent trends in I.C. Engine's Injection Systems, Combustion, ignition, Hybrid Vehicles and Onboard Diagnostics

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	1	-	1	-	-	-	-	-	1	1	1
CO2	3	2	2	1	-	1	-	-	-	-	-	1	1	1
CO3	3	1	2	-	-	1	-	-	-	-	-	1	1	1
CO4	3	2	1	-	-	1	-	-	-	-	-	1	1	1
CO5	3	2	2	1	-	1	-	-	-	-	-	1	1	1

ME4562	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the process planning concepts to make cost estimation for various products after process planning

UNIT I	**INTRODUCTION TO PROCESS PLANNING**	**9**
Introduction- methods of process planning-Drawing interpretation-Material evaluation – steps in process selection-.Production equipment and tooling selection		**CO1**
UNIT II	**PROCESS PLANNING ACTIVITIES**	**9**
Process parameters calculation for various production processes-Selection jigs and fixtures selection of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies		**CO2**
UNIT III	**INTRODUCTION TO COST ESTIMATION**	**9**
Importance of costing and estimation –methods of costing-elements of cost estimation –Types of estimates – Estimating procedure- Estimation labor cost, material cost- allocation of over head charges- Calculation of depreciation cost		**CO3**
UNIT IV	**PRODUCTION COST ESTIMATION**	**9**
Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, estimation of Foundry Shop		**CO4**
UNIT V	**MACHINING TIME CALCULATION**	**9**
Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations ,Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding		**CO5**
		TOTAL: 45 PERIODS

TEXTBOOKS

1. PETER SCALON, "Process planning, Design/Manufacture Interface", Elsevier science technology Books, Dec 2002.
2. Ostwalal P.F. and Munez J., "Manufacturing Processes and systems", 9th Edition, John Wiley, 1998.

REFERENCE BOOKS

1. Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 2nd Edition, PHI, 2002.
2. Russell R.S and Tailor B.W, "Operations Management", 4th Edition, PHI, 2003

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Select the process, equipments and tools for various industrial products
CO2	Prepare the process planning activity chart
CO3	Explain the concept of cost estimation
CO4	Compute the job order cost for different types of shop floor
CO5	Calculate the machining time for various machining operations

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	1	2	2	2	3	3	1	3	3	3	-
CO2	2	2	2	1	2	2	2	3	2	1	3	2	3	-
CO3	2	2	2	1	2	2	2	3	2	1	3	2	3	-
CO4	2	2	2	1	2	2	2	3	2	1	3	2	3	-
CO5	2	2	2	1	2	2	2	3	2	1	3	2	3	-

ME4563	GAS DYNAMICS AND JET PROPULSION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic difference between incompressible and compressible flow.
- To understand the phenomenon of shock waves and its effect on flow. To gain some basic knowledge about jet propulsion and Rocket Propulsion. (Use of Standard Gas Tables permitted)

UNIT I	BASIC CONCEPTS AND ISENTROPIC FLOWS	9
Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone – Effect of Mach number on compressibility – Isentropic flow through variable ducts – Nozzle and Diffusers		CO1
UNIT II	**FLOW THROUGH DUCTS**	**9**
Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties		CO2
UNIT III	**NORMAL AND OBLIQUE SHOCKS**	**9**
Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl – Meyer relations – Applications.		CO3
UNIT IV	**JET PROPULSION**	**9**
Theory of jet propulsion – Thrust equation – Thrust power and propulsive efficiency – Operating principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines		CO4
UNIT V	**SPACE PROPULSION**	**9**
Types of rocket engines – Propellants-feeding systems – Ignition and combustion – Theory of rocket propulsion – Performance study – Staging – Terminal and characteristic velocity – Applications – space flights.		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Anderson, J.D., "Modern Compressible flow", 3rd Edition, McGraw Hill, 2012.
2. Yahya, S.M. "Fundamentals of Compressible Flow", New Age International (P) Limited, New Delhi, 2002.

REFERENCE BOOKS

1. Cohen. H., G.E.C. Rogers and Saravanamutto, "Gas Turbine Theory", Longman Group Ltd.,1980\
2. Ganesan. V., "Gas Turbines", Tata McGraw Hill Publishing Co., New Delhi, 2010.
3. Shapiro. A.H.," Dynamics and Thermodynamics of Compressible fluid Flow", John wiley, New York, 1953.
4. Sutton. G.P., "Rocket Propulsion Elements", John wiley, New York,2010,
5. Zucrow. N.J., "Principles of Jet Propulsion and Gas Turbines", John Wiley, New York, 1970.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Apply the concept of compressible flows in variable area ducts.
CO2	Apply the concept of compressible flows in constant area ducts.
CO3	Examine the effect of compression and expansion waves in compressible flow.
CO4	Use the concept of gas dynamics in Jet Propulsion.
CO5	Apply the concept of gas dynamics in Space Propulsion.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	1	-	-	-	-	-	-	-	1	2	1
CO2	3	2	2	1	-	-	-	-	-	-	-	1	2	1
CO3	3	2	2	1	-	-	-	-	-	-	-	1	2	1
CO4	3	2	2	1	-	-	-	-	-	-	-	1	2	1
CO5	3	2	2	1	-	-	-	-	-	-	-	1	2	1

ME4564	OPERATIONAL RESEARCH	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide knowledge and training in using optimization techniques under limited resources for the engineering and business problems.

UNIT I	**LINEAR MODELS**	**15**
The phase of an operation research study – Linear programming – Graphical method– Simplex algorithm – Duality formulation – Sensitivity analysis		**CO1**
UNIT II	**TRANSPORTATION MODELS AND NETWORK MODELS**	**8**
Transportation Assignment Models –Traveling Salesman problem-Networks models – Shortest route – Minimal spanning tree – Maximum flow models –Project network – CPM and PERT networks – Critical path scheduling – Sequencing models.		**CO2**
UNIT III	**INVENTORY MODELS**	**6**
Inventory models – Economic order quantity models – Quantity discount models – Stochastic inventory models – Multi product models – Inventory control models in practice.		**CO3**
UNIT IV	**QUEUEING MODELS**	**6**
Queueing models - Queueing systems and structures – Notation parameter – Single server and multi server models – Poisson input – Exponential service – Constant rate service – Infinite population – Simulation.		**CO4**
UNIT V	**DECISION MODELS**	**10**
Decision models – Game theory – Two person zero sum games – Graphical solution- Algebraic solution– Linear Programming solution – Replacement models – Models based on service life – Economic life– Single / Multi variable search technique – Dynamic Programming – Simple Problem.		**CO5**
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Hillier and Libeberman, "Operations Research", Holden Day, 2005
2. Taha H.A., "Operations Research", Sixth Edition, Prentice Hall of India, 2003.

REFERENCE BOOKS

1. Azara M.J., Jarvis and Sherali H., "Linear Programming and Network Flows", John Wiley, 2009.
2. Budnick F.S., "Principles of Operations Research for Management", Richard D Irwin, 1990.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To understand the concepts of linear model theorem.
CO2	To understand the concept and application of transportation model
CO3	To understand the concept of Inventory control and its applications
CO4	To understand the concept of queuing model and its applications
CO5	To understand the decision models and decision making

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	1	2	-	2	-	-	3	3	-	3	1	1
CO2	1	1	1	2	-	2	-	-	3	3	-	3	1	1
CO3	1	1	1	2	-	2	-	-	3	3	-	3	1	1
CO4	1	1	1	2	-	2	-	-	3	3	-	3	1	1
CO5	1	1	1	2	-	2	-	-	3	3	-	3	1	1

ME4565	CASTING AND WELDING PROCESSES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the metallurgical concepts and applications of casting and welding process.
- To acquire knowledge in CAD of casting and automation of welding process.

UNIT I	CASTING DESIGN	9
Heat transfer between metal and mould — Design considerations in casting – Designing for directional solidification and minimum stresses - principles and design of gating and risering		CO1
UNIT II	**CASTING PROCESS**	**9**
Solidification of pure metal and alloys – shrinkage in cast metals – progressive and directional solidification — Degasification of the melt-casting defects – Castability of steel , Cast Iron, Al alloys, Babbit alloy and Cu alloy.		CO2
UNIT III	**RECENT TRENDS IN CASTING AND FOUNDRY LAYOUT**	**9**
Shell moulding, precision investment casting, CO2 moulding, centrifugal casting, Die casting, Continuous casting, Counter gravity low pressure casting, Squeeze casting and semisolid processes. Layout of mechanized foundry – sand reclamation – material handling in foundry pollution control in foundry — Computer aided design of casting.		CO3
UNIT IV	**WELDING METALLURGY AND DESIGN**	**9**
Heat affected Zone and its characteristics – W eldability of steels, cast iron, stainless steel, aluminum, Mg , Cu , Zirconium and titanium alloys – Carbon Equivalent of Plain and alloy steels Hydrogen embrittlement – Lamellar tearing – Residual stress – Distortion and its control . Heat transfer and solidification - Analysis of stresses in welded structures – pre and post welding heat treatments – weld joint design – welding defects – Testing of weldment.		CO4
UNIT V	**RECENT TRENDS IN WELDING**	**9**
Friction welding, friction stir welding – explosive welding – diffusion bonding – high frequency induction welding – ultrasonic welding – electron beam welding – Laser beam welding –Plasma welding – Electroslag welding- narrow gap, hybrid twin wire active TIG – Tandem MIG- modern brazing and soldering techniques – induction, dip resistance, diffusion processes – Hot gas, wave and vapour phase soldering. Overview of automation of welding in aerospace, nuclear, surface transport vehicles and under water welding.		CO5
TOTAL: 45 PERIODS		

TEXT BOOKS

1.Carrry B., Modern Welding Technology, Prentice Hall Pvt Ltd., 2002

2. CORNU.J. Advanced welding systems – Volumes I, II and III, JAICO Publishers, 1994.

REFERENCE BOOKS

1.HEINELOPER & ROSENTHAL, Principles of Metal Casting, Tata McGraw Hill, 2000.

2.IOTROWSKI – Robotic welding – A guide to selection and application – Society of mechanical Engineers, 1987.

3.Jain P.L., Principles of Foundry Technology, Tata McGraw Hill Publishers, 2003

4.LANCASTER.J.F. – Metallurgy of welding – George Alien & Unwin Publishers, 1980

5.Parmer R.S., Welding Engineering and Technology, Khanna Publishers,2002

6.SCHWARIZ, M.M. – Source book on innovative welding processes – American Society for Metals (OHIO), 1981

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	To understand the various mould and its components.
CO2	Explain the concepts of metal characterization during casting and its defects.
CO3	Illustrate the application with various Casting process.
CO4	Understanding the concepts of various designs of welding and metallurgy.
CO5	Analyzing the various trends in welding and its unique metalurgy

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	2	1	1	-	-	-	-	-	2	3	2
CO2	2	2	2	2	1	1	-	-	-	-	-	2	3	2
CO3	2	2	2	2	1	1	-	-	-	-	-	2	3	2
CO4	2	2	2	2	1	1	-	-	-	-	-	2	3	2
CO5	2	2	2	2	1	1	-	-	-	-	-	2	3	2

OEC414	BASICS OF BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study about the different bio potential and its propagation
- To understand the different types of electrodes and its placement for various recording
- To study the design of bio amplifier for various physiological recording
- To learn different measurement techniques for non-physiological parameters
- To discuss the recent trends in the field of diagnostic and therapeutic equipment

UNIT I	BIOPOTENTIAL RECORDING AND ELECTRODE TYPES	9
Biopotential origin and its propagation. Types of electrodes and its equivalent circuits - surface, needle and micro electrodes. Recording problems - measurement with two electrodes		CO1
UNIT II	**FEATURES OF BIOSIGNAL AND ELECTRODE CONFIGURATIONS**	**9**
Features of Bio-signal – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system. EEG – unipolar, bipolar, average mode and 10-20 electrode system. EMG– unipolar and bipolar mode.		CO2
UNIT III	**BIOAMPLIFIER CIRCUITS AND ASSIST DEVICES**	**9**
Basic requirements for bio-amplifier - differential bio-amplifier, PLI, Right leg driven ECG amplifier, Band pass filtering. Assist Devices- Dialyzer, Cardiac Pacemakers, and Heart Lung Machine.		CO3
UNIT IV	**MEASUREMENT OF NON-ELECTRICAL AND BIO-CHEMICAL PARAMETERS**	**9**
Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - Auscultatory method, direct methods: electronic manometer, Systolic, diastolic pressure, Blood flow and cardiac output measurement: Indicator dilution, and dye dilution method. Calorimeter, Sodium Potassium Analyzer, auto analyzer (simplified schematic description).		CO4
UNIT V	**CURRENT TRENDS IN MEDICAL DEVICES**	**9**
Laser in medicine and its applications, Thermograph – System, working, endoscopy unit, Cryogenic application, Introduction to tele-medicine.		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi,2007.
2. John G. Webster, "Medical Instrumentation: Application and Design", John Wiley and sons, NewYork,2004.(Unit I,II&III).

REFERENCE BOOKS

1. MyerKutz, "Standard Handbook of Biomedical Engineering and Design", McGraw Hill Publisher, 2003.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, NewDelhi, 2003.(Unit II&IV)
3. Joseph J. Carr and John M Brown, "Introduction to Biomedical Equipment Technology", Pearson Education,2004.
4. Chan and Anthony Y.K, ''Biomedical Device Technology: Principles and Design'', Springfield, Illinois : Charles C. Thomas publisher Limited,2016.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To learn the different bio potentials and its propagation
CO2	To get familiarized with different electrode placements for various physiological recording
CO3	To design bio amplifiers for various physiological recording
CO4	To understand various techniques for non-electrical and physiological measurements
CO5	To understand the current trends in medical devices.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	-	1	3	-	-	1	-	-	-	-	1
CO2	2	2	2	-	1	3	-	-	1	-	-	-	-	1
CO3	3	3	3	-	3	3	-	-	2	-	-	-	-	1
CO4	2	2	3	-	3	3	-	-	2	-	-	-	-	1
CO5	2	2	3	-	3	3	-	-	2	-	-	-	-	1

OEC412	FOUNDATION OF ROBOTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- ❖ To comprehend how a robot's fundamental parts work.
- ❖ To examine how different Ends of Effector and sensors are used.
- ❖ To disseminate information on programming and robot kinematics.
- ❖ To learn about the economics, safety, and future of robots

UNIT I	FUNDAMENTALS OF ROBOT	9
Robot - Definition - Robot Anatomy - Coordinate Systems, Work Envelope Types, and Classification – Specifications - Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load - Robot Parts and their Functions - Need for Robots - Different Applications.		CO1
UNIT II	**SYSTEMS FOR ROBOT DRIVE AND ENDEFFECTORS**	**9**
Pneumatic Drives - Hydraulic Drives - Mechanical Drives - Electrical Drives - D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison - End effectors - Classification, Types of Mechanical actuation, Gripper design, Robot drive system Types, Position, and velocity feedback devices - Robot joints and links - Types, Motion interpolation.		CO2
UNIT III	**SENSORS AND MACHINE VISION**	**9**
Sensors in robots: Touch Sensors, Tactile Sensors, Proximity, and range sensors, Force sensor, Light sensors, Pressure sensors - Triangulation Principles Structured - Lighting Approach, Time of Flight, Camera, Frame Grabber, Sensing and Digitizing Image Data - Signal Conversion, Image Storage, Lighting Techniques, Image Processing, and Analysis - Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms, Applications Inspection, Identification, Visual Serving and Navigation.		CO3
UNIT IV	**KINEMATICS AND PROGRAMMING FOR ROBOTS**	**9**
Robot kinematics – Basics of direct and inverse kinematics, Robot trajectories, 2D and 3D Transformation - Scaling, Rotation, Translation Homogeneous transformation. Control of robot manipulators – Point-to-point, Continuous Path Control, Robot programming - Introduction to Artificial Intelligence.		CO4
UNIT V	**ROBOT APPLICATIONS AND ECONOMIC IMPLEMENTATION**	**9**
RGV, AGV, Industrial applications of robots, Medical, Household, Entertainment, Space, Underwater, Defense, and Disaster management. Applications, Micro and Nanorobots, Future Applications. - Robotics adoption in Industries - Safety Considerations for Robot Operations - Economic Analysis of Robots.		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Klafter R.D., Chmielewski T.A, and Negin M., "Robotic Engineering - An Integrated Approach", Prentice Hall, 2003.
2. Bruno Siciliano, Oussama Khatib, "Springer Handbook of Robotics", Springer, 2008.

REFERENCE BOOKS

1. Deb.S.R and Sankha Deb, "Robotics Technology and Flexible Automation", Tata McGraw Hill Publishing Company Limited, 2010.
2. Mikell P. Groover, Mitchell Weiss, Roger N Nagel, Nicholas G Odrey, "Industrial Robotics Technology, Programming and Applications", Tata –McGraw Hill Pub. Co., 2008.
3. Craig J.J., "Introduction to Robotics Mechanics and Control", Pearson Education, 2008.
4. Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill, 1995.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	List and describe the fundamental components of industrial robots.
CO2	Examine the kinematics and control strategies of the robot.
CO3	To improve performance, classify the numerous robot sensors.
CO4	Able to apply basic engineering knowledge for the design of robotics
CO5	To list the different commercial and noncommercial uses of robots.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	2	2	2	-	-	-	-	2	1	1	-
CO2	3	3	3	3	2	3	-	-	-	-	2	1	1	-
CO3	3	2	3	3	2	2	-	-	-	-	2	1	1	-
CO4	3	3	3	2	2	2	-	-	-	-	2	2	1	-
CO5	3	2	3	3	2	3	-	-	-	-	2	1	1	-

OIT411	FUNDAMENTALS OF DATABASE DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the role of database management system in an organization and learn the database concepts.
- To understand the design databases using data modelling and data normalization techniques.
- To construct database queries using relational algebra and calculus.
- To understand the concept of a database transaction and related database facilities.
- To learn the basic concepts of Transactions, concurrency control techniques, and recovery procedures

UNIT I	CONCEPTUAL MODELLING	9
Introduction database design -Database Environment, - Data Models: Entity Relationship Model, Relational Model- Database Development Lifecycle		CO1
UNIT II	**RELATIONAL MODELS**	**9**
Integrity Constraints- SQL Data Manipulation and Definition- Views- Relational Models- Hierarchical and Network		CO2
UNIT III	**INTRODUCTION TO SQL**	**9**
Introduction to Structured Query Language-DDL Commands-DML Commands-TCL Commands -views-Index-Synonyms- Sub queries- SQL Functions-Joins-PL/SQL–simple programs		CO3
UNIT IV	**RELATIONAL DATABASE DESIGN AND NORMALIZATION**	**9**
ER and EER to relationship Model-ER Diagrams- -Functional Dependencies-First, Second and Third Normal Forms-Dependency preservation		CO4
UNIT V	**TRANSACTION MANAGEMENT**	**9**
Transaction Concepts- Properties- Schedules- Serializability- Concurrency Control – Two phase locking techniques		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", McGraw-Hill, 4thEdition, 2002.

REFERENCE BOOKS

1. Ramez Elmasri, Shamkant B. Navathe, "Fundamental Database Systems", Pearson Education, 3rdEdition, 2003.
2. Raghu Ramakrishnan, "Database Management System", Tata McGraw-Hill Publishing Company, 3rd Edition, 2003.
3. Hector Garcia Molina, Jeffrey D. Ullman, Jennifer Widom, "Database System Implementation", Pearson Education, United States, 1st Edition, 2000.
4. Peter Rob, Corlos Coronel, "Database System, Design, Implementation and Management", Thompson Learning Course Technology, 5th Edition, 2003.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	The fundamentals of Database systems are vital components of modern information systems.
CO2	Understand the need for Databases and relational Model concepts.
CO3	Database applications all pervasive and range in size from small in-memory databases to terabytes or even larger in various applications domains.
CO4	The course focuses and the fundamentals of knowledgebase and relational database management systems, and the current developments in database theory and their practices.
CO5	Write Queries in SQL and execute multiple sub-queries, functions and joins.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	2	1	3	2	2	2	1	2	2	2	-	-
CO2	1	2	2	1	3	2	2	2	1	2	2	2	-	-
CO3	1	2	2	1	3	2	2	2	1	2	2	2	-	-
CO4	1	2	2	1	3	2	2	2	1	2	2	2	-	-
CO5	1	2	2	1	3	2	2	2	1	2	2	2	-	-

OMA426	RESOURCE MANAGEMENT TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

- ❖ Be familiar with resource management techniques.
- ❖ Learn to solve problems in linear programming and Integer programming.
- ❖ To understand the concept of non-linear programming.
- ❖ Be exposed to CPM and PERT.

UNIT I	LINEAR PROGRAMMING	9
Principal components of decision problem – Modeling phases – LP Formulation and graphic solution – Resource allocation problems – Simplex method – Sensitivity analysis.		CO1
UNIT II	**DUALITY AND NETWORKS**	**9**
Definition of dual problem – Primal – Dual relationships – Dual simplex methods – Post optimality analysis – Transportation and Assignment model - Shortest route problem.		CO2
UNIT III	**INTEGER PROGRAMMING**	**9**
Cutting plan algorithm – Branch and Bound methods, Multistage (Dynamic) Programming.		CO3
UNIT IV	**CLASSICAL OPTIMISATION THEORY**	**9**
Unconstrained external problems, Newton – Raphson method – Equality constraints – Jacobian methods – Lagrangian method – Kuhn – Tucker conditions – Simple problems.		CO4
UNIT V	**OBJECT SCHEDULING**	**9**
Network diagram representation – Critical path method – Time charts and resource leveling – PERT		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS:

1. H.A. Taha "Operation Research", Prentice Hall of India, 2002.
2. Paneer Selvam "Operations Research", Prentice Hall of India, 2002

REFERENCE BOOKS:

1. Anderson "Quantitative Methods for Business", 8th Edition, Thomson Learning, 2002.
2. Winston "Operation Research", Thomson Learning, 2003.
3. Vohra "Quantitative Techniques in Management", Tata Mc Graw Hill, 2002.
4. Anand Sarma "Operation Research", Himalaya Publishing House, 2003

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Solve optimization problems using simplex method.
CO2	Solve optimization problems using Duality concept, solve Transportation and assignment models.
CO3	Apply integer programming and linear programming to solve real-life applications.
CO4	Solving Unconstrained external problems.
CO5	Use PERT and CPM for problems in project management.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	2	1	-	-	-	1	1	1	-	3	2
CO2	2	2	2	1	1	-	-	-	1	1	-	1	2	2
CO3	2	3	2	1	1	-	-	-	2	2	-	-	1	-
CO4	2	2	2	2	1	-	-	-	1	1	1	1	2	3
CO5	2	1	2	1	1	-	-	-	2	1	1	-	3	3

OEE411	RENEWABLE ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To create awareness about renewable and non-renewable Energy Sources, technologies and its impact on the environment
- To learn wind energy conversion system and its issues with grid integration.
- To learn the concepts of solar PV and solar thermal systems.
- To understand the concept of tidal energy, hydrogen energy, ocean thermal energy and its significance.

UNIT – I	RENEWABLE ENERGY SOURCES	9
Conventional energy sources- Fossil Fuels, Types of fossil fuel, Environmental consequences of fossil fuel use, Non-Conventional energy sources- Renewable energy(RE) and its types, Significances of renewable energy sources, Sustainable Design and development, Effects and Limitations of RE sources.		CO1
UNIT – II	**WIND ENERGY**	**9**
Wind formation, Power in the Wind – WPP (wind power plant)- Components of WPPs -Types of Wind Power Plants (WPPs)– Working of WPPs- Siting of WPPs-Grid integration issues of WPPs.		CO2
UNIT - III	**SOLAR - THERMAL SYSTEMS AND PV SYSTEMS**	**9**
Solar Radiation, Radiation Measurement, Solar Thermal system and its types, Solar Photovoltaic systems (SPV) : Basic Principle of SPV conversion – Types of PV Systems- Types of Solar Cells, Photovoltaic cell concepts: Cell, module, array, I-V Characteristics, Efficiency & Quality of the Cell, series and parallel connections - Applications.		CO3
UNIT - IV	**BIOMASS, GEOTHERMAL AND HYDRO ENERGY SOURCES**	**9**
Introduction-Bio mass resources –Energy from Bio mass: conversion processes-Biomass Cogeneration-Environmental Benefits. Geothermal Energy: Basics, Direct Use, Geothermal Electricity. Mini/micro hydro power: Classification of hydropower schemes, Essential components of hydroelectric system.		CO4
UNIT - V	**OTHER ENERGY SOURCES**	**9**
Tidal Energy: Energy from the tides, Barrage and Non Barrage Tidal power systems. Wave Energy: Energy from waves, wave power devices. Hydrogen Production and Storage- Fuel cell : Principle of working- various types - construction and applications.		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Joshua Earnest, Tore Wizeliu, 'Wind Power Plants and Project Development', PHI Learning Pvt.Ltd, New Delhi, 2015.
2. D.P.Kothari, K.C Singal, Rakesh Ranjan "Renewable Energy Sources and Emerging Technologies", PHI Learning Pvt.Ltd, New Delhi, 2013.

REFERENCE BOOKS

1. A.K.Mukerjee and Nivedita Thakur," Photovoltaic Systems: Analysis and Design", PHI Learning Private Limited, New Delhi, 2011
2. Richard A. Dunlap," Sustainable Energy" Cengage Learning India Private Limited, Delhi, 2015.
3. Chetan Singh Solanki, " Solar Photovoltaics : Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2011
4. Bradley A. Striebig, AdebayoA.Ogundipe and Maria Papadakis," Engineering Applications in Sustainable Design and Development", Cengage Learning India Private Limited, Delhi, 2016.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Ability to create awareness about non- renewable and renewable Energy Sources and technologies
CO2	Acquire knowledge on the concepts of wind energy conversion system, siting and grid related issues.
CO3	Ability to understand the solar PV and solar thermal systems
CO4	Ability to analyze other types of renewable energy resources like biomass, geothermal and Hydro energy.
CO5	Ability to Acquire knowledge on tidal energy, hydrogen energy, ocean thermal energy and fuel cell.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	1	1	1	3	3	3	1	1	1	3	1	1
CO2	3	3	3	3	3	3	3	3	3	1	3	3	1	1
CO3	3	3	3	3	3	3	3	3	3	1	3	3	1	1
CO4	3	3	3	3	3	3	2	3	3	1	2	3	1	1
CO5	3	3	3	3	3	3	2	3	3	1	2	3	1	1

OMA411	GRAPH THEORY AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the basic notions of graphs and trees which will then be used to solve related problems.
- To introduce and apply the concepts of trees, connectivity and planarity.
- To understand the basic concepts of colouring in graph theory.
- To understand the basic concepts of permutations and combinations.
- To acquaint the knowledge of recurrence relations and generating function.

UNIT I	INTRODUCTION OF GRAPHS	9
Graphs – Introduction – Isomorphism – Sub graphs – Walks, Paths, Circuits –Connectedness – Components – Euler graphs – Hamiltonian paths and circuits – Trees – Properties of trees – Distance and centers in tree – Rooted and binary trees.		CO1
UNIT II	**TREES, CONNECTIVITY AND PLANARITY**	**9**
Spanning trees – Fundamental circuits – Spanning trees in a weighted graph – cut sets – Properties of cut set – All cut sets – Fundamental circuits and cut sets – Connectivity and separability – Network flows – 1-Isomorphism – 2-Isomorphism – Combinational and geometric graphs – Planer graphs – Different representation of a planer graph.		CO2
UNIT III	**MATRICES, COLOURING AND DIRECTED GRAPH**	**9**
Chromatic number – Chromatic partitioning – Chromatic polynomial – Matching – Covering – Four color problem – Directed graphs – Types of directed graphs – Digraphs and binary relations – Directed paths and connectedness – Euler graphs.		CO3
UNIT IV	**PERMUTATIONS AND COMBINATIONS**	**9**
Fundamental principles of counting - Permutations and combinations - Binomial theorem - combinations with repetition - Combinatorial numbers - Principle of inclusion and exclusion - Derangements - Arrangements with forbidden positions.		CO4
UNIT V	**GENERATING FUNCTIONS**	**9**
Generating functions - Partitions of integers - Exponential generating function – Summation operator - Recurrence relations - First order and second order – Non-homogeneous recurrence relations - Method of generating functions.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Narsingh Deo, "Graph Theory: With Application to Engineering and Computer Science", Prentice Hall of India, 2003.
2. Grimaldi R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", Addison Wesley, 1994.

REFERENCE BOOKS

1. Clark J. and Holton D.A, "A First Look at Graph Theory", Allied Publishers, 1995.
2. Mott J.L., Kandel A. and Baker T.P. "Discrete Mathematics for Computer Scientists and Mathematicians", Prentice Hall of India, 1996.
3. Liu C.L., "Elements of Discrete Mathematics", Mc Graw Hill, 1985.
4. Rosen K.H., "Discrete Mathematics and Its Applications", Mc Graw Hill, 2007.

COURSE OUTCOMES

Upon completion of the course, students should be able to

CO1	Write precise and accurate mathematical definitions of objects in graph theory.
CO2	Use mathematical definitions to identify and construct examples and to distinguish examples from non - examples.
CO3	Validate and critically assess a mathematical proof.
CO4	Use a combination of theoretical knowledge and independent mathematical thinking in creative investigation of questions in graph theory.
CO5	Reason from definitions to construct mathematical proofs.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	1	1	1	2	1	1	1	-	2	-
CO2	3	3	2	1	1	1	-	2	1	1	-	1	2	-
CO3	2	3	2	1	2	1	-	1	2	2	-	-	2	-
CO4	3	2	2	2	1	1	-	2	1	1	1	1	2	-
CO5	3	3	2	1	1	1	1	1	2	1	1	-	2	-

OAD432	DEEP LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic ideas and principles of neural networks.
- To understand the basic concepts of deep learning.
- To appreciate the use of deep learning applications.

UNIT I	BASICS OF NEURAL NETWORKS	9
Basic Concept of Neurons – Perceptron Algorithm – Feed Forward and Backpropagation Networks.		CO1
UNIT II	**INTRODUCTION TO DEEP LEARNING**	**9**
Deep Feed-Forward Neural Networks – Gradient Descent – Back-Propagation and Other Differentiation Algorithms – Vanishing Gradient Problem – Mitigation – Rectified Linear Unit (ReLU) – Heuristics for Avoiding B ad Local Minima – Heuristics for Faster Training – Nestors Accelerated Gradient Descent – Regularization for Deep Learning – Dropout – Adversial Training – Optimization for Training Deep Models.		CO2
UNIT III	**CONVOLUTIONAL NEURAL NETWORKS**	**9**
CNN Architectures – Convolution – Pooling Layers – Transfer Learning – Image Classification using Transfer Learning – Recurrent and Recursive Nets – Recurrent Neural Networks – Deep Recurrent Networks – Recursive Neural Networks – Applications.		CO3
UNIT IV	**UNSUPERVISED DEEP LEARNING**	**9**
Autoencoders – Standard – Sparse – Denoising – Contractive – Variational Autoencoders-Adversarial Generative Networks - Deep Boltzmann Machine (DBM).		CO4
UNIT V	**APPLICATIONS OF DEEP LEARNING**	**9**
Images segmentation – Object Detection – Multi class Object Detection - Object Classification and Localization- Automatic Image Captioning – Image generation with Generative adversarial networks– Opinion Mining using Recurrent Neural Networks – Parsing and Sentiment Analysis using Recursive Neural Networks – Sentence Classification using Convolutional Neural Networks – Dialogue Generation with LSTMs.		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Ian J. Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2017.
2. Francois Chollet, "Deep Learning with Python", Manning Publications, 2018

REFERENCE BOOKS

1. Phil Kim, "Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence", Apress, 2017.
2. Ragav Venkatesan, Baoxin Li, "Convolutional Neural Networks in Visual Computing", CRC Press, 2018.
3. Navin Kumar Manaswi, "Deep Learning with Applications Using Python", Apress, 2018.
4. Joshua F. Wiley, "R Deep Learning Essentials", Packt Publications, 2016.
5. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the role of deep learning in machine learning applications.
CO2	Design and implement deep learning applications.
CO3	Critically analyze different deep learning models in image related projects.
CO4	Design and implement convolutional neural networks.
CO5	Know about applications of deep learning in NLP and image processing.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	2	1	3	2	2	2	1	3	2	1	1	-
CO2	2	1	2	1	3	2	2	2	1	3	2	1	1	-
CO3	2	1	2	1	3	2	2	2	1	3	2	1	1	-
CO4	2	1	2	1	3	2	2	2	1	3	2	1	1	-
CO5	2	1	2	1	3	2	2	2	1	3	2	1	1	-

OEC411	IoT CONCEPTS AND APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To apprise students with basic knowledge of IoT that paves a platform to understand physical and logical design of IOT.
- To teach a student how to analyze requirements of various communication models and protocols for cost-effective design of IoT applications on different IoT platforms.
- To introduce the technologies for implementing Internet of Things (IoT).

UNIT I	INTRODUCTION TO INTERNET OF THINGS	9
Definition of IoT - Characteristics of IoT – Evolution of IoT– Study of IoT Enabling Technologies – Architecture of IoT based Systems – Fog, Applications of Cloud and Edge in IoT		CO1
UNIT II	**IoT COMPONENTS**	**9**
Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects - IoT levels and deployment templates. Study of Communication Modules – Wifi, Bluetooth, GSM. Zigbee.		CO2
UNIT III	**IoT PROTOCOLS**	**9**
IoT Access Technologies: Physical Layer of IoT and MAC layer concepts of IoT, Architecture, topology and Security of IEEE 802.15.4 Network Layer: IP versions, Optimizing IP for IoT: IPv6, 6LoWPAN, MQTT. Introductory concepts of cloud computing.		CO3
UNIT IV	**TOOLS FOR IoT IMPLEMENTATION**	**9**
Introduction to Python, Basic programming concepts of Python, Python development tools like Jupyter, Co-lab - Introduction to different IoT tools, Applications development through IoT tools, Sensor based application through embedded system platform-devlopment, Implementation of IoT techniques using Python.		CO4
UNIT V	**IoT BASED APPLICATIONS**	**9**
Various applications of IoT based in Home automations – Design of IoT in Smart cities – Implementing in Environment – Case study of IoT based system in Logistics – Agriculture – Industry - Health and life style .		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.Bruno Siciliano, Oussama Khatib, "Springer Handbook of Robotics", Springer, 2008.
2. Samuel Greengard, The Internet of Things, The MIT Press, 2015

REFERENCE BOOKS

1. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012
2. IOT (Internet of Things) Programming: A Simple and Fast Way of Learning, IOT Kindle Edition.
3. Dieter Uckelmann, Mark Harrison, Florian Michahelles, "Architecting the Internet of Things" Springer-Verlag Berlin Heidelberg, 2011.
4. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Explain the concept of IoT.
CO2	Analyze the networking and sensors communications with IoT Components
CO3	Understand the communication models and various protocols for IoT.
CO4	Analyze and design different models for IoT implementation.
CO5	Analyze applications of IoT in real time scenario.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	2	2	1	-	-	-	-	-	2	3	-	-
CO2	2	2	2	2	1	-	-	-	-	-	2	3	-	-
CO3	2	2	2	3	1	-	-	-	-	-	2	3	-	-
CO4	2	1	3	3	1	-	-	-	-	-	2	3	-	-
CO5	3	1	3	3	2	-	-	-	-	-	2	3	-	-

OAD422	DATA SCIENCE FUNDAMENTALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the role of data science in big data
- To understand the tables and graphs describing data with averages.
- To form the relationship for organizing correlation cooeficient for quantitative data.
- To understand the concept dependency preservation and ER diagrams
- To learn the basic concepts of visualization with MAT PLOT LIB

UNIT I	**DATA SCIENCE IN BIG DATA**	**9**
Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – Data preparation - Exploratory Data analysis – build the model– presenting findings and building applications.		**CO1**
UNIT II	**DESCRIBING DATA**	**9**
Types of Data - Types of Variables -Describing Data with Tables and Graphs –Describing Data with Averages - Describing Variability - Normal Distributions and Standard (z) Scores		**CO2**
UNIT III	**RELATIONSHIPS FOR ORGANIZING**	**9**
Correlation –Scatter plots –correlation coefficient for quantitative data –computational formula for correlation coefficient – Regression –regression line –least squares regression line – Standard error of estimate.		**CO3**
UNIT IV	**PYTHON MAGIC COMMANDS**	**9**
ER and EER to relationship Model-ER Diagrams- -Functional Dependencies-First, Second and Third Normal Forms-Dependency preservation		**CO4**
UNIT V	**VISUALIZATION WITH MAT PLOT LIB**	**9**
Importing Matplotlib – Line plots – Scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – three dimensional plotting - Visualization with Seaborn.		**CO5**
		TOTAL: 45 PERIODS

TEXTBOOKS

1. David Cielen, Arno D.B.Meysman, andMohamedAli, "IntroducingDataScience" Manning Publications, 2016. (Unit I)
2. Robert S.Witteand John S.Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017. (Units II and III)

REFERENCE BOOKS

1. Jake Vander Plas,"Python DataScience Handbook",O'Reilly,2016.(Units IVand V)

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Define the data science process
CO2	Understand different types of data description for data science process
CO3	Apply data processing methods for processing health care data.
CO4	Use the Python Libraries for Data Wrangling
CO5	Apply visualization Libraries in Python to interpret and explore data

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	3	2	2	1	2	2	2	1	1	1	2	-	-
CO2	1	3	2	2	1	2	2	2	1	1	1	2	-	-
CO3	1	3	2	2	1	2	2	2	1	1	1	2	-	-
CO4	1	3	2	2	1	2	2	2	1	1	1	2	-	-
CO5	1	3	2	2	1	2	2	2	1	1	1	2	-	-

OEE423	CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the use of transfer function models for analysis physical systems and introduce the control system components.
- To provide adequate knowledge in the time response of systems and steady state error analysis.
- To accord basic knowledge in obtaining the open loop and closed–loop frequency responses of systems.
- To introduce stability analysis and design of compensators
- To introduce state variable representation of physical systems

UNIT – I	SYSTEMS AND REPRESENTATION	9
Basic elements in control systems: – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function – AC and DC servomotors – Block diagram reduction techniques – Signal flow graphs.		CO1
UNIT – II	**TIME RESPONSE**	**9**
Time response: – Time domain specifications – Types of test input – I and II order system response – Error coefficients – Generalized error series – Steady state error – Effects of P, PI, PID modes of feedback control –Time response analysis.		CO2
UNIT – III	**FREQUENCY RESPONSE**	**9**
Frequency response: – Bode plot – Polar plot – Determination of closed loop response from open loop response - Correlation between frequency domain and time domain specifications		CO3
UNIT – IV	**STABILITY AND COMPENSATOR DESIGN**	**9**
Characteristics equation – Routh Hurwitz criterion – Nyquist stability criterion- Performance criteria – Effect of Lag, lead and lag-lead compensation on frequency response.		CO4
UNIT – V	**STATE VARIABLE ANALYSIS**	**9**
Concept of state variables – State models for linear and time invariant Systems – Solution of state and output equation in controllable canonical form – Concepts of controllability and observability.		CO5
	TOTAL PERIODS:	**45**

TEXT BOOKS:

1. Nagarath, I.J. and Gopal, M., "Control Systems Engineering", New Age International Publishers,2017.
2. Katsuhiko Ogata, "Modern Control Engineering", Pearson, 2015.

REFERENCE BOOKS:

1. Benjamin C. Kuo, "Automatic Control Systems", Wiley,2014.
2. Richard C.Dorf and Bishop, R.H., "Modern Control Systems", PearsonEducation,2009.
3. John J.D., Azzo Constantine, H. and Houpis Sttuart, N Sheldon, "Linear Control System Analysis and Design with MATLAB", CRC Taylor& Francis Reprint2009.
4. Rames C.Panda and T. Thyagarajan, "An Introduction to Process Modelling Identification and Control of Engineers", Narosa Publishing House,2017.
5. M.Gopal, "Control System: Principle and design", McGraw Hill Education,2012.
6. NPTEL Video Lecture Notes on "Control Engineering "by Prof. S. D. Agashe, IIT Bombay.

Course Outcomes (CO) Upon completion of the course, students will be able to:	
CO1	Ability to develop various representations of system and to reduce the complex systems into simpler system in transfer function.
CO2	Ability to do time domain analysis of various models of linear system and understand the use of controllers in closed loop system
CO3	Ability to do frequency domain analysis of various models of linear system
CO4	Infer the stability of systems and ability to design appropriate compensator for the given specifications
CO5	Ability to represent the system in state variable forms.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	2	2	1	2	2	3	2	-	-
CO2	3	3	3	3	3	2	2	1	2	2	3	2	-	-
CO3	3	3	3	3	3	2	2	1	2	2	3	2	-	-
CO4	3	3	3	3	3	2	2	1	2	2	3	2	-	-
CO5	3	3	3	3	3	2	2	1	2	2	3	2	-	-

OEE421	ELECTRIC AND HYBRID VEHICLE	L	T	P	C
		3	0	0	3

OBJECTIVES

- To provide knowledge of the operation and dynamics of electrical vehicles
- To impart knowledge on vehicle control for standard drive cycles of electrical vehicles (EVs)
- To estimate the energy requirement of EVs and Hybrid Electric Vehicles (HEVs)
- To provide knowledge about different energy sources and energy management in HEVs.
- To provide knowledge of supervisory control of EVs

UNIT - I	INTRODUCTION TO CONVENTIONAL AND ELECTRIC VEHICLES	9
Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics. Electric Vehicle: EV system- Series parallel architecture of Hybrid Electric Vehicles (HEV) - Plug-in Hybrid Electric Vehicles (PHEV)- Power train components and sizing, Gears, Clutches, Transmission and Brakes.		CO1
UNIT - II	**MECHANICS OF ELECTRIC VEHICLES**	**9**
Fundamentals of vehicle mechanics - tractive force, power and energy requirements for standard drive cycles of EV's - motor torque and power rating and battery capacity.		CO2
UNIT - III	**CONTROL OF DC AND AC MOTOR DRIVES**	**9**
Speed control for constant torque, constant HP operation of all electric motors - DC/DC chopper based four quadrant operation of DC motor drives, inverter based V/f Operation (motoring and braking) of induction motor drives, Construction and operation of PMSM, Brushless DC motor drives, Switched reluctance motor (SRM) drives.		CO3
UNIT - IV	**ENERGY STORAGE AND MANAGEMENT SYSTEMS**	**9**
Battery: Principle of operation, types, models, Estimation of SOC & SOH, Traction Batteries and their capacity for standard drive cycles. Alternate sources: Fuel cells, Ultra capacitors, Fly wheels.		CO4
UNIT - V	**HYBRID VEHICLE CONTROL STRATEGY**	**9**
HEV supervisory control - Selection of modes - power spilt mode - parallel mode - engine brake mode - regeneration mode - series parallel mode.		CO5
	TOTAL PERIODS:	**45**

TEXT BOOKS:

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
2. Iqbal Husain, "Electric and Hybrid vehicles: Design fundamentals", CRC PRESS, Boca Raton London, New York Washington, D.C,2005.

REFERENCE BOOKS:P

1. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.
3. Larminie, James and John Lowry, "Electric Vehicle Technology Explained" John Wiley and Sons, 2012.
4. Tariq Muneer and Irene Illescas García, "The automobile, In Electric Vehicles: Prospects and Challenges", Elsevier, 2017.

COURSE OUTCOMES (CO) Upon completion of the course, students will be able to	
CO1	Learned the significance of Electric Vehicle compared to conventional vehicles.
CO2	Understood the concept of mechanics of Electric Vehicles.
CO3	Acquired the knowledge in control of DC And AC motor drives.
CO4	Concepts related to battery technology and energy storage systems are analysed.
CO5	Acquired knowledge in control strategy for Hybrid Vehicle & Battery management systems for EV

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	3	1	3	2	2	3	3	2	1	3	2	1
CO2	3	2	3	3	3	2	2	3	3	2	1	2	2	1
CO3	3	3	3	3	2	2	2	3	2	2	2	3	2	1
CO4	3	2	3	3	3	3	3	3	3	3	2	3	2	1
CO5	3	2	2	2	3	3	3	3	3	3	2	3	2	1

OME423	ADDITIVE MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES

- ❖ Understand the need for rapid prototyping.
- ❖ Demonstrate the design tools for additive manufacturing
- ❖ Discuss the principle and operation of Photo polymerization and Powder Bed Fusion.
- ❖ Explain the working of extrusion and sheet lamination processes.
- ❖ Summarize the influence of concentrated beam on additive manufacturing

UNIT I	INTRODUCTION	9
Overview - Need - Development of Additive Manufacturing Technology -Principle – AM Process Chain-Classification – Rapid Prototyping- Rapid Tooling – Rapid Manufacturing – Applications - Benefits – Case studies.		CO1
UNIT II	**DESIGN FOR ADDITIVE MANUFACTURING**	**9**
Design tools: Data processing - CAD model preparation – Part orientation and support structure generation – Model slicing – Tool path generation- Design for Additive Manufacturing: Concepts and objectives - AM unique capabilities – DFAM for part quality improvement.		CO2
UNIT III	**PHOTOPOLYMERIZATION AND POWDER BED FUSION PROCESSES**	**9**
Photopolymerization: SLA-Photo curable materials – Process - Advantages and Applications. Powder Bed Fusion: SLS-Process description – powder fusion mechanism – Process Parameters – Typical Materials and Application. Electron Beam Melting.		CO3
UNIT IV	**EXTRUSION-BASED AND SHEET LAMINATION PROCESSES**	**9**
Extrusion Based System: FDM-Introduction – Basic Principle – Materials – Applications and Limitations – Bioextrusion. Sheet Lamination Process:LOM - Gluing or Adhesive bonding – Thermal bonding-.		CO4
UNIT V	**PRINTING PROCESSES AND BEAM DEPOSITION PROCESSES**	**9**
Droplet formation technologies – Continuous mode – Drop on Demand mode –Three Dimensional Printing – Advantages – Bio-plotter - Beam Deposition Process: LENS- Process description – Material delivery – Process parameters – Materials – Benefits – Applications		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1 Chua C.K., Leong K.F., and Lim C.S., **"**Rapid prototyping: Principles and applications**"**, Third edition, World Scientific Publishers, 2010.

2 Ian Gibson, David W.Rosen, Brent Stucker **"**Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing**"** Springer, 2010.

REFERENCE BOOKS

1 Andreas Gebhardt **"**Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing**"** Hanser Gardner Publication 2011.

2 Kamrani A.K. and Nasr E.A., **"**Rapid Prototyping: Theory and practice**"**, Springer, 2006.

3 Liou L.W. and Liou F.W., **"**Rapid Prototyping and Engineering applications :A tool box for prototype development**"**, CRC Press, 2007.

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Summarize the need for Additive manufacturing.
CO2	Explain the working of design tools in AM product making
CO3	Distinguish photo polymerization and PBF processes
CO4	Compare working benefits of extrusion and sheet lamination processes
CO5	Discuss the effect of drop/beam deposition in AM.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	2	-	-	2	3	1	1	-	-	1	3	1
CO2	3	-	2	-	-	2	3	1	1	-	-	1	3	1
CO3	3	-	2	-	-	2	2	1	1	-	-	1	3	1
CO4	3	-	2	-	-	2	2	1	1	-	-	1	3	1
CO5	3	-	2	-	2	2	2	1	1	-	-	1	3	1

OME427	REVERSE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To impart knowledge to the students about the need for and the various tools required for reverse engineering with exposure to the software needed for implementing reverse engineering.

UNIT I	**INTRODUCTION**	**5**
Scope and tasks of RE - Domain analysis- process of duplicating		**CO1**
UNIT II	**TOOLS FOR RE**	**8**
Functionality- dimensional- developing technical data - digitizing techniques - construction of surface model - solid-part material- characteristics evaluation - software and application-prototyping - verification		**CO2**
UNIT III	**CONCEPTS**	**12**
History of Reverse Engineering – Preserving and preparation for the four-stage process – Evaluation and Verification- Technical Data Generation, Data Verification, Project Implementation.		**CO3**
UNIT IV	**DATA MANAGEMENT**	**10**
Data reverse engineering – Three data Reverse engineering strategies – Definition – organization data issues - Software application – Finding reusable software components – Recycling real-time embedded software – Design experiments to evaluate a Reverse Engineering tool – Rule based detection for reverse Engineering user interfaces – Reverse Engineering of assembly programs: A model based approach and its logical basics		**CO4**
UNIT V	**INTEGRATION**	**10**
Cognitive approach to program understated – Integrating formal and structured methods in reverse engineering – Integrating reverse engineering, reuse and specification tool environments to reverse engineering -–coordinate measurement – feature capturing – surface and solid members		**CO5**
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Reverse Engineering, Linda Wills, Kluiver Academic Publishers, 1996 6. White paper on RE
2. Reverse Engineering, Katheryn, A. Ingle, McGraw-Hill, 1994 .

REFERENCE BOOKS

1. Co-ordinate Measurement and reverse engineering, Donald R. Honsa, ISBN 1555897, American Gear Manufacturers Association
2. Data Reverse Engineering, Aiken, Peter, McGraw-Hill, 1996
3. Design Recovery for Maintenance and Reuse, T J Biggerstaff, IEEE Corpn. July 1991
4. S. Rugaban, Technical Report, Georgia Inst. of Technology, 1994

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Understand the basic principles of reverse engineering
CO2	Select the suitable tools and methodology for reverse engineering any product
CO3	Generate Technical Data and verify
CO4	Manage the data with different tools
CO5	Integrate the reverse engineering

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	3	-	-	-	-	-	-	3	3	-	-
CO2	3	3	-	3	-	-	-	-	-	-	3	3	-	-
CO3	3	3	-	3	-	-	-	-	-	-	3	3	-	-
CO4	3	3	-	3	-	-	-	-	-	-	3	3	-	-
CO5	3	3	-	3	-	-	-	-	-	-	3	3	-	-

OMB413	DIGITAL MARKETING	L	T	P	C
		3	0	0	3

OBJECTIVES

- ❖ The primary objective of this module is to examine and explore the role and importance of digital marketing in today's rapidly changing business environment.
- ❖ It also focusses on how digital marketing can be utilised by organisations and how its effectiveness can measured.

UNIT I	INTRODUCTION TO DIGITAL MARKETING	9
Online Market space- Digital Marketing Strategy- Components -Opportunities for building Brand- Website - Planning and Creation- Content Marketing.		CO1
UNIT II	**SEARCH ENGINE OPTIMISATION**	**9**
Search Engine optimization - Keyword Strategy- SEO Strategy - SEO success factors -On-Page Techniques - Off-Page Techniques. Search Engine Marketing- How Search Engine works- SEM components- PPC advertising -Display Advertisement.		CO2
UNIT III	**E-MAIL MARKETING**	**9**
E- Mail Marketing - Types of E- Mail Marketing - Email Automation - Lead Generation – Integrating Email with Social Media and Mobile- Measuring and maximising email campaign effectiveness. Mobile Marketing- Mobile Inventory/channels- Location based; Context based; Coupons and offers, Mobile Apps, Mobile Commerce, SMS Campaigns-Profiling and targeting.		CO3
UNIT IV	**SOCIAL MEDIA MARKETING STRATEGIES**	**9**
Social Media Marketing - Social Media Channels- Leveraging Social media for brand conversations and buzz .Successful /benchmark Social media campaigns. Engagement Marketing- Building Customer relationships - Creating Loyalty drivers - Influencer Marketing.		CO4
UNIT V	**BRAND PERFORMANCE**	**9**
Digital Transformation & Channel Attribution- Analytics- Ad-words, Email, Mobile, Social Media, Web Analytics - Changing your strategy based on analysis- Recent trends in Digital marketing.		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1.Fundamentals of Digital Marketing by Puneet Singh Bhatia; Publisher: Pearson Education; First edition 2017.
2.Digital Marketing by Vandana Ahuja ;Publisher: Oxford University Press (April 2015)

REFERENCE BOOKS

1. Marketing 4.0: Moving from Traditional to Digital by Philip Kotler; Publisher: Wiley; 1st edition 2017
2. Ryan, D. (2014). Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation, Kogan Page Limited.
3. Pulizzi, J Beginner's Guide to Digital Marketing, Mcgraw Hill Education.
4. Barker, Barker, Bormann and Neher(2017), Social Media Marketing: A Strategic Approach, 2E South-Western, Cengage Learning.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1	To examine and explore the role and importance of digital marketing in today's rapidly changing business environment.
CO2	To focusses on how digital marketing can be utilised by organisations and how its effectiveness can measured.
CO3	To know the key elements of a digital marketing strategy
CO4	To study how the effectiveness of a digital marketing campaign can be measured
CO5	To demonstrate advanced practical skills in common digital marketing tools such as SEO, SEM, Social media and Blogs.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	1	3	3	1	1	2	1	3	1	-	2
CO2	-	-	-	1	3	1	1	2	1	1	1	1	-	2
CO3	-	-	-	2	1	1	2	1	3	1	1	2	-	2
CO4	-	-	-	2	3	3	2	1	1	1	3	2	-	2
CO5	-	-	-	1	2	2	2	3	1	1	2	2	-	2

OAD414	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide a strong foundation on fundamental concepts in Artificial Intelligence.
- To enable Problem-solving through various searching techniques.
- Introduce Machine Learning and supervised learning algorithms
- Study about ensembling and unsupervised learning algorithms
- To apply Artificial Intelligence techniques primarily for machine learning.

UNIT I	INTRODUCTION TO AI AND SEARCHING	9
Introduction to AI - AI Applications - Problem solving agents – search algorithms – uninformed search strategies – Heuristic search strategies: A* algorithm – Game Playing: Alpha Beta Pruning – constraint satisfaction problems (CSP).		CO1
UNIT II	**KNOWLEDGE REPRESENTATION**	**9**
Knowledge-based agents – propositional logic – propositional theorem proving – propositional model checking – agents based on propositional logic. First-order logic – forward chaining – backward chaining – resolution.		CO2
UNIT III	**SUPERVISED LEARNING**	**9**
Introduction to machine learning – Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier		CO3
UNIT IV	**ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING**	**9**
Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization		CO4
UNIT V	**INTELLIGENCE AND APPLICATIONS**	**9**
Natural language processing-Morphological Analysis-Syntax analysis -Semantic Analysis-Ail applications – Language Models - Information Retrieval – Information Extraction – Machine Translation – Machine Learning - Symbol-Based – Machine Learning: Connectionist – Machine Learning.		CO5
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Stuart Russell and Peter Norvig, “Artificial Intelligence – A Modern Approach”, Fourth Edition, Pearson Education, 2021.
2. Elaine Rich and Kevin Knight, ―Artificial Intelligence‖, Third Edition, Tata McGraw-Hill, 2010.
3. Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Fourth Edition, 2020.

REFERENCE BOOKS

1. Dan W. Patterson, “Introduction to Artificial Intelligence and Expert Systems”, Pearson Education,2007
2. Kevin Night, Elaine Rich, and Nair B., “Artificial Intelligence”, McGraw Hill, 2008
3. Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006
4. Deepak Khemani, “Artificial Intelligence”, Tata McGraw Hill Education, 2013
5. Christopher M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.
6. Tom Mitchell, “Machine Learning”, McGraw Hill, 3rd Edition,1997.
7. Charu C. Aggarwal, “Data Classification Algorithms and Applications”, CRC Press, 2014
8. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, “Foundations of Machine Learning”, MIT Press, 2012.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Use appropriate search algorithms for problem solving
CO2	Provide a basic exposition to the goals and methods of Artificial Intelligence.
CO3	Build supervised learning models
CO4	Build ensembling and unsupervised models
CO5	Improve problem solving skills using the acquired knowledge in the areas of natural language processing with machine learning.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	2	1	3	2	2	2	1	3	2	1	1	1
CO2	2	1	2	1	3	2	2	2	1	3	2	1	1	1
CO3	2	1	2	1	3	2	2	2	1	3	2	1	1	1
CO4	2	1	2	1	3	2	2	2	1	3	2	1	1	1
CO5	2	1	2	1	3	2	2	2	1	3	2	1	1	1

OCS422	MACHINE LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic concepts of machine learning and probability theory.
- To learn the supervised learning and their algorithms.
- To understand unsupervised learning like clustering.
- To understand the theoretical and practical aspects of probabilistic graphical models.
- To learn other learning aspects such as reinforcement learning, representation learning, deep learning, neural networks and other technologies.

UNIT I	**INTRODUCTION**	**9**
Machine Learning – Types of Machine Learning – Supervised Learning – Unsupervised Learning – Basic Concepts in Machine Learning – Machine Learning Process – Weight Space – Testing Machine Learning Algorithms – A Brief Review of Probability Theory –Turning Data into Probabilities – Candidate Elimination Algorithm		**CO1**
UNIT II	**SUPERVISED LEARNING**	**9**
Linear Models for Regression – Bayesian Linear Regression – Common Regression Algorithms – Simple Linear Regression – Multiple Linear Regression –Common Classification Algorithms – k-Nearest Neighbors – Decision Trees – Random Forest model – Support Vector Machines		**CO2**
UNIT III	**UNSUPERVISED LEARNING**	**9**
K-Means Clustering – Dirichlet Process Mixture Models – Spectral Clustering – Hierarchical Clustering – The Curse of Dimensionality – Dimensionality Reduction – Principal Component Analysis – Latent Variable Models (LVM) – Latent Dirichlet Allocation (LDA)		**CO3**
UNIT IV	**GRAPHICAL MODELS**	**9**
Bayesian Networks – Conditional Independence – Naive Bayes Classifiers – Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Random Fields – Hidden Markov Model.		**CO4**
UNIT V	**INTELLIGENCE AND APPLICATIONS**	**9**
Natural language processing-Morphological Analysis – Syntax analysis – Semantic Analysis –Ail applications – Language Models – Information Retrieval – Information Extraction – Machine Translation – Machine Learning - Symbol-Based – Machine Learning		**CO5**
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Ethem Alpaydin, "Introduction to Machine Learning," Third Edition, Prentice Hall of India, 2015.
2. Stephen Marsland, ―Machine Learning – An Algorithmic Perspective‖, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.

REFERENCE BOOKS

1. Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
2. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
3. Tom Mitchell, "Machine Learning", McGraw-Hill, 2017.
4. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", Second Edition, Springer, 2008.
5. Fabio Nelli, "Python Data Analytics with Pandas, Numpy, and Matplotlib", Second Edition, Apress, 2018.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Gain knowledge about basic concepts of machine learning techniques and terminology
CO2	Develop predictive model based on both input and output data using supervised algorithms
CO3	Ability to understand the unsupervised learning algorithm and dimensionality reduction techniques
CO4	Design systems that use the appropriate graphical models of machine learning
CO5	Improve problem solving skills using the acquired knowledge in the areas of natural language Processing with machine learning.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	3	3	2	1	-	-	-	-	-	-	1	-	-
CO2	2	3	3	2	2	-	-	-	-	-	-	1	-	-
CO3	2	3	3	2	3	-	-	-	-	-	-	1	-	-
CO4	2	3	3	2	3	-	-	-	-	-	-	1	-	-
CO5	2	2	3	2	1	-	-	-	-	-	-	1	-	-

OCS423	AUGMENTED AND VIRTUAL REALITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To gain the knowledge of historical and modern overviews and perspectives on virtual reality.
- To learn the fundamentals of sensation, perception, and perceptual training.
- To have the scientific, technical, and engineering aspects of augmented and virtual reality systems.
- To learn the evaluation of virtual reality from the lens of design.
- To learn the technology of augmented reality and implement it to have practical knowledge.

UNIT I	**INTRODUCTION**	**9**
Introduction to Augmented-Virtual and Mixed Reality, Taxonomy, technology and features of augmented reality, difference between AR, VR and MR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality.		**CO1**
UNIT II	**VR SYSTEMS**	**9**
VR as a discipline, Basic features of VR systems, Architecture of VR systems, VR hardware: VR input hardware: tracking systems, motion capture systems, data gloves, VR output hardware: visual displays, Methodology and terminology, user performance studies, VR health and safety issues, Usability of virtual reality system.		**CO2**
UNIT III	**STEREOSCOPIC VISION & HAPTIC RENDERING**	**9**
Fundamentals of the human visual system, Depth cues, Stereopsis, Retinal disparity, Haptic sense, Haptic devices, Algorithms for haptic rendering and parallax, Synthesis of stereo pairs.		**CO3**
UNIT IV	**VR DEVELOPMENT**	**9**
Challenges of VR in Mechanical development, Control Architectures, Rendering mechanical components, 3D interaction techniques: Manipulation Techniques and Input Devices, Interaction Techniques for 3D Manipulation,		**CO4**
UNIT V	**APPLICATIONS**	**9**
AR software, Camera parameters and camera calibration, Marker-based augmented reality, AR Toolkit, Medical, military & mechanical applications, Advanced Real time Tracking, other applications, games, movies, simulations, therapy, Understanding Meta, AR VR in Cyber Currency, Mechanics in VR, Matlab.		**CO5**
		TOTAL: 45 PERIODS

TEXTBOOKS

1. George Mather, Foundations of Sensation and Perception: Psychology Press; 2ndedition, 2009.
2. The VR Book: Human-Centered Design for Virtual Reality, by Jason Jerald
3. Learning Virtual Reality by Tony Parisi, O' Reilly
4. Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition.Wiley, IEEE Press, 2003/2006.
5. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.

REFERENCE BOOKS

1. Steven M. LaValle, "Virtual Reality", Cambridge University Press, 2016
2. Alan Craig, William Sherman and Jeffrey Will, Developing Virtual Reality Applications, Foundations of Effective Design, Morgan Kaufmann, 2009.
3. Schmalstieg / Hollerer, "Augmented Reality: Principles & Practice", Pearson Education India; First edition(12 October 2016),ISBN-10: 9332578494

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Identify, examine, and develop software that reflects fundamental techniques for the design and deployment of VR and AR experiences.
CO2	Describe how VR and AR systems work.
CO3	Choose, develop, explain, and defend the use of particular designs for AR and VR experiences.
CO4	Evaluate the benefits and drawbacks of specific AR and VR techniques on the human body.
CO5	Identify and examine state-of-the-art AR and VR design problems and solutions from the industry and academia.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	1	2	1	-	-	-	-	-	-	-	-	-	-
CO2	1	2	2	-	2	-	-	-	-	-	-	1	-	-
CO3	1	2	2	-	-	-	-	-	-	-	-	2	-	-
CO4	1	2	2	-	2	-	-	-	-	-	-	1	-	-
CO5	1	2	2	2	3	-	-	-	-	-	-	2	-	-

OME416	TESTING OF MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the various destructive and non-destructive testing methods of materials and its industrial applications.

UNIT I	**INTRODUCTION TO MATERIALS TESTING**	**9**
Overview of materials, Classification of material testing, Purpose of testing, Selection of material, Development of testing, Testing organizations and its committee, Testing standards, Result Analysis, Advantages of testing		**CO1**
UNIT II	**MECHANICAL TESTING**	**9**
Introduction to mechanical testing, Hardness test (Vickers, Brinell, Rockwell), Tensile test, Impact test (Izod, Charpy) - Principles, Techniques, Methods, Advantages and Limitations, Applications. Bend test, Shear test, Creep and Fatigue test - Principles, Techniques, Methods, Advantages and Limitations, Applications.		**CO2**
UNIT III	**NON DESTRUCTIVE TESTING**	**9**
Visual inspection, Liquid penetrant test, Magnetic particle test, Thermography test – Principles, Techniques, Advantages and Limitations, Applications. Radiographic test, Eddy current test, Ultrasonic test, Acoustic emission- Principles, Techniques, Methods, Advantages and Limitations, Applications.		**CO3**
UNIT IV	**MATERIAL CHARACTERIZATION TESTING**	**9**
Macroscopic and Microscopic observations, Optical and Electron microscopy (SEM and TEM) - Principles, Types, Advantages and Limitations, Applications. Diffraction techniques, Spectroscopic Techniques, Electrical and Magnetic Techniques- Principles, Types, Advantages and Limitations, Applications.		**CO4**
UNIT V	**OTHER TESTING**	**9**
Thermal Testing: Differential scanning calorimetry, Differential thermal analysis. Thermo- mechanical and Dynamic mechanical analysis: Principles, Advantages, Applications. Chemical Testing: X-Ray Fluorescence, Elemental Analysis by Inductively Coupled Plasma-Optical Emission Spectroscopy and Plasma-Mass Spectrometry.		**CO5**
		TOTAL: 45 PERIODS

TEXTBOOKS

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2009.
2. Cullity, B. D., "Elements of X-ray diffraction", 3rd Edition, Addison-Wesley Company Inc., New York, 2000.
3. P. Field Foster, "The Mechanical Testing of Metals and Alloys" 7th Edition, Cousens Press, 2007.

REFERENCE BOOKS

1. Metals Handbook: Mechanical testing, (Volume 8) ASM Handbook Committee, 9th Edition, American Society for Metals, 1978.
2. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA.
3. Brandon D.G., "Modern Techniques in Metallography", Von Nostrand Inc. NJ, USA, 1986.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Explain the role of testing organization and select the appropriate testing standards for materials.
CO2	Identify the suitable destructive testing method to inspect industrial components.
CO3	Select the appropriate Non-Destructive testing method to assess the quality of industrial components.
CO4	Illustrate the Material characterization testing methods and able to analyse the tested results.
CO5	Demonstrate the various thermal and chemical testing methods of materials.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	3	-	-	-	-	-	-	3	3	-	-
CO2	3	3	-	3	-	-	-	-	-	-	3	3	-	-
CO3	3	3	-	3	-	-	-	-	-	-	3	3	-	-
CO4	3	3	-	3	-	-	-	-	-	-	3	3	-	-
CO5	3	3	-	3	-	-	-	-	-	-	3	3	-	-