ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

REGULATIONS – 2019

CHOICE BASED CREDIT SYSTEM

B.E. MANUFACTURING ENGINEERING

THE VISION OF THE DEPARTMENT OF MANUFACTURING ENGINEERING:

To be outstanding institute where students can gain acumen and to brew them so that they unswervingly meet the needs of the society.

THE MISSION OF THE DEPARTMENT OF MANUFACTURING ENGINEERING:

- To foster the growth of its members and develop them in new vistas promoting them to their fullest cognition.
- To be nationally recognized as the leader of Manufacturing Engineering in education and research.
- Bring augmentation to the Department, College and University.
- Discern the potential of its members.
- Have its members vivaciously conscripted nationally by employers and graduate programs.
- To evoke new ideas in the minds of its members and infuse nascent technology to modern era of manufacturing.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

To qualify as Manufacturing Engineering Graduates, the candidates are expected to meet the following Program Educational Objectives (PEOs) within 5 years after graduation:

I. To be employed in jobs related manufacturing sectors at National and Global levels.
II. To be engaged in life-long learning, certification from professional organizations and active participation in professional societies/activities.
III. To be successful in their carrier and take up leadership role in their professional life.
IV. To become an experts and provide solutions to the industrial problems in the manufacturing sectors.
V. Become an entrepreneur/ startups and to establish an industry to provide job to others.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

PROGRAMME OUTCOMES (POs):

The Programme Outcomes (POs) of the Manufacturing Engineering graduates are given below:

PO	Graduate Attribute	Programme Outcome
1	Engineering knowledge	Engineering/Fundamental knowledge in mathematics, engineering, sciences, computer science, humanities, and social science
2	Problem analysis	Identify, formulate and solve industrial problems with the knowledge gained.
3	Design/development of solutions	Design a component or system and provide solutions by understanding its current status to improve its performance and satisfying its constraints.
4	Conduct investigations of complex problems	Conduct experimentation and collect, analyze as well as interpret the data in a systematic way.
5	Modern tool usage	Ability to apply various modern tools and techniques to improve the efficiency of the system.
6	The Engineer and society	Conduct themselves to uphold the professional and social obligations.
7	Environment and sustainability	Design and develop the systems with environment consciousness and sustainable manufacturing.
8	Ethics	Behave and practice ethically in the professional carrier.
9	Individual and team work	Demonstrate leadership skills and also be able to function as a team player.
10	Communication	Communicate professionally in both oral and written forms.
11	Project management and finance	Ability to manage through effective economic planning and control.
12	Life-long learning	Creating interest in the lifelong learning attitude.

PROGRAM SPECIFIC OUTCOMES (PSOs):

On successful completion of Manufacturing Engineering degree program, the graduate shall have the following Program Specific Outcomes (PSOs).

1. Ability to apply the knowledge gained in the fundamentals of manufacturing engineering in a systematic manner with ethics and sustainability.
2. Ability to understand, devise methodologies to solve problems and come out with best possible solutions in manufacturing engineering as an individual and as a team.
3. Ability to apply fundamental aspects of manufacturing engineering to innovate and to create new products and processes with sustainable manufacturing.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

PEO / PO MAPPING:

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
I	✓	✓	✓	✓								
II					✓	✓	✓	✓	✓	✓	✓	✓
III			✓	✓		✓			✓		✓	
IV		✓	✓	✓	✓				✓	✓	✓	
V						✓	✓	✓	✓	✓	✓	✓

MAPPING OF COURSE OUTCOME AND PROGRAMME OUTCOME

		Course Name	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12
YEAR 1	Semester 1	Technical English												
		Engineering Mathematics - I												
		Engineering Physics												
		Engineering Chemistry												
		Engineering Graphics	✓		✓		✓					✓		✓
		Basic Sciences Laboratory												
		Workshop Practices Laboratory	✓	✓	✓	✓								
	Semester 2	Engineering Mathematics - II												
		Problem Solving and Python Programming	✓	✓	✓	✓	✓			✓	✓			✓
		Basics of Electrical and Electronics Engineering	✓	✓	✓	✓	✓							
		Engineering Mechanics	✓		✓									
		Professional Communication												
		Problem Solving and Python Programming Laboratory	✓	✓	✓	✓	✓			✓	✓			✓
		Electrical and Electronics Engineering Laboratory	✓	✓	✓	✓					✓		✓	
YEAR 2	Semester 3	Transform Techniques and Partial Differential Equations												
		Mechanics of Materials												
		Computer Aided Design												
		Machining Technology	✓	✓	✓	✓	✓	✓				✓		
		Thermodynamics	✓	✓	✓	✓	✓	✓				✓		
		Computer Aided Machine Drawing	✓	✓	✓	✓	✓	✓						
		Manufacturing Technology Laboratory	✓	✓	✓	✓	✓	✓						
	Semester 4	Environmental Sciences						✓	✓	✓				
		Fluid Mechanics and Machinery	✓	✓	✓	✓	✓	✓						
		Mechanics of Machines	✓	✓	✓	✓	✓	✓						
		Casting and Welding Technology	✓	✓	✓	✓	✓	✓						
		Engineering Materials and Metallurgy	✓	✓	✓	✓	✓	✓						
		Metallurgy Laboratory	✓	✓	✓	✓	✓	✓						
		Strength of Materials and Fluid Machinery Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

		Course Name	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12
		Total Quality Management	✓			✓	✓	✓			✓			
YEAR 3	Semester 5	Metrology and Computer Aided Inspection	✓	✓	✓	✓	✓	✓						
		Metal and Powder Forming	✓	✓	✓	✓	✓	✓						
		Machine Design	✓	✓	✓	✓	✓	✓				✓		
		Dynamics Laboratory	✓	✓	✓	✓	✓	✓						
		Metrology Laboratory	✓	✓	✓	✓	✓	✓				✓		
		Professional Elective - I												
		*Industrial Training /Internship	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
YEAR 4	Semester 6	Non - Traditional Machining Processes	✓	✓	✓	✓	✓	✓						✓
		Additive Manufacturing	✓	✓	✓	✓	✓	✓						✓
		CNC Machine Tools	✓	✓	✓	✓	✓	✓						✓
		Professional Elective - II												
		Professional Elective - III												
		Open Elective - I												
		Computer Aided Manufacturing and Engineering	✓	✓	✓	✓	✓	✓						✓
		Advanced Manufacturing Laboratory	✓	✓	✓	✓	✓	✓						✓
	Semester 7	Manufacturing Management Systems		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Mechatronics	✓	✓	✓	✓	✓	✓						
		Hydraulics and Pneumatics	✓	✓	✓	✓	✓	✓						
		Professional Elective - IV												
		Professional Elective - V												
		Open Elective - II												
		Mechatronics Laboratory	✓	✓	✓	✓	✓	✓						
		Project I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Semester 8	Professional Elective - VI												
		Professional Elective - VII												
		Project II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

PROGRESS THROUGH KNOWLEDGE

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

B.E. MANUFACTURING ENGINEERING

REGULATIONS – 2019

CHOICE BASED CREDIT SYSTEM

CURRICULA AND SYLLABI FOR I TO VIII SEMESTERS

SEMESTER I

Sl. No.	Course Code	Course Title	Cate Gory	Periods per week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1.	HS5151	Technical English	HSMC	4	0	0	4	4
2.	MA5158	Engineering Mathematics - I	BSC	3	1	0	4	4
3.	PH5151	Engineering Physics	BSC	3	0	0	3	3
4.	CY5151	Engineering Chemistry	BSC	3	0	0	3	3
5.	GE5151	Engineering Graphics	ESC	1	0	4	5	3
PRACTICALS								
6.	BS5161	Basic Sciences Laboratory	BSC	0	0	4	4	2
7.	GE5162	Workshop Practices Laboratory	ESC	0	0	4	4	2
			TOTAL	**14**	**1**	**12**	**27**	**21**

SEMESTER II

Sl. No.	Course Code	Course Title	Cate Gory	Periods per week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1.	HS5251	Professional Communication	HSMC	4	0	0	4	4
2.	MA5252	Engineering Mathematics - II	BSC	3	1	0	4	4
3.	GE5153	Problem Solving and Python Programming	ESC	3	0	0	3	3
4.	EE5251	Basics of Electrical and Electronics Engineering	ESC	3	0	0	3	3
5.	GE5152	Engineering Mechanics	ESC	3	1	0	4	4
PRACTICALS								
6.	GE5161	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
7.	EE5261	Electrical and Electronics Engineering Laboratory	ESC	0	0	4	4	2
			TOTAL	**16**	**2**	**8**	**26**	**22**

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

SEMESTER III

Sl. No.	Course Code	Course Title	Cate Gory	Periods per week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1.		Elective – Humanities I	HSMC	3	0	0	3	3
2.	MA5355	Transform Techniques and Partial Differential Equations	BSC	3	1	0	4	4
3.	ML5352	Mechanics of Materials	ESC	3	0	0	3	3
4.	ME5351	Computer Aided Design	PCC	3	0	0	3	3
5.	MF5301	Machining Technology	PCC	3	0	0	3	3
6.	MF5351	Thermodynamics	PCC	3	0	0	3	3
PRACTICALS								
7.	ME5361	Computer Aided Machine Drawing	PCC	0	0	4	4	2
8.	ME5461	Manufacturing Technology Laboratory	PCC	0	0	4	4	2
			TOTAL	**18**	**1**	**8**	**27**	**23**

SEMESTER IV

Sl. No.	Course Code	Course Title	Cate Gory	Periods per week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1.		Elective – Humanities II	HSMC	3	0	0	3	3
2.	GE5251	Environmental Sciences	BSC	3	0	0	3	3
3.	CE5251	Fluid Mechanics and Machinery	ESC	3	0	0	3	3
4.	ME5452	Mechanics of Machines	PCC	3	0	0	3	3
5.	MF5401	Casting and Welding Technology	PCC	3	0	0	3	3
6.	ML5351	Engineering Materials and Metallurgy	PCC	3	0	0	3	3
7.		Audit Course – I*	AC	3	0	0	3	0
PRACTICALS								
8.	MF5411	Metallurgy Laboratory	PCC	0	0	2	2	1
9.	CE5361	Strength of Materials and Fluid Machinery Laboratory	ESC	0	0	4	4	2
			TOTAL	**21**	**0**	**6**	**27**	**21**

*Audit course is optional.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

SEMESTER V

Sl. No.	Course Code	Course Title	Cate Gory	Periods per week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1.	GE5451	Total Quality Management	HSMC	3	0	0	3	3
2.	MF5501	Metrology and Computer Aided Inspection	PCC	3	0	0	3	3
3.	MF5502	Metal and Powder Forming	PCC	3	0	0	3	3
4.	ME5553	Machine Design	PCC	3	1	0	4	4
5.		Professional Elective - I	PEC	3	0	0	3	3
6.		Audit Course – II*	AC	3	0	0	3	0
PRACTICALS								
7.	ME5514	Dynamics Laboratory	PCC	0	0	4	4	2
8.	MF5511	Metrology Laboratory	PCC	0	0	4	4	2
9.	MF5512	*Industrial Training /Internship	EEC	0	0	4	4	2
			TOTAL	**18**	**1**	**12**	**31**	**22**

*Audit Course is optional.

* Students will have to undergo industrial training / Internship during previous vacation period.

SEMESTER VI

Sl. No.	Course Code	Course Title	Cate Gory	Periods per week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1.	MF5651	Non - Traditional Machining Processes	PCC	3	0	0	3	3
2.	MF5652	Additive Manufacturing	PCC	3	0	0	3	3
3.	MF5601	CNC Machine Tools	PCC	3	0	0	3	3
4.		Professional Elective - II	PEC	3	0	0	3	3
5.		Professional Elective - III	PEC	3	0	0	3	3
6.		Open Elective - I	OEC	3	0	0	3	3
PRACTICALS								
7.	MF5611	Computer Aided Manufacturing and Engineering Laboratory	PCC	0	0	4	4	2
8.	MF5612	Advanced Manufacturing Laboratory	PCC	0	0	4	4	2
			TOTAL	**18**	**0**	**8**	**26**	**22**

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

SEMESTER VII

Sl. No.	Course Code	Course Title	Cate Gory	Periods per week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1.	MF5701	Manufacturing Management Systems	PCC	3	0	0	3	3
2.	ME5752	Mechatronics	PCC	3	0	0	3	3
3.	ME5451	Hydraulics and Pneumatics	PCC	3	0	0	3	3
4.		Professional Elective - IV	PEC	3	0	0	3	3
5.		Professional Elective - V	PEC	3	0	0	3	3
6.		Open Elective - II	OEC	3	0	0	3	3
PRACTICALS								
7.	ME5761	Mechatronics Laboratory	PCC	0	0	4	4	2
8.	MF5711	Project I	EEC	0	0	6	6	3
			TOTAL	**18**	**0**	**10**	**28**	**23**

SEMESTER VIII

Sl. No.	Course Code	Course Title	Cate Gory	Periods per week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1.		Professional Elective -VI	PEC	3	0	0	3	3
2.		Professional Elective -VII	PEC	3	0	0	3	3
PRACTICALS								
3.	MF5811	Project II	EEC	0	0	16	16	8
			TOTAL	**6**	**0**	**16**	**22**	**14**

TOTAL CREDIT: 168 CREDITS

PROGRESS THROUGH KNOWLEDGE

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

HUMANITIES AND SOCIAL SCIENCES (HSMC) – MANAGEMENT AND OTHERS

Sl. No.	Course Code	Course Title	Periods per week			Credits	Semester
			L	T	P		
1.	HS5151	Technical English	4	0	0	4	1
2.	HS5251	Professional Communication	4	0	0	4	2
3.	GE5451	Total Quality Management	3	0	0	3	5

HSMC– ELECTIVES – HUMANITIES I (ODD SEMESTER)

Sl. No	Course Code	Course Title	Periods per week			Credits
			Lecture	Tutorial	Practical	
1.	HU5171	Language and Communication	3	0	0	3
2.	HU5172	Values and Ethics	3	0	0	3
3.	HU5173	Human Relations at Work	3	0	0	3
4.	HU5174	Psychological Processes	3	0	0	3
5.	HU5175	Education, Technology and Society	3	0	0	3
6.	HU5176	Philosophy	3	0	0	3
7.	HU5177	Applications of Psychology in Everyday Life	3	0	0	3

HSMC– ELECTIVES – HUMANITIES II (EVEN SEMESTER)

Sl. No	Course Code	Course Title	Periods per week			Credits
			Lecture	Tutorial	Practical	
1.	HU5271	Gender Culture and Development	3	0	0	3
2.	HU5272	Ethics and Holistic Life	3	0	0	3
3.	HU5273	Law and Engineering	3	0	0	3
4.	HU5274	Film Appreciation	3	0	0	3
5.	HU5275	Fundamentals of Language and Linguistics	3	0	0	3
6.	HU5276	Understanding Society and Culture through Literature	3	0	0	3

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

BASIC SCIENCE COURSE (BSC)

Sl. No.	Course Code	Course Title	Periods per week			Credits	Semester
			L	T	P		
1.	MA5158	Engineering Mathematics - I	3	1	0	4	1
2.	PH5151	Engineering Physics	3	0	0	3	1
3.	CY5151	Engineering Chemistry	3	0	0	3	1
4.	BS5161	Basic Sciences Laboratory	0	0	4	2	1
5.	MA5252	Engineering Mathematics - II	3	1	0	4	2
6.	MA5355	Transform Techniques and Partial Differential Equations	3	1	0	4	3
7.	GE5251	Environmental Sciences	3	0	0	3	4

ENGINEERING SCIENCE COURSE (ESC)

Sl. No.	Course Code	Course Title	Periods per week			Credits	Semester
			L	T	P		
1.	GE5151	Engineering Graphics	1	0	4	3	1
2.	GE5162	Workshop Practices Laboratory	0	0	4	2	1
3.	GE5153	Problem Solving and Python Programming	3	0	0	3	2
4.	EE5251	Basics of Electrical and Electronics Engineering	3	0	0	3	2
5.	GE5152	Engineering Mechanics	3	1	0	4	2
6.	GE5161	Problem Solving and Python Programming Laboratory	0	0	4	2	2
7.	EE5261	Electrical and Electronics Engineering Laboratory	0	0	4	2	2
8.	CE5361	Strength of Materials and Fluid Machinery Laboratory	0	0	4	2	4
9.	CE5251	Fluid Mechanics and Machinery	3	0	0	3	4
10.	ML5352	Mechanics of Materials	3	0	0	3	3

PROFESSIONAL CORE COURSES (PCC)

Sl. No	Course Code	Course Title	Periods per week			Credits	Semester
			L	T	P		
1.	MF5301	Machining Technology	3	0	0	3	3
2.	ME5452	Mechanics of Machines	3	0	0	3	3
3.	ME5553	Machine Design	3	1	0	4	4
4.	MF5351	Thermodynamics	3	0	0	3	3
5.	MF5401	Casting and Welding Technology	3	0	0	3	4
6.	ME5514	Dynamics Laboratory	0	0	4	2	3
7.	ME5461	Manufacturing Technology Laboratory	0	0	4	2	3

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

8.	MF5501	Metrology and Computer Aided Inspection	3	0	0	3	5
9.	ML5351	Engineering Materials and Metallurgy	3	0	0	3	4
10.	ME5351	Computer Aided Design	3	0	0	3	5
11.	ME5361	Computer Aided Machine Drawing	0	0	4	2	5
12.	MF5511	Metrology Laboratory	0	0	4	2	5
13.	MF5411	Metallurgy Laboratory	0	0	2	1	4
14.	MF5652	Additive Manufacturing	3	0	0	3	6
15.	MF5502	Metal and Powder Forming	3	0	0	3	5
16.	MF5601	CNC Machine Tools	3	0	0	3	6
17.	MF5611	Computer Aided Manufacturing and Engineering Laboratory	0	0	4	2	6
18.	MF5612	Advanced Manufacturing Laboratory	0	0	4	2	6
19.	MF5651	Non - Traditional Machining Processes	3	0	0	3	6
20.	MF5701	Manufacturing Management Systems	3	0	0	3	7
21.	ME5752	Mechatronics	3	0	0	3	7
22.	ME5451	Hydraulics and Pneumatics	3	0	0	3	7
23.	ME5761	Mechatronics Laboratory	0	0	4	2	7

PROFESSIONAL ELECTIVE COURSES

SEMESTER V, ELECTIVE I

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MF5071	Processing of Plastics	PEC	3	0	0	3	3
2.	PR5072	Production of Automotive Components	PEC	3	0	0	3	3
3.	ME5071	Automobile Engineering	PEC	3	0	0	3	3
4.	ME5074	Design of Jigs, Fixtures and Press Tools	PEC	3	0	0	3	3
5.	PR5071	Processing of Plastics and Polymers	PEC	3	0	0	3	3
6.	GE5076	Professional Ethics in Engineering	PEC	3	0	0	3	3

SEMESTER VI, ELECTIVE II

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MF5001	Non Destructive Testing: Theory and Practice	PEC	3	0	0	3	3
2.	MF5002	Industrial Robotics	PEC	3	0	0	3	3
3.	IE5551	Engineering Quality Control	PEC	3	0	0	3	3
4.	IE5653	Reliability Engineering	PEC	3	0	0	3	3
5.	ME5081	Process Planning and Cost Estimation	PEC	3	0	0	3	3
6.	GE5552	Engineering Management	PEC	3	0	0	3	3

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

SEMESTER VI, ELECTIVE III

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MF5003	Precision Engineering	PEC	3	0	0	3	3
2.	MF5004	System Simulation	PEC	3	0	0	3	3
3.	ME5073	Design for Manufacturing	PEC	3	0	0	3	3
4.	ME5083	Product Life Cycle Management	PEC	3	0	0	3	3
5.	ME5082	Product Design and Development	PEC	3	0	0	3	3

SEMESTER VII, ELECTIVE IV

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MF5072	Sustainable Manufacturing	PEC	3	0	0	3	3
2.	MF5005	Electronics Manufacturing Technology	PEC	3	0	0	3	3
3.	IE5073	Lean Six Sigma	PEC	3	0	0	3	3
4.	ME5079	New and Renewable Sources of Energy	PEC	3	0	0	3	3
5.	ME5078	MEMS and Microsystems	PEC	3	0	0	3	3

SEMESTER VII, ELECTIVE V

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MF5006	Industrial Inspection Maintenance and Safety	PEC	3	0	0	3	3
2.	MF5007	Total Productive Maintenance	PEC	3	0	0	3	3
3.	ME5077	Measurements and Controls	PEC	3	0	0	3	3
4.	ME5076	Marketing Management	PEC	3	0	0	3	3
5.	ME5751	Finite Element Analysis	PEC	3	0	0	3	3

SEMESTER VIII, ELECTIVE VI

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MF5008	Flexible Manufacturing Systems	PEC	3	0	0	3	3
2.	IE5552	Operations Research	PEC	3	0	0	3	3
3.	IE5651	Manufacturing Automation	PEC	3	0	0	3	3
4.	PR5074	Materials Procurement Management	PEC	3	0	0	3	3
5.	IE5072	Enterprise Resource Planning	PEC	3	0	0	3	3

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

SEMESTER VIII, ELECTIVE VII

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MF5009	Digital Twin Driven Smart Manufacturing	PEC	3	0	0	3	3
2.	ME5075	Entrepreneurship Development	PEC	3	0	0	3	3
3.	IE5074	Machine Learning Algorithms	PEC	3	0	0	3	3
4.	IE5075	Principles of Computer Integrated Manufacturing Systems	PEC	3	0	0	3	3
5.	IE5071	Decision Support and Intelligent Systems	PEC	3	0	0	3	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl.No	Code No.	Course Title	Periods per week			Total Contact Periods	Credits
			L	T	P		
1.	MF5512	Industrial Training / Internship	0	0	4	4	2
2.	MF5711	Project I	0	0	6	6	3
3.	MF5811	Project II	0	0	16	16	8

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

Sl. No	Course Code	Course Title	Periods per week			Total Contact Periods	Credits
			L	T	P		
1.	AD5091	Constitution of India	3	0	0	3	0
2.	AD5092	Value Education	3	0	0	3	0
3.	AD5093	Pedagogy Studies	3	0	0	3	0
4.	AD5094	Stress Management by Yoga	3	0	0	3	0
5.	AD5095	Personality Development Through Life Enlightenment Skills	3	0	0	3	0
6.	AD5096	Unnat Bharat Abhiyan	3	0	0	3	0
7.	AD5097	Essence of Indian Knowledge Tradition	3	0	0	3	0
8.	AD5098	Sanga Tamil Literature Appreciation	3	0	0	3	0

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

HS5151 **TECHNICAL ENGLISH** **L T P C**
4 0 0 4

COURSE OBJECTIVES:

The first semester English course entitled 'Technical English' aims to,

- Familiarise first year students of engineering and technology with the fundamental aspects of technical English.
- Develop all the four language skills by giving sufficient practice in the use of the skills in real life contexts.
- Enhance the linguistic and communicative competence of first year engineering and technology students.

UNIT I INTRODUCING ONESELF **12**

Listening: Listening and filling a form, listening to speeches by specialists from various branches of engineering and completing activities such as answering questions, identifying the main ideas of the listening text, style of the speaker (tone and tenor) – **Speaking**: Introducing oneself – introducing friend/ family - **Reading:** Descriptive passages (from newspapers / magazines)- **Writing**: Writing a paragraph (native place, school life)- **Grammar:** Simple present, present continuous – **Vocabulary Development**: One word substitution

UNIT II DIALOGUE WRITING **12**

Listening: Listening to conversations (asking for and giving directions) –**Speaking:** making conversation using (asking for directions, making an enquiry), Role plays-dialogues- **Reading:** Reading a print interview and answering comprehension questions-**Writing**: Writing a checklist, Dialogue writing- **Grammar**: Simple past – question formation (Wh- questions, Yes or No questions, Tag questions)- **Vocabulary Development**: Stress shift, lexical items related to the theme of the given unit.

UNIT III FORMAL LETTER WRITING **12**

Listening: Listening to speeches by famous people and identifying the central message of the speech – answering multiple-choice questions)-**Speaking:** Giving short talks on a given topic-**Reading:** Reading motivational essays on famous engineers and technologists (answering open-ended and closed questions)- **Writing:** Writing formal letters/ emails (Complaint letters)-**Grammar**: Future Tense forms of verbs, subject and verb agreement-**Vocabulary Development**: Collocations – Fixed expressions

UNIT IV WRITING COMPLAINT LETTERS **12**

Listening: Listening to short talks (5 minutes duration and fill a table, gap-filling exercise) note taking/note making- **Speaking:** Small group discussion, giving recommendations-**Reading:** Reading problem – solution articles/essays drawn from various sources- **Writing:** Making recommendations – Writing a letter/ sending an email to the Editor- note making- **Grammar:** Modals – Phrasal verbs – cause and effect sentences- **Vocabulary Development**: Connectives, use of cohesive devices in writing, technical vocabulary.

UNIT V WRITING DEFINITIONS AND PRODUCT DESCRIPTION **12**

Listening: Listening to a product description (labeling and gap filling) exercises- **Speaking:** Describing a product and comparing and contrasting it with other products- **Reading**: Reading graphical material for comparison (advertisements)-**Writing:** Writing Definitions (short and long) – compare and contrast paragraphs- **Grammar:** Adjectives – Degrees of comparison - compound nouns- **Vocabulary Development**: Use of discourse markers – suffixes (adjectival endings).

TOTAL : 60 PERIODS

LEARNING OUTCOMES

At the end of the course the students will have gained,

- Exposure to basic aspects of technical English.
- The confidence to communicate effectively I various academic situations.
- Learnt the use of basic features of Technical English.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

TEXT BOOK:

1. Revised Edition of 'English for Engineers and Technologists' Volume 1 published by Orient Black Swan Limited 2019.

ASSESSMENT PATTERN:

- Assessments will assess all the four skills through both pen and paper and computer based tests.
- Assessments can be pen and paper based, quizzes.

MA5158	ENGINEERING MATHEMATI CS – I (Common to all branches of B.E. / B.Tech. Programmes in I Semester)	L	T	P	C
		3	1	0	4

COURSE 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 12

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II DIFFERENTIAL CALCULUS 12

Limit of function – One sided limit – Limit Laws – Continuity – left and right continuity – types of discontinuities – Intermediate Value Theorem – Derivatives of a function - Differentiation rules – Chain rule – Implicit differentiation – logarithmic differentiation – Maxima and minima – Mean value theorem – (Optional: Polar coordinate system – Differentiation in polar coordinates).

UNIT III FUNCTIONS OF SEVERAL VARIABLES 12

Partial derivatives – Homogeneous functions and Euler's theorem – Total derivative – Differentiation of implicit functions – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Errors and approximations – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT IV INTEGRAL CALCULUS 12

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.

UNIT V MULTIPLE INTEGRALS 12

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.

Attested

TOTAL :60 PERIODS

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

COURSE OUTCOMES:

At the end of the course the students will be able to

- Use the matrix algebra methods for solving practical problems.
- Apply differential calculus tools in solving various application problems.
- Able to use differential calculus ideas on several variable functions.
- Apply different methods of integration in solving practical problems.
- Apply multiple integral ideas in solving areas, volumes and other practical problems.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, New Delhi, 2017.
2. James Stewart, "Calculus with Early Transcendental Functions", Cengage Learning, 6th Edition, New Delhi,2013.
3. Joel Hass, Christopher Heil and Maurice D.Weir, "Thomas' Calculus", Pearson, 14th Edition, New Delhi, 2018.
4. Narayanan S. and Manicavachagom Pillai T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.

REFERENCES:

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), 7th Edition, New Delhi, 2009.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2015.
3. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education2nd Edition, 5th Reprint, Delhi, 2009.
4. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics",Narosa Publications, 5th Edition, New Delhi, 2017.
5. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7th Edition, New Delhi , 2012.
6. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., 11th Reprint, New Delhi, 2010.

PH5151 ENGINEERING PHYSICS L T P C

(Common to all branches of B.E / B.Tech programmes) **3 0 0 3**

COURSE OBJECTIVES:

- To make the students in understanding the importance of mechanics.
- To equip the students on the knowledge of electromagnetic waves.
- To introduce the basics of oscillations, optics and lasers.
- To enable the students in understanding the importance of quantum physics.
- To elucidate the application of quantum mechanics towards the formation of energy bands in crystalline materials.

UNIT I MECHANICS 9

Moment of inertia (M.I) - Radius of gyration - Theorems of M .I - M.I of circular disc, solid cylinder , hollow cylinder , solid sphere and hollow sphere - K.E of a rotating body – M.I of a diatomic molecule – Rotational energy state of a rigid diatomic molecule - centre of mass – conservation of linear momentum – Relation between Torque and angular momentum - Torsional pendulum.

UNIT II ELECTROMAGNETIC WAVES 9

Gauss's law – Faraday's law - Ampere's law - The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT III OSCILLATIONS, OPTICS AND LASERS 9

Simple harmonic motion - resonance - waves on a string - standing waves - traveling waves - Energy transfer of a wave - sound waves - Doppler effect - reflection and refraction of light waves - total internal reflection - interference - interferometers - air wedge experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO_2 laser, semiconductor laser - applications.

UNIT IV BASIC QUANTUM MECHANICS 9

Photons and light waves - Electrons and matter waves - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization - Particle in a infinite potential well - Normalization, probabilities and the correspondence principle.

UNIT V APPLIED QUANTUM MECHANICS 9

The harmonic oscillator - Barrier penetration and quantum tunneling - Tunneling microscope - Resonant diode - Finite potential wells - particle in a three dimensional box - Bloch's theorem for particles in a periodic potential, Kronig-Penney model and origin of energy bands.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of this course, the students should able to

- Understanding the importance of mechanics.
- Express the knowledge of electromagnetic waves.
- Know the basics of oscillations, optics and lasers.
- Understanding the importance of quantum physics.
- Apply quantum mechanical principles towards the formation of energy bands in crystalline materials.

TEXT BOOKS

1. D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education, 2017.
2. D.Halliday, R.Resnick and J.Walker. Principles of Physics. John Wiley & Sons, 2015.
3. N.Garcia, A.Damask and S.Schwarz. Physics for Computer Science Students. Springer-Verlag, 2012.

REFERENCES

1. R.Wolfson. Essential University Physics. Volume 1 & 2. Pearson, 2016.
2. D.J.Griffiths. Introduction to Electrodynamics. Pearson Education, 2015
3. K.Thyagarajan and A.Ghatak. Lasers: Fundamentals and Applications. Springer, 2012.

PROGRESS THROUGH KNOWLEDGE

CY5151 ENGINEERING CHEMISTRY (COMMON TO ALL BRANCHES) L T P C 3 0 0 3

COURSE OBJECTIVES:

- To introduce the basic concepts of polymers, their properties and some of the important applications.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To facilitate the understanding of the laws of photochemistry, photoprocesses and instrumentation & applications of spectroscopic techniques.
- To familiarize the operating principles and applications of energy conversion, its processes and storage devices.
- To inculcate sound understanding of water quality parameters and water treatment techniques.

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT I POLYMER CHEMISTRY 9

Introduction: Functionality-degree of polymerization. Classification of polymers- natural and synthetic, thermoplastic and thermosetting. Types and mechanism of polymerization: addition (free radical, cationic, anionic and living); condensation and copolymerization. Properties of polymers: Tg, tacticity, molecular weight-weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension. Structure, Properties and uses of: PE, PVC, PC, PTFE, PP, Nylon 6, Nylon 66, Bakelite, Epoxy; Conducting polymers – polyaniline and polypyrrole.

UNIT II NANOCHEMISTRY 9

Basics-distinction between molecules, nanomaterials and bulk materials; size-dependent properties. Types –nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Characterization - Scanning Electron Microscope and Transmission Electron Microscope - Principle and instrumentation (block diagram). Properties (optical, electrical, mechanical and magnetic) and Applications of nanomaterials - medicine, agriculture, electronics and catalysis.

UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY 9

Photochemistry: Laws of photochemistry - Grotthuss-Draper law, Stark-Einstein law and Lambert-Beer Law (derivation and problems). Photo physical processes – Jablonski diagram. Chemiluminescence, photo-sensitization and photoquenching – mechanism and examples. Spectroscopy: Electromagnetic spectrum - absorption of radiation - electronic, vibrational and rotational transitions. Width and intensities of spectral lines. Atomic absorption spectroscopy, UV-Vis and IR spectroscopy- principles, instrumentation (Block diagram) and applications.

UNIT IV ENERGY CONVERSIONS AND STORAGE 9

Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant – fast breeder reactor. Solar energy conversion - solar cells. Wind energy. Batteries - types of batteries – primary battery (dry cell), secondary battery (lead acid, nickel-cadmium and lithium-ion-battery). Fuel cells – H_2-O_2 and microbial fuel cell. Explosives – classification, examples: TNT, RDX, Dynamite; Rocket fuels and propellants – definition and uses.

UNIT V WATER TECHNOLOGY 9

Water – sources and impurities – water quality parameters: colour, odour, pH, hardness, alkalinity, TDS, COD and BOD. Boiler feed water – requirement – troubles (scale & sludge, caustic embrittlement, boiler corrosion and priming & foaming. Internal conditioning – phosphate, calgon and carbonate treatment. External conditioning - zeolite (permutit) and ion exchange demineralization. Municipal water treatment process – primary (screening, sedimentation and coagulation), secondary (activated sludge process and trickling filter process) and tertiary (ozonolysis, UV treatment, chlorination, reverse osmosis).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- To recognize and apply basic knowledge on different types of polymeric materials, their general preparation methods and applications to futuristic material fabrication needs.
- To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
- To identify and apply suitable spectroscopic technique for material analysis and study different forms of photochemical reactions.
- To recognize different forms of energy resources and apply them for suitable applications in energy sectors.
- To demonstrate the knowledge of water and their quality in using at different industries.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

TEXT BOOKS:

1. Jain P. C. & Monica Jain., "Engineering Chemistry", 16th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2015.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
3. S.S.Dara, "A text book of Engineering Chemistry", Chand Publications, 2014.

REFERENCES:

1. Schdeva M V, "Basics of Nano Chemistry", Anmol Publications Pvt Ltd
2. B.Sivasankar, "Instrumental Methods of Analysis", Oxford University Press. 2012.
3. Friedrich Emich, "Engineering Chemistry", Scientific International Ltd.
4. V RGowariker, N V Viswanathan and Jayadev Sreedhar, "Polymer Science" New AGE International Publishers, 2009.

GE5151 ENGINEERING GRAPHICS L T P C
1 0 4 3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. Drawing free hand sketches of basic geometrical shapes and multiple views of objects.
2. Drawing orthographic projections of lines and planes.
3. Drawing orthographic projections of solids.
4. Drawing development of the surfaces of objects.
5. Drawing isometric and perspective views of simple solids.

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 FREE HANDSKETCHING 14

Basic Geometrical constructions, Curves used in engineering practices-Conics – Construction of ellipse, parabola and hyperbola by different methods – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles – Representation of Three-Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES 15

Orthographic projection- principles-Principle 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 trapezoidal method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS 15

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to both the principal planes by rotating object method and auxiliary plane method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 15

Sectioning of solids in simple vertical position when the cutting plane is inclined to the one 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. Development of lateral surfaces of solids with cut-outs and holes.

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 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 and miscellaneous problems. Perspective projection of simple solids-Prisms pyramids and cylinders by visual ray method and vanishing point method.

COMPUTER AIDED DRAFTING (DEMONSTRATION ONLY) 3

Introduction to drafting packages and demonstration of their use

TOTAL (L: 15 + P: 60)=75 PERIODS

COURSE OUTCOMES:

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

1. Draw free hand sketching of basic geometrical shapes and multiple views of objects.
2. Draw orthographic projections of lines and planes
3. Draw orthographic projections of solids
4. Draw development of the surfaces of objects
5. Draw isometric and perspective views of simple solids.

TEXT BOOKS:

1. Bhatt, N. D.,Panchal V M and Pramod R. Ingle, “Engineering Drawing”, Charotar Publishing House, 53rd Edition, 2014.
2. Parthasarathy, N. S. and Vela Murali, “Engineering Drawing”, Oxford University Press, 2015

REFERENCES:

1. Agrawal, B. and Agrawal C.M., “Engineering Drawing”, Tata McGraw, N.Delhi, 2008.
2. Gopalakrishna, K. R., “Engineering Drawing”, Subhas Stores, Bangalore, 2007.
3. Natarajan, K. V., “A text book of Engineering Graphics”, 28thEd., Dhanalakshmi Publishers, Chennai, 2015.
4. Shah, M. B., and Rana, B. C., “Engineering Drawing”, Pearson, 2ndEd., 2009.
5. Venugopal, K. and Prabhu Raja, V., “Engineering Graphics”, New Age,2008.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only.
4. The students will be permitted to use appropriate scale to fit solution within A3 size.
5. The examination will be conducted in appropriate sessions on the same day.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9				0.9					0.6		0.6	0.6	0.9	0.6
2	0.9									0.6		0.6	0.6	0.6	
3	0.9				0.9					0.6		0.6	0.6	0.6	
4	0.9		0.6		0.9					0.6		0.6	0.6	0.6	
5	0.9		0.9		0.9					0.6		0.6	0.6	0.6	

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

BS5161	BASIC SCIENCES LABORATORY	L T P C
	(Common to all branches of B.E. / B.Tech Programmes)	0 0 4 2

PHYSICS LABORATORY: (Any Seven Experiments)

COURSE OBJECTIVES:

- To inculcate experimental skills to test basic understanding of physics of materials including properties of matter, thermal and optical properties.
- To induce the students to familiarize with experimental determination of velocity of ultrasonic waves and band gap determination.

LIST OF EXPERIMENTS:

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of disc
2. Non-uniform bending - Determination of Young's modulus
3. Uniform bending – Determination of Young's modulus
4. Lee's disc Determination of thermal conductivity of a bad conductor
5. Potentiometer-Determination of thermo e.m.f of a thermocouple
6. Laser- Determination of the wave length of the laser using grating
7. Air wedge - Determination of thickness of a thin sheet/wire
8. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
9. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
10. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
11. Post office box -Determination of Band gap of a semiconductor.
12. Spectrometer- Determination of wavelength using gating.
13. Photoelectric effect
14. Michelson Interferometer.
15. Estimation of laser parameters.
16. Melde's string experiment

TOTAL: 30 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able

- To determine various moduli of elasticity and also various thermal and optical properties of materials.
- To determine the velocity of ultrasonic waves, band gap determination and viscosity of liquids

CHEMISTRY LABORATORY: (Minimum of 8 experiments to be conducted)

COURSE OBJECTIVES:

- To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.
- To induce the students to familiarize with electroanalytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and polymers by spectroscopy and viscometry methods.

LIST OF EXPERIMENTS:

1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler‟s method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

9. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
11. Determination of molecular weight of polyvinylalcohol using Ostwald viscometer.
12. Pseudo first order kinetics-ester hydrolysis.
13. Corrosion experiment-weight loss method.
14. Phase change in a solid.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

- To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.
- To determine the amount of metal ions through volumetric and spectroscopic techniques
- To determine the molecular weight of polymers by viscometric method.
- To quantitatively analyse the impurities in solution by electroanalytical techniques
- To design and analyse the kinetics of reactions and corrosion of metals

TEXT BOOKS:

1. Laboratory Manual- Department of Chemistry, CEGC, Anna University (2014).
2. Vogel"s Textbook of Quantitative Chemical Analysis (8th edition, 2014).

GE5162	WORKSHOP PRACTICES LABORATORY (Common to all Branches of B.E. / B.Tech. Programmes)	L T P C 0 0 4 2

COURSE OBJECTIVES:

The main learning objective of this course is to provide hands on training to the students in:

1. Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common household wood work.
2. Wiring various electrical joints in common household electrical wire work.
3. Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work.
4. Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & ELECTRICAL)

PART I CIVIL ENGINEERING PRACTICES 15

PLUMBING WORK:

a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
b) Preparing plumbing line sketches.
c) Laying pipe connection to the suction side of a pump
d) Laying pipe connection to the delivery side of a pump.
e) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK:

a) Sawing,
b) Planing and
c) Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Wood Work Study:

a) Studying joints in door panels and wooden furniture
b) Studying common industrial trusses using models.

PART II ELECTRICAL ENGINEERING PRACTICES 15

WIRING WORK:

a) Wiring Switches, Fuse, Indicator and Lamp etc. such as in basic household,
b) Wiring Stair case light.
c) Wiring tube – light.
d) Preparing wiring diagrams for a given situation.

Wiring Study:

a) Studying an Iron-Box wiring.
b) Studying a Fan Regulator wiring.
c) Studying an Emergency Lamp wiring.

GROUP – B (MECHANICAL AND ELECTRONICS)

PART III MECHANICAL ENGINEERING PRACTICES 15

WELDING WORK:

a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
b) Practicing gas welding.

BASIC MACHINING WORK:

a) (simple)Turning.
b) (simple)Drilling.
c) (simple)Tapping.

ASSEMBLY WORK:

a) Assembling a centrifugal pump.
b) Assembling a household mixer.
c) Assembling an air conditioner.

SHEET METAL WORK:

a) Making of a square tray

FOUNDRY WORK:

a) Demonstrating basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES 15

SOLDERING WORK:

a) Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:

a) Assembling and testing electronic components on a small PCB.

ELECTRONIC EQUIPMENT STUDY:

a) Studying a FM radio.
b) Studying an electronic telephone.

TOTAL (P: 60) = 60 PERIODS

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

COURSE OUTCOMES:

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

1. Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.
2. Wire various electrical joints in common household electrical wire work.
3. Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.
4. Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.6	0.3											0.3	0.3	
2		0.6	0.6											0.6	
3		0.6	0.3										0.6	0.6	
4		0.6	0.6	0.3										0.6	

HS5251 PROFESSIONAL COMMUNICATION

L	T	P	C
4	0	0	4

COURSE OBJECTIVES:

The course entitles 'Professional Communication' aims to,

- Improve the relevant language skills necessary for professional communication.
- Develop linguistic and strategic competence in workplace context.
- Enhance language proficiency and thereby the employability of budding engineers and technologists.

UNIT I TECHNICAL COMMUNICATION 12

Listening: Listening to telephone conversations (intent of the speaker and note taking exercises)- Speaking: Role play exercises based on workplace contexts, introducing oneself- Reading: Reading the interview of an achiever and completing exercises (skimming, scanning and predicting)- Writing: Writing a short biography of an achiever based on given hints- Grammar: Asking and answering questions, punctuation in writing, prepositional phrases- Vocabulary Development: use of adjectives.

UNIT II SUMMARY WRITING 12

Listening: Listening to talks/lectures both general and technical and summarizing the main points- Speaking: Participating in debates- Reading: Reading technical essays/ articles and answering comprehension questions-Writing: Summary writing-Grammar: Participle forms, relative clauses- Vocabulary Development: Use of compound words, abbreviations and acronyms.

UNIT III PROCESS DESCRIPTION 12

Listening: Listening to a process description and drawing a flowchart-Speaking: Participating in Group Discussions, giving instructions- Reading: Reading instruction manuals- Writing: Writing process descriptions- Writing instructions- Grammar: Use of imperatives, active and passive voice, sequence words- Vocabulary Development: Technical jargon

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT IV REPORT WRITING 12

Listening: Listening to a presentation and completing gap-filling exercises- Speaking: Making formal presentations- Reading: Reading and interpreting charts/tables and diagrams- Writing: Interpreting charts/tables and diagrams, writing a report- Grammar: Direct into indirect speech, use of phrases- Vocabulary Development: reporting words

UNIT V WRITING JOB APPLICATIONS 12

Listening: Listening to a job interview and completing gap=filling exercises- Speaking: Mock interview, telephone interviews- Reading: Reading a job interview, SOP, company profile and completing comprehension exercises- Writing: job applications and resumes and SOPs-Grammar: Present perfect and continuous tenses- Vocabulary Development: Technical vocabulary.

TOTAL : 60 PERIODS

LEARNING OUTCOMES:

At the end of the second semester the learners should be able to,

- Read and comprehend technical texts effortlessly.
- Write reports of a technical kind.
- Speak with confidence in interviews and thereby gain employability

TEXT BOOK:

1. Revised Edition of 'English for Engineers and Technologists' Volume 1 published by Orient Black Swan Limited 2019.

ASSESSMENT PATTERN:

- Assessments will assess all the four skills through both pen and paper and computer based tests.
- Assessments can be pen and paper based, quizzes.

MA5252	ENGINEERING MATHEMATICS – II	L	T	P	C
	(Common to all branches of B.E. / B.Tech. Programmes in II Semester)	3	1	0	4

COURSE OBJECTIVES:

- To acquaint the students with the concepts of vector calculus which naturally arises in many engineering problems.
- To develop an understanding of the standard techniques of complex variable theory in particular analytic function and its mapping property.
- To familiarize the students with complex integration techniques 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 make the students appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT I VECTOR CALCULUS 12

Gradient and directional derivative – Divergence and Curl – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral – Area of a curved surface – Volume integral – Green's theorem, Stoke's theorem and Gauss divergence theorem – Verification and application in evaluating line, surface and volume integrals.

UNIT II ANALYTIC FUNCTION 12

Analytic functions – Necessary and sufficient conditions for analyticity – Properties – Harmonic conjugates – Construction of analytic function – Conformal mapping – Mapping by functions – Bilinear transformation $w = c + z,\ az,\ 1/z,\ z^2$.

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT III COMPLEX INTEGRATION **12**

Line integral – 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 semicircular contour with no pole on real axis.

UNIT IV DIFFERENTIAL EQUATIONS **12**

Method of variation of parameters – Method of undetermined coefficients – Homogenous equations of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients.

UNIT V LAPLACE TRANSFORMS **12**

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems – Transforms of derivatives and integrals – Initial and Final Value Theorems – Inverse Transforms – Convolution Theorem – Transform of periodic functions – Application to solution of linear ordinary differential equations with constant coefficients.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

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

- Calculate grad, div and curl and use Gauss, Stokes and Greens theorems to simplify calculations of integrals.
- Construct analytic functions and use their conformal mapping property in application problems.
- Evaluate real and complex integrals using the Cauchy's integral formula and residue theorem.
- Apply various methods of solving differential equation which arise in many application problems.
- Apply Laplace transform methods for solving linear differential equations.

TEXT BOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2015.
2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, New Delhi, 2017.

REFERENCES:

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), 7th Edition, New Delhi, 2009.
2. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, 4th Edition, New Delhi, 2011.
3. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, 5th Edition, New Delhi, 2017.
4. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7th Edition, New Delhi, 2012.
5. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., 11th Reprint, New Delhi, 2010.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

GE5153 PROBLEM SOLVING AND PYTHON PROGRAMMING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To know the basics of algorithmic problem solving.
- To develop Python programs with conditionals and loops.
- To define Python functions and use function calls.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

UNIT I INTRODUCTION TO COMPUTING AND PROBLEM SOLVING 9

Fundamentals of Computing – Computing Devices – Identification of Computational Problems – Pseudocodes and Flowcharts – Instructions – Algorithms – Building Blocks of Algorithms – Introduction to Python Programming – Python Interpreter and Interactive Mode – Variables and Identifiers – Arithmetic Operators– Values and Types – Statements.

SUGGESTED ACTIVITIES:

- Developing Pseudocodes and flowcharts for real life activities such as railway ticket booking using IRCTC, admission process to undergraduate course, academic schedules during a semester etc.
- Developing algorithms for basic mathematical expressions using arithmetic operations.
- Installing Python.
- Simple programs on print statements, arithmetic operations.

SUGGESTED EVALUATION METHODS:

- Assignments on pseudocodes and flowcharts.
- Tutorials on Python programs.

UNIT II CONDITIONALS AND FUNCTIONS 9

Operators – Boolean Values – Operator Precedence – Expression – Conditionals: If-Else Constructs – Loop Structures/Iterative Statements – While Loop – For Loop – Break Statement – Function Call and Returning Values – Parameter Passing – Local and Global Scope – Recursive Functions.

SUGGESTED ACTIVITIES:

- Simple Python program implementation using Operators, Conditionals, Iterative Constructs and Functions.
- Implementation of a simple calculator.
- Developing simple applications like calendar, phone directory, to-do lists etc.
- Flow charts for GCD, Exponent Functions, Fibonacci Series using conditionals and iterative statements.
- External learning - Recursion vs. Iteration.

SUGGESTED EVALUATION METHODS:

- Tutorials on the above activities.
- Group discussion on external learning.

UNIT III SIMPLE DATA STRUCTURES IN PYTHON 10

Introduction to Data Structures – List – Adding Items to a List – Finding and Updating an Item – Nested Lists – Cloning Lists – Looping Through a List – Sorting a List – List Concatenation – List Slices – List Methods – List Loop – Mutability – Aliasing – Tuples: Creation, Accessing, Updating, Deleting Elements in a Tuple, Tuple Assignment, Tuple as Return Value, Nested Tuples, Basic Tuple Operations – Sets.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

SUGGESTED ACTIVITIES:

- Implementing python program using lists, tuples, sets for the following scenario:
  - Simple sorting techniques
  - Student Examination Report
  - Billing Scheme during shopping.
- External learning - List vs. Tuple vs. Set – Implementing any application using all the three data structures.

SUGGESTED EVALUATION METHODS:

- Tutorials on the above activities.
- Group Discussion on external learning component.

UNIT IV STRINGS, DICTIONARIES, MODULES 10

Strings: Introduction, Indexing, Traversing, Concatenating, Appending, Multiplying, Formatting, Slicing, Comparing, Iterating – Basic Built-In String Functions – Dictionary: Creating, Accessing, Adding Items, Modifying, Deleting, Sorting, Looping, Nested Dictionaries Built-in Dictionary Function – Finding Key and Value in a Dictionary – Modules – Module Loading and Execution – Packages – Python Standard Libraries.

SUGGESTED ACTIVITIES:

- Implementing Python program by importing Time module, Math package etc.
- Creation of any package (student's choice) and importing into the application.

SUGGESTED EVALUATION METHODS:

- Tutorials on the above activities.

UNIT V FILE HANDLING AND EXCEPTION HANDLING 7

Introduction to Files – File Path – Opening and Closing Files – Reading and Writing Files – File Position – Exception: Errors and Exceptions, Exception Handling, Multiple Exceptions.

SUGGESTED ACTIVITIES:

- Developing modules using Python to handle files and apply various operations on files.
- Usage of exceptions, multiple except blocks - for applications that use delimiters like age, range of numerals etc.
- Implementing Python program to open a non-existent file using exceptions.

SUGGESTED EVALUATION METHODS:

- Tutorials on the above activities.
- Case Studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Develop algorithmic solutions to simple computational problems.
CO2: Develop and execute simple Python programs.
CO3: Write simple Python programs for solving problems.
CO4: Decompose a Python program into functions.
CO5: Represent compound data using Python lists, tuples, dictionaries etc.
CO6: Read and write data from/to files in Python programs.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									✓
CO2	✓		✓		✓							✓
CO3	✓	✓	✓									✓
CO4	✓	✓	✓	✓	✓							✓
CO5	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
CO6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

TEXT BOOKS:

1. Reema Thareja, “Python Programming: Using Problem Solving Approach”, Oxford University Press, 2017.
2. Allen B. Downey, “Think Python: How to Think Like a Computer Scientist”, Second Edition, Shroff/O‘Reilly Publishers, 2016. (http://greenteapress.com/wp/thinkpython/).

REFERENCES:

1. Guido van Rossum, Fred L. Drake Jr., “An Introduction to Python – Revised and Updated for Python 3.2”, Network Theory Ltd., 2011.
2. John V Guttag, “Introduction to Computation and Programming Using Python”, Revised and Expanded Edition, MIT Press , 2013
3. Charles Dierbach, “Introduction to Computer Science using Python”, Wiley India Edition, 2016.
4. Timothy A. Budd, “Exploring Python”, Mc-Graw Hill Education (India) Private Ltd., 2015.
5. Kenneth A. Lambert, “Fundamentals of Python: First Programs”, Cengage Learning, 2012.

EE5251	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic concepts of electric circuits, magnetic circuits and wiring.
- To understand the operation of AC and DC machines.
- To understand the working principle of electronic devices and circuits.

UNIT I BASIC CIRCUITS AND DOMESTIC WIRING 9

Electrical circuit elements (R, L and C)-Dependent and independent sources – Ohm’s Law-Kirchhoff’s laws - mesh current and node voltage methods (Analysis with only independent source) - Phasors – RMS-Average values-sinusoidal steady state response of simple RLC circuits. Types of wiring- Domestic wiring - Specification of Wires-Earthing-Methods-Protective devices.

UNIT II THREE PHASE CIRCUITS AND MAGNETIC CIRCUITS 9

Three phase supply – Star connection – Delta connection –Balanced and Unbalanced Loads-Power in three-phase systems – Comparison of star and delta connections – Advantages-Magnetic circuits-Definitions-MMF, Flux, Reluctance, Magnetic field intensity, Flux density, Fringing, self and mutual inductances-simple problems.

UNIT III ELECTRICAL MACHINES 9

Working principle of DC generator, motor-EMF and Torque equation-Types –Shunt, Series and Compound-Applications. Working principle of transformer-EMF equation-Operating principles of three phase and single phase induction motor-Applications. Working principles of alternator-EMF equation-Operating principles of Synchronous motor, stepper motor-Applications.

UNIT IV BASICS OF ELECTRONICS 9

Intrinsic semiconductors, Extrinsic semiconductors – P-type and N-type, P-N junction, VI Characteristics of PN junction diode, Zener effect, Zener diode, Zener diode Characteristics-Rectifier circuits-Wave shaping.

UNIT V CURRENT CONTROLLED AND VOLTAGE CONTROLLED DEVICES 9

Working principle and characteristics - BJT, SCR, JFET, MOSFET.

TOTAL: 45 PERIODS

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

COURSE OUTCOMES:

CO1 To be able to understand the concepts related with electrical circuits and wiring.
CO2 To be able to study the different three phase connections and the concepts of magnetic circuits.
CO3 Capable of understanding the operating principle of AC and DC machines.
CO4 To be able to understand the working principle of electronic devices such as diode and zener diode.
CO 5 To be able to understand the characteristics and working of current controlled and voltage controlled devices.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓							
CO2	✓	✓	✓	✓	✓						✓	
CO3	✓	✓	✓	✓	✓						✓	✓
CO4	✓	✓	✓	✓	✓						✓	✓
CO5	✓		✓	✓	✓						✓	✓

TEXT BOOKS:

1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", McGraw Hill Education, 2014
2. Del Toro, "Electrical Engineering Fundamentals", Second edition, Pearson Education, New Delhi, 1989.
3. John Bird, "Electrical Circuit theory and technology", Routledge; 5th edition, 2013

REFERENCES:

1. Thomas L. Floyd, 'Electronic Devices', 10th Edition, Pearson Education, 2018.
2. Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education; 7th edition, 2017
3 Kothari DP and I.J Nagrath, "Basic Electrical Engineering", McGraw Hill, 2010.
4 Muhammad H.Rashid, "Spice for Circuits and electronics", 4th ed., Cengage India,2019.

GE5152 ENGINEERING MECHANICS L T P C
3 1 0 4

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. Applying the various methods to determine the resultant forces and its equilibrium acting on a particle in 2D and 3D.
2. Applying the concept of reaction forces (non-concurrent coplanar and noncoplanar forces) and moment of various support systems with rigid bodies in 2D and 3D in equilibrium. Reducing the force, moment, and couple to an equivalent force - couple system acting on rigid bodies in 2D and 3D.
3. Applying the concepts of locating centroids/center of gravity of various sections / volumes and to find out area moments of inertia for the sections and mass moment of inertia of solids.
4. Applying the concepts of frictional forces at the contact surfaces of various engineering systems.
5. Applying the various methods of evaluating kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

UNIT I STATICS OF PARTICLES (9+3)

Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles -Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force, Unit Vectors. Equilibrium of a Particle- Newton's First Law of Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space.

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT II EQUILIBRIUM OF RIGID BODIES (9+3)

Principle of Transmissibility, Equivalent Forces, Vector Product of Two Vectors, Moment of a Force about a Point, Varignon's Theorem, Rectangular Components of the Moment of a Force, Scalar Product of Two Vectors, Mixed Triple Product of Three Vectors, Moment of a Force about an Axis, Couple - Moment of a Couple, Equivalent Couples, Addition of Couples, Resolution of a Given Force into a Force -Couple system, Further Reduction of a System of Forces, Equilibrium in Two and Three Dimensions - Reactions at Supports and Connections.

UNIT III DISTRIBUTED FORCES (9+3)

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration , Theorems of Pappus-Guldinus, Distributed Loads on Beams, Centre of Gravity of a Three-Dimensional Body, Centroid of a Volume, Composite Bodies , Determination of Centroids of Volumes by Integration.

Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration , Polar Moment of Inertia , Radius of Gyration of an Area , Parallel-Axis Theorem , Moments of Inertia of Composite Areas, Moments of Inertia of a Mass - Moments of Inertia of Thin Plates, Determination of the Moment of Inertia of a Three-Dimensional Body by Integration

UNIT IV FRICTION (9+3)

The Laws of Dry Friction. Coefficients of Friction, Angles of Friction, Wedges, Wheel Friction. Rolling Resistance, Ladder friction.

UNIT V DYNAMICS OF PARTICLES (9+3)

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton's Second Law of Motion -Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods - Work of a Force , Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact, Method of Virtual Work - Work of a Force, Potential Energy, Potential Energy and Equilibrium.

TOTAL (L: 45 + T: 15)=60 PERIODS

COURSE OUTCOMES:

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

1. Apply the various methods to determine the resultant forces and its equilibrium acting on a particle in 2D and 3D.
2. Apply the concept of reaction forces (non-concurrent coplanar and noncoplanar forces) and moment of various support systems with rigid bodies in 2D and 3D in equilibrium. Reducing the force, moment, and couple to an equivalent force - couple system acting on rigid bodies in 2D and 3D.
3. Apply the concepts of locating centroids / center of gravity of various sections / volumes and to find out area moments of inertia for the sections and mass moment of inertia of solids.
4. Apply the concepts of frictional forces at the contact surfaces of various engineering systems.
5. Apply the various methods of evaluating kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

TEXT BOOKS:

1. Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, SanjeevSanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 11thEdition, 2017.
2. Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.

REFERENCES:

1. Boresi P and Schmidt J, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.
2. Hibbeller, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition, Prentice Hall, 2013.
3. Irving H. Shames, Krishna Mohana Rao G, Engineering Mechanics – Statics and Dynamics, 4thEdition, Pearson Education Asia Pvt. Ltd., 2005.

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

4. Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, 7th edition, Wiley student edition, 2013.
5. Timoshenko S, Young D H, Rao J V and Sukumar Pati, Engineering Mechanics, 5thEdition, McGraw Hill Higher Education, 2013.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9	0.6	0.6	0.3								0.6	0.9	0.3	0.3
2	0.9	0.6	0.6	0.3								0.6	0.9	0.3	0.3
3	0.9	0.6	0.9	0.3								0.6	0.9	0.3	0.6
4	0.9	0.6	0.9	0.3								0.6	0.9	0.3	0.6
5	0.9	0.6	0.9	0.3								0.6	0.9	0.3	0.6

GE5161 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY **L T P C**
0 0 4 2

COURSE OBJECTIVES:

- To understand the problem solving approaches.
- To learn the basic programming constructs in Python.
- To articulate where computing strategies support in providing Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

EXPERIMENTS:

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same.
2. Python programming using simple statements and expressions.
3. Scientific problems using Conditionals and Iterative loops.
4. Implementing real-time/technical applications using Lists, Tuples.
5. Implementing real-time/technical applications using Sets, Dictionaries.
6. Implementing programs using Functions.
7. Implementing programs using Strings.
8. Implementing programs using written modules and Python Standard Libraries.
9. Implementing real-time/technical applications using File handling.
10. Implementing real-time/technical applications using Exception handling.
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Develop algorithmic solutions to simple computational problems
CO2: Develop and execute simple Python programs.
CO3: Structure simple Python programs for solving problems.
CO4: Decompose a Python program into functions.
CO5: Represent compound data using Python data structures.
CO6: Apply Python features in developing software applications.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									✓
CO2	✓		✓		✓							✓
CO3	✓	✓	✓									✓
CO4	✓	✓	✓	✓	✓							✓
CO5	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
CO6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

EE5261 ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

1. To impart hands on experience in verification of circuit laws and measurement of circuit parameters
2. To train the students in performing various tests on electrical motors.
3. It also gives practical exposure to the usage of CRO, power sources & function generators

LIST OF EXPERIMENTS

1. Verification of Kirchhoff's Law.
2. Steady state response of AC and DC circuits (Mesh, Node Analysis)
3. Frequency response of RLC circuits.
4. Measurement power in three phase circuits by two-watt meter method.
5. Regulation of single phase transformer.
6. Performance characteristics of DC shunt generator.
7. Performance characteristics of single phase induction motor.
8. Characteristics of PN diode and Zener diode
9. Characteristics of Zener diode
10. Half wave and full wave Rectifiers
11. Application of Zener diode as shunt regulator.
12. Characteristics of BJT and JFET

TOTAL: 60 PERIODS

COURSE OUTCOMES:

1. To become familiar with the basic circuit components and know how to connect them to make a real electrical circuit;
2. Ability to perform speed characteristic of different electrical machines
3. Ability to use logic gates and Flip flops

MA5355 TRANSFORM TECHNIQUES AND PARTIAL DIFFERENTIAL EQUATIONS

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To introduce the effective mathematical tools for the solutions of partial differential equations that model physical processes;
- To introduce Fourier series analysis which is central to many applications in engineering :
- To develop the analytic solutions for partial differential equations used in engineering by Fourier series;
- To acquaint the student with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic;
- To develop Z- transform techniques which will perform the same task for discrete time systems as Laplace Transform, a valuable aid in analysis of continuous time systems.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS **12**

Formation – Solutions of first order equations – Standard types and Equations reducible to standard types – Lagrange's Linear equation – Solution of linear equations of higher order with constant coefficients – Linear non-homogeneous partial differential equations.

UNIT II FOURIER SERIES **12**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half-range Sine and cosine series – Complex form of Fourier series – Parseval's identity – Harmonic Analysis.

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATION 12

Classification of partial differential equations- Method of separation of variables – Solutions of one dimensional wave equation and one-dimensional heat equation – Steady state solution of two-dimensional heat equation – Fourier series solutions in cartesian coordinates.

UNIT IV FOURIER TRANSFORM 12

Fourier integral theorem – Fourier transform pair - Sine and cosine transforms – Properties – Transform of elementary functions – Convolution theorem – Parseval's identity.

UNIT V Z – TRANSFORM AND DIFFERENCE EQUATIONS 12

Z-transform – Elementary properties – Inverse Z-transform – Convolution theorem – Initial and final value theorems – Formation of difference equation – Solution of difference equation using Z - transform.

TOTAL : 60 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

- Solve partial differential equations which arise in application problems.
- Analyze the functions as an infinite series involving sine and cosine functions.
- Obtain the solutions of the partial differential equations using Fourier series.
- Obtain Fourier transforms for the functions which are needed for solving application problems.
- Manipulate discrete data sequences using Z transform techniques.

TEXT BOOKS:

1. Erwin kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 10th Edition, New Delhi, 2015.
2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, New Delhi, 2017.

REFERENCES:

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), 7th Edition, New Delhi, 2009.
2. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, 4th Edition, New Delhi, 2011.
3. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7th Edition, New Delhi, 2012.
4. Ramana, B.V. "Higher Engineering Mathematics", Tata McGraw Hill, 11th Reprint, New Delhi, 2010.

PROGRESS THROUGH KNOWLEDGE

ML5352 MECHANICS OF MATERIALS L T P C

3 0 0 3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare students for:

1. Applying the principle concepts behind stress, strain and deformation of solids for various engineering applications.
2. Analyzing the transverse loading on beams and stresses in beam for various engineering applications.
3. Analyzing the torsion principles on shafts and springs for various engineering applications.
4. Analyzing the deflection of beams for various engineering applications.
5. Analyzing the thin and thick shells and principal stresses in beam for various engineering applications

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 – Volumertric strains

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM 9

Beams – types transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over – hanging beams. Theory of simple bending – Bending stress distribution – Flitched beams – Shear stress distribution.

UNIT III TORSION 9

Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts – Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs.

UNIT IV DEFLECTION OF BEAMS 9

Double Integration method – Macaulay's method – Area moment Theorems for computation of slopes and deflections in beams - Conjugate beam and strain energy – Maxwell's reciprocal theorems.

UNIT V THICK & THIN SHELLS & PRINCIPAL STRESSES 9

Stresses in thin cylindrical shell due to internal pressure, circumferential and longitudinal stresses and deformation in thin cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lame's theory – Application of theories of failure – Stresses on inclined planes – principal stresses and principal planes – Mohr's circle of stress.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Apply the principle concepts behind stress, strain and deformation of solids for various engineering applications.
2. Analyze the transverse loading on beams and stresses in beam for various engineering applications.
3. Analyze the torsion principles on shafts and springs for various engineering applications.
4. Analyze the deflection of beams for various engineering applications.
5. Analyze the thin and thick shells and principal stresses in beam for various engineering applications.

TEXT BOOKS:

1. Bansal, R.K., Strength of Materials, Laxmi Publications (P) Ltd., 2007
2. Jindal U.C., Strength of Materials, Asian Books Pvt. Ltd., New Delhi, 2007

REFERENCES:

1. Egor. P.Popov " Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2001
2. Ferdinand P. Beer, Russell Johnson, J.r. and John J. Dewole Mechanics of Materials, Tata McGraw Hill publishing 'co. Ltd., New Delhi.
3. Hibbeler, R.C., Mechanics of Materials, Pearson Education, Low Price Edition, 2007.
4. Subramanian R., Strength of Materials, oxford University Press, Oxford Higher Education Series, 2007.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9	0.9	0.9										0.9	0.6	
2	0.9	0.9	0.9										0.9	0.6	
3	0.9	0.9	0.9										0.9	0.6	
4	0.9	0.9	0.9										0.9	0.6	
5	0.9	0.9	0.9										0.9	0.6	

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

ME5351 **COMPUTER AIDED DESIGN** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. Applying the fundamental concepts of computer graphics and its tools in a generic framework.
2. Creating and manipulating geometric models using curves, surfaces and solids.
3. Applying concept of CAD systems for 3D modeling and visual realism.
4. Creating and adding geometric tolerances in assembly modeling.
5. Applying CAD standard practices in engineering design.

UNIT I FUNDAMENTALS OF COMPUTER GRAPHICS 9

Product cycle- Design process - Computer Aided Design – Computer graphics – co-ordinate systems- 2D and 3D transformations- homogeneous coordinates - graphic primitives (point, line, circle drawing algorithms) - Clipping- viewing transformation.

UNIT II GEOMETRIC MODELING 9

Representation of curves - Hermite cubic spline curve, Bezier curve, B-spline curves, Surface Modeling – Surface Entities, Representation of Surface, Bezier Surface, B-Spline Surface and Coons Surface. Solid Modeling - Solid Entities, Solid Representation, Boundary Representation (B-Rep), Sweeps Representation, Constructive Solid Geometry (CSG).

UNIT III VISUAL REALISM 9

Need for hidden surface removal, The Depth - Buffer Algorithm, Properties that help in reducing efforts, Scan Line coherence algorithm, Span - Coherence algorithm, Area-Coherence Algorithms, Warnock's Algorithm, Priority Algorithms– shading – coloring – computer animation.

UNIT IV PART ASSEMBLY 9

Mass properties - Assembly modeling – Inference of position and orientation –Geometric Dimensioning and Tolerancing – Functional importance of various types of fits, Geometrical dimensioning and Tolerancing, Tolerance stacking – types and remedies.

UNIT V CAD STANDARDS 9

Standards for computer graphics- Graphical Kernel System (GKS) - Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, ACIS and DXF - communication standards.

TOTAL = 45 PERIODS

COURSE OUTCOMES:

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

1. Apply the fundamental concepts of computer graphics and its tools in a generic framework.
2. Create and manipulating geometric models using curves, surfaces and solids.
3. Apply concept of CAD systems for 3D modeling and visual realism.
4. Create and adding geometric tolerances in assembly modeling.
5. Apply standard CAD practices in engineering design.

TEXT BOOKS:

1. Ibrahim Zeid "Mastering CAD CAM" Tata McGraw-Hill Publishing Co.2007.
2. P. N. Rao, CAD/CAM: Principles and Applications, Tata McGraw Hill, 2006.

REFERENCES:

1. Groover, M. P., CAD/CAM: Computer-Aided Design and Manufacturing, Pearson Education, 2008.
2. Chris McMahon and Jimmie Browne "CAD/CAM Principles, practice and manufacturing management "Pearson education Asia, 2001.
3. Donald Hearn and M. Pauline Baker "Computer Graphics"'. Prentice Hall, Inc, 1992.
4. Foley, Wan Dam, Feiner and Hughes – "Computer graphics principles & practice", Pearson Education - 2003.
5. William M Neumann and Robert F.Sproul "Principles of Computer Graphics", McGraw Hill Book Co. Singapore, 1989.

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.3	0.3	0.3	0.3	0.6					0.9		0.9	0.6	0.3	0.6
2	0.3	0.3	0.3	0.3	0.6					0.9		0.9	0.6	0.3	0.6
3	0.3	0.3	0.3	0.3	0.6					0.9		0.9	0.6	0.3	0.6
4	0.3	0.3	0.3	0.3	0.6					0.9		0.9	0.6	0.3	0.6
5	0.3	0.3	0.3	0.3	0.6					0.9		0.9	0.6	0.3	0.6

MF5301 **MACHINING TECHNOLOGY** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To impart knowledge on basics of metal cutting.
- To describe the basic principles of machine tools and processes
- To elaborate abrasive and finishing operations.
- To be acquainted with design principles of jigs and fixtures and its applications.
- To outline basics of automation and structure of machine tools.

UNIT I INTRODUCTION TO MANUFACTURING AND MACHINING 9

Introduction to manufacturing and machining -classification of metal removal processes and machine tools- Mechanics of machining (Metal Cutting) - Geometry of single point cutting tools- Mechanism of chip formation- Orthogonal and oblique cutting-Machining forces and Merchants Circle Diagram and Analytical and experimental determination of cutting forces-Dynamometers for measuring cutting forces- Power- Cutting temperature- causes, effects, assessment and control-cutting fluid application-Machinability and surface finish-Failure of cutting tools and tool life- Cutting tool materials.

UNIT II MACHINE TOOLS AND PROCESSES 9

Kinematics of drilling operations -machine tools: lathes and lathe operations -–Drilling machines-Drills-Drill tool nomenclature- Milling machines-Milling cutter nomenclature- Milling operations-Shaper-Planer and Broaching machines Nomenclature-operations.

UNIT III ABRASIVE MACHINING AND FINISHING OPERATIONS 9

Abrasive Processes (Grinding)-Basic principles, Purpose and application of grinding-Selection of wheels and their conditioning-Classification of grinding machines and their uses-Super finishing processes- Honing, lapping and super finishing-Gear and thread Finishing

UNIT IV JIGS AND FIXTURES 9

Work holding devices, tool Holding devices and attachments- Jigs and Fixtures for machine shops Purposes of jigs and fixtures and their design principles- Application of typical jigs and fixtures-case studies.

UNIT V MACHINE TOOL STRUCTURE TESTING AND AUTOMATION 9

Machine tools structures -Erecting and testing of machine tools- Vibration and chatters in machining- Automation: Capstan and turret lathe - Single spindle and multi spindle automats - Swiss type and automatic screw Machines-Feeding Mechanisms-Transfer mechanism.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course the students shall be able to:

- CO1: Apply the knowledge in the basics of metal cutting.
- CO2: Apply suitable machining processes based on requirements.
- CO3: To distinguish different finishing operations.
- CO4: Design jigs and fixtures as per requirements.
- CO5: Test the machine tool structure and differentiate various automation.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.6		0.6		0.6								0.9	0.9	0.9
2	0.6	0.6	0.6	0.6	0.6								0.3	0.9	0.3
3		0.3	0.3	0.3	0.6			0.6					0.9	0.9	0.9
4		0.6	0.6		0.6								0.3	0.9	0.3
5	0.6	0.9	0.9	0.9	0.9			0.9					0.3	0.9	0.3

TEXT BOOKS:

1. Sharma P.C., "A Textbook of Production Technology (Manufacturing Processes)", 8th Edition, S. Chand Publishing., India 2014 ISBN:9788121911146.
2. Jain R.K., "Production Technology: Manufacturing Processes, Technology and Automation", 17th Edition, Khanna publication, India, 2014, ISBN-10: 9788174090997,ISBN-3: 978-8174090997

REFERENCES:

1. John R. Walker and Bob Dixon, "Machining Fundamentals", 9th Edition, The Goodheart-Willcox Co.,United States,2014,ISBN: 978-1-61960-209-0.
2. Krar S.F., "Technology of Machine Tools", 7th Edition, McGraw-Hill, New York, 2011,ISBN-13: 978-0073510835,ISBN-10: 0073510831.
3. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th Edition, PHI Learning, United States, 1994, Reprint 2008, ISBN: 9788120306639, 8120306635
4. Serope Kalpakjian, Steven Schmid, "Manufacturing Engineering & Technology",7thEdtion, Pearson, United States, 2013,ISBN : 0131489658.
5. Winston A. Knight , Geoffrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools (Mechanical Engineering)", 3rd Edition, United States, 2005,ISBN 0070850577, 9780070850576.

MF5351 THERMODYNAMICS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To describe the basic concepts and first law of thermodynamics.
- To analyse the second law of thermodynamics.
- To evaluate the properties of pure substances.
- To gain knowledge on the concepts of conduction, convection and radiation.
- To apply the concepts of thermodynamics in IC engines, boilers, turbines, refrigeration and air-conditioning.

UNIT I BASICS CONCEPTS AND FIRST LAW OF THERMODYNAMICS 9

Basic concepts; Continuum and macroscopic approach; thermodynamic systems (closed and open); thermodynamic properties and equilibrium; state of a system, state postulate for simple compressible substances, paths and processes on state diagrams; concepts of heat and work, different modes of work; zeroth law of thermodynamics; concept of temperature. First Law of Thermodynamics; Concept of energy and various forms of energy; internal energy, enthalpy; specific heats; first law applied to elementary processes, closed systems and control volumes, steady and unsteady flow analysis.

UNIT II SECOND LAW OF THERMODYNAMICS 9

Second law of thermodynamics; Limitations of the first law of thermodynamics, concepts of heat engines and heat pumps/refrigerators, Kelvin-Planck and Clausius statements and their equivalence; reversible and irreversible processes; Carnot cycle and Carnot theorems; thermodynamic temperature scale; Clausius inequality and concept of entropy; the principle of increase of entropy, T-s diagrams; second law analysis of control volume; availability and irreversibility; third law of thermodynamics.

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT III PROPERTIES OF PURE SUBSTANCE 9

Thermodynamic properties of pure substances in solid, liquid and vapour phases; P-v-T behaviour of simple compressible substances, thermodynamic property tables and charts, psychrometric charts ideal and real gases : Vander waals equations - Reduced property - Compressibility chart - Properties of mixture of gases - Dalton's law and Gibbs - Internal energy, Enthalpy and specific heats of gas mixtures.

UNIT IV HEAT TRANSFER 9

Modes of Heat Transfer-Concept of heat resistance and electrical analogy -Conduction: One dimensional heat conduction in plane wall, composite walls and cylinder system, fins - Simple Problems - Convection - Free and forced -Flow over flat plates and tubes - Heat exchangers-Radiation -radiation laws, black, grey body radiation - radiation Shield.

UNIT V APPLICATIONS 9

Internal Combustion Engines: Air-standard Otto, Diesel and dual cycles, air compressors, C.I and S.I Engines - Four Stroke and two stroke engines-Gas turbines, boilers :Fire tube boiler & Water Tube Boilers, Steam turbines; Impulse turbine and reaction turbine - Refrigeration Cycle - Vapour Compression & vapour absorption system, gas refrigeration system - Environmental friendly refrigerants -Air-Conditioning.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course the students shall be able to:

- CO1. Apply first law of thermodynamics to engineering applications.
- CO2. Differentiate first and second law of thermodynamics.
- CO3. Estimate the properties of real and ideal gas mixtures using thermodynamic charts.
- CO4. Evaluate the heat transfer through conduction, convection and radiation
- CO5. Analyse the operation of IC engine, boilers, turbine, refrigerator etc.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9	0.9	0.3				0.3					0.3	0.6	0.3	0.3
2	0.9	0.9	0.3				0.3					0.3	0.6	0.3	0.3
3	0.9	0.9	0.3				0.3					0.3	0.6	0.3	0.3
4	0.9	0.9	0.3				0.3					0.3	0.6	0.3	0.3
5	0.3	0.3	0.3				0.3					0.3	0.6	0.3	0.3

TEXT BOOKS:

1. Cengel Y.A. and Boles M.A., "Thermodynamics an Engineering Approach", 8th edition, McGraw hill, United States, 2017.
2. Nag P.K., "Engineering Thermodynamics", 6th edition, McGraw Hill, United States, 2017.

REFERENCES:

1. Arora C.P., "Refrigeration and Air Conditioning", 3rd Edition, Tata McGraw Hill, United States, 2017.
2. Claus Borgnakke, "Fundamentals of Engineering Thermodynamics" 8th edition, John Wiley & Sons, United States, 2013.
3. Holman J.P., "Heat transfer", 10th edition, McGraw Hill, United States 2017.
4. Moran M.J. and Shapiro H.N., "Fundamentals of Engineering Thermodynamics", 9th Edition, Wiley, United States, 2018.
5. Rathakrishnan E., "Fundamentals of Engineering Thermodynamics", 2nd Edition, Prentice Hall of India, 2005.
6. Van Wylen and Sonntag, "Classical Thermodynamics", 4th Edition, Wiley, United States, 1994.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

ME5361 COMPUTER AIDED MACHINE DRAWING L T P C
0 0 4 2

COURSE OBJECTIVES:
The main learning objective of this course is to provide hands on training to the students in:

1. Applying standard drawing practices using fits and tolerances.
2. Modeling orthogonal views of machine components.
3. Modeling orthogonal views of assembled components.
4. Preparing standard drawing layout for modeled parts or assemblies with BoM.

PART I DRAWING STANDARDS & FITS AND TOLERANCES 4

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 & Tolerancing.

PART II 2D DRAFTING 56

Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailing, Detailed Drawing.

1. Bearings – Bush Bearing
2. Valves – Safety and Non-return Valves.
3. Couplings – Flange, Oldham's, Muff, Gear couplings.
4. Joints – Universal, Knuckle, Gib& Cotter, Strap, Sleeve &Cotter joints.
5. Engine parts – Piston, Connecting Rod, Crosshead (vertical and horizontal), Stuffing box, Multi-plate clutch.
6. Machine Components – Screw Jack, Machine Vice, LatheTail Stock, Lathe Chuck, Plummer Block, Vane and Gear pumps.

Total: 20% of classes for theory classes and 80% of classes for practice
Note: 25% of assembly drawings must be done manually and 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 CAD software.

TOTAL (L: 4 + P: 56) = 60 PERIODS

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

1. Apply standard drawing practices using fits and tolerances.
2. Model orthogonal views of machine components.
3. Model orthogonal views of assembled components.
4. Prepare standard drawing layout for modeled parts or assemblies with BoM.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1					0.9					0.6		0.9	0.6		0.6
2					0.9					0.6		0.9	0.6		0.6
3					0.9					0.6		0.9	0.6		0.6
4					0.9					0.6		0.9	0.6		0.6

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

ME5461 MANUFACTURING TECHNOLOGY LABORATORY L T P C
0 0 4 2

COURSE OBJECTIVES:

The main learning objective of this course is to provide hands on training to the students in:

1. Selecting appropriate tools, equipments and machines to complete a given job.
2. Performing various welding process using GMAW.
3. Performing various machining process such as rolling, drawing, turning, shaping, drilling, milling.
4. Fabricating gears using gear making machines.
5. Analyzing the defects in the cast and machined components.

LIST OF EXPERIMENTS

1. Fabricating simple structural shapes using Gas Metal Arc Welding machine.
2. Preparing green sand moulds with cast patterns.
3. Casting aluminum parts using stir casting machine.
4. Reducing the thickness of the plates using rolling machine.
5. Reducing the diameter of on circular parts using wire drawing process machine.
6. Taper Turning and Eccentric Turning on circular parts using lathe machine.
7. Knurling, external and internal thread cutting on circular parts using lathe machine.
8. Shaping – Square and Hexagonal Heads on circular parts using shaper machine.
9. Drilling and Reaming using vertical drilling machine.
10. Milling contours on plates using vertical milling machine.
11. Cutting spur and helical gear using milling machine.
12. Generating gears using gear hobbing machine.
13. Generating gears using gear shaping machine.
14. Grinding components using cylindrical, surface and centerless grinding machine.
15. Broaching components using broaching machine.

TOTAL = 60 PERIODS

COURSE OUTCOMES:

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

1. Select appropriate tools, equipments and machines to complete a given job.
2. Perform various welding process using GMAW.
3. Perform various machining process such as rolling, drawing, turning, shaping, drilling, milling.
4. Fabricate gears using gear making machines.
5. Analyze the defects in the cast and machined components.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9						0.3					0.3	0.3	0.6	0.6
2	0.9						0.3					0.3	0.3	0.6	0.6
3	0.9						0.3					0.3	0.3	0.6	0.6
4	0.9						0.3					0.3	0.3	0.6	0.6
5	0.9						0.3					0.3	0..3	0.6	0.6

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

GE5251 ENVIRONMENTAL SCIENCES L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and non-renewable resources, causes of their degradation and measures to preserve them.
- To familiarize the influence of societal use of resources on the environment and introduce the legal provisions, National and International laws and conventions for environmental protection.
- To inculcate the effect of population dynamics on human and environmental health and inform about human right, value education and role of technology in monitoring human and environmental issues.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – bio geographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 8

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 – soil waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land 47 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.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, 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 –

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

consumerism and waste products – environment protection act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
- To identify the causes, effects and environmental pollution and natural disasters and contribute to the preventive measures in the immediate society.
- To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.
- To recognize different forms of energy and apply them for suitable applications in for technological advancement and societal development.
- To demonstrate the knowledge of societal activity on the long and short term environmental issues and abide by the legal provisions, National and International laws and conventions in professional and personal activities and to identify and analyse effect of population dynamics on human value education, consumerism and role of technology in environmental issues.

TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers (2018).
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2016).
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education (2004).

REFERENCES:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press (2005).
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. (2013).

CE5251 FLUID MECHANICS AND MACHINERY L T P C
3 0 0 3

COURSE OBJECTIVE:

To introduce the students about properties of the fluids, behaviour of fluids under static conditions and to impart basic knowledge of the dynamics of fluids and 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 with an exposure to the significance of boundary layer theory and its thicknesses with expose to basic principles of working of hydraulic machineries and to design Pelton wheel, Francis and Kaplan turbine, centrifugal and reciprocating pumps..

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS 10

Properties of fluids- Pressure Measurements-Buoyancy and floatation-Flow characteristics-Eulerian and Lagrangian Principle of fluid flow– concept of control volume and system – Reynold's transportation theorem- continuity equation, energy equation and momentum equation-Applications.

UNIT II FLOW THROUGH PIPES AND BOUNDARY LAYER 9

Reynold's Experiment- Laminar flow through circular conduits- Darcy Weisbach equation – friction factor- Moody diagram- minor losses- Hydraulic and energy gradient – Pipes in series and parallel-Boundary layer concepts – types of boundary layer thickness.

UNIT III DIMENSIONAL ANALYSIS AND MODEL STUDIES 7

Fundamental dimensions - Dimensional homogeneity - Rayleigh's method and Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.

UNIT IV TURBINES 10

Impact of jets - Velocity triangles - Theory of roto-dynamic machines - Classification of turbines – Pelton wheel, Francis turbine (inward and outward) and Kaplan turbine- Working principles - Work done by water on the runner - Efficiencies – Draft tube - Specific speed - Performance curves for turbines – Governing of turbines.

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.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course, the student is expected to be able to

CO1 Understand the difference between solid and fluid, its properties and behaviour in static conditions.

CO2 Understand the conservation laws applicable to fluids and its application through fluid kinematics and dynamics.

CO3 Formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performances of prototype by model studies.

CO4 Estimate losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel.

CO5 Understand the concept of boundary layer and its application to find the drag force excreted by the fluid on the flat solid surface.

TEXT BOOKS:

1. Modi P.N. and Seth, S.M. Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, (2017)
2. Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014.

REFERENCES:

1. Narayana Pillai N. Principles of Fluid Mechanics and Fluid Machines, (3rd Ed.), University Press (India) Pvt. Ltd. 2009.
2. S K Som; Gautam Biswas and S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Pvt. Ltd., 2012
3. Subramanya, K. Fluid Mechanics and Hydraulic Machines, Tata McGraw- Hill Pub. Co., New Delhi, 2011
4. Yunus A. Cengel ; John M. Cimbala, Fluid Mechanics, McGraw Hill Education Pvt. Ltd.,2014
5. Streeter, V. L. and Wylie E. B., Fluid Mechanics, McGraw Hill Publishing Co.(2010)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	H	H	H	H	H	H
PO2	Problem analysis	H	H	H	H	H	H
PO3	Design / development of solutions	M	H	H	H	H	H
PO4	Investigation	M	M	H	H	H	H
PO5	Modern Tool Usage	L	L	L	L	L	L
PO6	Individual and Team work	L	L	L	M	M	H
PO7	Communication	L	L	L	L	L	L
PO8	Engineer and Society	M	M	M	M	M	M
PO9	Ethics	L	L	L	L	L	L
PO10	Environment and Sustainability	M	M	M	M	M	M
PO11	Project Management and Finance	L	L	L	L	L	L
PO12	Life Long Learning	M	M	M	H	H	H
PSO1	Knowledge of Civil Engineering discipline	H	H	H	H	H	H
PSO2	Critical analysis of Civil Engineering problems and innovation	M	M	H	M	M	M
PSO3	Conceptualization and evaluation of engineering solutions to Civil Engineering Issues	H	H	H	M	M	H

L - Low, M - Medium, H - High

ME5452 MECHANICS OF MACHINES L T P C
3 0 0 3

COURSE OBJECTIVES:

1. To understand the principles in the formation of mechanisms and their kinematics.
2. To learn the basic concepts of toothed gearing and kinematics of gear trains.
3. To study the effect of friction in different machine elements.
4. To analyze the forces and torque acting on simple mechanical systems
5. To understand the importance of balancing and vibration.

UNIT I KINEMATIC ANALYSIS IN SIMPLE MECHANISMS AND CAMS 9

Mechanisms – Terminology and definitions – kinematics inversions and anlaysis of 4 bar and slide crank chain – velocity and acceleration polygons – cams – classifications – displacement diagrams - layout of plate cam profiles.

UNIT II TOOTHED GEARING AND GEAR TRAINS 9

Gear terminology – law of toothed gearing – involute gearing – Gear tooth action - Interference and undercutting – gear trains – parallel axis gear trains – epicyclic gear trains.

UNIT III FRICTION ASPECTS IN MACHINE COMPONENTS 9

Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads – Friction clutches – Belt drives – Friction aspects in brakes.

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT IV STATIC AND DYNAMIC FORCE ANALYSIS 9

Applied and Constrained Forces – Free body diagrams – Static equilibrium conditions – Static Force analysis in simple mechanisms – Dynamic Force Analysis in simple machine members – Inertia Forces and Inertia Torque – D'Alembert's principle.

UNIT V BALANCING OF ROTATING MASSES AND VIBRATION 9

Static and Dynamic balancing – Balancing of revolving masses – Balancing machines – Free vibrations – natural Frequency – Damped Vibration – bending critical speed of simple shaft – Forced vibration – harmonic Forcing – Vibration isolation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Design the linkages and the cam mechanisms for specified output motions.
2. Determine the gear parameters of toothed gearing and speeds of gear trains in various applications.
3. Evaluate the frictional torque in screw threads, clutches, brakes and belt drives.
4. Determine the forces on members of mechanisms during static and dynamic equilibrium conditions.
5. Determine the balancing masses on rotating machineries and the natural frequencies of free and forced vibratory systems.

TEXT BOOK

1. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford University Press, 2017.

REFERENCES

1. Cleghorn. W. L., Nikolai Dechev, "Mechanisms of Machines", Oxford University Press, 2015.
2. Rao.J.S. and Dukkipati.R.V. "Mechanism and Machine Theory", New Age International Pvt. Ltd., 2006.
3. Rattan, S.S, "Theory of Machines", McGraw-Hill Education Pvt. Ltd., 2014.
4. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw-Hill, 2009.
5. Thomas Bevan, "The Theory of Machines", Pearson Education Ltd., 2010.

MF5401 CASTING AND WELDING TECHNOLOGY L T P C
3 0 0 3

COURSE OBJECTIVES:

- To impart the basics of casting.
- To introduce various casting processes
- To be acquainted with design of gating system and to obtain defect free castings
- To elaborate various welding methods including advanced techniques, with emphasis on basic principles, limitations and application.
- To outline metallurgical aspects of welding and its defects.

UNIT I BASICS OF CASTING 9

Metals cast in the foundry- Ingot casting; Continuous casting and Shape casting-Factors determine the selection of a casting alloy-Introduction to shape casting process & steps involved-Patterns: Definition, classification, materials used for pattern, various pattern allowances and their importance-–Sand molding: Types of base sand, requirement of base sand-testing-Binder-Additives, need and types- Preparation of sand molds: Molding machines- Jolt type, squeeze type and sand slinger--Cores: Definition, need, types. Method of making cores

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT II CASTING PROCESSES 9

Study of important molding process with advantages & limitations of casting processes.: classification of casting Processes-Sand mould: Green sand- Core sand- Dry sand- Sweep mold- CO_2 mold-–Casting using metal molds: Gravity die casting, Pressure die casting, Centrifugal casting, squeeze casting, Slush casting, Thixocasting-Precision Moulds: Shell mold, Investment mold, Plaster mold, Cement bonded mold.-.

UNIT III GATING SYSTEM SOLIDIFICATION AND CASTING DEFECTS 9

Concept of gating (Top, bottom, parting line, horn gate) and risering (Open, blind) -Functions and types. -Melting Furnaces-Solidification: definition, nucleation, solidification variables, directional Solidification-Need and methods. Degasification in liquid Metals-Sources of gas, degasification methods. -Fettling and cleaning of castings: Basic steps involved. -Sand casting defects- causes, features and remedies.

UNIT IV WELDING PROCESSES 9

Welding processes: definition, principles, classification, application, advantages & limitations of Welding-Arc welding: Metal arc welding (MAW), Flux shielded metal arc welding (FSMAW), Submerged Arc Welding (SAW), Inert Gas Welding (TIG & MIG), Plasma Arc Welding and Atomic Hydrogen Welding (AHW)-Resistance welding: Seam welding, Butt welding, Spot welding and Projection welding. Gas Welding: Principle, Oxy-Acetylene welding, oxy-hydrogen welding, air-acetylene welding, Gas cutting, powder cutting. Soldering, brazing. Special type of welding: Friction welding, Explosive welding, Thermit welding, Laser welding and electron beam welding.

UNIT V METALLURGICAL ASPECTS IN WELDING AND ITS DEFECTS 9

Structure of welds, Formation of different zones during welding, Heat Affected Zone (HAZ), Parameters affecting HAZ. Effect of carbon content on structure and properties of steel, Shrinkage in welds & Residual stresses-Pre and Post Weld Treatments- Welding defects- Detection, causes & remedy.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course the students shall be able to:

- CO1: Gain basic knowledge in casting.
- CO2: Select suitable casting process for application requirement.
- CO3: Apply gating design and mould design knowledge to overcome defects in casting.
- CO4: Select suitable welding process according to the requirements.
- CO5: Apply metallurgical aspects of welding to overcome defects in welding.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.6	0.6	0.6	0.6	0.6								0.9	0.3	0.3
2	0.6	0.6	0.6	0.6	0.6		0.6						0.9	0.9	0.9
3	0.6	0.6	0.6	0.6	0.6		0.6						0.9	0.9	0.6
4	0.6	0.6	0.6	0.6	0.6		0.6						0.3	0.9	0.6
5	0.6	0.6	0.6	0.6	0.6		0.6						0.3	0.9	0.9

TEXT BOOKS:

1. Parmer R.S., “Welding Processes & Technology”, Khanna Publishers, India, 2013, ISBN: 9788174091260, 8174091262.
2. Gowri S., Suresh Babu A., and Hariharan P., “Manufacturing Technology-I”, Pearson Education, India, 2008, ISBN: 9788131710234, 8131710238.

REFERENCES:

1. ASM Hand Book Vol: 15, “Casting”, ASM International, Geauga County, Ohio, 2008, ISBN: 978-0-87170-711-6.
2. Campbell J., “Castings Practice: The Ten Rules of Castings”, Butterworth-Heinemann., United Kingdom, 2004, ISBN (13): 978 0750647915, (10) 9780750647915.

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

3. Cary H.B., "Modern Welding Technology", 6th Edition, Prentice Hall, United States, 2004,ISBN(10): 0131130293,(13): 978-0131130296.
4. Jeffus L., "Welding: Principles and Applications", Delmar, Cengage Learning, Delmar Publishers., United States, 2012, ISBN (13): 978-1111039172,10: 1111039178.
5. Jeffus L., "Welding for Collision Repair", Cengage Learning, Delmar Publishers., United States, 1999, ISBN (10): 0766809668, (13): 978-0766809666.

ML5351 ENGINEERING MATERIALS AND METALLURGY L T P C
3 0 0 3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. Constructing the phase diagram and using of iron-iron carbide phase diagram for microstructure formation.
2. Selecting and applying various heat treatment processes and its microstructure formation.
3. Applying the different types of ferrous and non-ferrous alloys and their uses in engineering field.
4. Applying the different polymer, ceramics and composites and their uses in engineering field.
5. Applying 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.

UNITII 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.

UNIT III FERROUS AND NON-FERROUS METALS 9

Effect of alloying additions on steel (Mn, Si, Cr, Mo, 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

UNIT IV NON-METALLIC MATERIALS 9

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS,PAI, PPO, PPS, PEEK, PTFE, Thermo set polymers – Urea and Phenol formaldehydes - Engineering Ceramics – Properties and applications of Al2O3, SiC, Si3N4, PSZ and SIALON – intermetallics- Composites- Matrix and reinforcement Materials- applications of Composites - Nano composites.

UNIT V MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS 9

Mechanisms of plastic deformation, slip and twinning – Types of fracture – fracture mechanics- 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.

Attested

TOTAL = 45 PERIODS

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

COURSE OUTCOMES:

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

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

TEXT BOOKS:

1. Kenneth G.Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of India Private Limited, 4th Indian Reprint 2002.
2. Sydney H.Avner, “Introduction to Physical Metallurgy”, McGraw Hill Book Company, 1994

REFERENCES:

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, 2006.
4. Raghavan.V, “Materials Science and Engineering”, Prentice Hall of India Pvt.Ltd. 1999.
5. Williams D Callister, “Material Science and Engineering” Wiley India Pvt Ltd, Revised Indian edition 2007.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9	0.9	0.6	0.3		0.3	0.3						0.6	0.3	
2	0.9	0.6	0.3										0.6	0.3	
3	0.9		0.3			0.3							0.6	0.3	
4	0.9		0.3			0.3							0.6	0.3	
5	0.9	0.6	0.3	0.6									0.6	0.3	

MF5411 **METALLURGY LABORATORY** **L T P C**
0 0 2 1

COURSE OBJECTIVES:

- To impart practical knowledge of heat treatment processes.
- To elaborate the effect of various parameters on heat treatment process
- To get conversant with the microstructural changes
- To familiarize with hardness evaluation
- To gain practical knowledge on heat treatment of various materials.

LIST OF EXPERIMENTS:

1. Annealing and normalising of hardened steels
2. Spheroidization annealing of high carbon steels
3. Effect of quenching media on hardening of steel
4. Effect of tempering temperature and time on tempering of steel
5. Effect of carbon percentage on the hardness of steel
6. Carburizing – Low carbon steel
7. Case hardness depth measurements
8. Austempering treatment
9. Hardenability test – Jominy End Quench Test
10. Heat treatment of cast iron
11. Heat treatment of Stainless Steels and High speed steels
12. Heat treatment of non-ferrous alloys

TOTAL: 30 PERIODS

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

COURSE OUTCOMES:

At the end of this course students can able to:

CO1. Demonstrate the various heat treatment processes.

CO2. Evaluate the microstructural changes and hardness during heat treatment.

CO3. Analyse the influence of various parameters on heat treatment process

CO4. Differentiate the heat treatment process of ferrous and non-ferrous alloys.

CO5.Work in R&D activity in the field of materials science

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.6	0.6	0.3	0.3			0.6			0.6			0.6	0.3	0.3
2	0.6	0.6	0.6	0.3			0.6			0.6			0.6	0.3	0.3
3	0.6	0.6	0.6	0.6			0.6			0.6			0.6	0.3	0.3
4	0.6	0.6		0.6			0.6			0.6			0.6	0.3	0.3
5				0.6		0.6	0.6	0.3		0.6		0.9	0.6	0.3	0.3

CE5361 STRENGTH OF MATERIALS AND FLUID MACHINERY LABORATORY

L T P C
0 0 4 2

COURSE OBJECTIVES:

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

PART – I STRENGTH OF MATERIALS **30**

LIST OF EXPERIMENTS

1. Tension test on mild steel rod
2. Torsion test on mild steel rod
3. Hardness test on metal beam (Rockwell and Brinell Hardness Tests)
4. Compression test on helical spring
5. Deflection test on carriage spring

PART – II FLUID MECHANICS AND MACHINES LABORATORY **30**

LIST OF EXPERIMENTS

A. FLOW MEASUREMENT

1. Verification of Bernoulli's theorem
2. Flow through orifice/venturi meter
3. Friction factor for flow through pipes
4. Impact of jet on fixed plate

B. METACENTER

5. Determination of metacentric height

C. PUMPS

6. Characteristics of centrifugal pumps
7. Characteristics of gear pump
8. Characteristics of submersible pump
9. Characteristics of reciprocating pump

D. TURBINES

10. Characteristics of Pelton wheel turbine

TOTAL: 60 PERIODS

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

COURSE OUTCOMES:

On completion of the course, the student is expected to be able to

1. Perform Tension, Torsion, Hardness, Compression, and Deformation test on Solid materials.
2. Use the measurement equipment's for flow measurement.
3. Perform test on different fluid machinery.
4. Verify and apply Bernoulli equation for flow measurement like orifice/venturi meter.
5. Measure friction factor in pipes and compare with Moody diagram and verify momentum conservation law.
6. Determine the performance characteristics of rotodynamic pumps.
7. Determine the performance characteristics of positive displacement pumps.
8. Determine the performance characteristics of turbine.

REFERENCES:

1. Hydraulic Laboratory Manual, Centre for Water Resources, Anna University, 2015.
2. Modi P.N. and Seth S.M., Hydraulics and Fluid Mechanics. Standard Book House. New Delhi, 2017.
3. Subramanya K, Fluid Mechanics and Hydraulic Machines, Tata McGraw Hill Edu. Pvt. Ltd. 2011

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	M	H	H	H	H	H
PO2	Problem analysis	M	M	H	H	H	H
PO3	Design / development of solutions	L	L	M	M	M	M
PO4	Investigation	H	H	H	H	H	H
PO5	Modern Tool Usage	L	L	L	L	L	L
PO6	Individual and Team work	M	M	H	H	H	H
PO7	Communication	L	L	L	L	L	L
PO8	Engineer and Society	M	M	M	M	M	M
PO9	Ethics	L	L	L	L	L	L
PO10	Environment and Sustainability	M	M	M	M	M	M
PO11	Project Management and Finance	L	L	L	L	L	L
PO12	Life Long Learning	M	M	M	M	M	M
PSO1	Knowledge of Civil Engineering discipline	M	H	H	H	H	H
PSO2	Critical analysis of Civil Engineering problems and innovation	L	L	M	M	M	M
PSO3	Conceptualization and evaluation of engineering solutions to Civil Engineering Issues	L	L	L	L	L	L

L- Low, M – Medium, H - High

Attested

CTOR
Centre for Academic Courses
Anna University, Chennai-600 025

GE5451 **TOTAL QUALITY MANAGEMENT** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
- Explain the TQM Principles for application.
- Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
- Describe Taguchi's Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR.
- Illustrate and apply QMS and EMS in any organization.

UNIT I INTRODUCTION **9**

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM - Gurus of TQM (Brief introduction) -- TQM Framework- Barriers to TQM –Benefits of TQM.

UNIT II TQM PRINCIPLES **9**

Leadership - Deming Philosophy, Quality Council, Quality statements and Strategic planning- Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal-- Continuous process improvement –Juran Trilogy, PDSA cycle, 5S and Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating and Relationship development.

UNIT III TQM TOOLS & TECHNIQUES I **9**

The seven traditional tools of quality - New management tools - Six-sigma Process Capability- Bench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using the findings, Pitfalls and Criticisms of Benchmarking - FMEA - Intent , Documentation, Stages: Design FMEA and Process FMEA.

UNIT IV TQM TOOLS & TECHNIQUES II **9**

Quality circles – Quality Function Deployment (QFD) - Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures- Cost of Quality - BPR.

UNIT V QUALITY MANAGEMENT SYSTEM **9**

Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-Specific Standards - AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements-Implementation-Documentation-Internal Audits-Registration-ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001-Benefits of EMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to apply TQM concepts in a selected enterprise.
CO2: Ability to apply TQM principles in a selected enterprise.
CO3: Ability to understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
CO4: Ability to understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.
CO5: Ability to apply QMS and EMS in any organization.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓										✓
CO2						✓						✓
CO3					✓				✓			
CO4		✓			✓	✓	✓	✓				✓
CO5			✓			✓	✓	✓				

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

TEXT BOOK:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Bester field,MaryB.Sacre,HemantUrdhwareshe and RashmiUrdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.

REFERENCES:

1. Joel.E. Ross, “Total Quality Management – Text and Cases”,Routledge.,2017.
2. Kiran.D.R, “Total Quality Management: Key concepts and case studies, Butterworth – Heinemann Ltd, 2016.
3. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, Third Edition, 2003.
4. Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd., 2006 .

MF5501 METROLOGY AND COMPUTER AIDED INSPECTION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart the basics of metrology, measurement concepts and perform measurement tasks accurately.
- To identify the right measurement practices for linear and angular measurements.
- To be familiarized with the right instrument and method of measurement for surface finish and form measurements
- To describe the various measurement techniques using laser metrology.
- To gain knowledge on computer aided inspection and advances in metrology.

UNIT I BASIC CONCEPTS OF MEASUREMENTS 9

Important terminologies - Elements of measurements, need for measurement - Factors influencing measurements - Precision and Accuracy - Methods of measurement - Errors in measurements - Causes - Standards and Calibration - Types-Handling of measuring instruments - Do's and Don’ts - Maintenance of Instruments - Clean room.

UNIT II LINEAR AND ANGULAR MEASUREMENTS 9

Measurement of engineering components - Comparators, Slip gauges, Rollers, Limit gauges - Design - Types - Principles - Applications: Auto collimator - Angle dekkor - Alignment telescope - Sine bar - Bevel protractors'.

UNIT III SURFACE FINISH AND FORM MEASUREMENTS 9

Measurement of various elements of screw threads and gears - Radius measurement - Surface finish measurement - Straightness, Flatness and roundness- Principles - Application – Computerized form measuring equipments.

UNIT IV LASER METROLOGY 9

Precision instrument based on Laser - Use of Lasers - Principle –Interferometers, Interference microscope -Optical flats - Laser Interferometer - Application in Linear and Angular measurements - Testing of machine tools using Laser Interferometer.

UNIT V COMPUTER AIDED INSPECTION AND ADVANCES IN METROLOGY 9

Co-ordinate Measuring Machines - Constructional features - Types - Applications of CMM - CNC CMM applications - Measurement arms, Laser tracker - Fundamentals of Computer Aided Inspection - Machine Vision and applications in Metrology - Introduction to Nanometrology.

TOTAL: 45 PERIODS

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

COURSE OUTCOMES:

At the end of this course, the student shall be able to:

- CO1: Recognize the basics of metrology, measurement concepts and perform measurement tasks accurately.
- CO2: Identify the right measurement practices for linear and angular measurements.
- CO3: Identify the right instrument and method of measurement for surface finish and form measurements
- CO4: Describe various measurement techniques using laser metrology.
- CO5: Recognize the computer aided inspection and advances in metrology.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.6	0.9	0.3	0.9	0.9	0.3	0.3	0.6	0.9	0.6	0.3	0.9	0.9	0.9	0.6
2	0.6	0.3	0.6	0.6	0.9	0.3		0.6	0.3	0.3		0.6	0.6	0.9	0.3
3	0.6	0.3	0.6	0.6	0.9	0.6	0.3	0.6	0.3	0.3		0.6	0.6	0.9	0.3
4	0.6	0.6	0.3	0.9	0.9	0.9	0.6	0.3	0.6	0.3		0.6	0.9	0.9	0.6
5	0.6		0.3	0.3	0.9	0.3		0.3		0.3	0.3	0.6	0.9	0.9	0.9

TEXT BOOKS:

1. Bewoor A.K., and Kulkarni,V.A., “Metrology and Measurement”, Tata McGraw-Hill., India, 2009.ISBN: 978-0070140004.
2. Jain R.K., “Engineering Metrology”, 19th Edition, Khanna Publishers., India, 2005, ISBN13: 978-8174091536.

REFERENCES:

1. “ASTE Handbook of Industries Metrology”, Prentice Hall of India Ltd., India, 1992.
2. Galyer J.F.W. and Shotbolt C.R., “Metrology for Engineers”, Cassel O.R., London, 1993,ISBN-13: 978-0304318445
3. Rajput R.K., “Engineering Metrology and Instrumentations”, Kataria & Son Publishers., India, 2001.
4. Thomas, “Engineering Metrology”, Butthinson & Co., 1984.
5. Whitehouse D.J., “The Handbook of Surface and Nanometrology”, 2nd Edition, CRC Press., United States, 2011,ISBN: 9781420082029.

PROGRESS THROUGH KNOWLEDGE

MF5502 METAL AND POWDER FORMING **L T P C 3 0 0 3**

COURSE OBJECTIVES:

- To describe types of deformations and classification of forming processes.
- To classify and explain bulk forming processes.
- To describe sheet metal forming processes
- To distinguish differences between conventional forming and special forming processes.
- To elobrate various stages involved in the powder forming processes.

UNIT I INTRODUCTION **9**

Mechanical behavior of materials- Elastic and plastic deformations - Classification of forming processes - Temperature in metal working: Cold, Warm and hot working - Introduction to the theory of plastic deformation.

UNIT II BULK FORMING **9**

Introduction - Plastic deformation in forging, rolling, extrusion, rod/wire, tube drawing and swaging processes and their applications - Effect of friction, calculation of forces, work done, process parameters, equipment’s and defects - Design for manufacturing - Economics of bulk forming.

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT III SHEET METAL FORMING 9

Introduction - Sheet metal characteristics - Conventional sheet metal forming processes like shearing, bending and miscellaneous forming processes - High energy rate forming processes - Super plastic forming processes - Deep drawing process - Principles, process parameters, advantages, limitations and applications of the above - Formability of sheet metals - Equipment's - Defects - Design for manufacturing - Economics of sheet metal forming.

UNIT IV SPECIAL FORMING 9

Orbital forging - Isothermal forging - Hot and cold Isostatic pressing - High speed extrusion - High speed forming machines - Rubber pad forming - Water hammer forming - Fine blanking - Incremental forming and comparing the above with conventional forming.

UNIT V POWDER FORMING 9

Introduction - Powder production methods - Particle size characterization – Blending – Compacting – Sintering - Secondary and finishing operations - Advantages and applications of powder metallurgy - Design for manufacturing - Powder forging, rolling, extrusion, drawing - Economics of powder forging.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course the students will be able to:

- CO1: Illustrate deformation types and classification of forming processes.
- CO2: Describe bulk forming processes and their applications.
- CO3: Elaborate different sheet metal forming processes and their applications.
- CO4: Compare and distinguish conventional and special forming processes.
- CO5: Discuss powder forming processes and its applications

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9	0.3				0.3	0.3			0.3		0.9	0.6	0.3	0.3
2	0.9	0.6	0.3			0.3	0.3			0.3		0.9	0.6	0.3	0.3
3	0.9	0.6	0.3			0.3	0.3			0.3		0.9	0.6	0.3	0.3
4	0.9	0.3		0.3	0.6	0.3	0.3			0.3		0.9	0.6	0.6	0.6
5	0.9	0.3	0.3	0.3	0.6	0.3	0.3			0.3		0.9	0.6	0.6	0.6

TEXT BOOKS:

1. Kalpakjian S. and Schmid S.R., "Manufacturing Processes for Engineering Materials", Pearson., New Delhi, India, 2012.
2. Kalpakjian S. and Schmid S.R., "Manufacturing Engineering and Technology", Pearson., New Delhi, India, 2018.

REFERENCES:

1. Heinz Tschätsch, "Metal Forming Practise: Processes - Machines – Tools", Springer-Verlag Berlin Heidelberg., Germany, 2006.
2. Juneja B.L., "Fundamentals of Metal forming Processes", New Age International Publishers Ltd., Chennai, India, 2018.
3. Kumar Surender, "Technology of Metal Forming Processes", PHI learning Pvt. Ltd., New Delhi, India, 2008.
4. Mikell P. Groover, "Fundamental of Modern Manufacturing: Materials, Processes and Systems", John Wiley and Sons Ltd., United States, 2013.
5. Nagpal G.R.,"Metal Forming Processes", Khanna Publishers., New Delhi, India, 2000.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

ME5553 **MACHINE DESIGN** **L T P C**
3 1 0 4

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Designing machine members subjected to static loads.
2. Designing shafts, couplings, welded joints, riveted joints and bearings for various applications.
3. Designing helical springs, flywheels, connecting rods and crankshafts for various applications.
4. Designing flexible elements like belt, ropes and chain drives for engineering applications.
5. Designing spur, helical gear drives and multi speed gear box for power transmission.

UNIT I STEADY STRESSES IN MACHINE MEMBERS 9+3
Introduction to the design process - factor influencing machine design, selection of materials based on mechanical properties - Preferred numbers, fits and tolerances – Direct, Bending and torsional stress equations – Impact and shock loading – calculation of principle stresses for various load combinations, eccentric loading -Factor of safety - theories of failure – Design based on strength and stiffness.

UNIT II SHAFTS, COUPLINGS, JOINTS AND BEARINGS 9+3
Design of solid and hollow shafts based on strength, rigidity and critical speed – Keys, key ways and splines –Rigid and flexible couplings. Threaded fasteners, Welded joints and riveted joints for structures, Sliding contact and rolling contact bearings (Simple problems)

UNIT III ENERGY STORING ELEMENTS AND ENGINE COMPONENTS 9+3
Various types of springs, optimization of helical springs - Flywheels considering stresses in rims and arms for engines and punching machines- Connecting Rods and crank shafts.

UNIT IV DESIGN FOR FLEXIBLE ELEMENTS 9+3
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.

UNIT V SPUR GEARS, HELICAL GEARS AND GEAR BOXES 9+3
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. Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box -Constant mesh gear box. – Design of multi speed gear box for machine tool applications – Variable speed gear box.

TOTAL: 60 PERIODS

Note: (Use of P S G Design Data Book is permitted in the University examination)

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Design machine members subjected to static loads.
2. Design shafts, couplings, welded joints, riveted joints and bearings for various applications.
3. Design helical springs, flywheels, connecting rods and crankshafts for various applications.
4. Design flexible elements like belt, ropes and chain drives for engineering applications.
5. Design spur, helical gear drives and multi speed gear box for power transmission.

TEXT BOOK:
1. Bhandari V B, “Design of Machine Elements”, 4th Edition, Tata McGraw-Hill Book Co, 2016.

REFERENCES:
1. Ansel C Ugural, “Mechanical Design – An Integral Approach”, 1st Edition, Tata McGraw-Hill Book Co, 2004.
2. Design Data Hand Book”, PSG College of Technology, Coimbatore, 2013.
3. Merhyle Franklin Spotts, Terry E. Shoup, and Lee EmreyHornberger, “Design of Machine Elements” 8th Edition, Printice Hall, 2004.
4. Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine component Design”,6th Edition, Wiley, 2017.

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

5. Sundararajamoorthy T. V. and Shanmugam .N, “Machine Design”, Anuradha Publications, Chennai, 2003.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.6	0.6	0.9					0.3				0.6	0.9		0.6
2	0.6	0.6	0.9					0.3				0.6	0.9		0.6
3	0.6	0.6	0.9					0.3				0.6	0.9		0.6
4	0.6	0.6	0.9					0.3				0.6	0.9		0.6
5	0.6	0.6	0.9					0.3				0.6	0.9		0.6

ME5514 **DYNAMICS LABORATORY** **L T P C**
0 0 4 2

COURSE OBJECTIVES:

- To gain practical experience in studying gear trains and mechanisms
- To get exposure in determining mass moment of inertia and studying gyroscopes and cams
- To expose the students to different types of governors
- To impart knowledge to determine natural frequency of free and forced vibratory systems

LIST OF EXPERIMENTS

1. Study of gear parameters. Experimental study of velocity ratios of simple, compound, epicyclic and differential gear trains.
2. Kinematics of Crank Rocker, Double crank, Double rocker, Slider Crank and Oscillating cylinder Mechanisms. Kinematics of single and double universal joints.
3. Determination of Mass moment of inertia of Fly wheel and Axle system.
4. Determination of Mass Moment of Inertia of axisymmetric bodies using Turn table apparatus.
5. Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
6. Motorized gyroscope – Study of gyroscopic effect and couple.
7. Governor - Determination of range sensitivity and effort for Watts, Porter, Proell, and Hartnell Governors.
8. Cams – Cam profile drawing, Motion curves and study of jump phenomenon
9. Single degree of freedom Spring Mass System – Determination of natural Frequency and verification of Laws of springs – Damping coefficient determination.
10. Multi degree freedom suspension system – Determination of influence coefficient.
11. Determination of torsional natural frequency of single and double rotor systems - Undamped and Damped Natural frequencies.
12. Vibration of Equivalent Spring mass system – undamped and damped vibration.
13. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.
14. Transverse vibration of Free-Free beam – with and without concentrated masses.
15. Forced Vibration of Cantilever beam – Mode shapes and natural frequencies.
16. Determination of transmissibility ratio using vibrating table.

TOTAL:60 PERIODS

COURSE OUTCOMES:

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

1. measure gear parameters and velocity ratios of gear trains
2. determine mass moment of inertia of flywheel and axle system, axisymmetric bodies and pendulum
3. determine gyroscopic couple and various parameters of governors
4. determine natural frequency of free and forced vibratory systems

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓							
CO2	✓	✓	✓	✓								
CO3	✓	✓	✓	✓								
CO4	✓	✓	✓	✓								
CO5	✓	✓	✓	✓	✓							

MF5511 **METROLOGY LABORATORY** **L T P C**
0 0 4 2

COURSE OBJECTIVES:

- To familiarize the basic concepts in various methods of engineering measurement techniques and applications.
- To make students familiar with the fundamental principles of measuring techniques by practicing exercises on various measuring instruments.
- To gain knowledge on metallographic study of the given samples and heat treatment study of steel.
- To familiarize the importance of measurement and inspection in manufacturing industries.
- To train the students with advanced metrological devices.

LIST OF EXPERIMENTS - METROLOGY LAB:

1. Checking the straightness of component using Autocollimator.
2. Measurement of tooth thickness using gear tooth Vernier caliper.
3. Tool Makers microscope-Element measurement of components.
4. Calibration of Mechanical/electrical comparator and checking of dimensions.
5. Exercises in Microhite.
6. Measurement of Taper Angle using sine bar.
7. Measurement of components using profile projectors.
8. Measurement of Surface Roughness parameters using Roughness tester.
9. Study Exercises in Video measuring system and CMMs.
10. Study Exercises on 3D Roughness measurement - Non Contact.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of this course the student will be able to:

CO1: Recognize the importance of various technical terms and perform measurement tasks accurately.

CO2: Identify the right instrument and method of measurement for a particular application.

CO3: Follow the right procedure for measurement of various components depending upon the applications.

CO4: Describe the microstructure features of specimens and correlate with their macroscopic behaviour.

CO5: Recognize the fundamental concepts of measurement, standards, calibration, maintenance of laboratory facilities and handling of equipments

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9	0.6	0.9	0.9	0.9							0.6	0.9	0.6	0.9
2	0.9	0.6		0.6								0.3	0.6	0.9	0.6
3	0.9		0.6	0.6								0.3	0.6	0.9	0.6
4	0.9	0.6										0.3	0.6	0.6	0.6
5	0.9	0.6			0.6							0.3	0.6	0.3	0.6

ANNA UNIVERSITY
PROGRESS THROUGH KNOWLEDGE

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

MF5512 **INDUSTRIAL TRAINING/ INTERNSHIP** **L T P C**
0 0 4 2

COURSE OBJECTIVES:

- To familiarize students with real life situations in industrial organizations
- To accelerate the learning process
- To train the students in utilizing their knowledge in a realistic way
- To gain practical knowledge on organization structure
- To experience and understand real life situations

DURATION:

The students have to undergo practical industrial training for four weeks (During Fourth Semester holidays) in recognized industrial establishments.

I. At the end of the training they have to submit a report with following information:

1. Profile of the Industry,
2. Product range,
3. Organization structure,
4. Plant layout,
5. Processes/Machines/Equipment/devices,
6. Personnel welfare schemes,
7. Details of the training undergone,
8. Projects undertaken during the training, if any
9. Learning points.

II. End Semester examination will be a Viva-Voce Examination during Fifth Semester

COURSE OUTCOMES:

At the end of the course the student will be able to

- Recognize the different forms of organization
- Realize the functions of management
- Foresee group dynamics
- Discuss the modern concepts in industrial management.
- Develop skills to read, write and comprehend

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.3											0.3	0.3		
2						0.3	0.3	0.3				0.3	0.3	0.3	
3			0.3						0.9			0.3	0.9		
4						0.3	0.3	0.3	0.3		0.6	0.3	0.6	0.6	
5	0.3			0.6								0.3			

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

MF5651 NON-TRADITIONAL MACHINING PROCESSES L T P C
3 0 0 3

COURSE OBJECTIVES:

- To classify non-traditional machining processes and describe mechanical energy based non-traditional machining processes.
- To differentiate chemical and electro chemical energy based processes.
- To describe thermo-electric energy based processes
- To explain nano finishing processes.
- To introduce hybrid non-traditional machining processes and differentiate hybrid non-traditional machining processes

UNIT I INTRODUCTION AND MECHANICAL ENERGY BASED PROCESSES 9

Introduction - Need for non-traditional machining processes - Classification of non-traditional machining processes - Applications, advantages and limitations of non-traditional machining processes - Abrasive jet machining, Abrasive water jet machining, Ultrasonic machining their principles, equipment, effect of process parameters, applications, advantages and limitations.

UNIT II CHEMICAL AND ELECTRO CHEMICAL ENERGY BASED PROCESSES 9

Principles, equipments, effect of process parameters, applications, advantages and limitations of Chemical machining, Electro-chemical machining, Electro-chemical honing, Electro-chemical grinding, Electro chemical deburring.

UNIT III THERMO-ELECTRIC ENERGY BASED PROCESSES 9

Principles, equipments, effect of process parameters, applications, advantages and limitations of Electric discharge machining, Wire electric discharge machining, Laser beam machining, Plasma arc machining, Electron beam machining, Ion beam machining.

UNIT IV NANO FINISHING PROCESSES 9

Principles, equipments, effect of process parameters, applications, advantages and limitations of Abrasive flow machining – Chemo mechanical polishing, Magnetic abrasive finishing, Magnetorheological finishing, Magneto rheological abrasive flow finishing.

UNIT V HYBRID NON-TRADITIONAL MACHINING PROCESSES 9

Introduction - Various hybrid non-traditional machining processes, their working principles, equipments, effect of process parameters, applications, advantages and limitations. Selection and comparison of different non-traditional machining processes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course the students shall be able to:

- CO1: Formulate different types of non-traditional machining processes and evaluate mechanical energy based non-traditional machining processes.
- CO2: Illustrate chemical and electro chemical energy based processes.
- CO3: Evaluate thermo-electric energy based processes.
- CO4: Interpret nano finishing processes.
- CO5: Analyse hybrid non-traditional machining processes and differentiate non- traditional
- machining processes.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9						0.3			0.3		0.3	0.6	0.6	0.6
2	0.9		0.3		0.3		0.3			0.3		0.3	0.6	0.6	0.6
3	0.9		0.3		0.3		0.3			0.3		0.3	0.6	0.6	0.6
4	0.9		0.6		0.3		0.3			0.3		0.3	0.6	0.6	0.6
5	0.9		0.9	0.6	0.9		0.3			0.3		0.3	0.9	0.9	0.9

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

TEXT BOOKS:

1. Adithan. M., "Unconventional Machining Processes", Atlantic, New Delhi, India, 2009. ISBN 13: 9788126910458
2. Anand Pandey, "Modern Machining Processes", Ane Books Pvt. Ltd., New Delhi, India, 2019.

REFERENCES:

1. Benedict, G.F., "Non-traditional Manufacturing Processes", Marcel Dekker Inc., New York 1987. ISBN-13: 978-0824773526.
2. Carl Sommer, "Non-Traditional Machining Handbook", Advance Publishing., United States, 2000, ISBN-13: 978-1575373256.
3. Golam Kibria, Bhattacharyya B. and Paulo Davim J., "Non-traditional Micromachining Processes: Fundamentals and Applications", Springer International Publishing., Switzerland, 2017, ISBN:978-3-319-52008-7.
4. Jagadeesha T., "Non-Traditional Machining Processes", I.K. International Publishing House Pvt. Ltd., New Delhi, India, 2017, ISBN-13: 978-9385909122.
5. Kapil Gupta, Neelesh K. Jain and Laubscher R.F., "Hybrid Machining Processes: Perspectives on Machining and Finishing", 1st edition, Springer International Publishing., Switzerland, 2016, ISBN-13: 978-3319259208.

MF5652 ADDITIVE MANUFACTURING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce the development of Additive Manufacturing (AM), various business opportunities and applications
- To familiarize various software tools, processes and techniques to create physical objects that satisfy product development / prototyping requirements, using AM.
- To be acquainted with vat polymerization and material extrusion processes.
- To be familiar with powder bed fusion and direct energy deposition.
- To gain knowledge on applications of binder jetting, material jetting and laminated object manufacturing processes

UNIT I INTRODUCTION 9

Overview – Need - Development of Additive Manufacturing (AM) Technology: Rapid Prototyping- Rapid Tooling – Rapid Manufacturing – Additive Manufacturing. AM Process Chain- Classification – Benefits. Applications: Building Printing-Bio Printing- Food Printing-Printing Electronics. Business Opportunities and Future Directions - Intellectual Property.

UNIT II DESIGN FOR ADDITIVE MANUFACTURING (DFAM) 9

Concepts and Objectives- AM Unique Capabilities: Part Consolidation-Topology Optimization-Light weight Structure - DFAM for Part Quality Improvement. Data Processing - CAD Model Preparation -Part Orientation and Support Structure Generation -Model Slicing - Tool Path Generation-Customized Design and Fabrication for Medical Applications- Case Studies.

UNIT III VAT POLYMERIZATION AND MATERIAL EXTRUSION 9

Photo polymerization: Stereolithography Apparatus (SLA)- Materials -Process -Advantages-Limitations- Applications. Digital Light Processing(DLP) - Materials – Process - Advantages - Applications. Extrusion Based System: Fused Deposition Modeling (FDM)- Process-Materials - Applications and Limitations.

UNIT IV POWDER BED FUSION AND DIRECT ENERGY DEPOSITION 9

Powder Bed Fusion: Selective Laser Sintering (SLS): Process – Powder Fusion Mechanism – Process Parameters – Typical Materials and Application. Selective Laser Melting (SLM) and Electron Beam Melting (EBM): Materials – Process - Advantages and Applications.

Beam Deposition Process: Laser Engineered Net Shaping (LENS)- Process -Material Delivery - Process Parameters -Materials -Benefits -Applications.

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT V OTHER ADDITIVE MANUFACTURING PROCESSES 9

Binder Jetting: Three Dimensional Printing - Materials -Process - Benefits and Limitations. Material Jetting: Multijet Modeling- Materials - Process - Benefits. Sheet Lamination Process: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding – Thermal Bonding- Materials-Application and Limitation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course students shall be able to:

- CO1: Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities.
- CO2: Acquire knowledge on process of transforming a concept into the final product in AM technology.
- CO3: Elaborate the vat polymerization and material extrusion processes and its applications.
- CO4: Acquire knowledge on process and applications of powder bed fusion and direct energy deposition.
- CO5: Evaluate the advantages, limitations, applications of binder jetting, material jetting and laminated object manufacturing processes.

CO	PO											PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9						0.3	0.9		0.6		0.9	0.3	0.3	0.3
2	0.9	0.6	0.3	0.3	0.6		0.9	0.6		0.6		0.9	0.3	0.9	0.6
3	0.9	0.3					0.6			0.6		0.9	0.6	0.6	0.3
4	0.9	0.3					0.6			0.6		0.9	0.6	0.6	0.3
5	0.9	0.3					0.6			0.6		0.9	0.6	0.6	0.3

TEXT BOOKS:

1. Andreas Gebhardt and Jan-Steffen Hötter “Additive Manufacturing: 3D Printing for Prototyping and Manufacturing”, Hanser publications, United States, 2015, ISBN: 978-1-56990-582-1.
2. Ian Gibson, David W. Rosen and Brent Stucker “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, 2nd edition, Springer., United States, 2015, ISBN-13: 978-1493921126.

REFERENCES:

1. Amit Bandyopadhyay and Susmita Bose, “Additive Manufacturing”, 1st Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590.
2. Andreas Gebhardt, “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing”, Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN :9783446425521.
3. Kamrani A.K. and Nasr E.A., “Rapid Prototyping: Theory and practice”, Springer., United States ,2006, ISBN: 978-1-4614-9842-1.
4. Liou, L.W. and Liou, F.W., “Rapid Prototyping and Engineering applications: A tool box for prototype development”, CRC Press., United States, 2011, ISBN: 9780849334092.
5. Milan Brandt, “Laser Additive Manufacturing: Materials, Design, Technologies, and Applications”, Woodhead Publishing., United Kingdom, 2016, ISBN: 9780081004333.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

MF5601 **CNC MACHINE TOOLS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To introduce the evolution, types and principles of CNC machine tools
- To familiarize the students with constructional features of CNC machine tools
- To acquaint the students with various drives and axis measuring systems used in CNC machine tools
- To gain knowledge on manual part program and generation of CNC part program using CAM packages
- To familiarize the students with various tooling and work holding devices used in CNC machine tools

UNIT I INTRODUCTION TO CNC MACHINE TOOLS 9

Evolution of CNC Technology - principles - features - advantages - applications - CNC and DNC concept - CNC controllers - characteristics - interpolators - types of CNC Machines -, construction / operation, machine specification of turning centre - machining centre (3 and higher axes) - grinding machine - vertical turret lathe - turn-mill centre – multitask machines

UNIT II STRUCTURE OF CNC MACHINE TOOL 9

CNC Machine building - structural details - configuration and design - guide ways – Friction, Anti friction and other types of guide ways - elements used to convert the rotary motion to a linear motion - Screw and nut - recirculating ball screw - spindle assembly - torque transmission elements - gears - timing belts - flexible couplings - Bearings.

UNIT III DRIVES AND CONTROLS 9

Spindle drives - feed drives - stepper motor - servo motor - linear motor - Axis measuring system - open loop and closed loop control - synchro - synchro resolver- gratings- moiré fringe gratings- encoders - inductosyn - laser interferometer.

UNIT IV CNC PROGRAMMING 9

Coordinate system - structure of a CNC part program - G & M Codes - tool length compensation - cutter radius and tool nose radius compensation - mirror image - canned cycles- programming for machining centre and turning centre for well known controllers - generation of CNC codes from CAM packages.

UNIT V TOOLING AND WORK HOLDING DEVICES 9

Cutting tool materials for CNC machine tools- hard metal insert tooling- inserts and tool holder classification - qualified - semi qualified and preset tooling - ATC - APC - tooling for machining and turning centre - silent tool - work holding devices for rotating and fixed work parts- use of probes in CNC machines - economics of CNC - maintenance of CNC machines.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students shall be able to:

- CO1: Recognize the evolution, types and principle of CNC machine tools
- CO2: Acquire knowledge on constructional features of CNC machine tools
- CO3: Identify drives and axis measuring system used in CNC machine tools
- CO4: Demonstrate competency in manual part program and generation of CNC part program using CAM packages
- CO5: Elaborate various tooling and work holding devices used in CNC machine tools

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9		0.3		0.6							0.6	0.3	0.6	0.3
2	0.9		0.6		0.6							0.6	0.6	0.6	0.6
3	0.9	0.3	0.3		0.6							0.6	0.3	0.3	0.3
4	0.9	0.9	0.3		0.6							0.6	0.6	0.6	0.6
5	0.9		0.3		0.6						0.3	0.6	0.6	0.6	0.6

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

TEXT BOOKS:

1. HMT, “Mechatronics”, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2017, ISBN-13: 978-0074636435.
2. Mike Mattson., “CNC Programming Principles and Applications”, 2nd Edition, Delmar Cengage learning, United States, 2010, ISBN: 9781418060992.

REFERENCES:

1. Evans K., Polywka J. and Stanley Gabrel. “Programming of CNC Machines”, 4thEdition, Industrial Press Inc., New York, 2016, ISBN: 9780831135249.
2. Jones B.L., “Introduction to Computer Numerical Control”, Pitman, London, 1987.
3. Radhakrishnan P., “Computer Numerical Control Machines and Computer Aided Manufacturing”, New Age International Publishers., United States, 2018, ISBN-13: 978-8122433975.
4. Rao P.N., “CAD/CAM Principles and Applications”, 3rd Edition, Tata McGraw, Hill Publishing Company Limited, New Delhi, 2010, ISBN-13: 978-0070681934.
5. Smid P., “CNC Programming Hand book”, 3rd Edition, Industrial Press Inc., United States, 2008, ISBN-13: 978-0831133474.

MF5611 COMPUTER AIDED MANUFACTURING AND ENGINEERING LABORATORY L T P C
0 0 4 2

COURSE OBJECTIVES:

- To familiarize students with manual CNC part programming for milling and turning machines
- To generate part programs using CNC programming and simulation s/w for CNC Lathe, CNC Milling
- To get hands on experience by machining the parts on actual machines like CNC Lathe, CNC milling machine and CNC Wire EDM
- To introduce robot programming method
- To present the concept of printing parts using additive manufacturing

LIST OF EXPERIMENTS:

1. Study of different CNC control systems and CNC codes.
2. Programming and simulation for turning, taper turning, circular interpolation, thread cutting, facing and parting operations.
3. Programming and simulation using Canned cycles for CNC Lathe.
4. Programming and simulation for machining of internal surfaces in CNC Lathe.
5. Programming and simulation for 3D profile milling, drilling, rigid tapping, boring operation.
6. Programming and simulation for circular and rectangular pocket milling.
7. Programming using canned cycles for CNC Milling machine.
8. CNC code generation using machine simulation / CAM software packages – CNC Lathe.
9. CNC code generation using simulation / CAM software packages - CNC Milling machine / Machining centre.
10. Programming for CNC Wire cut EDM.
11. Robot programming for Material handling applications.
12. Understanding assembly, polishing and palletizing for different types of robots using software.
13. Experiment on extrusion based 3D printing machine

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students shall be able to:

- CO1: Display competency in manual CNC part programming for milling and turning machines
- CO2: Exhibit generation of part programs using CNC programming and simulation s/w for CNC Lathe, CNC Milling
- CO3: Demonstrate machining the parts on actual machines CNC Lathe, CNC Milling Machine and CNC Wire EDM.
- CO4: Describe the Robot programming methods
- CO5: Acquire knowledge on printing parts using additive manufacturing

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.3				0.9							0.3	0.6		
2	0.6				0.9							0.3	0.6		
3	0.3				0.9							0.3	0.6		
4	0.9				0.9							0.3	0.6	0.3	
5	0.9				0.9							0.3	0.6	0.3	0.3

LIST OF EQUIPMENTS REQUIRED:

1. Computers - 30.
2. CNC programming and machine simulation software for turning and milling.
3. CAM software for turning and for milling - for automatic code generation of Lathe, Mill and Wire cut EDM.
4. CNC Production type turning centre.
5. CNC Machining centre-3 axes.
6. CNC Wire Cut EDM.
7. 3D scanner with s/w.
8. Ariticulate Robot.
9. Extrusion based additive manufacturing machine

MF5612 ADVANCED MANUFACTURING LABORATORY L T P C
0 0 4 2

COURSE OBJECTIVES:

- To familiarize the students with advanced machine tools.
- To familiarize the students with extrusion based additive manufacturing
- To acquaint the students with traditional and nontraditional machining process
- To introduce the manufacture of polymer composites.
- To introduce the concepts of Thin film based deposition process.

Simple exercises using the following machines:

1. CNC Turning Centre
2. CNC Wire cut EDM
3. 5 Axis CNC Machining Centre
4. Abrasive Waterjet Machine (AWJM)
5. Extrusion based additive manufacturing
6. Micro machining of 3D parts using mechanical micro machining system
7. Electro Chemical Micro Machine (ECMM)
8. Resin Transfer Moulding System
9. Physical Vapor Deposition Unit (PVD)

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students shall be able to:

- CO1: Acquire knowledge on advanced machine tools.
- CO2: Demonstrate extrusion based additive manufacturing.
- CO3: Discuss traditional and nontraditional machining process.
- CO4: Demonstrate the manufacture of polymer composites.
- CO5: Value thin film based deposition process.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9		0.6	0.9	0.9		0.3		0.6			0.6	0.6	0.6	0.9
2	0.9		0.6	0.9	0.9		0.3		0.6			0.6	0.6	0.6	0.9
3	0.9		0.6	0.9	0.9		0.3		0.6			0.6	0.6	0.6	0.6
4	0.9		0.6	0.9	0.9		0.3		0.6			0.6	0.6	0.6	0.6
5	0.9		0.6	0.9	0.9		0.3		0.6			0.6	0.6	0.6	0.6

MF5701 MANUFACTURING MANAGEMENT SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce Students to the latest trends in manufacturing planning and control System
- To gain knowledge on design of forecasting systems and different forecasting methods
- To impart the basic concepts of resource requirements
- To outline the need and approaches to computer aided process planning
- To familiarize the functions of shop floor control and associated systems.

UNIT I MANUFACTURING PLANNING AND CONTROL 9

Basic concepts – Types of Production System – Functions of Production Planning and Control – Problems with Production Planning and Control – Computer Integrated Production Management System – Evolution of the Manufacturing Planning and Control (MPC) System-Demand Management in MPC System and the MPC Environment: Make-to-stock, Assemble-to-order, Make-to-order, Engineer-to-order.

UNIT II FORECASTING 9

Forecasting –Time Horizon – Design of Forecasting Systems – Developing the Forecast Logic – Forecasting Methods – Single and Double Moving Average Methods, Single and Double Exponential Smoothing Methods, Simple Regression Method of Forecasting –Measure of Forecast Accuracy.

UNIT III RESOURCE PLANNING 9

Basic Concepts of Material Requirement Planning (MRP)– Inputs to the MRP System: Master Production Schedule, Bill of Materials, Inventory Record File – MRP Logic – Gross Requirements, Net requirements, Lot Sizing – Capacity Requirement Planning (CRP) – Distribution Resource Planning (DRP) – Manufacturing Resource Planning (MRP II) –Enterprise Resource Planning (ERP).

UNIT IV COMPUTER AIDED PROCESS PLANNING 9

Need for Process Planning – Functions of Process Planning – Approaches to Computer Aided Process Planning (CAPP) – Variant Process Planning :Group Technology, Part Family Search – Generative method of CAPP:Input Format – Part Description Methods– Computer Aided Design (CAD) Models – Decision Logic – Artificial Intelligence – Knowledge Representation – Forward and Backward Planning – Databases and Algorithms – Expert Process Planning - Automatic Process Planning – Future Trends–Case Studies.

UNIT V SHOP FLOOR CONTROL 9

Functions of Shop Floor Control – Order Release – Order Scheduling: Job Sequencing and Priority Rules – Order Progress –Factory Data Collection System –Online and Offline Data Collection Systems – Automatic Identification System.

TOTAL: 45 PERIODS

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

COURSE OUTCOMES:

At the end of this course, the students shall be able to:

- CO1: Be familiarized with the latest trends in manufacturing planning and control System
- CO2: Perceive design of forecasting systems and different forecasting methods
- CO3: Be acquainted with the basic concepts of resource requirements
- CO4: Recognize the need and approaches of computer aided process planning
- CO5: Evaluate the functions of shop floor control and associated systems.

	PO												PSO		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	0.6		0.6		0.6								0.6	0.3	0.3
2	0.6	0.6	0.6		0.6						0.6		0.6	0.6	0.9
3	0.6	0.6	0.6	0.6	0.6						0.6		0.9	0.9	0.9
4	0.6		0.6		0.6								0.6	0.9	0.9
5	0.6		0.6		0.6								0.6	0.3	0.6

TEXT BOOKS

1. Groover M.P., “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall of India., 2016, ISBN-13: 978-9332572492.
2. Thomas E. Vollmann, William Lee Berry, David Clay Whybark and F. Robert Jacobs, “Manufacturing Planning and Control Systems for Supply Chain Management” , MCGraw Hill., United States, 2014, ISBN: 9789339205331.

REFERENCES

1. Chand T.C., “Expert process planning for manufacturing”, Addison Wesley publishing company., United States, 1990, ISBN-13: 978-0201182972.
2. Groover M. and Zimmers E., “CAD/CAM, Computer Aided Design and Manufacturing”, Prentice Hall of India., Reprint 2013, ISBN-13: 978-0131101302.
3. Mahadevan .B, "Operations Management: Theory and practice", Pearson., United Kingdom, 2015, ISBN-13: 978-9332547520.
4. Mahapatra, P.B.,” Computer-Aided Production Management”, Prentice-Hall of India Pvt. Limited., 2004, ISBN-13: 978-8120317420.
5. Nanua Singh, "System Approach to Computer Integrated Design and Manufacturing", Wiley India Edition., Reprint 2011, ISBN-13: 978-0471585176.

ONLINE COURSE MATERIALS

1. Course Material from NPTEL: http://nptel.ac.in/courses/112102101/
2. MIT Courseware: http://ocw.mit.edu/courses/mechanical-engineering/2-158j-computational-geometry-spring-2003.

ME5752 **MECHATRONICS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. Selecting sensors to develop mechatronics systems.
2. Explaining the architecture and timing diagram of microprocessor, and also interpret and develop programs.
3. Designing appropriate interfacing circuits to connect I/O devices with microprocessor.
4. Applying PLC as a controller in mechatronics system.
5. Designing and develop the apt mechatronics system for an application.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT I INTRODUCTION AND SENSORS 9

Introduction to Mechatronics – Systems – 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.

UNIT II 8085 MICROPROCESSOR 9

Introduction – Pin Configuration - Architecture of 8085 – Addressing Modes – Instruction set, Timing diagram of 8085.

UNIT III PROGRAMMABLE PERIPHERAL INTERFACE 9

Introduction – Architecture of 8255, Keyboard Interfacing, LED display – Interfacing, ADC and DAC Interface, Temperature Control – Stepper Motor Control – Traffic Control Interface.

UNIT IV PROGRAMMABLE LOGIC CONTROLLER 9

Introduction – Architecture – Input / Output Processing – Programming with Timers, Counters and Internal relays – Data Handling – Selection of PLC.

UNIT V ACTUATORS AND MECHATRONICS SYSTEM DESIGN 9

Types of Stepper and Servo motors – Construction – Working Principle – Characteristics, Stages of Mechatronics Design Process – Comparison of Traditional and Mechatronics Design Concepts with Examples – Case studies of Mechatronics Systems – Pick and Place Robot – Engine Management system – Automatic Car Park Barrier.

TOTAL = 45 PERIODS

COURSE OUTCOMES:

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

1. Select sensors to develop mechatronics systems.
2. Explain the architecture and timing diagram of microprocessor, and also interpret and develop programs.
3. Design appropriate interfacing circuits to connect I/O devices with microprocessor.
4. Apply PLC as a controller in mechatronics system.
5. Design and develop the apt mechatronics system for an application.

TEXT BOOKS:

1. Bolton W., “Mechatronics”, Pearson Education, 6th Edition, 2015.
2. Ramesh S Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085”, Penram International Publishing Private Limited, 6th Edition, 2013.

REFERENCES:

1. Bradley D.A., Dawson D., Buru N.C. and Loader A.J., “Mechatronics”, Chapman and Hall, 1993.
2. Davis G.Alciatore and Michael B.Histand, “Introduction to Mechatronics and Measurement systems”, McGraw Hill Education, 2011.
3. Devadas Shetty and Richard A. Kolk, “Mechatronics Systems Design”, Cengage Learning, 2010.
4. Nitaigour Premchand Mahalik, “Mechatronics Principles, Concepts and Applications”, McGraw Hill Education, 2015.
5. Smaili.A and Mrad.F, “Mechatronics Integrated Technologies for Intelligent Machines”, Oxford University Press, 2007.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9	0.6											0.9		
2	0.9				0.9								0.9		
3	0.9		0.9										0.9		
4	0.9	0.6			0.9									0.9	
5	0.9								0.9						0.9

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

ME5451 **HYDRAULICS AND PNEUMATICS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Applying the working principles of fluid power systems and hydraulic pumps.
2. Applying the working principles of hydraulic actuators and control components.
3. Designing and develop hydraulic circuits and systems.
4. Applying the working principles of pneumatic power system and its components.
5. Solving problems and troubles in fluid power systems.

UNIT I FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS 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

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

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.

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

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. Design of Pneumatic circuits for metal working, handling, clamping counter and timer circuits. – Low cost Automation – Hydraulic and Pneumatic power packs.

TOTAL = 45 PERIODS

Note: (Use of standard Design Data Book is permitted in the University examination)

COURSE OUTCOMES: Upon completion of this course, the students will be able to:
1. Apply the working principles of fluid power systems and hydraulic pumps.
2. Apply the working principles of hydraulic actuators and control components.
3. Design and develop hydraulic circuits and systems.
4. Apply the working principles of pneumatic power system and its components.
5. Solve problems and troubles in fluid power systems.

TEXT BOOKS:
Attested
1. Anthony Esposito, "Fluid Power with Applications", Prentice Hall, 2009.
2. James A. Sullivan, "Fluid Power Theory and Applications", Fourth Edition, Prentice Hall, 1997

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

REFERENCES:

1. Jagadeesha. T., “Pneumatics Concepts, Design and Applications “, Universities Press, 2015.
2. Joshi.P., Pneumatic Control”, Wiley India, 2008.
3. Majumdar, S.R., “Oil Hydraulics Systems – Principles and Maintenance”,TataMcGraw Hill, 2001.
4. Shanmugasundaram.K., “Hydraulic and Pneumatic Controls”. Chand & Co, 2006.
5. Srinivasan.R., “Hydraulic and Pneumatic Controls”, Vijay Nicole Imprints, 2008.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.6	0.3		0.3								0.3	0.6		
2	0.6	0.3	0.3	0.3									0.6		
3	0.6	0.3	0.3	0.3									0.6		
4	0.6	0.3	0.3	0.3									0.6		
5	0.6	0.3	0.3	0.3									0.6		

ME5761 **MECHATRONICS LABORATORY** **L T P C**
0 0 4 2

COURSE OBJECTIVES:

The main learning objective of this course is to provide hands on training to the students in:

1. Measuring of physical quantity such as displacement, force and temperature, and also the operation of signal conditioning circuits.
2. Applying a suitable sensor and image processing technique for Mechatronics Systems.
3. Designing appropriate circuits to automate and control the Hydraulic, Pneumatic, and Electric actuators.
4. Applying PLC, PID and microcontroller as a control unit in the Mechatronics System.
5. Developing a model of robot by using simulation software, and also execute real-time control over a Robot by IoT.

LIST OF EXPERIMENTS:

1. Design of Signal Conditioning Circuits and Analog Controller: V to I Converter – I to V Converter – Integrator – Differentiator – Instrumentation Amplifier – PID.
2. Experiments on the application of Sensors – LDR, Optocoupler, Ultrasonic, Infrared, Hall effect and MEMS Accelerometer.
3. Measurement of Displacement, Force and Temperature using Transducers and Data Acquisition System (DAQ).
4. Modeling and Analysis of basic Hydraulic, Pneumatic, Electro-Pneumatic, Electrical and Electronic Circuits by using simulation software.
5. Actuation of double acting cylinder by using Hydraulic, Pneumatic and Electro-Pneumatic circuits.
6. Automating the cylinder sequence A+B+B-A- by using Microcontroller.
7. PLC Automation with Timers and Counters – Cylinder Sequencing – Sorting of Objects on Conveyor Belt.
8. DC Drives – Speed and Direction Control by using Microcontroller.
9. AC Drives – Speed and Direction Control by using Microcontroller.
10. Stepper Motor – Position, Speed and Direction Control.
11. Servo Motor – Position, Speed and Direction Control.
12. Automatic Temperature Control System – Interfacing of temperature sensor, cooling system (Fan), LCD Display with Microcontroller.
13. Modeling and Analysis of Robot by using Simulation Software.
14. Experiments on Six-Axis Articulated Robot – Material Handling Application.
15. Actuation and control of Robot by using Internet of Things (IoT).
16. Experiments on the application of Image Processing – Machine Vision System – Robot Vision System.

TOTAL = 60 PERIODS

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

COURSE OUTCOMES:

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

1. Measure of physical quantity such as displacement, force and temperature, and also the operation of signal conditioning circuits.
2. Apply a suitable sensor and image processing technique for Mechatronics Systems.
3. Design appropriate circuits to automate and control the Hydraulic, Pneumatic, and Electric actuators.
4. Apply PLC, PID and microcontroller as a control unit in the Mechatronics System.
5. Develop a model of robot by using simulation software, and also execute real-time control over a Robot by IoT.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9	0.6											0.9		
2	0.9			0.9									0.9		
3	0.9		0.9										0.9		
4	0.9				0.9									0.9	
5	0.9								0.9						0.9

MF5711 **PROJECT I** **L T P C**
0 0 6 3

COURSE OBJECTIVES:

- To apply the knowledge of science and engineering fundamentals for the solution of complex engineering problems.
- To identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using engineering science.
- To design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
- To identify the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge and need for sustainable development.
- To demonstrate knowledge while understanding the engineering principles, and apply them to one's own work, as a member and as a leader in a team; manage the projects in multidisciplinary environments.

Each and every student may choose a nagging workplace problem, research problems and socially relevant problems that have been difficult for them to solve. At the end of the semester, they have to submit a report for evaluation.

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 jointly by external and internal examiners constituted by the Head of the Department based on oral presentation and the project report.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students shall be able to:

- CO1: Explore the variables that affect creativity and innovation.
- CO2: Identify the concepts to relevant research problems or practical applications
- CO3: Design and fabricate the creative and innovative ideas into working model using principles of engineering science
- CO4: Enhance professional skills to communicate in both oral and written forms and be proficient in working in diverse teams of individuals
- CO5: Recognize the importance of leadership skills.

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1			0.9						0.9				0.9		
2	0.6													0.9	
3	0.9		0.9						0.9	0.9				0.9	
4															0.9
5									0.9						0.9

MF5811 **PROJECT II** **L T P C**
0 0 16 8

COURSE 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.
- To develop good communication skills and team work.
- To familiarize students with real life situations
- To accelerate learning process

A project topic must be selected by the students in consultation with their guides. The aim of the project work is to deepen comprehension of principles by applying them to a new problem which may be the design and fabrication of a device for a specific application, a research project with a focus on an application needed by the industry/society, a computer project, a management project or a design project.
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 jointly by external and internal examiners constituted by the Head of the Department based on oral presentation and the project report.

TOTAL: 300 PERIODS

COURSE OUTCOMES:

At the end of this course, the students should be able to:

- CO1: Manage the selection and initiation of individual projects and of portfolios of projects in the enterprise.
- CO2: Demonstrate a strong working knowledge of ethics and professional responsibility.
- CO3: Conduct project planning activities that accurately forecast project costs, timelines, and quality.
- CO4: Implement processes for successful resource, communication, and risk and change management.
- CO5: Demonstrate effective organizational leadership and change management skills for projects and project teams.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1		0.9	0.9	0.6								0.3	0.9		
2					0.3			0.9				0.3	0.3	0.3	
3					0.3						0.9	0.3		0.9	
4							0.3			0.9	0.3	0.3		0.6	
5						0.3		0.3	0.9			0.3			

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

MF5071 **PROCESSING OF PLASTICS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To introduce types of plastics and properties
- To equip the students with the knowledge of processes utilized in developing materials or making components using plastics
- To introduce joining and machining of plastics
- To impart knowledge in preparation of polymer composites.
- To develop the competence in major industrially practiced plastic processing techniques with sustainability.

UNIT I INTRODUCTION TO PLASTICS 9

Introduction to polymers and plastics-Plastics- -Glass thermal properties-Mechanical Properties – Rheological properties- Additives, colourants and fillers- Classification -–Thermoplastics: Acrylic, ABS. Nylon, PLA, Polycarbonate, Polyethylene, Polypropylene, Polystyrene, Polyvinyl chloride, Teflon-Thermosets: Polyester, Polyurethanes, Bakelite, Duroplast, Urea-formaldehyde foam, Epoxy ,Polyimides, Furan resins ,Silicone- Properties and applications.

UNIT II PROCESSING OF THERMOPLASTICS AND THERMOSETS 9

Principle, advantages, disadvantages and applications- Processing of thermoplastics :Extrusion, Injection Molding, Blow moulding, Rotational Molding, Calendaring, Film Blowing Thermoforming, Foaming- -Processing of thermosets: Compression Molding, Transfer Molding, Injection Molding, Jet Moulding, Liquid Resin Molding, Resin Transfer Molding(RTM), Reaction Injection Molding (RIM). Rotational Molding (Rotomolding), Laminated plastics-Casting-Powder coating processes.

UNIT III JOINING AND MACHINING OF PLASTICS 9

Mechanical fastening- Press Fit-snap fit - Adhesive bonding : Theories of Adhesion- Thermal welding : Direct thermal welding processes: Heated tool welding, Hot gas welding- Indirect Thermal welding processes: Friction or spin welding, Induction welding, Ultrasonic and vibration welding, Dielectric welding- Solvent cementing-Machining of plastics.

UNIT IV REINFORCED PLASTICS 9

Reinforced plastics (Composites) - Hand layup – Sprayup- Vaccum and Pressure bag moulding-Matched die molding. -Continuous laminating - Pultrusion - Injection molding- Filament winding - Prepregs -Sheet molding compound -Bulk molding compound- - principle, advantages, disadvantages and applications.

UNIT V SUSTAINABLE PLASTICS 9

Polymer Products: case Studies-Sustainability: Overview-Survey of polymer waste disposal methods- Recycling: Identical products, Low demand products-Recycling and reclamation equipments-Depolymerisation-Incineration-Biodegradability-Source Reduction.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students shall be able to

- CO1: Identify various processing methods used for different types of plastics and their useful properties in daily life.
- CO2: Select suitable process for application requirements.
- CO3: Select various machining variables used for joining and machining plastic components.
- CO4: Select suitable process for polymer matrix composites.
- CO5: Be concerned with sustainable practice and its requirement

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.6												0.9	0.6	0.6
2	0.6												0.9	0.6	0.9
3	0.6												0.9	0.6	0.9
4	0.6	0.6	0.6	0.6	0.6		0.6						0.9	0.6	0.9
5	0.6	0.6	0.6	0.6	0.6		0.9						0.9	0.9	0.9

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

TEXT BOOKS:

1. Belofsky K., Plastics: "Product Design and Process Engineering" Hanser Gardner Publications., United States, 1995, ISBN: 9781569901427,1-56990-142-2,1-56990-179-1,3-446-17417-6,3-446-18155-5.
2. Charles A. Harper , "Handbook of Plastics Technologies: The Complete Guide to Properties and Performance", 2nd Edition, McGraw-Hill Education., United States, 2006.ISBN: 0071460683, 978-0071460682.

REFERENCES:

1. David H. Morton-Jones and John W. Ellis, "Polymer Products Design, Materials and Processing",1st Edition, Chapman and Hall., United Kingdom, 1986, ISBN-13: 978-94-010-8320-1e-ISBN-13: 978-94-009-4101-4.
2. Joseph P. Greene, "Sustainable Plastics: Environmental Assessments of Biobased, Biodegradable, and Recycled Plastics",1st Edition, John Wiley & Sons Ltd, United States, 2014,ISBN: 978-1-118-10481-1.
3. Kobyashi A., "Machining of Plastics",1st edition, Mc-Graw Hill. United States 1981,ISBN 0070352666 , 9780070352667.
4. Muccio E.A., "Plastics processing technology" ,1st edition, ASM International., United States 1994. ISBN: 0871704943, 978-0871704948.
5. NIIR Board, "Polymers and Plastics Technology Handbook" ,1st edition, Asia Pacific Business Press Inc., India ,2004, ISBN 8178330768, 9788178330761.

PR5072 PRODUCTION OF AUTOMOTIVE COMPONENTS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To impart knowledge in various manufacturing methods in developing automotive components.
- To study the concepts of automobile engineering.
- To impart the knowledge in various parts of automotive engine.
- To understand the concepts of fuel and transmission system.
- To learn the recent developments in automobile industries.

UNIT I ENGINE 9

Working principle of two strokes, four stroke and wankel engines – wet and dry liners – Piston and Piston rings – types – classification. Production of Cylinder block, Cylinder head, liners, oil pan, piston and piston rings and testing.

UNIT II ENGINE COMPONENTS 9

Working principle of crank shaft – Cam shaft – valve operating mechanisms – carburetors - spark plug– connecting rod - Production of Connecting rod , Crankshaft , push rod and rocker arm ,valves, tappets , carburetors and spark plugs.

UNIT III FUEL AND TRANSMISSION SYSTEM 9

Working principle of – Fuel pumps – fuel injection pumps of diesel engines – multi point fuel injection system – Gear Box – clutch system – differential mechanism – steering system – braking system. Production of Friction lining materials for clutch and brakes, propeller shaft, gear box housing, steering column, Energy absorbing steering column.

UNIT IV CHASSIS AND SUSPENSION SYSTEM 9

Working principle of – Suspension system – leaf spring and shock absorbers – wheel housing – design concepts of chassis (aerodynamics and cross worthiness) - Production of Brake shoes, leaf spring, wheel disc, wheel rim –usage of non-metallic materials for chassis components.

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT V RECENT ADVANCEMENTS 9

Application of sensors and actuators – Emission control system – catalytic converter – Hydro forming of exhaust manifold and lamp housing – stretch forming of Auto body panels – MMC liners – thermal barrier coating of Engine head and valves – Selection of materials for Auto components – sensors and actuators- exhaust gas recycler (EGR)

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, students will be able to:

CO1: Acquire knowledge of production of various automotive components.
CO2: Learn the working principles of engines.
CO3: Get knowledge about various engine components.
CO4: Learn working of Fuel and Transmission System and its types.
CO5: Acquire knowledge of recent development in automobile industries.

TEXT BOOKS:

1. Hiroshi yamagata, "The Science and Technology of materials in Automotive Engines", CRC Press Word head publishing Limited, Cambridge, England, 2005.
2. Mohamed A.Omar, "The Automotive Body Manufacturing System and Processes", John Wiley Publications, USA, 2011.

REFERENCES:

1. Brian Cantor, "Automotive Engineering", CRC Press ,Taylor and Francis Group, London, 2008.
2. Garrett. T.K., Newton. K., Steeds. W.,"The Motor Vehicle ",Butterworth-Heinemann, 13th edition, 2001
3. Kirpal Singh, "Automobile Engineering.,Vol.Iand II", Standard Publishers, New Delhi,13th edition,2012.
4. SeropeKalpakjian and Steven R. Schmid, "Manufacturing Processes for Engineering Materials", Fourth Edition – Pearson Education publications, 2003.
5. V Ganesan, "Internal Combustion Engines", Tata McGraw Hill Publications, 4th Edition, 2017.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	✓		✓				✓	✓				✓	
CO2	✓		✓				✓	✓				✓	
CO3	✓		✓				✓	✓				✓	
CO4	✓		✓				✓	✓				✓	
CO5	✓		✓				✓	✓				✓	

PROGRESS THROUGH KNOWLEDGE

ME5071 AUTOMOBILE ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES: The main learning objective of this course is to prepare the students for:

1. Explaining various types of automobiles, their power packs and types of vehicle bodies.
2. Analyzing the various types of power train and fuel supply and management systems.
3. Analyzing the various types of transmission systems for a vehicle.
4. Analyzing the working parameters of various braking and suspension system in a vehicle.
5. Analyzing the working parameters of various electrical and electronic devices in a vehicle

UNIT I INTRODUCTION TO AUTOMOBILE AND TYPES 9

An overview of different types of automobiles and their power sources. Specifications, Performance Parameters, Types of power delivery, Safety standards, Trends in automobile design. Two and Types, Regulations, Car body construction. Bus Body Details, General consideration relating to chassis layout. Introduction to MV Act, Pollution Norms,

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT II POWERTRAIN AND FUEL MANAGEMENT SYSTEMS 9

Reciprocating Engine systems, Hybrid systems. Pollutant emissions and their control; Catalytic converter systems, Electronic Engine Management systems for SI and CI engines. Liquid and gaseous alternate fuels - Alcohol, LPG, CNG, and Hydrogen

UNIT III CLUTCH AND TRANSMISSION SYSTEMS 9

Clutch system and types, Gear box and types - manual, automatic, and AMT, propeller shafting, Differential, Axles - function, and types, Wheels, Tyres - types, construction and specification, suspension system - types and functioning,

UNIT IV BRAKING AND SUSPENSION SYSTEMS 9

Braking system - requirements and types, Steering system - working, types and steering geometry parameters. Wheel balancing & Alignment Wind Tunnel testing, Servicing of Vehicles,

UNIT V ELECTRICAL AND ELECTRONIC SYSTEMS 9

Introduction to Battery, Alternator, and Starter Motor systems, working principle, and circuitry, Safety systems - seat belts, air-bag, ABS, Modern electronic features in vehicles like tyre pressure monitoring, ESP, EBD, Automatic headlamp ON, Rain sensing wipers, speed sensing auto locking, OBD. HVAC system

TOTAL = 45 PERIODS

COURSE OUTCOMES:

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

1. Explain various types of automobiles, their power packs and types of vehicle bodies.
2. Analyze the various types of power train and fuel supply and management systems.
3. Analyze the various types of transmission systems for a vehicle.
4. Analyze the working parameters of various braking and suspension system in a vehicle.
5. Analyze the working parameters of various electrical and electronic devices in a vehicle.

TEXT BOOKS:

1. Jack Erjavek, “Automotive Technology – A Systems Approach”, Thomson Learning, 3rdEdition, 1999.
2. William H. Crouse and Donald L. Anglin, “Automotive Mechanics”, Tata McGraw Hill, 10thEdition, 2004.

REFERENCES:

1. Gill P.S., “A Textbook of Automobile Engineering – Vol. I , II and III”, S.K. Kataria and Sons, 2ndEdition, 2012.
2. Giri, N.K., “Automotive Technology”, Khanna Publishers, 2ndEdition, 2002.
3. Kirpal Singh, Automobile Engineering Volume I and II, Standard Publishers &Distributors, 14th Edition, 2017.
4. Kumar D.S., “Automobile Engineering”, S.K. Kataria and Sons, 2ndEdition, 2017.
5. Robert Bosch GmbH, “Automotive Handbook”, Robert Bosch, 2004.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9	0.3	0.3	0.3			0.3					0.3	0.6		0.3
2	0.9	0.3	0.3	0.3			0.3					0.3	0.6		0.3
3	0.9	0.3	0.3	0.3			0.3					0.3	0.6		0.3
4	0.9	0.3	0.3	0.3			0.3					0.3	0.6		0.3
5	0.9	0.3	0.3	0.3			0.3					0.3	0.6		0.3

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

ME5074 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS L T P C
3 0 0 3

COURSE OBJECTIVES: The main learning objective of this course is to prepare the students for:

1. Applying the principles of locating and clamping in Jigs and fixtures and various components related to Press tools.
2. Designing various types of Jigs for given components and draw multiple views of the same with dimensions and parts List.
3. Designing various types of Fixtures for given components and draw multiple views of the same with dimensions and parts List.
4. Designing various parts of cutting dies and draw the standard dimensioned views.
5. Designing various parts of forming dies and draw the standard dimensioned views.

UNIT I PRINCIPLES OF JIGS, FIXTURES AND PRESS WORKING 9

Objectives and importance of tool design—work holding devices- Basic elements of jigs and fixtures- location – clamping-indexing-operational chart-Fits and Tolerances Tools for press working- Press Working Terminologies –cutting and non cutting operations – Types of presses – press accessories – Computation of press capacity – Strip layout – Material Utilization – Shearing action – Clearances – Press Work Materials – Center of pressure– knockouts – direct and indirect – pressure pads – Ejectors- Die Block – Punch holder, Die set, 103 guide plates – Stops – Strippers – Pilots – Selection of Standard parts –Recent trends in tooling recent trends in tool design- computer Aids for sheet metal forming Analysis – basic introduction - tooling for numerically controlled machines- setup reduction for work holding – Single minute exchange of dies-Poka Yoke.

UNIT II JIGS 9

Design and development of jigs for given component - Types of Jigs – Post, Turnover, Channel, latch, box, pot, angular post jigs – Indexing jigs

UNIT III FIXTURES 9

Design and development of fixtures for given component- General principles of milling, Lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures – Modular fixturing systems- Quick change fixtures

UNIT IV DESIGN OF CUTTING DIES 9

Complete design and preparation of standard views of simple blanking, piercing, compound and progressive dies -fine Blanking dies

UNITV DESIGN OF BENDING, FORMING, DRAWING AND MISCELLANEOUS DIES 9

Difference between bending forming and drawing – Blank development for above operations – Types of Bending dies – Press capacity – Spring back– Variables affecting Metal flow in drawing operations – draw die inserts – draw beads- ironing – Design and development of bending, forming, drawing, reverse redrawing and combination dies – Blank development for axisymmetric, rectangular and elliptic parts – Single and double action dies

TOTAL = 45 PERIODS

COURSE OUTCOMES:

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

1. Apply the principles of locating and clamping in Jigs and fixtures and various components related to Press tools.
2. Design various types of Jigs for given components and draw multiple views of the same with dimensions and parts List.
3. Design various types of Fixtures for given components and draw multiple views of the same with dimensions and parts List.
4. Design various parts of cutting dies and draw the standard dimensioned views.
5. Design various parts of forming dies and draw the standard dimensioned views.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

TEXT BOOKS:

1. Joshi, P.H. “Jigs and Fixtures”, Second Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2010.
2. Joshi P.H “Press tools - Design and Construction”, S. Chand & Co Ltd. 2001.

REFERENCES:

1. “ASTME – Fundamentals of tool design”, Prentice Hall of India, 1984.
2. Donaldson, Lecain and Goold, “Tool Design”, Tata McGraw Hill, 2000.
3. Hoffman “Jigs and Fixture Design” – Thomson Delmar Learning, Singapore, 2004.
4. Kempster, “Jigs and Fixture Design”, Hoddes and Stoughton, 1974.
5. K. Venkataraman, “Design of Jigs Fixtures & Press Tools”, Anne Publications, 2015.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9	0.6	0.9		0.3							0.3	0.9	0.9	0.9
2	0.9	0.6	0.9		0.3							0.3	0.9	0.9	0.9
3	0.9	0.9	0.9		0.3							0.3	0.9	0.6	0.9
4	0.9	0.9	0.9		0.3							0.3	0.9	0.6	0.3
5	0.9	0.6	0.9		0.3							0.3	0.6	0.9	0.6

PR5071 PROCESSING OF PLASTICS AND POLYMERS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To expose the students to the basics of plastics and their applications.
- To expose the students to the basics of polymers and their applications.
- To impart knowledge about various plastic and polymer processing techniques.
- To enlighten the students about the various polymer mixing and blending techniques.
- To impart knowledge about various properties of polymers and its testing methods.

UNIT I INTRODUCTION TO PLASTICS 9

Plastics – Classification – Structure – Properties of Thermo plastics – Properties of Thermosetting Plastics – Engineering Plastics, Specialty Plastics and High temperature plastics. Properties and application of Epoxy, polyester, PMMA, PEEK, Poly propylene, polymide, phenolics, polyetherimide – Merits and Disadvantages.

UNIT II INTRODUCTION TO POLYMERS 9

Chemistry and Classification of Polymers – Glass transition temperature, thermal expansion and its effects, molecular weight, stress strain behaviour. Types of polymers - plastics and rubbers . Applications of various types of polymers.

UNIT III PROCESSING OF PLASTICS AND POLYMERS 9

Extrusion - Injection Moulding –Thermoforming – Compression moulding - Transfer moulding – Blow molding - reaction injection molding - pultrusion – calendaring - rotational molding - Rubber processing in two-roll mill, internal mixer.

UNIT IV POLYMER MIXING AND BLENDING 9

Introduction - mechanism of mixing and dispersion - mixing of solid-solid - liquid-liquid and liquids-solids - dispersive mixing distributive mixing - laminar mixing - overview of polymer mixing and blending machinery.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT V POLYMER TESTING 9

Mechanical-static and dynamic: tensile, flexural, compressive, abrasion, endurance, fatigue, hardness, tears, resilience, impact, toughness. Conductivity-thermal and electrical, dielectric constant, dissipation factor, power factor, electric resistance, Surface resistivity, volume resistivity, swelling, ageing resistance, environmental stress, Cracking resistance.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, students will be able to:

CO1: acquire knowledge of plastics and their applications are well known to the students.
CO2: acquire knowledge of polymers and their applications are well known to the students.
CO3: acquire knowledge of uses and techniques of plastics and polymer processing are well known to the students.
CO4: expose about various polymer mixing and blending techniques is well known to the students.
CO5: collect Information of various properties of polymers and its testing methods are well known to the students.

TEXT BOOKS:

1. Brent Strong. A,"Plastics Materials and Processing", Pearson Prentice Hall, Inc., New Jersey, 3rd Edition, 2005.
2. Jean-Michel Charrier, "Polymer materials and Processing: Plastics, Elastomers, and Composites" ,Hanser Publishing, Munich Vienna New York, 1990.

REFERENCES:

1. Krishan K Chawla, "Composite Material Science and Engineering", Third Edition, Springer, 2013.
2. Horald Belofsky, "Plastics Product design and Process Engineering", Hanser Publications, 2002.
3. Charles A.Harper,"ModernPlasticsHandBook",McGraw-Hill,NewYork,2000.
4. Anand. J.S, "Applications of Plastics", CIPET,Chennai,1997.
5. B.R. Gupta, "Polymer Processing Technology", Asian Books Pvt. Ltd, 2008

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	✓			✓	✓	✓	✓	✓				✓	
CO2	✓			✓	✓	✓	✓	✓				✓	
CO3	✓			✓	✓	✓	✓	✓				✓	
CO4	✓			✓	✓	✓	✓	✓				✓	
CO5	✓			✓	✓	✓	✓	✓				✓	

GE5076 PROFESSIONAL ETHICS IN ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES:

- Identify the core values that shape the ethical behavior of an engineer.
- Utilize opportunities to explore one's own values in ethical issues.
- Become aware of ethical concerns and conflicts.
- Enhance familiarity with codes of conduct.
- Increase the ability to recognize and resolve ethical dilemmas.

UNIT I 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 – Professions and Professionalism - Professional Ideals and Virtues – Uses of Ethical Theories.

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT II ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics - Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study

UNIT III ENGINEER'S RESPONSIBILITY FOR SAFETY 9

Safety and Risk – Assessment of Safety and Risk – Risk Analysis – Reducing Risk – The Government Regulator's Approach to Risk - l Case Studies Chernoby and Bhopal

UNIT IV RESPONSIBILITIES AND RIGHTS 9

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) - Discrimination

UNIT V GLOBAL ISSUES 9

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers –Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students should be able to:

CO1: Use ethical theories in the professional life
CO2: Do social experimentation with engineering approaches
CO3: Follow safety norms in the engineering practices
CO4: Confidence in their approaches and claim their rights
CO5: Take moral leadership with the knowledge in global practices

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1								✓		✓		✓
CO2						✓		✓				✓
CO3								✓				✓
CO4								✓				
CO5								✓	✓			✓

TEXT BOOKS

1. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics Concepts and Cases", Cengage Learning., Belmont, 2009, ISBN-13: 978-0-495-50279-1 ISBN-10: 0-495-50279-0.
2. Mike Martin and Roland Schinzinger, "Introduction To Engineering Ethics", 2nd Edition McGraw Hill., New York, 2010, ISBN 978-0-07-248311-6—ISBN 0-07-248311-3.

REFERENCES

1. Charles D Fleddermann, "Engineering Ethics", 4th edition, Prentice Hall., New Mexico, Newjersey, 1999, ISBN-13: 978-0-13-214521-3 , ISBN-10: 0-13-214521-9
2. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press,United Kingdom , 2002, ISBN: 9780195143027.
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", 1st edition, Oxford University Press, United Kingdom, 2000, ISBN-13: 978-0195134889, ISBN-10: 0195134885
4. John R Boatright, "Ethics and the Conduct of Business", 8th edition Pearson Education, Boston, 2017,ISBN-10:9789352862306, ISBN-13:978-9352862306
5. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian Perspective", Wiley, 2004, ISBN-10: 8177221671 ISBN -13: 9788177221671.

Noted

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

MF5001 NON DESTRUCTIVE TESTING: THEORY AND PRACTICE L T P C
3 0 0 3

COURSE OBJECTIVES:

- To acquaint the students with the overview of NDT
- To elaborate the concept and procedure for liquid and magnetic penetrant testing and evaluate through practical study
- To introduce the concept and procedure for radiograph testing methods and evaluate through practical study
- To brief the concepts and procedures for Ultrasonic testing methods and their applications
- To impart knowledge in other methods of NDT and electrical method with case study

UNIT I OVERVIEW OF NDT 9

NDT Vs Mechanical testing- Need for NDT- Factors influencing the reliability of NDE – Materials and characterization – Discontinuities in manufacturing processes - visual inspection: Basics, Optical aids - Direct and Indirect VT – Inspection objectives, inspection checkpoints, sampling plan, inspection pattern – classification of indications for acceptance criteria - Codes, Standards and Specifications (ASME,ASTM,AWS etc.)-case study.

UNIT II LIQUID PENETRANT & MAGNETIC INSPECTION 9

Theory: Penetrant systems: Principles - Process - Liquid penetrant materials - Emulsifiers-cleaners developers - sensitivity - Advantages - Interpretation of results - Limitations and Applications. Magnetic methods: Advantages - Limitations - Methods of generating fields: magnetic particles and suspending liquids Magnetograph - field sensitive probes: applications. Measurement of metal properties-Magnetic Barkhausen Noise Analysis (MBN) – advantages and limitations - case study.
Practice: Inspection of welds using - solvent removable visible dye penetrant, fluorescent dye penetrant, Magnetic Particle Testing - Dry method, wet method.

UNIT III RADIOGRAPHIC METHODS 9

Theory: Principles of radiography - sources of radiation - Ionising radiation - sources-X-rays - Alpha - Beta and Gamma rays - Recording of radiation - Radiographic sensitivity - special techniques - Fluoroscopy/Real-time radioscopy - Principle of neutron radiography - attenuation of neutrons - direct and indirect technique - advantages and limitations – Principle and application of in-motion and flash radiography. Radiation safety- Case study.
Practice: Inspection of welded plate by radiographic single wall single image technique- X rays/gamma rays.

UNIT IV ULTRASONIC TESTING 9

Ultrasonic testing: principle – Advantages – disadvantages – Applications - Generation of Ultrasonic waves - general characteristics of ultrasonic waves: methods and instruments for ultrasonic materials testing- Time of Flight Diffraction-case study

UNIT V ELECTRICAL AND OTHER METHODS 9

Electrical methods: Eddy current methods: potential - drop methods, applications- Advanced Methods: Acoustic emission inspection -Leak detection-Thermal inspection- Strain measurement and analysis-case study.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students should be able to:

- CO1: Discuss the basics of NDT and its industrial standards
- CO2: Acquire knowledge on the concept and procedure for liquid and magnetic penetrant testing.
- CO3: Interpret the given mechanical components to inspect using radiograph testing methods techniques
- CO4: Apply ultrasonic techniques based on materials and its application.
- CO5: Describe the applications of electrical and other NDT methods.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9												0.9		
2	0.6				0.9										0.9
3	0.9				0.9										0.9
4	0.6	0.9			0.6								0.9		
5	0.6				0.9									0.6	

TEXT BOOKS:

1. Halmshaw R., "Non Destructive Testing",1st Edition, Edward Arnold Publication., London, 1987.ISBN: 0713136340, 9780713136340.
2. Hull B. and John V., "Non-destructive testing",1st Edition , English Language Book Soc., London, 1989.ISBN: 0333525361, 9780333525364.

REFERENCES:

1. "Non destructive Testing Handbook", Vol. 1-10, 3rd Edition, American Society for Non-Destructive Testing., 2010. ISBN: 978-1-57117-186-3.
2. Hellier C., "Handbook of Non destructive Evaluation", 1st edition, McGraw-Hill Professional., United States, 2001. ISBN: 0070281211, 978-0070281219.
3. Paipetis A.S, Matikas T. E., and Aggelis D. G., "Emerging Technologies in Non-Destructive Testing",1st edition, CRC Press., United States, 2012. ISBN :9780415621311.
4. Ravi Prakash, "Non destructive Testing Techniques", 1st Edition, New Age Science., India, 2009. ISBN: 1906574065, 978-1906574062.

MF5002 INDUSTRIAL ROBOTICS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To familiarize the functions of the basic components of a robot
- To study and to apply the selection and design of various types of end effectors for a robot
- To familiarize the students with the sensors and machine vision for robots
- To impart knowledge in robot kinematics and dynamics
- To acquaint students with the basic robotic intelligence considering robot intelligence and economic analysis.

UNIT I FUNDAMENTALS OF ROBOT 9

Robot - Definition - Laws of Robot- Robot Anatomy –Manipulators, 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 - Material Handling, Processing and Assembly

UNIT II END EFFECTOR 9

Robot Drive systems-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-End effector commands -Design of end effector.

UNIT III SENSORS AND ROBOT MACHINE VISION 9

Requirements of a sensor, Principles and Applications of various types of sensors - contact sensors - touch sensors, position & displacement sensors - potentiometers, encoders, LVDT, pneumatic sensors, force & torque sensors, wrist sensors, joint sensors, tactile array sensors, slip sensors for robot grippers, Proximity & Range sensors, optical sensors, Electro-optical imaging sensors –Advanced sensors for robot-Sensor commands-Robot Machine vision- Training of vision system-Case study

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT IV ROBOT KINEMATICS AND DYNAMICS 9

Forward Kinematics and Inverse Kinematics, Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 & 3 Dimension)- D-H Parameters Co-ordinate reference frame, Velocity and Forces - Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design - Derivations and problems.

UNIT V ROBOT INTELLIGENCE & ECONOMIC ANALYSIS 9

Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands and simple Programs-Other languages-Introduction to Advanced programming- C, C++, python- Artificial Intelligence: Basics – Goals of artificial intelligence - Machine learning-Basics-Cobot-HMI-RGV, AGV: Implementation of Robots in Industries - Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students should be able to:

- CO1: Describe the basic concepts in a robotic system
- CO2: Design an end effector considering the selection and design criteria
- CO3: Recognize the use of sensors and machine vision for robots
- CO4: Acquire knowledge on robot kinematic and dynamic system
- CO5: Discuss the applications of robot intelligence

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9												0.9		
2	0.6				0.6										0.9
3	0.6				0.9								0.9		
4	0.9	0.6			0.9									0.6	
5	0.9				0.9								0.9	0.9	

TEXT BOOKS:

1. King-Sun Fu , C.S.George Lee and Ralph Gonzalez , “Robotics Control, Sensing, Vision and Intelligence”, International Edition, McGraw Hill., United States, 1987. ISBN-10: 0071004211
2. Groover M.P., “Industrial Robotics (SIE): Technology, Programming and Applications”, 2nd edition, McGraw Hill., United States, 2012. ISBN: 9781259006210.

REFERENCES:

1. Abbeel P., “Machine Learning for Robotics”.In: Flach P.A., De Bie T., Cristianini N. (eds) Machine Learning and Knowledge Discovery in Databases. ECML PKDD 2012, Lecture Notes in Computer Science, vol. 7523, Springer, Berlin, Heidelberg, 2012. ISBN: 978-3-642-33459-7, 978-3-642-33460-3.
2. Craig J.J., “Introduction to Robotics Mechanics and Control”, 3rd Edition, Pearson Education, India, 2008, ISBN: 8131718360, 978-8131718360.
3. Deb S.R., “Robotics Technology and Flexible Automation”, 4th Edition, Tata Mc Graw Hill Book Co., United States, 2009, ISBN: 9788120308428
4. Klafter R.D., Chmielewski T.A and Negin M., “Robotic Engineering - An Integrated Approach”, Prentice Hall, United States, 2010. ISBN: 0134687523, 978-0134687520.
5. Koren Y., “Robotics for Engineers”, Mc Graw Hill Book Co., United States, 1992.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IE5551 ENGINEERING QUALITY CONTROL L T P C
3 0 0 3

COURSE OBJECTIVES:

- Developing the basic concepts of quality control procedures.
- Impart knowledge to design and implement Statistical Process control in any industry.
- Design and implement acceptance sampling inspection methods in industry.
- Study the process and machine capability.
- Develop the applications of various charts.

UNIT I QUALITY FUNDAMENTALS 9

Importance of quality- evolution of quality- definitions of quality- dimensions of quality- quality control- quality assurance- areas of quality- quality planning- quality objectives and policies- quality costs- economics of quality- Quality loss function- quality Vs productivity- Quality Vs reliability.

UNIT II CONTROL CHARTS FOR VARIABLES 9

Process variation- preliminary decisions- control limits and their computation- construction and application of X bar, R and S charts - warning and modified control limits- process adjustment for trend- Comparison of process variation with specification limits- O.C. curve for X bar chart.

UNIT III STATISTICAL PROCESS CONTROL 9

Process stability- process capability study using control charts- capability indices- Cp, Cpk and Cpm – capability analysis using histogram and normal probability plot- machine capability study- gauge capability study- setting statistical tolerances for components and assemblies- individual measurement charts- X-chart, moving average and moving range chart, multi-vari chart.

UNIT IV CONTROL CHARTS FOR ATTRIBUTES 9

Limitations of variable control charts- Control charts for fraction non-conforming- p and np charts, variable sample size, operating characteristic function, run length- Control chart for nonconformities (defects)- c, u, ku charts, demerits control chart- applications.

UNIT V ACCEPTANCE SAMPLING 9

Need- economics of sampling- sampling procedure- single and double sampling- O.C. curves- Average outgoing quality- Average sample number- Average total inspection- Multiple and sequential sampling- Standard sampling plans- MIL Standards, Dodge-Roming, IS 2500.

TOTAL: 45 PERIODS

PROGRESS THROUGH KNOWLEDGE

COURSE OUTCOMES:

CO1: Students will become familiar with details of quality costs, economies and planning.
CO2: Control the quality of processes using control charts for variables in manufacturing/service industries.
CO3: Good understanding and in depth knowledge has been imparted in the process capability study.
CO4: Control the occurrence of defects in product or services industries.
CO5: Determination of acceptance sampling procedures are practiced.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓				✓			✓
CO2	✓	✓	✓		✓				✓			✓
CO3	✓	✓	✓		✓				✓			✓
CO4	✓	✓	✓		✓				✓			✓
CO5	✓	✓	✓		✓				✓			✓

TEXT BOOKS:

1. Douglus C. Montgomery, “Introduction to Statistical Quality Control”, Wiley-India, Seventh Edition, 2013.
2. Krishnaiah K.,” Applied Statistical Quality Control and Improvement”, PHI, 2014.

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

REFERENCES:

1. AmitavaMitra, “Fundamentals of Quality Control and Improvement”, Wiley, Third Edition, 2008.
2. Dale H. Besterfield, Quality Control, Pearson Education Asia, Eight Edition, 2008.
3. Eugene L. Grant and Richard S. Leaven Worth, “Statistical Quality Control”, McGraw-Hill Education, Seventh Edition, 2000.

IE5653 RELIABILITY ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES:

- Describe reliability concepts.
- Teach the students in filling the life data into theoretical distribution.
- Teach the students in reliability evaluation of various configuration.
- Describe knowledge in reliability monitoring methods.
- Appraise effectively various techniques to improve reliability of the system.

UNIT I RELIABILITY CONCEPT 9

Reliability definition –Reliability parameters- f(t), F(t) and R(t) functions- Measures of central tendency – Bath tub curve – A priori and posteriori probabilities of failure – Component mortality - Useful life.

UNIT II LIFE DATA ANALYSIS 9

Data classification – Non parametric methods: Ungrouped, Grouped, Complete, Censored data – Time to failure distributions - Survival graphs – Probability plotting: Exponential, Weibull - Goodness of fit tests – -Bartlett's test, KS test, chi-square test.

UNIT III RELIABILITY ESTIMATION 9

Series parallel configurations – Parallel redundancy – m/n system – Complex systems: RBD approach – Baye’s method – Minimal path and cut sets - Fault Tree analysis – Standby system.

UNIT IV RELIABILITY MANAGEMENT 9

Reliability testing: Failure terminated test – Time terminated test – Upper and lower MTBFs – Sequential Testing – Reliability growth monitoring – Reliability allocation.

UNIT V RELIABILITY IMPROVEMENT 9

Analysis of downtime – Repair time distribution – Maintainability prediction – Measures of maintainability – Availability definitions – System Availability – Replacement decisions – Economic life.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Students will be able to conduct failure data analysis.
CO2: Students will be able to estimate reliability of standard systems as well as complex systems.
CO3: Students will be able to explore reliability management tools and techniques.
CO4: Students will be able to contribute in maintainability and availability demonstration programs.
CO5: Students will be able to take decisions on inspection and replacement.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓	✓							
CO2	✓	✓	✓	✓	✓				✓			
CO3	✓	✓	✓	✓	✓				✓		✓	✓
CO4	✓	✓	✓	✓	✓						✓	✓
CO5	✓	✓	✓									

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

TEXT BOOK:

1. Charles E.Ebeling, “An Introduction to Reliability and Maintainability Engineering”, TMH, 2007

REFERENCE:

1. Roy Billington and Ronald N. Allan, “Reliability Evaluation of Engineering Systems”, Springer, 2007.

ME5081 PROCESS PLANNING AND COST ESTIMATION L T P C
3 0 0 3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. Creating a process plan for a given Product.
2. Preparing cost elements for a given product.
3. Allocating overhead to different departments.
4. Estimating cost for the casting and forging products.
5. Analyzing the costs for machining a product.

UNIT I PROCESS PLANNING 9

Defining process planning –Drawing interpretation –Material selection process and methods – Selection of Production Processes from Tables – Selection of Process Parameters from Tables– Factors to be considered in selecting: Processes; Process Sequencing; Operation Sequencing; Equipment & Tool Selection; Tool Holding Devices; Measuring Instruments –Computer Aided Process Planning – Retrieval / Variance CAPP and Generative CAPP - Case Study in Process Planning.

UNIT II FUNDAMENTAL OF ESTIMATING AND ELEMENTS OF COST 9

Concept and Purpose of Estimating, Functions of Estimating Department, Concept of Costing, Costing versus Estimating, Types of Estimates, Importance of Estimates, Estimating Procedure, Cost Estimators and their Qualifications, Principal Constituents in a Cost Estimate – Elements of Cost – Introduction, Material Cost, Labour Cost, Expenses and Cost of Product (Ladder Cost).

UNIT III OVERHEADS AND DEPRECIATION 9

Overheads, Allocation or Distribution of Overhead Cost , Depreciation and Methods to Calculate it, Interest on Capital, Idleness Costs, Repair and Maintenance Cost

UNIT IV ESTIMATION OF CASTING, FORGING & WELDING COSTS 9

Estimation of cost for Casting processes, Welding processes and Forging processes.

UNIT V ESTIMATION OF MACHINING TIME AND COST 9

Estimation of Machining Time and Cost – Lathe operations, Drilling, Milling, Shaping Planing, and Grinding operations.

TOTAL = 45 PERIODS

COURSE OUTCOMES:

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

1. Create a Process Plan for a given Product.
2. Prepare Cost elements for a given Product.
3. Allocate Overhead to different departments.
4. Estimate cost forthCasting and Forging products.
5. Analyze the costs for machining a product.

Attested

TEXT BOOKS:

1. Adithan, M, Process Planning and Cost Estimation, New Age International Publishers, 2007.
2. Peter Scallan, Process planning, The Design/Manufacture Interface, Butterworth-Heinemann, 2003.

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

REFERENCES:

1. Chitale A. K., and Gupta R. C., "Product Design and manufacturing", Prentice Hall of India, New Delhi, 1997.
2. Gideon Halevi, "Process and operation planning", Kluwer academic publishers (Printed ebook), 2003.
3. Narang G.B.S. & Kumar .V, "Production and Costing", Khanna Publishers, 2000.
4. Phillip F. Ostwald & Jairo Munoz, "Manufacturing Processes And Systems", 9th Edition, Wiley student edition, 2002.
5. Robert Creese, Adithan M. &Pabla B. S., "Estimating and Costing for the Metal Manufacturing Industries", Marcel Dekker, 1992.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9	0.9	0.6	0.6								0.3	0.6		
2	0.9	0.9	0.6	0.3							0.3	0.3	0.6		
3	0.9	0.9	0.6	0.6							0.3	0.3	0.6		
4	0.9	0.9	0.6	0.6							0.3	0.3	0.6		
5	0.9	0.9	0.6	0.6							0.3	0.3	0.6		

GE5552 ENGINEERING MANAGEMENT **L T P C**
3 0 0 3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. Explaining basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.
2. Applying various functions of management in professional organization.
3. Applying organizational theory in professional organization.
4. Applying the principles of productivity and operations management in professional organization.
5. Applying modern concepts and marketing in management in professional organization.

UNIT I INTRODUCTION TO MANAGEMENT **9**

Definition and functions of Management - Approaches to the study of Management – Mintzberg's Ten Managerial Roles – Principles of Taylor; Fayol; Weber; Parker – Forms of Organization: Sole Proprietorship; Partnership; Company (Private and Public); Cooperative – Public Sector Vs Corporate Organization – Business Environment: Economic; Social; Political; Legal – Trade Union: Definition; Functions; Pros and cons.

UNIT II FUNCTIONS OF MANAGEMENT **9**

Planning: Characteristics; Nature; Importance; Steps; Limitation – Organizing: Features; Process; Principles; Types – Departmentalization: Functional – Divisional (Product; Customer; Geographic) – Staffing: Systems Approach; Recruiting and Selection Process – Directing (Leading): Traits; Style; Managerial Grid (Blake-Mounton, Reddin) – Communication: Purpose; Model; Barriers – Controlling: Types; Audit (External, Internal, Merits) – Decision Making: Elements; Characteristics; Process; Classification – Controlling techniques.

UNIT III ORGANIZATION THEORY **9**

Human Resource Development (HRD): Goals – Organizational Conflict: Positive Aspects; Individual; Role; Interpersonal; Intra Group; Inter Group; Conflict Management – Need and Motivation Theories: Maslow's Hierarchy of Needs Theory; Herzberg's Motivation-Hygiene Theory; McClelland's Needs Theory of Motivation – Change Management: Concept of Change; Lewin's Process of Change Model; Sources of Resistance; Overcoming Resistance; Guidelines to managing Conflict.

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT IV PRODUCTIVITY AND OPERATIONS MANAGEMENT 9

Productivity: Concept; Measurements; Affecting Factors; Methods to Improve – Operations Management Tools: (Simple problems in) Transportation Model (Balanced); Assignment Model (Hungarian); Network Model (Shortest path); Critical Path Method; Decision Trees.

UNIT V MODERN CONCEPTS AND MARKETING MANAGEMENT 9

Concept, features, merits and demerits of: SWOT Analysis; Business Process Re-engineering (BPR); Supply Chain Management (SCM) – Marketing: Concept; Functions; Importance; Segmentation; Mix; Problems of Marketing in Small Enterprise; Competitive Analysis and Advantage – E-marketing.

TOTAL = 45 PERIODS

COURSE OUTCOMES:

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

1. Explain basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.
2. Apply various functions of management in professional organization.
3. Apply organizational theory in professional organization.
4. Apply the principles of productivity and operations management in professional organization.
5. Apply modern concepts and marketing in management in professional organization.

TEXT BOOKS:

1. Koontz. H. and Weihrich. H., Essentials of Management: An International Perspective, 8th Edition, Tata McGrawhill, New Delhi, 2010.
2. M. Govindarajan and S. Natarajan, Principles of Management, Prentice Hall of India, New Delhi, 2009.

REFERENCES:

1. Joseph J, Massie, 'Essentials of Management' Prentice Hall of India Pvt. Ltd., 1985.
2. M. Govindarajan, Marketing Management, Prentice Hall of India, New Delhi, 2010.
3. R. Panneerselvam, Operations Research, Prentice Hall of India, New Delhi, 2013.
4. S.Chandran, Organizational Behaviours, Vikas Publishing House Pvt. Ltd., 1994.
5. Saxena, P.K., Principles of Management: A Modern Approach, Global India Publications, 2009.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1						0.6		0.6				0.3	0.3		
2						0.6		0.6				0.3	0.3		
3						0.6		0.6	0.9	0.9		0.3	0.3		
4	0.9	0.9	0.9	0.9		0.6		0.3			0.9	0.3	0.6		
5						0.6		0.6			0.3	0.3	0.6		

MF5003 PRECISION ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce various technologies with respect to its precision and accuracy.
- To operate high precision machineries with ease.
- To explore new areas in error control of cutting tools.
- To elaborate the influence and effects of using precision technologies.
- To outline the applications and exploitation of MEMS in various fields.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT I ELEMENTS OF PRECISION ENGINEERING 9

Introduction - Precision, Accuracy & Smoothness - Need - Development of overall machining precision-Classes of achievable machining Accuracy - Precision machining - High precision Machining-Ultra precision Machining-application of precision machining - Materials for tools and machine elements - carbides - ceramic, CBN & diamond - Tool and work material compatibility.

UNIT II PRECISION MACHINE COMPONENTS 9

Introduction - Guide ways - Drive systems - Spindle drive - preferred numbers - Rolling elements - hydrodynamic & hydrostatic bearings - Hybrid fluid bearings - Aero static and aero dynamic bearings - Hybrid gas bearings - materials for bearings.

UNIT III ERROR CONTROL 9

Error - Sources - Static stiffness - Variation of the cutting force - total compliance - Different machining methods - Thermal effects - heat source - heat dissipation - Stabilization - decreasing thermal effects - forced vibration on accuracy - clamping & setting errors - Control - errors due to locations - principle of constant location surfaces.

UNIT IV PRECISION MANUFACTURING 9

Micro machining processes - diamond machining - micro engraving - Micro replication techniques - forming - casting - injection moulding - micro embossing - Energy assisted processes - LBM, EBM, FIB, Micro electro discharge machining-photolithography - LIGA process- Silicon micro machining - Wet and dry etching-thin film deposition.

UNIT V MEMS 9

Introduction - MEMS - characteristics- principle - Design - Application: automobile, defence, health care, Industrial, aerospace etc.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of this course the student shall be able to:

- CO1: Gain knowledge on elements of precision engineering.
- CO2: Be familiarized with precision machine components.
- CO3: Describe the concept of error control.
- CO4: Apply the concepts of precision manufacturing.
- CO5: Be acquainted with MEMS and its applications.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.6		0.9	0.9	0.3	0.9	0.6	0.6	0.9	0.6	0.9	0.6	0.6	0.3	0.9
2	0.3	0.6	0.6	0.9	0.6		0.3	0.6	0.6	0.3	0.6		0.3	0.3	0.6
3	0.3		0.6	0.6	0.9	0.6	0.9	0.9	0.9	0.3	0.3	0.6	0.3	0.6	0.6
4	0.9	0.6	0.3	0.6	0.9	0.3	0.6	0.3	0.9	0.6	0.6		0.6	0.3	0.9
5	0.3		0.3	0.3	0.3	0.6	0.6	0.3	0.9	0.6		0.3	0.6	0.6	0.9

TEXT BOOKS:

1. Murthy R.L., “Precision Engineering”, 3rd Edition, New Age International, India, 2009. ISBN: 9788122407501
2. Venkatesh V.C. and Izman S., “Precision Engineering”, Tata McGraw Hill., India, 2007. ISBN: 0070620903, 978-0070620902.

REFERENCES:

1. James, D. and Meadow, S., “Geometric Dimensioning and Tolerancing”,1st Edition, Marcel Dekker Inc., United States, 1995.ISBN: 0824793099, 9780824793098
2. Juliar W.Gardner and Vijay K. Varadan, “Micro Sensors, MEMS and Smart Devices”,1st Edition, John Wiley and Sonsb., 2001. ISBN: 9780471861096, 9780470846087.
3. Nakazawa H., “Principles of Precision Engineering”, Oxford University Press., Institute of Physics Publishing, Bristol and Philadelphia, Bristol, BSI 6BE United kingdom, 1994.ISBN: 0198562667, 978-0198562665.

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

4. Paulo Davim, "Microfabrication and Precision Engineering: Research and Development", 1st Edition, Woodhead publishing., United Kingdom , 2017. ISBN: 0857094866, 9780857094865
5. Raady Frank, “Understanding Smart Sensors”, 1st Edition, Artech. House., Boston, 1996. ISBN: 0890068240, 9780890068243.
6. Stephen A.Campbell, “The Science And Engineering Of Micro Electronic Fabrication”,1st Edition, Oxford University Press., United Kingdom, 1996.ISBN: 0195105087, 978-0195105087.

MF5004 SYSTEM SIMULATION L T P C
3 0 0 3

COURSE OBJECTIVES:

- To familiarize the importance of applying simulation techniques for solving various problems on discrete event systems.
- To teach various random number generation techniques, its use in simulation, tests and validity of random numbers etc.
- To introduce various simulation languages and comparisons.
- To impart knowledge on the fundamentals of evolutionary algorithms and acquire skills to develop new powerful algorithms.
- To introduce the principles and operations of various systems and how to analyze them.

UNIT I INTRODUCTION 9

History of simulation - Concept - Types of simulation - System: system components - simulation as a decision making tool - Advantages and limitations of simulation - Applications - Monte Carlo simulation-Simulators.

UNIT II RANDOM NUMBERS/VARIATES 9

Generation of Random numbers - Applications - Pseudo random numbers - methods of generating random variates - random variates for uniform, normal, binominal, Poisson, exponential distributions. Test for random numbers such as Kolmogorov smirnov, chi square, Autocorrelation - Poker’s test.

UNIT III DESIGN OF SIMULATION EXPERIMENTS 9

Problem formulation – data collection and reduction – logic developments – initial conditions – run length, tabular method of simulation –Introduction to simulation model building for queuing, production, inventory and maintenance using higher level languages.

UNIT IV DISCRETE SYSTEM SIMULATION LANGUAGES 9

Need for simulation language - Comparison of various simulation languages and simulation packages.

UNIT V QUEUING POLICIES, ALGORITHMS AND CASE STUDIES 9

Introduction to basic Single - pass heuristics, meta-heuristics and applications - Application of Genetic algorithms and Ant colony based algorithms in Discrete event simulation models with simple examples. Development of simulation models using the simulation language studies for systems for systems like, queuing systems, production systems, inventory systems, maintenance and replacement systems, investment analysis and network. Manual simulation problems.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students should be able to:

- CO1: Identify the problem and build an appropriate simulation model.
- CO2: Recognize the type of model to be built suiting to the industrial situation and choose right measures of performances for evaluation and analysis

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

- CO3: Discuss the findings with statistical analysis and successfully compromise the management in implementing their proposed ideas to produce superior results.
- CO4: Locate the simulation models developed in other simulation software and involve in expert suggestions to improvise the same.
- CO5: Discuss simulation situations through their own models and show the effects of altering them.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9	0.9	0.9	0.9	0.6	0.6	0.6	0.3	0.6	0.6	0.3	0.9	0.9	0.9	0.9
2	0.6	0.9	0.6	0.9	0.9	0.3		0.3	0.6	0.3	0.9	0.6	0.6	0.6	0.9
3	0.9	0.9	0.9	0.9	0.6			0.3	0.9	0.9	0.3	0.6	0.9	0.9	0.9
4	0.9	0.9	0.9	0.9	0.9	0.3	0.3	0.3	0.6	0.3		0.6	0.9	0.9	0.9
5	0.6	0.9	0.9	0.9	0.9	0.3		0.3	0.9	0.9	0.6	0.6	0.6	0.9	0.9

TEXT BOOKS:

1. Banks J. and Carson J.S., Nelson B.L., “Discrete event system simulation”, 4th Edition, Pearson., United Kingdom, 2005.
2. Geoffrey Gordon, "System Simulation", second edition, Prentice Hall, India, 2005

REFERENCES:

1. Banks J., Carson II J.S., and Nelson, B.L., “Discrete Event System Simulation” 2nd ed., New Jersey: Prentice Hall Int’l Inc India,. 1996.
2. Kalechman M., “Practical MATLAB® basics for engineers”, CRC press.,Taylor and Francis group, First Indian reprint, 2012.
3. Schriber T.J., “Simulation using GPSS”, John Wiley, 2002. 2. Law A.M. and Kelton W.D., “Simulation Modeling and Analysis”, McGraw Hill., United States, 2003.
4. Shannon R.E., “systems simulation – The art and Science”, Prentice Hall., India, 1975.
5. Fishwick P.A., “Imulation Model Design and Execution : Building Digital Worlds” New Jersey: Prentice Hall Int’l Inc., India, 1995.
6. A.M. law and Kelton W.D., “Simulation Modeling and Analysis” .2nd Edition, New York: McGraw Hill Inc., United States, 1991.

WEB REFERENCE BOOKS: http:www.bcnn.net.

ME5073 DESIGN FOR MANUFACTURING L T P C
3 0 0 3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. Applying economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications. Also, apply design consideration principles of casting in the design of cast products.
2. Applying design consideration principles of forming in the design of extruded, stamped, and forged products.
3. Applying design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products.
4. Applying design consideration principles of welding in the design of welded products.
5. Applying design consideration principles of assembly in the design of assembled products.

UNIT I INTRODUCTION AND CASTING 9

Introduction - Economics of process selection - General design principles for manufacturability; Design considerations for: Sand cast – Die cast – Permanent mold cast parts.

UNIT II FORMING 9

Design considerations for: Metal extruded parts – Impact/Cold extruded parts – Stamped parts – Forged parts.

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT III MACHINING **9**

Design considerations for: Turned parts – Drilled parts – Milled, planed, shaped and slotted parts– Ground parts.

UNIT IV WELDING **9**

Arc welding – Design considerations for: Cost reduction – Minimizing distortion – Weld strength – Weldment & heat treatment. Resistance welding – Design considerations for: Spot – Seam – Projection – Flash & Upset weldment.

UNIT V ASSEMBLY **9**

Design for assembly – General assembly recommendations – Minimizing the no. of parts – Design considerations for: Rivets – Screw fasteners – Gasket & Seals – Press fits – Snap fits – Automatic assembly.

TOTAL = 45 PERIODS

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

1. Apply economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications. Also, apply design consideration principles of casting in the design of cast products.
2. Apply design consideration principles of forming in the design of extruded, stamped, and forged products.
3. Apply design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products.
4. Apply design consideration principles of welding in the design of welded products.
5. Apply design consideration principles of assembly in the design of assembled products.

TEXT BOOKS:

1. James G. Bralla, “Handbook of Product Design for Manufacture”, McGraw Hill, 1986.
2. O. Molloy, E.A. Warman, S. Tilley, Design for Manufacturing and Assembly: Concepts, Architectures and Implementation, Springer, 1998.

REFERENCES:

1. Corrado Poli, Design for Manufacturing: A Structured Approach, Elsevier, 2001.
2. David M. Anderson, Design for Manufacturability & Concurrent Engineering: How to Design for Low Cost, Design in High Quality, Design for Lean Manufacture, and Design Quickly for Fast Production, CIM Press, 2004.
3. Erik Tempelman, Hugh Shercliff, Bruno Ninaber van Eyben, Manufacturing and Design: Understanding the Principles of How Things Are Made, Elsevier, 2014.
4. Henry Peck, “Designing for Manufacture”, Sir Isaac Pitman & Sons Ltd., 1973.
5. Matousek, “Engineering Design”, Blackie & Sons, 1956.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9	0.9	0.9											0.6	0.3
2	0.9	0.9	0.9											0.6	0.3
3	0.9	0.9	0.9											0.6	0.3
4	0.9	0.9	0.9											0.6	0.3
5	0.9	0.9	0.9											0.6	0.3

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

ME5083 **PRODUCT LIFE CYCLE MANAGEMENT** **L T P C**
3 0 0 3

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Explaining the history, concepts and terminology of PLM.
2. Applying the functions and features of PLM/PDM.
3. Applying different modules offered in commercial PLM/PDM tools.
4. Implementing PLM/PDM approaches for industrial applications.
5. Integrating PLM/PDM with legacy data bases, CAx & ERP systems.

UNIT I 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.

UNIT II 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

UNIT III 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.

UNIT IV 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

UNIT V 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

TOTAL = 45 PERIODS

COURSE OUTCOMES: Upon completion of this course, the students will be able to:
1. Explain the history, concepts and terminology of PLM
2. Apply the functions and features of PLM/PDM
3. Apply different modules offered in commercial PLM/PDM tools.
4. Implement PLM/PDM approaches for industrial applications.
5. Integrate PLM/PDM with legacy data bases, CAx & ERP systems

TEXT BOOKS:

1. Antti Saaksvuori and Anselmi Immonen, “Product Lifecycle Management”, Springer Publisher, 2008.
2. Michael Grieves, “Product Life Cycle Management”, Tata McGraw Hill, 2006.

REFERENCES:

1. Arie Karniel and Yoram Reich, Managing the Dynamics of New Product Development Processes: A New Product Lifecycle Management Paradigm, Springer, 2011.
2. Ivica Crnkovic, Ulf Asklund and Annita Persson Dahlqvist, “Implementing and Integrating Product Data Management and Software Configuration Management”, Artech House Publishers, 2003.
3. John Stark, “Global Product: Strategy, Product Lifecycle Management and the Billion Customer Question”, Springer Publisher, 2007.

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

4. John Stark, “Product Lifecycle Management: 21st Century Paradigm for Product Realisation”, Springer Publisher, 2011.
5. Kevin Roebuck, Product Lifecycle Management (PLM): High-impact Strategies - What You Need to Know: Definitions, Adoptions, Impact, Benefits, Maturity, Vendors, Emereo, 2011.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.3	0.3	0.3										0.6	0.3	
2	0.6	0.6	0.3	0.3									0.6		
3	0.6	0.6	0.3	0.3									0.6	0.3	
4	0.6	0.6	0.3	0.3									0.6	0.3	
5	0.6	0.6	0.3	0.3									0.6		

ME5082 PRODUCT DESIGN AND DEVELOPMENT L T P C
3 0 0 3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. Applying the principles of generic development process; conducting customer need analysis; and setting product specification for new product design and development.
2. Generating, selecting, screening, and testing concepts for new product design and development.
3. Applying the principles of product architecture and industrial design to design and develop new products.
4. Applying the principles of DFMA and Prototyping to design and develop new product.
5. Applying the concepts of economics principles; project management practices in the development of new product.

UNIT I INTRODUCTION TO PRODUCT DEVELOPMENT, CUSTOMER NEED ANALYSIS, PRODUCT SPECIFICATION 9

Introduction – A Generic Development Process – Adapting the Generic Product Development Process - Product Development Process Flows – Identifying Customer Needs - Product Specifications: Establishing Target Specifications; Setting the Final Specifications.

UNIT II CONCEPT GENERATION, SELECTION, AND TESTING 9

Concept Generation: The Activity of Concept Generation - Concept Selection: Concept Screening; Concept Scoring – Concept Testing.

UNIT III PRODUCT ARCHITECTURE AND INDUSTRIAL DESIGN 9

Product Architecture: Implications of the Architecture; Establishing the Architecture; Delayed Differentiation; Platform Planning; Related System-Level Design Issues – Industrial Design: Assessing the Need for Industrial Design; Impact of Industrial Design; The Industrial Design Process; Management of the Industrial Design Process; Assessing the Quality of Industrial Design.

UNIT IV DFM AND PROTOTYPING 9

Design for Manufacturing: Estimate the Manufacturing Costs; Reduce the Costs of Components; Reduce the Costs of Assembly; Reduce the Costs of Supporting Production; Consider the Impact of DFMA– Prototyping: Type; Uses; Principles; Technologies; Planning for Prototypes.

UNIT V PRODUCT DEVELOPMENT ECONOMICS AND MANAGING PROJECTS 9

Product Development Economics: Elements of Economic Analysis; Economic Analysis Process - Managing Projects: Understanding and Representing Tasks; Baseline Project Planning; Accelerating Projects; Project Execution.

TOTAL = 45 PERIODS

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

COURSE OUTCOMES:

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

1. Apply the principles of generic development process; conduct customer need analysis; and set product specification for new product design and development.
2. Generate, select, screen, and test concepts for new product design and development.
3. Apply the principles of product architecture and industrial design to design and develop new products.
4. Apply the principles of DFMA and Prototyping to design and develop new product.
5. Apply the concepts of economics principles; project management practices in the development of new product.

TEXT BOOKS:

1. Jamnia, A., Introduction to Product Design and Development for Engineers, CRC Press, 2018.
2. Karl, T. Ulrich and Steven, D. Eppinger, "Product Design and Development", McGraw Hill, 2003.

REFERENCES:

1. Belz A., 36-Hour Course: "Product Development" McGraw-Hill, 2010.
2. Chitale, A. K. and Gupta, R. C., Product Design and Manufacturing, PHI Learning, 2013.
3. Pugh S., "Total Design – Integrated Methods for successful Product Engineering", Addison Wesley Publishing, 1991.
4. Rosenthal S., "Effective Product Design and Development", Business One, 1992.
5. Silva, A., Handbook of Research on Trends in Product Design and Development: Technological and Organizational Perspectives: Technological and Organizational Perspectives, IGI Global, 2010.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.6	0.6	0.9	0.3								0.3	0.3	0.3	
2	0.6	0.6	0.9	0.6								0.3	0.3	0.6	
3	0.6	0.6	0.9	0.3								0.3	0.6	0.6	
4	0.6	0.6	0.9	0.6								0.3	0.6	0.6	
5	0.6	0.6	0.9	0.3						0.9		0.3	0.3	0.3	

MF5072 SUSTAINABLE MANUFACTURING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To impart knowledge on sustainable manufacturing polices
- To introduce the best practices for sustainable manufacturing,
- To introduce lean manufacturing practices
- To be acquainted with selection of sustainable machinery with lower energy consumption.
- To provide knowledge in hazardous management and recyclability.

UNIT I SUSTAINABLE MANUFACTURING AND POLICIES 9

Introduction to sustainable manufacturing - Origins of sustainable manufacturing - Sustainable manufacturing concepts - Indian/European/US environmental policies - Legislative, cultural, societal and political issues - Sustainable quality systems - Emission less manufacturing - Comparison between green, eco-manufacturing, eco- machining, clean manufacturing and sustainable manufacturing.

UNIT II SUSTAINABILITY MANUFACTURING BEST PRACTICES 9

Introduction to best practices of sustainability manufacturing – Manufacturability issues in sustainable product design - Environmentally conscious design/manufacturing processes - Societal impact - Product functionality, serviceability, maintainability, upgradability - Innovative product/process designs for sustainability - Preservation of sustainable development.

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT III LEAN MANUFACTURING AND GREEN ENERGY 9

Introduction to lean Manufacturing - Lean manufacturing tools - Comparison of conventional manufacturing and lean Manufacturing - Advantages and Limitations of lean Manufacturing. Introduction to green energy concepts - Green house effect - Global warming - Climate change - Environmental degradation– Environmental pollution – Pollution due to manufacturing industries - Remedies.

UNIT IV SUSTAINABLE MACHINERY AND ENERGY CONSUMPTION 9

Selection of appropriate machine, materials, energy, resource utilisation for sustainability manufacturing – Performance evaluation of different machinery and its components in terms of energy consumption - Causes for inefficient operations of machinery – Scope for energy conservation - World energy consumption - Determination of power demand and consumption - Comparison of power generation cost using renewable and non- renewable sources.

UNIT V HAZARDOUS MANAGEMENT AND RECYCLABILITY 9

Introduction to hazardous management in industries – Need for hazardous waste management - Appropriate method of collection, storage, transport and disposal of hazardous waste - Hazardous waste prevention and Life cycle assessment - Advantages and limitations of hazardous management - Recyclability: Recycling, recharging, disassembly, recovery, remanufacturing - End-of-life and product take-back issues - Training of next generation workforces for sustainable manufacturing.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of this course the student shall be able to:

- CO1: Identify the best practices for sustainable manufacturing in industries,
- CO2: Describe the various policies for sustainability manufacturing.
- CO3: Implement lean principles to reduce industrial wastes
- CO4: look for selection of sustainable machinery with lower energy consumption.
- CO5: Recognize hazardous management techniques and safe practices.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.6					0.6	0.9	0.9					0.9	0.3	0.6
2						0.6	0.9	0.9					0.9	0.3	0.6
3	0.6	0.6	0.6	0.6	0.6	0.6	0.9	0.9					0.9	0.9	0.9
4	0.6	0.6	0.6	0.6	0.6	0.6	0.9	0.9					0.9	0.9	0.9
5	0.6	0.6	0.6	0.6	0.6	0.6	0.9	0.9					0.9	0.9	0.9

TEXT BOOKS:

1. Davim, J.P., “Sustainable Manufacturing”, John Wiley & Sons.,United States, 2010,ISBN: 978-1-848-21212-1,
2. Günther Seliger, Marwan M.K. Khraisheh and Jawahirl.S., “Advances in Sustainable Manufacturing”, Springer Berlin Heidelberg., London, ISBN 978-3-642-20183-7,2011.

REFERENCES:

1. Clive George and Colin Kirkpatrick., “Impact Assessment and Sustainable Development”, Edward Elgar Publishing Ltd., United States, 2007,ISBN: 978 1 84542 787 0
2. Craig B. Smith , Kelly E. Parmenter., “Energy Management Principles: Applications, Benefits,Savings”,2nd edition, Elsevier;,2015.ISBN: 9780128026441,9780128025062.
3. Davim J. Pauls, “Green Manufacturing Processes and Systems”, Springer.,Germany 2013,ISBN: 9783642337925.
4. Dornfield David, “Green Manufacturing”, Springer., Germany,2012, ISBN 978-1-4419-6016-0.
5. Günther Seliger, “Sustainability in Manufacturing: Recovery of Resources in Product and Material Cycles”, Springer Berlin Heidelberg,2010., ISBN 978-3-540-49871-1.

Approved

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

MF5005 ELECTRONICS MANUFACTURING TECHNOLOGY L T P C
3 0 0 3

COURSE OBJECTIVES:

- To impart knowledge on wafer preparation and PCB fabrication
- To introduce Through Hole Technology (THT) and Surface Mount Technology (SMT) with various types of electronic components
- To elaborate various steps in Surface Mount Technology (SMT)
- To be acquainted with various testing and inspection methods of populated PCBS
- To outline repair, rework and quality aspects of Electronic assemblies.

UNIT I INTRODUCTION TO ELECTRONICS MANUFACTURING 9

History, definition, wafer preparation by growing, machining, and polishing, diffusion, microlithography, etching and cleaning, Printed circuit board –fabrication, types, single sided, double sided, multi-layer and flexible printed circuit board

UNIT II COMPONENTS AND PACKAGING 9

Introduction to packaging, types-Through hole technology(THT) and Surface mount technology (SMT), Through hole components – axial, radial, multi leaded, odd form
Surface-mount components- active, passive. Interconnections - chip to lead interconnection, die bonding, wire bonding, TAB, flip chip, chip on board, multi chip module, direct chip array module, leaded, leadless, area array and embedded packaging, miniaturization and trends.

UNIT III SURFACE MOUNT TECHNOLOGY 9

SMT Process, SMT equipment and material handling systems, handling of components and assemblies - moisture sensitivity and ESD, safety and precautions needed, IPC and other standards, stencil printing process - solder paste material, storage and handling, stencils and squeegees, process parameters, quality control. Component placement- equipment type, flexibility, accuracy of placement, throughput, packaging of components for automated assembly, soldering- wave soldering, reflow process, process parameters, profile generation and control, adhesive, underfill and encapsulation process

UNIT IV INSPECTION AND TESTING 9

Inspection techniques, equipment and principle- AOI, X-ray. Defects and Corrective action - stencil printing process, component placement process, reflow soldering process, electrical testing of PCB assemblies- In circuit test, functional testing, fixtures and jigs.

UNIT V REPAIR, REWORK, QUALITY AND RELIABILITY OF ELECTRONICS ASSEMBLIES 9

Repair and rework of PCB- Coating removal, base board repair, conductor repair, thermo-mechanical effects and thermal management, Reliability fundamentals, reliability testing, failure analysis, design for manufacturability, assembly, reworkability, testing, reliability, and environment.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students should be able to:

- CO1: Perceive wafer preparation and PCB fabrication
- CO2: Recognize the importance of Through Hole Technology (THT) and Surface Mount Technology (SMT)
- CO3: Demonstrate various steps in Surface Mount Technology (SMT)
- CO4: Identify various testing and inspection methods of populated PCBS
- CO5: Discuss various techniques in repair, rework, quality and reliability of electronics Assemblies

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9											0.6	0.3	0.3	0.6
2	0.9											0.6	0.3	0.3	0.3
3	0.9		0.3									0.6	0.6	0.6	0.6
4	0.9		0.3			0.3						0.6	0.6	0.6	0.6
5	0.9		0.3			0.6	0.3					0.6	0.6	0.9	0.9

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

TEXT BOOKS:

1. Prasad R., "Surface Mount Technology – Principles and practice",2nd Edition, Chapman and Hall., New York, 1997, ISBN 0-41-12921-3.
2. Tummala R.R., "Fundamentals of microsystem packaging", Tata *McGraw Hill* Co. Ltd., New Delhi, 2001, ISBN 00-71-37169-9.

REFERENCES:

1. Harper C.A., "Electronic Packaging and Interconnection Handbook" 2nd Edition, McGraw Hill Inc., New York, N.Y., 1997, ISBN 0-07-026694-8.
2. Lee N.C., "Reflow Soldering Process and Trouble Shooting SMT, BGA, CSP and Flip Chip Technologies", Elsevier Science. United Kingdom, 2001.
3. Puligandla Viswanadham and Pratap Singh., "Failure Modes and Mechanisms in Electronic Packages", Chapman and Hall., New York, 1997, N.Y. ISBN 0-412-105591-8. Science and Technology, United Kingdom, 1997, ISBN 0750698756.
4. Totta P., Puttlitz K. and Stalter K., "Area Array Interconnection Handbook", Kluwer Academic Publishers, Norwell, MA, United States, 2001, ISBN 0-7923-7919-5.
5. Zarrow P. and Kopp D., "Surface Mount Technology Terms and Concepts", Elsevier, 1997.

IE5073 LEAN SIX SIGMA L T P C
3 0 0 3

COURSE OBJECTIVES:

- Explain the basics of Lean and Six Sigma.
- Teach the need and the process of integrating Lean and Six sigma.
- Summarize to identify and select the resources required for LSS Projects and selection of projects including Team building.
- Teach the DMAIC process and study the various tools for undertaking LSS projects.
- Illustrate to institutionalize the LSS efforts.

UNIT I INTRODUCTION TO LEAN AND SIX SIGMA 9

Introduction to Lean- Definition, Purpose, Features of Lean ; Top seven wastes, Need for Lean management, The philosophy of lean management, Creating a lean enterprise, Elements of Lean, Lean principles, the lean metric, Hidden time traps. Introduction to quality, Definition of six sigma, origin of six sigma, Six sigma concept and Critical success factors for six sigma.

UNIT II INTEGRATION OF LEAN AND SIX SIGMA 9

Evolution of lean six sigma, the synergy of Lean and six sigma, Definition of lean six sigma, the principles of lean six sigma, Scope for lean six sigma, Features of lean six sigma. The laws of lean six sigma, Key elements of LSS, the LSS model and the benefits of lean six sigma. Initiation - Top management commitment – Infrastructure and deployment planning, Process focus, organizational structures, Measures – Rewards and recognition, Infrastructure tools, structure of transforming event and Launch preparation.

UNIT III PROJECT SELECTION AND TEAM BUILDING 9

Resource and project selection, Selection of Black belts, Training of Black belts and Champions, Identification of potential projects, top down (Balanced score card) and Bottom up approach – Methods of selecting projects – Benefit/Effort graph, Process mapping, value stream mapping, Predicting and improving team performance, Nine team roles and Team leadership.

UNIT IV THE DMAIC PROCESS AND TOOLS 9

The DMAIC process – Toll gate reviews; The DMAIC tools; Define tools – Project definition form, SIPOC diagram; Measure tools – Process mapping, Lead time/cycle time, Cause and Effect matrix, Idea – generating and organizing tools – Brainstorming, Nominal group technique and Multi-voting; Data collection and accuracy tools- Check sheet, Gauge R&R; Understanding and eliminating variation- run charts; Analyze tools - Scatter plots, ANOVA, Regression analysis, Time trap analysis; Improve tools – Mistake proofing, Set up time reduction (SMED) and the pull system; Control tools – statistical process control.

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT V INSTITUTIONALIZING AND DESIGN FOR LSS 9

Institutionalizing lean six sigma – improving design velocity, creating cycle time base line, valuing projects, gating the projects, reducing product line complexity, Design for lean six sigma, QFD, Theory of Inventive Problem solving (TRIZ), Robust design; Case study presentations.

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1: The students will be able to understand what is Lean and Six sigma and their importance in the globalized competitive world.

CO2: The students will be able to understand the importance of integrating Lean and Six sigma and also the process of their integration.

CO3: The students will be able to plan the Resources required to undertake the LSS projects and also acquire how to select the suitable projects and the teams.

CO4: The students will be able apply DMAIC methodology to execute LSS projects and in this regard they will be acquainted with various LSS tools.

CO5: The students will be able to understand the process of institutionalizing the LSS effort and also understand the Design for LSS.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓										✓
CO2						✓				✓		✓
CO3					✓				✓			
CO4	✓				✓		✓				✓	✓
CO5			✓			✓	✓	✓				

TEXT BOOK:

1. Michael L. George, Lean Six Sigma, McGraw-Hill., 2002.

REFERENCES:

1. James P. Womack, Daniel T. Jones, Lean Thinking, Free press business., 2003.
2. Ronald G.Askin and Jeffrey B.Goldberg, Design and Analysis of Lean Production Systems, John Wiley &Sons., 2003.
3. Salman Taghizadegan, Essentials of Lean Six Sigma, Elsevier., 2010.

ME5079 NEW AND RENEWABLE SOURCES OF ENERGY L T P C
3 0 0 3

COURSE OBJECTIVES: The main learning objective of this course is to prepare the students for:

1. Describing the current energy scenario in terms of conventional renewable energy and future plan.
2. Applying the principle of various solar energy generating devices.
3. Applying the principle of various wind energy devices.
4. Applying the principle of various bio energy devices.
5. Applying the principle of various ocean and geothermal energy devices.

UNIT I ENERGY SCENARIO 9

Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status-Potential of various renewable energy sources-Global energy status-Per capita energy consumption in various countries - Future energy plans

UNIT II SOLAR ENERGY 9

Solar radiation – Measurements of solar radiation and sunshine – Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems – Solar PV applications.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT III WIND ENERGY 9

Wind data and energy estimation – Betz limit - Site selection for wind farms – characteristics Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues - Applications.

UNIT IV BIO-ENERGY 9

Bio resources – Biomass direct combustion – thermochemical conversion - biochemical conversion-mechanical conversion - Biomass gasifier - Types of biomass gasifiers - Cogeneration –- Carbonisation – Pyrolysis - Biogas plants – Digesters –Biodiesel production – Ethanol production - Applications.

UNIT V OCEAN AND GEOTHERMAL ENERGY 9

Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications - Environmental impact.

TOTAL = 45 PERIODS

COURSE OUTCOMES:

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

1. Describe the current energy scenario in terms of conventional renewable energy and future plan.
2. Apply the principle of various solar energy generating devices.
3. Apply the principle of various wind energy devices.
4. Apply the principle of various bio energy devices.
5. Apply the principle of various ocean and geothermal energy devices.

TEXT BOOKS:

1. G.D. Rai, “Non-Conventional Energy Sources”, Standard Publishers Distributors, 1992.
2. John Twidell, Tony Weir, and Anthony D. Weir, Renewable Energy Resources, Taylor & Francis, 2006.

REFERENCES:

1. B.H. Khan, “Non-Conventional Energy Resources”, McGraw Hill, 2009.
2. G.N. Tiwari, “Solar Energy – Fundamentals Design, Modelling and applications”, Alpha Science, 2015.
3. Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford University Press, 2012.
4. N.K. Bansal, Non-Conventional Energy Resources, Vikas Publishing House, 2014.
5. S.P. Sukhatme, “Solar Energy: Principles of Thermal Collection and Storage”, Tata McGraw Hill, 2009.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1			0.6				0.9								0.3
2	0.6	0.6	0.9	0.6	0.3		0.9			0.3	0.6	0.9	0.9	0.6	0.6
3	0.6	0.6	0.9	0.6	0.3		0.9			0.3	0.6	0.9	0.9	0.6	0.6
4	0.6	0.6	0.9	0.6	0.3		0.9			0.3	0.6	0.9	0.9	0.6	0.6
5	0.6	0.6	0.9	0.6	0.3		0.9			0.3	0.6	0.9	0.9	0.6	0.6

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

ME5078 **MEMS AND MICROSYSTEMS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. Selecting suitable material for MEMS and Microsystems, and explain the scaling laws involved in miniaturization.
2. Explaining the various micro-manufacturing processes.
3. Applying the working principle of electrostatic and thermal based MEMS sensors and actuators in the design of MEMS devices.
4. Applying the working principle of piezo-resistive, piezo-electric and magnetic effect in the design of MEMS devices.
5. Designing the elements of Micro-fluidic systems, and select suitable MEMS devices for Industrial applications.

UNIT I BASIC ENGINEERING FOR MEMS **9**

History of MEMS Development, Multidisciplinary Nature of Microsystems, Energy Domains, Scaling Laws in Miniaturization, Essential Electrical and Mechanical Concepts in MEMS, Materials for MEMS and Microsystems.

UNIT II MICROMANUFACTURING TECHNIQUES **9**

Photolithography, Ion Implantation, Diffusion, Oxidation, Chemical Vapour Deposition, Physical Vapour Deposition-Sputtering, Deposition by Epitaxy, Etching, Bulk Micromanufacturing, Micromachining Processes, LIGA Process, Microsystem Assembly and Testing.

UNIT III ELECTROSTATIC AND THERMAL BASED MEMS **9**

Introduction to Electrostatic Sensors and Actuators, Parallel-Plate Capacitor, Application of Parallel-Plate Capacitors, Interdigitated Finger Capacitors, Applications of Comb-Drive Devices, Introduction to Thermal Sensors and Actuators, Sensors and Actuators Based on Thermal Expansion, Thermocouples, Thermal Resistors, Shape Memory Alloy, Applications of Thermal Sensors and Actuators.

UNIT IV PIEZO-RESISTIVE / ELECTRIC AND MAGNETIC BASED MEMS **9**

Introduction to Piezoresistive & Piezoelectric effects, Piezoresistive & Piezoelectric materials, Stress Analysis of Mechanical Elements, Applications of Piezoresistive & Piezoelectric Sensors and Actuators, Essential Concepts and Principles of Magnetic Sensors and Actuators, Fabrication of Micro Magnetic Components, Applications of Magnetic Sensors and Actuators.

UNIT V MICROFLUIDICS AND APPLICATIONS OF MEMS **9**

Microfluidics - Fluid Mechanics Concepts, Design and Fabrication of Channels, Valves, Pumps, Case Studies - Accelerometer, Gyros, RF MEMS and MOEMS.

TOTAL = 45 PERIODS

COURSE OUTCOMES:

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

1. Select suitable material for MEMS and Microsystems, and explain the scaling laws involved in miniaturization.
2. Explain the various micro-manufacturing processes.
3. Apply the working principle of electrostatic and thermal based MEMS sensors and actuators in the design of MEMS devices.
4. Apply the working principle of piezo-resistive, piezo-electric and magnetic effect in the design of MEMS devices.
5. Design the elements of Micro-fluidic systems, and select suitable MEMS devices for Industrial applications.

TEXT BOOKS:

Attested

1. Chang Liu, “Foundations of MEMS”, Pearson Education, 2011.
2. Tai-Ran Hsu, “MEMS and Microsystems: Design and Manufacture”, McGraw Hill Education, 2002.

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

REFERENCES:

1. Marc J. Madou, “Fundamentals of Microfabrication and Nanotechnology”, CRC Press, 2011.
2. Mohamed Gad-el-Hak, “The MEMS handbook: MEMS Applications”, CRC press, 2006.
3. Nitaigour Premchand Mahalik, “MEMS”, McGraw Hill Education, 2007.
4. Stephen D Senturia, “Microsystem Design”, Kluwer Academic Publishers, 2001.
5. Thomas M. Adams and Richard A. Layton, “Introductory MEMS: Fabrication and Applications”, Springer, 2010.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9											0.3	0.9		
2	0.9		0.3										0.6		
3	0.9	0.6											0.6		
4	0.9		0.9								0.9		0.6		
5	0.9		0.9						0.6			0.6			0.9

MF5006 INDUSTRIAL INSPECTION MAINTENANCE AND SAFETY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To detect defects and defectives and to improve the quality of the products.
- To Involve in sampling technique practices to eliminate defects and ensure high quality products
- To introduce new inspection techniques and equipment’s in industry.
- To impart knowledge on safety engineering practices.
- To familiarize various techniques in preventive and predictive maintenance of machines.

UNIT I FUNDAMENTALS OF INSPECTION **9**

Inspection-Introduction, Need for inspection, Inspection types, Types of Defects, Modes of Inspection

UNIT II SAMPLING TECHNIQUES **9**

Probability sampling: Simple Random Sampling (SRS), Stratified Sampling, Cluster Sampling, Systematic Sampling, Multistage Sampling (in which some of the methods above are combined in stages)

Non Probability sampling: volunteer samples, haphazard (convenience) samples

Quality and risk decisions: Single sampling plan, Double sampling plans, Multi sampling plan, OC curves - Problems on sampling

UNIT III STAGES IN INDUSTRIAL INSPECTION **9**

Inspection of raw materials, inline inspection, Off line Inspection, Industrial Inspection System, Industrial Plant Inspection, Inspection and Test Plan, Shop Inspection, Vendor Inspection, Industrial Quality Control, Factory Acceptance Test, Inspection scope, Industrial Test Systems, Industrial Test Calibration

UNIT IV MAINTENANCE TECHNIQUES **9**

Introduction - Maintenance at the activity level, Types of maintenance: Preventive: Time Based Maintenance (TBM), Failure Finding Maintenance (FFM), Risk Based Maintenance (RBM), Condition Based Maintenance (CBM), Predictive Maintenance (PDM), Corrective maintenance: Deferred maintenance, Emergency maintenance, Maintenance practice and scheduling – Motivation, Reliability in maintenance, Development of maintenance engineering practices.

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT V INSPECTION OF EQUIPMENTS AND SAFETY PRACTICES 9

Development of policies, Preparation of Inspection guidelines, Condition monitoring, Maintenance programme, Service and Repair, Safe work practices, Safety and condition assessing check list, Equipment installation and servicing procedures, Accident prevention programs, Risk analysis, Hazard analysis, safety at work place-Indoor and outdoor

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students shall be able to:

- CO1: Recognize the fundamental concepts of inspection, the need, types and importance.
- CO2: Identify various random sampling plans and apply them in industrial cases.
- CO3: Discuss various types of inspections and various ways of using them.
- CO4: Describe various inspection techniques.
- CO5: Recognize various industrial inspection, maintenance and safety policies.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9	0.9	0.6	0.6	0.9	0.9	0.9	0.6	0.9	0.6	0.6	0.9	0.6	0.3	0.6
2	0.6	0.9	0.6	0.3	0.9	0.9	0.9	0.6	0.3	0.3	0.6	0.6	0.3	0.3	0.9
3	0.9	0.3	0.3	0.3	0.6	0.6	0.9	0.3	0.3	0.6	0.6	0.6	0.3	0.3	0.6
4	0.9	0.3	0.3		0.6	0.3	0.9	0.3	0.3	0.6	0.3	0.6	0.6	0.6	0.6
5	0.9	0.6	0.6	0.6	0.6	0.6	0.9	0.6	0.6	0.3	0.6	0.9	0.9	0.3	0.9

TEXT BOOKS:

1. Prithwiraj Jana, “A Quick Guide of Industrial Inspection”, Create Space Independent Publishing Platform, 2017
2. R. C. Mishra, K. Pathak, “Maintenance Engineering and Management”, 2nd Edition, PHI learning Pvt Ltd., India, 2012
3. Sue Cox, Robin Tait, “ReliabilitySafety and Risk Management: An Integrated Approach” Butterworth-Heinemann -Technology & Engineering,1998

REFERENCES:

1. Crowl D.A. and Louvar J.F., “Chemical Process Safety: Fundamentals with Applications”, 2ndEdition., Prentice Hall, United States, 2001.
2. Mannan S., “Lee’s Loss Prevention in the Process Industries”, Vol. I, 3rd Edition, Butterworth-Heinemann United Kingdom ,2004.
3. Mannan S., “Lee’s Loss Prevention in the Process Industries”,Vol.II,3rd Edition, Butterworth-Heinemann, United Kingdom, 2005.
4. M. K. Poltev, “Occupational Health and Safety in Manufacturing Industries”, MIR -1985.
5. Riccardo Manzini, Alberto Regattieri and Hoang Pham, “Maintenance for Industrial Systems”, Springer Science & Business Media, 2010
6. Cochran William G., “Sampling techniques”, John Wiley & Sons, 2007.

WEB REFERENCE:

https://www.inspection-for-industry.com/

MF5007 TOTAL PRODUCTIVE MAINTENANCE L T P C
3 0 0 3

COURSE OBJECTIVES:

- To familiarize students with the major concepts on maintenance
- To introduce the models used in maintenance
- To train students with the concept of total productive maintenance
- To introduce some of the methods used in maintenance management
- To familiarize the students with some of the inspection and monitoring methods used

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT I MAINTENANCE CONCEPTS 9

Introduction - TPM pillars -Objectives and functions –Productivity, Quality, Reliability and Maintainability (PQRM) - Terotechnology - Reliability Centered Maintenance - Predictive Maintenance - Condition Based Maintenance - maintainability prediction - availability and system effectiveness-maintenance costs - maintenance organization.

UNIT II MAINTENANCE MODELS 9

Minimal repair - As Good As New policy - maintenance types - balancing PM and breakdown maintenance - PM schedules: deviations on both sides of target values - PM schedules: functional characteristics - replacement models.

UNIT III TOTAL PRODUCTIVE MAINTENANCE 9

Zero breakdowns - Zero Defects and TPM - maximizing equipment effectiveness – Autonomous maintenance program - five pillars of TPM - TPM small group activities - TPM organization - Management Decision - Educational campaign - Creation of Organizations - Establishment of basic policies and goals - Formation of master plan - TPM implementation.

UNIT IV MAINTENANCE LOGISTICS 9

Human factors in maintenance - maintenance manuals - maintenance staffing methods - queuing applications - simulation - spare parts management - maintenance planning and scheduling.

UNIT V ONLINE MONITORING 9

Condition monitoring - Infrared Thermography, Oil Analysis, acoustic emissions testing, Motor Current Analysis, Vibration Measurement and Analysis, Wear Debris Monitoring, Visual checks - corrosion control - Maintenance Management Information System - Expert system applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students shall be able to:

- CO1: Classify the major concepts of maintenance
- CO2: Recognize various models used in maintenance
- CO3: Gain knowledge on total productive maintenance
- CO4: Discuss the methods used in maintenance management
- CO5: Gain knowledge on the inspection and monitoring methods used

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.3	0.3	0.3			0.6	0.6	0.6				0.3	0.6		
2						0.6	0.6	0.6				0.3	0.6	0.6	
3	0.3					0.6						0.3	0.6		
4		0.3				0.3						0.3	0.6		
5			0.3			0.3					0.6	0.3	0.6	0.3	

TEXT BOOKS:

1. Nakajima S., “Introduction to TPM”, Productivity Press, Chennai, 1992.
2. Srivastava S.K., “Maintenance Engineering (Principle, Practices & Management)”, S. Chand Group, 2011.

REFERENCES:

1. Goto F.,“Equipment planning for TPM Maintenance Prevention Design”, Productivity Press., United States,1992.
2. Kelly A., “Maintenance planning and control”, Butterworths, London, 1991.
3. Shirose K., “Total Productive Maintenance for Workshop Leaders”, Productivity Press., United States.
4. Shirose K., “TPM for Operators”, Productivity Press, United States, 1996.
5. Suzuki T., “New Directions for TPM”, Productivity Press, United States,1992
6. Wireman T., “Total Productive Maintenance”, Industrial Press Inc., New york, 2004.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

ME5077 MEASUREMENTS AND CONTROLS L T P C
3 0 0 3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. Identify measurement parameters and analyze errors of measurements.
2. Select and apply suitable transducer for a particular measurement.
3. Identify measurement parameters and select the appropriate sensor for it.
4. Explain the working of various types of control systems of apply for specific applications.
5. Apply the principle of automatic control systems to control various parameter(s).

UNIT I MEASUREMENTS AND ERROR ANALYSIS 9

General concepts – Units and standards – Measuring instruments –sensitivity, readability, range, accuracy, precision – static and dynamic response – repeatability hysteresis – systematic and random errors –Statistical analysis of experimental data – Regression analysis – Curve fitting - calibration and Uncertainty.

UNIT II INSTRUMENTS 9

Transducer, Modifying (intermediate) and Terminal stages – Mechanical and electrical transducers, preamplifiers – charge amplifiers – filters – attenuators – D' Arsonval – CRO – Oscillographs – recorders – microprocessor based data logging, processing and output

UNIT III PARAMETERS FOR MEASUREMENT 9

Dimension, displacement, velocity, acceleration, Impact – Force, torque, power- Pressure, Temperature, Heat Flux, Heat Transfer Coefficients, Humidity – Flow – Velocity - Time, frequency and phase angle – noise and sound level.

UNIT IV CONTROL SYSTEMS 9

Basic elements – feedback principle, implication of measurements – Error detectors – final actuating elements – Two position, multi-position, floating, proportional controls – relays – servo amplifiers – servo motors – Electrical, magnetic, electronic control systems

UNIT V APPLICATION OF CONTROL SYSTEMS 9

Governing of speed, kinetic and process control – pressure, temperature, fluid level, flow-thrust and flight control – photo electric controls – designing of measurement and control systems for different applications

Total (L: 45) = 45 Periods

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

1. Identify measurement parameters and analyze errors of measurements.
2. Select and apply suitable transducer for a particular measurement.
3. Identify measurement parameters and select the appropriate sensor for it.
4. Explain the working of various types of control systems of apply for specific applications.
5. Apply the principle of automatic control systems to control various parameter(s).

TEXT BOOKS:

1. Venkateshan S P, Mechanical Measurements, 2nd Edition, John Wiley & Sons, Ltd, 2015.
2. William Bolton, Instrumentation and Control Systems, 2nd Edition, Newnes, 2015.

REFERENCES:

1. Beckwith, Marangoni and Lienhard, Mechanical Measurements, Pearson, 2013.
2. Ernest Doebelin and Dhanesh Manik, Measurement Systems, McGraw Hill International Edition, 2017.
3. Holman J P, "Experimental Methods for Engineers", McGraw Hill Int. Edition, 7th Ed., 2017.
4. Nagrath I J, "Control Systems Engineering", New Age International Publishers, 2018.
5. Nakra B.C , and Chaudhry K.K, Instrumentation, Measurement, and Analysis, Tata McGraw Hill, 4th Edition, 2016.

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.6	0.6	0.6	0.6								0.3	0.6	0.3	
2	0.6	0.6	0.6	0.6								0.3	0.6	0.3	
3	0.6	0.6	0.6	0.6								0.3	0.6	0.3	
4	0.6	0.6	0.6	0.6								0.3	0.6	0.3	
5	0.6	0.6	0.6	0.6								0.3	0.6	0.3	

ME5076 **MARKETING MANAGEMENT** **L T P C**
3 0 0 3

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:

1. Explaining the basic concepts in marketing.
2. Explaining the various buying behaviour methods.
3. Analyzing the various product pricing concepts.
4. Analyzing the various marketing planning principles and its strategies.
5. Describing the trends of advertising, sales promotion methods..

UNITI CONCEPTS IN MARKETING **9**
Definition, Marketing Process, Dynamics, Needs, Wants and Demands, Marketing Concepts, Environment, Mix, Types, Philosophies, Selling vs Marketing, Consumer Goods, Industrial Goods.

UNITII BUYING BEHAVIOUR AND MARKET SEGMENTATION **9**
Cultural, Demographic factors, Motives, Types, Buying Decisions, Segmentation factors, Demographic, Psycho graphic and Geographic Segmentation, Process, Patterns. Services marketing and Industrial marketing.

UNITIII PRODUCT, PRICE AND MARKETING RESEARCH **9**
Product, Classifications of product, Product Hierarchy, Product Life Cycle, New product development, Branding. Price: Objectives, Pricing Decisions and Pricing Methods, Pricing Management, Introduction, Uses, Process of Marketing Research.

UNIT IV MARKETING PLANNING AND STRATEGY FORMULATION **9**
Components of a Marketing Plan, Strategy Formulation and the Marketing Process, Implementation, Portfolio Analysis, BCG, GEC, DPM, Ansoff Grids.

UNIT V ADVERTISING, SALES PROMOTION AND DISTRIBUTION **9**
Advertising-Characteristics, Impact, Goals, Types, Sales Promotion – Point of purchase, Unique Selling Propositions, Characteristics, Wholesaling, Retailing, Channel Design, Logistics, Modern Trends in Retailing, Modern Trends, e-Marketing.

TOTAL= 45 PERIODS

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

1. Explain the basic concepts in marketing.
2. Explain the various buying behaviour methods.
3. Analyze the various product pricing concepts.
4. Analyze the various marketing planning principles and its strategies.
5. Describe the trends of advertising, sales promotion methods.

TEXT BOOKS:

1. Govindarajan. M, “Marketing management – concepts, cases, challenges and trends”, Prentice hall of India, second edition, 2007.
2. Philip Kolter & Keller, “Marketing Management”, Prentice Hall of India, XII edition, 2006

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

REFERENCES:

1. Adrain palmer, “Introduction to marketing theory and practice”, Oxford university press IE 2004.
2. Czinkota & Kotabe, “Marketing management”, Thomson learning, Indian edition 2007.
3. Donald S. Tull and Hawkins, “Marketing Research”, Prentice Hall of Inida-1997.
4. Philip Kotler and Gary Armstrong “Principles of Marketing” Prentice Hall of India, XII Edn, 2000.
5. Ramasamy and Nama kumari, “Marketing Management: Planning, Implementation and Control, Macmillan and Company”, 2002.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.3			0.6		0.6			0.3	0.6		0.3	0.6	0.3	0.6
2	0.3			0.6		0.6			0.3	0.6		0.3	0.6	0.3	0.6
3	0.3			0.6		0.6			0.3	0.6		0.3	0.6	0.3	0.6
4	0.3			0.6		0.6			0.3	0.6		0.3	0.6	0.3	0.6
5	0.3			0.6		0.6			0.3	0.6		0.3	0.6	0.3	0.6

ME5751 FINITE ELEMENT ANALYSIS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES: The main learning objective of this course is to prepare the students for:

1. Developing mathematical models for Boundary Value Problems and their numerical solution.
2. Applying concepts of Finite Element Analysis to solve one dimensional problem.
3. Determining field variables for two dimensional scalar variable problems.
4. Determining field variables for two dimensional vector variable problems.
5. Applying the need for Isoparametric transformation and the use of numerical integration.

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.

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 including thermal stresses-heat transfer. Natural frequencies of longitudinal vibration and mode shapes. Fourth Order Beam Equation – Transverse deflections and Transverse Natural frequencies of beams.

UNIT III TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS **9**

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements and Quadrilateral elements- Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems – Torsion of Non circular shafts.

UNIT IV TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS **9**

Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Constitutive matrices and Strain displacement matrices – Stiffness matrix – Stress calculations - Plate and shell elements.

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT V ISOPARAMETRIC FORMULATION AND ADVANCED TOPICS 9

Natural co-ordinate systems – Isoparametric elements – Shape functions for isoparametric elements – One and two dimensions – Serendipity elements – Numerical integration - Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software- Introduction to Non Linearity.

TOTAL = 45 PERIODS

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

1. Develop mathematical models for Boundary Value Problems and their numerical solution
2. Apply concepts of Finite Element Analysis to solve one dimensional problems
3. Determine field variables for two dimensional scalar variable problems
4. Determine field variables for two dimensional vector variable problems
5. Apply the need for Isoparametric transformation and the use of numerical integration

TEXT BOOKS:

1. Rao, S.S., "The Finite Element Method in Engineering", 6th Edition, Butterworth-Heinemann,2018.
2. Reddy,J.N. "Introduction to the Finite Element Method", 4thEdition, Tata McGrawHill,2018.

REFERENCES:

1. David Hutton, "Fundamentals of Finite Element Analysis", Tata McGrawHill, 2005
2. Dhanaraj. R and Prabhakaran Nair. K, "Finite Element Analysis", Oxford Publications, 2015.
3. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and Applications of Finite Element Analysis", 4th Edition, Wiley Student Edition, 2004.
4. Seshu.P, "Text Book of Finite Element Analysis", PHI Learning Pvt. Ltd., NewDelhi, 2012.
5. Tirupathi R. Chandrupatla and Ashok D. Belegundu, "Introduction to Finite Elements in Engineering", International Edition, Pearson Education Limited, 2014.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.6												0.9		
2		0.9											0.9		
3			0.6										0.9		
4		0.9											0.9		
5					0.6										0.3

PROGRESS THROUGH KNOWLEDGE

MF5008 FLEXIBLE MANUFACTURING SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce the concepts of Flexible Manufacturing Systems
- To gain knowledge on computer control and software for Flexible Manufacturing Systems
- To outline flexible manufacturing system simulation and database
- To familiarize the principles of group technology and justify flexible manufacturing systems
- To implement flexible manufacturing systems in various applications and to impart knowledge on factories of the future.

UNIT I PLANNING AND SCHEDULING OF FLEXIBLE MANUFACTURING SYSTEMS 9

Introduction to Flexible Manufacturing System (FMS) - Development of Manufacturing Systems - Benefits - Major Elements of FMS - Types of Flexibility - FMS Application and Flexibility – Single product, Single batch, n-product, n-batch Scheduling Problem-Knowledge Based Scheduling System.

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT II COMPUTER CONTROL AND SOFTWARE FOR FLEXIBLE MANUFACTURING SYSTEMS 9

Introduction - Composition of FMS - Hierarchy of Computer Control - Computer Control of Work Center and Assembly Lines - FMS Supervisory Computer Control. Computer Software for FMS - Introduction, System Issues, Types of Software Specification and Selection - Trends.

UNIT III FLEXIBLE MANUFACTURING SYSTEM SIMULATION AND DATA BASE 9

Introduction-Application of Simulation -Simulation Process-Model of FMS - Simulation Software - Limitation - Manufacturing Data Systems - Data Flow - FMS Database Systems - Planning for FMS Database.

UNIT IV GROUP TECHNOLOGY AND JUSTIFICATION OF FLEXIBLE MANUFACTURING SYSTEMS 9

Introduction - Matrix Formulation - Mathematical Programming Formulation - Graph Formulation - Knowledge Based System for Group Technology - Economic Justification of FMS - Application of Possibility Distributions in FMS Systems -Justification.

UNIT V IMPLEMENTATION OF FMS AND FACTORIES OF THE FUTURE 9

FMS application in Machining, Sheet Metal Fabrication, Prismatic Component Production - Aerospace Application - FMS Development towards Factories of the Future - Artificial Intelligence and Expert Systems in FMS - Design Philosophy and Characteristics for Future.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students shall be able to:

- CO1: Be familiarized with concepts of Flexible Manufacturing Systems
- CO2: Perceive Computer Control and Software for Flexible Manufacturing Systems
- CO3: Be acquainted with Flexible Manufacturing System Simulation and Database
- CO4: Evaluate principles of Group Technology and justify Flexible Manufacturing Systems
- CO5: Describe various flexible manufacturing systems and their applications.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.6		0.3										0.6	0.6	0.3
2	0.6		0.3										0.6	0.6	0.6
3	0.6		0.6		0.9								0.6	0.6	0.6
4	0.6		0.6		0.6								0.6	0.9	0.9
5	0.6		0.6				0.6						0.6	0.9	0.9

TEXT BOOK

1. Jha.N.K., “Handbook of flexible manufacturing systems”, Academic Press Inc., United States of America, 2012, ISBN-13: 978-03-231-3935-9.

REFERENCES

1. Groover M.P., “Automation, production systems and computer integrated manufacturing”, Prentice Hall of India Pvt., New Delhi, 2016, ISBN-13: 978-93-325-7249-2.
2. Kalpakjian S., “Manufacturing Engineering and Technology”, Addison-Wesley Publishing Co., United States of America, 2013, ISBN-13: 978-01-331-2874-1.
3. Ohno T., “Toyota production system: Beyond large-scale production”, Productivity Press (India) Pvt. Ltd., 1992, ISBN-13: 978-09-152-9914-0.
4. Radhakrishnan P. and Subramanyan S., “CAD/CAM/CIM”, Wiley Eastern Ltd., New Age International Ltd., India, 2009, ISBN-13: 978-81-224-2236-8.
5. Raouf A. and Daya B.M., “Flexible manufacturing systems: recent development”, Elsevier Science, Netherlands, 2005, ISBN-13 978-04-448-9798-5.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IE5552 **OPERATIONS RESEARCH** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- Provide knowledge of optimization techniques and approaches. Formulate a real-world problem as a mathematical programming model.
- Enable the students apply mathematical, computational and communication skills needed for the practical utility of Operations Research.
- Knowledge to solve networking problems.
- Knowledge to solve various inventory problems.
- Gain knowledge on solving different waiting line models.

UNIT I LINEAR PROGRAMMING 9

Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method. Solutions to LPP using simplex algorithm – Two phase method – Big M method

UNIT II ADVANCES IN LINEAR PROGRAMMING 9

Revised simplex method - primal dual relationships – Dual simplex algorithm – Sensitivity analysis –changes in RHS value – changes in Coefficient of constraint – Adding new constraint – Adding new variable.

UNIT III NETWORK ANALYSIS 9

Transportation problems: Northwest corner rule, least cost method, Vogel's approximation method - stepping stone method - MODI method – Unbalanced transportation – Assignment problem – Hungarian algorithm –Project Management CPM & PERT. Minimum spanning tree problem: Prim's algorithm, Kruskal's algorithm - Shortest path problem: Dijkstra's algorithms, Floyds algorithm - maximal flow problem: Maximal-flow minimum cut theorem - Maximal flow algorithm

UNIT IV INVENTORY MODELS 9

Purchase model with no shortages – Manufacturing model with no shortages - Model with price breaks - Reorder point model - Probabilistic inventory model

UNIT V QUEUING THEORY 9

Queuing theory terminology – Single server, multi server- limited and unlimited queue capacity-limited and unlimited population –limited and infinite queue length.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Learned to translate a real-world problem, given in words, into a mathematical Formulation.
CO2: An understanding of the role of algorithmic thinking in the solution of operations research problems.
CO3: Be able to build and solve Transportation Models and Assignment Models, maximal flow problem, minimum spanning tree and shortest path problem.
CO4: Able to handle issues in various Inventory models.
CO5: The students acquire capability in applying and using of queuing models for day today problem

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓	✓							
CO2	✓	✓		✓	✓							
CO3	✓	✓	✓	✓	✓							
CO4	✓	✓	✓	✓	✓							
CO5	✓	✓	✓	✓	✓							

TEXT BOOKS:

1. Panneerselvam R, "Operations Research", PHI, 2009.
2. Srinivasan G., "Operations Research Principles and Applications", PHI, 2017.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

REFERENCES:
1. Hamdy A Taha, “Operations Research – An Introduction”, Pearson, 2017.
2. Philips, Ravindran and Solberg, “Operations Research principle and practise”, John Wiley,2007
3. Ronald L Rardin, “Optimisation in Operations Research”, Pearson, 2018.

IE5651 MANUFACTURING AUTOMATION L T P C
3 0 0 3

COURSE OBJECTIVES:

- Define automation and justification in manufacturing.
- Explain the control technologies in automation.
- Explain the concept of fixed automation using transfer lines.
- Describe the programmable automation such as CNC and industrial robotics.
- Use of automated material handling, storage and data capture.

UNIT I MANUFACTURING OPERATIONS 9
Automation in production systems, principles and strategies, Product/production relationships, Production concepts and mathematical models, manufacturing economics.

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.

UNIT III TRANSFER LINES 9
Automated production lines – applications, Analysis – with and without buffers, automated assembly systems, line unbalancing concept.

UNIT IV NUMERICAL CONTROL AND ROBOTICS 9
NC - CNC – Part programming – DNC – Adaptive control – Robot anatomy – Specifications – End effectors – Industrial applications.

UNIT V AUTOMATED HANDLING AND STORAGE 9
Automated guided vehicle systems, AS/RS, Carousel storage, Automatic data capture - Bar code technology.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Selection of automated equipment with cost justification.
CO2: Ability to understand control technologies.
CO3: Selection of buffer size and location in transfer lines.
CO4: Ability to prepare a simple CNC program, select a robot configuration for given application.
CO5: Recommend an appropriate automated material handling, storage and data capture method.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓									✓	
CO2		✓	✓	✓								
CO3			✓		✓		✓				✓	
CO4		✓	✓		✓							
CO5		✓	✓		✓							

TEXT BOOK:
1. Mikell P.Groover, Automation, “Production Systems and Computer Integrated Manufacturing” PHI, 2008.

Attested

REFERENCES:
1. Mikell P.Groover, Emory W. Zimmers, Jr., “CAD/CAM: Computer - Aided Design and Manufacturing”, PHI, 2007.

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

PR5074 MATERIALS PROCUREMENT MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce the various aspects of Purchasing.
- To introduce concepts of stores management.
- To familiarize the students about basic inventory management
- To introduce MRP, aggregate planning, JIT concepts.
- To illustrate the usefulness of quantitative techniques in materials management.

UNIT I PURCHASING MANAGEMENT 9

Introduction to materials management – objectives – organization —- value analysis – make or buy decisions-Purchasing and procedures – Selection of sources of supply – Vendor development – Vendor evaluation and rating – Vendor rating methods- Imports – Buyer and Seller relationship.

UNIT II STORES MANAGEMENT 9

Store function – Location – Layout – Stock taking – Materials handling Travel chart method– Transportation– Codification – Inventory pricing– warehousing –Logistics.

UNIT III BASIC INVENTORY MANAGEMENT 9

Basic EOQ Models- Assumptions- Quantity discount model- Q system- P system- Reorder level- ABC analysis- Deterministic and Probabilistic models- Finite Production

UNIT IV ADVANCED INVENTORY MANAGEMENT 9

Bill of Materials-Market Production Schedule requirements planning– Aggregate planning- Aggregate planning strategies-Costs-Techniques-Tabulation method-Linear Programming Method – JIT- Lot size under constraints.

UNIT V O .R TECHNIQUES IN MATERIAL MANAGEMENT 9

Application of O.R. Techniques in Materials Management- Linear Programming – Distribution model- Replacement analysis- Scheduling – Forecasting-Forecasting techniques.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, students will be able to:

CO1: Identify a suitable vendor for a given requirement.
CO2: Design stores layout, select materials handling equipment.
CO3: Select a suitable inventory system for a given requirement.
CO4: Develop suitable aggregate planning strategies.
CO5: Identify suitable quantitative technique for a given situation.

TEXT BOOKS:

1. Gopalakrishnan. P, “Purchasing and Material Management”, Text and cases, Tata McGraw Hill, 1996.
2. Kesavan.R, Elanchezhian.C and VijayaRamnath.B, “Engineering Management”, Eswar Press. 2005.

REFERENCES:

1. Gupta P.K. and Man Mohan, “Problems in Operations Research”, Sultan chand and Sons, 2014.
2. Jhamb L.C,” Inventory Management”, Everest Publishing House, 2013.
3. Menan K.S and Sarikakulkarni, Purchasing and Inventory Management, Shross, 2011.
4. Stephan.N, Chapmen J.R and Tany Arnold, “Introduction to Materials Management”, Pearson 2017.
5. Nair N.K, “Purchasing and Materials Management”, Vikas Publishing, 1990.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	√		√			√		√	√	√	√	√	√
CO2	√		√			√		√	√	√	√	√	√
CO3	√		√			√		√	√	√	√	√	√
CO4	√		√			√		√	√	√	√	√	√
CO5	√		√			√		√	√	√	√	√	√

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IE5072 **ENTERPRISE RESOURCE PLANNING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- Describe an idea about ERP.
- Grasp the activities of ERP project management cycle.
- Understanding the emerging trends in ERP developments.
- Creating awareness of core and extended modules of ERP.
- Understand the ERP trending concepts.

UNIT I INTRODUCTION **9**

Overview of enterprise systems – Evolution - Risks and benefits - Fundamental technology - Issues to be consider in planning design and implementation of cross functional integrated ERP systems.

UNIT II ERP SOLUTIONS AND FUNCTIONAL MODULES **9**

Overview of ERP software solutions- Small, medium and large enterprise vendor solutions, BPR, and best business practices - Business process Management, Functional modules.

UNIT III ERP IMPLEMENTATION **9**

Planning Evaluation and selection of ERP systems - Implementation life cycle - ERP implementation, Methodology and Frame work- Training – Data Migration. People Organization in implementation-Consultants, Vendors and Employees.

UNIT IV POST IMPLEMENTATION **9**

Maintenance of ERP- Organizational and Industrial impact; Success and Failure factors of ERP Implementation.

UNIT V EMERGING TRENDS ON ERP **9**

Extended ERP systems and ERP add-ons -CRM, SCM, Business analytics - Future trends in ERP systems-web enabled, Wireless technologies, cloud computing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Knowledge of ERP implementation cycle.
CO2: Awareness of core and extended modules of ERP.
CO3: Able to understand ERP implementation steps.
CO4: Able to understand post implementation procedure.
CO5: Able to understand ERP trending concepts.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓				✓					✓	
CO2		✓				✓					✓	
CO3	✓	✓				✓					✓	
CO4		✓				✓					✓	
CO5	✓	✓				✓					✓	

TEXT BOOK:

1. Alexis Leon, ERP demystified, second Edition Tata McGraw-Hill, 2008.

REFERENCES:

1. Alexis Leon, Enterprise Resource Planning, second edition, Tata McGraw-Hill, 2008.
2. Jagan Nathan Vaman, ERP in Practice, Tata McGraw-Hill, 2008
3. MahadeoJaiswal and Ganesh Vanapalli, ERP Macmillan India, 2009
4. Sinha P. Magal and Jeffery Word, Essentials of Business Process and Information System, Wiley India, 2012
5. Summer, ERP, Pearson Education, 2008
6. Vinod Kumar Grag and N.K. Venkitakrishnan, ERP- Concepts and Practice, Prentice Hall of India, 2006.

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

MF5009 DIGITAL TWIN DRIVEN SMART MANUFACTURING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce digital twin concepts and their applications in industry.
- To familiarize with trends in discrete Industry
- To be acquainted with digital twin in process industry.
- To impart knowledge in Industry 4.0
- To elaborate the advantages of digital twin.

UNIT I INTRODUCTION 9

Digital twin - Definition, types of Industry & its key requirements, Importance, Application of Digital Twin in process, product, service industries, History of Digital Twin, DTT role in industry innovation, Technologies/tools enabling Digital Twin

UNIT II DIGITAL TWIN IN A DISCRETE INDUSTRY 9

Basics of Discrete Industry, Trends in the discrete industry, control system requirements in a discrete industry, Digital Twin of a Product, Digital Thread in Discrete Industry, Data collection & analysis for product & production improvements, Automation simulation, Digital Enterprise

UNIT III DIGITAL TWIN IN A PROCESS INDUSTRY 9

Basics of Process Industry, Trends in the process industry, control system requirements in a process industry, Digital Twin of a plant, Digital Thread in process Industry, Data collection & analysis for process improvements, process safety, Automation simulation, Digital Enterprise

UNIT V INDUSTRY 4.0 9

Industrial Revolutions, Industry 4.0 – Definition, principles, Application of Industry 4.0 in process & discrete industries, Benefits of Industry 4.0, challenges in Industry 4.0, Smart manufacturing, Internet of Things, Industrial Gateways, Basics of Communication requirements.

UNIT V ADVANTAGES OF DIGITAL TWIN 9

Improvement in product quality, production process, process Safety, identify bottlenecks and improve efficiency, achieve flexibility in production, continuous prediction and tuning of production process through Simulation, reducing the time to market.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students shall be able to:

- CO1: Acquire knowledge on digital twin and its importance.
- CO2: Support digital twin in discrete Industry.
- CO3: Value digital twin in process industry.
- CO4: Operate Industry 4.0 and Smart Manufacturing in Industry.
- CO5: Discover the advantages of digital twin.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9	0.9	0.6	0.6	0.9						0.3	0.6	0.3	0.3	0.3
2	0.9	0.9	0.6	0.6	0.9						0.3	0.6	0.6	0.6	0.6
3	0.9	0.9	0.6	0.6	0.9						0.3	0.6	0.3	0.3	0.6
4	0.9	0.9	0.6	0.6	0.9						0.3	0.6	0.6	0.6	0.6
5	0.9	0.9	0.6	0.6	0.9						0.3	0.6	0.3	0.3	0.3

TEXT BOOKS:

1. Alp Ustundag and Emre Cevikcan, "Industry 4.0: Managing The Digital Transformation", Springer Series in Advanced Manufacturing., Switzerland, 2017
2. Andrew Yeh Chris Nee, Fei Tao, and Meng Zhang, "Digital Twin Driven Smart Manufacturing", Elsevier Science., United States, 2019

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

REFERENCES:
1. Alasdair Gilchrist , "Industry 4.0: The Industrial Internet of Things", Apress., United States ,2015.
2. Christoph Jan Bartodziej, “The Concept Industry 4.0 An Empirical Analysis of Technologies and Applications in Production Logistics”, Springer Gambler., Germany, 2017.
3. Ibrahim Garbie, “Sustainability in Manufacturing Enterprises, Concepts, analyses and assessments for Industry 4.0”, Springer., Switzerland, 2016.
4. Ronald R. Yager and Jordán Pascual Espada, ”New Advances in the Internet of Things”, Springer., Switzerland, 2018
5. Ulrich Sendler, “The Internet of Things, Industries 4.0 Unleashed”, Springer., Germany, 2016.

ME5075 ENTREPRENEURSHIP DEVELOPMENT L T P C
3 0 0 3

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Explaining the types, characteristics of entrepreneurship and its role in economic development.
2. Applying the theories of achievement motivation and the principles of entrepreneurship development program to enterprise.
3. Selecting the appropriate form of business ownership in setting up an enterprise.
4. Applying the fundamental concepts of finance and accounting to enterprise.
5. Identifying sickness in industry, selecting the appropriate corrective measures, and identifying the growth strategies in enterprise.

UNIT I ENTREPRENEURSHIP 9
Entrepreneur – Characteristics – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur – Role of Entrepreneurship in Economic Development – Factors Affecting Entrepreneurial Growth – Economic, Non Economic, Government Actions.

UNIT II MOTIVATION 9
Entrepreneurial Motivation: Theories and Factors, Achievement Motivation –Entrepreneurial Competencies – Entrepreneurship Development Programs – Need, Objectives – Business Game, Thematic Apperception Test, Self Rating, Stress management.

UNIT III BUSINESS 9
Small Enterprises – Definition, Characteristics, Project Identification and selection – Project Formulation: Significance, content, formulation of project report – Project Appraisal: Concept and method – Ownership Structures: Selection & Pattern.

UNIT IV FINANCING AND ACCOUNTING 9
Finance: Need, Sources, Capital Structure, Term Loans – Accounting: Need, Objectives, Process, Journal, Ledger, Trial Balance, Final Accounts – Working Capital Management: Significance, Assessment, Factors, Sources, Management.

UNIT V SUPPORT TO ENTREPRENEURS 9
Sickness in small Business: Concept, Signals, Symptoms, Magnitude, Causes and Consequences, Corrective Measures – Government Policy for Small Scale Enterprises – Growth Strategies in Small Scale Enterprise – Institutional Support to Entrepreneurs: Need and Support – Taxation Benefits to Small Scale Industry: Need, Depreciation, Rehabilitation, Investment.

TOTAL = 45 PERIODS

COURSE OUTCOMES: Upon completion of this course, the students will be able to:
1. Explain the types, characteristics of entrepreneurship and its role in economic development.
2. Apply the theories of achievement motivation and the principles of entrepreneurship development program.
3. Select the appropriate form of business ownership in setting up an enterprise.
4. Apply the fundamental concepts of finance and accounting to enterprise.
5. Identify sickness in industry, select the appropriate corrective measures, and identify the growth strategies in enterprise.

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

TEXT BOOKS:

1. S.S.Khanka, "Entrepreneurial Development" S.Chand & Co. Ltd. Ram Nagar New Delhi,1999.
2. Kurahko & Hodgetts, "Entrepreneurship – Theory, process and practices", Thomson learning 6th edition.

REFERENCES:

1. Charantimath, P. M., Entrepreneurship Development and Small Business Enterprises, Pearson, 2006.
2. Hisrich R D and Peters M P, "Entrepreneurship" 5th Edition Tata McGraw-Hill, 2002.
3. Mathew J Manimala," Entrepreneurship theory at cross roads: paradigms and praxis" Dream tech, 2nd edition 2006.
4. Rabindra N. Kanungo, "Entrepreneurship and innovation", Sage Publications, New Delhi, 1998.
5. Singh, A. K., Entrepreneurship Development and Management, University Science Press, 2009.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1						0.6		0.3	0.3	0.3		0.3			
2						0.6		0.3	0.3	0.3		0.3		0.3	
3						0.6	0.6	0.6	0.3	0.3	0.9	0.3		0.3	
4						0.6	0.3	0.6		0.3	0.3	0.3		0.3	
5						0.6	0.6	0.3		0.3		0.3		0.3	

IE5074 MACHINE LEARNING ALGORITHMS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand basic concepts of learning.
- To understand decision tree learning.
- To evaluate hypotheses.
- To understand Bayesian learning.
- To understand computational learning theory.

UNIT I CONCEPT LEARNING 9

A Concept Learning Task: Notation, The Inductive Learning Hypothesis, Concept Learning as Search, FIND-S: Algorithm for finding a Maximally Specific Hypothesis: Version Spaces and the CANDIDATE-ELIMINATION Algorithm; Convergence of CANDIDATE-ELIMINATION Algorithm to the correct Hypothesis; Appropriate Training Examples for learning; Applying Partially Learned Concept, Inductive Bias: A Biased Hypothesis Space; An Unbiased Learner; The Futility of Bias-Free Learning.

UNIT II DECISION TREE LEARNING 9

Decision Tree Representation, Appropriate problems for decision tree learning, The basic decision tree Learning Algorithm, Hypothesis Space Search in decision tree learning, Inductive Bias in Decision Tree Learning, Issues in Decision Tree Learning: Over fitting the Data; Incorporating Continuous-Valued Attributes; Alternative Measures for Selecting Attributes; Handling Training Examples with Missing Attribute Values; Handling Attributes with differing Costs.

UNIT III EVALUATING HYPOTHESES 9

Estimating Hypothesis Accuracy: Sample Error and True Error; Confidence Intervals for Discrete-Valued Hypotheses. Basics of Sampling Theory: Error Estimation and Estimating Binomial Proportions; the Binomial Distribution; Mean and Variance; Estimators, Bias; and Variance; Confidence Intervals; Two-sided and one-sided bounds. A General approach for deriving confidence intervals: Central Limit Theorem. Difference in Error of two hypotheses; Hypothesis Testing. Comparing Learning Algorithms: Paired *t* Tests; Practical Considerations.

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT IV BAYESIAN LEARNING 9

Bayes Theorem, Bayes Theorem and Concept Learning, Maximum Likelihood and Least-Squared Error Hypotheses, Maximum Likelihood Hypotheses for predicting probabilities: Gradient search to maximize likelihood in a neural net. Minimum description length principle, Bayes Optimal Classifier, Gibbs Algorithm, Naive Bayes Classifier, Bayesian Belief Networks: Conditional Independence; Representation; Inference; Learning Bayesian Belief Networks; Gradient Ascent Training of Bayesian Networks; Learning the structure of Bayesian Networks; The EM Algorithm: Estimating Means of *k* Guassions; General Statement of EM Algorithm; Derivation of the *k* Means Algorithm.

UNIT V COMPUTATIONAL LEARNING THEORY 9

Introduction, probably learning an approximately correct hypothesis: The Problem Setting; Error of a Hypothesis; Learnability. Sample Complexity for Finite Hypothesis Spaces: Agnostic Learning and Inconsistent Hypotheses; Conjunctions of Boolean earnability of Other Concept Classes. Sample Complexity for infinite hypothesis spaces: Shattering a set of Instances; The Vapnik-Chervonenkis Dimension; Sample Complexity and the VC Dimension. The mistake bound model of learning: Mistake bound for the FIND-S Algorithm; Mistake bound for the HALVING Algorithm; Optimal Mistake Bounds; WEIGHTED-MAJORITY Algorithm.

COURSE OUTCOMES:

CO1: Ability to understand basic concepts of learning.
CO2: Ability to understand decision tree learning.
CO3: Ability to evaluate hypotheses.
CO4: Ability to understand Bayesian learning.
CO5: Ability to understand computational learning theory.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓				✓			✓			
CO2		✓				✓			✓			
CO3		✓				✓			✓			
CO4		✓				✓			✓			
CO5		✓				✓			✓			

TEXT BOOK:

1. Machine Learning by Tom M. Mitchell ,McGraw-Hill International Edition, 1997

PROGRESS THROUGH KNOWLEDGE

IE5075 PRINCIPLES OF COMPUTER INTEGRATED MANUFACTURING SYSTEMS

L T P C
3 0 0 3

COURSE OBJECTIVES:

- Define flexible automation and describe its components.
- Explain the process of computer aided design.
- Relate the enablers of CAD and CAM integration and business function.
- Tell the fundamentals of integrated management systems.
- Correlate CIM with DBMS.

UNIT I GT AND FMS 9

Part families, production flow analysis, cellular manufacturing, ROC, Flexible manufacturing systems- components, FMS applications, FMS analysis – Bottleneck model.

UNIT II COMPUTER-AIDED DESIGN 9

Fundamentals of CAD – design process, manufacturing database – Computer graphics –functions, constructing the geometry, transformation, wire frame Vs solid modelling.

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT III MANUFACTURING SUPPORT SYSTEMS 9

Product design and CAD, CAD/CAM and CIM, Computer aided process planning- Variant and generative approaches, Concurrent engineering and design for manufacture, Lean production, Agile manufacturing.

UNIT IV FUNDAMENTALS OF COMMUNICATIONS 9

Information, Communications matrix, Computer communications, Network architecture, Tools and techniques.

UNIT V DATABASE AND CIM MANAGEMENT 9

Manufacturing data, database technology, Database management, Management of CIM – role, cost justification, expert systems

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Analyze a cellular and flexible manufacturing system for its performance measures.
CO2: Gain knowledge in the basics of computer aided design.
CO3: Make competitive manufacturing systems with the use of appropriate tools and techniques.
CO4: Develop integrated manufacturing system with the required network structure and manufacturing database.
CO5: Able to understand DBMS concepts.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓		✓							✓	
CO2			✓									
CO3			✓		✓						✓	
CO4			✓		✓							
CO5	✓	✓	✓									

TEXT BOOK:

1. Mickel P Groover, “Automation production systems and computer integrated manufacturing”, PHI, second edition, 2008.

REFERENCE:

1. Kant Vajpayee S, “Principles of Computer-Integrated Manufacturing”, PHI, 2005.

IE5071 DECISION SUPPORT AND INTELLIGENT SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES:

- Explain the fundamental terms, concepts and theories associated with the phases of Decision Support Systems.
- Describe the uses of various mathematical models, data warehousing and mining.
- Discuss and develop skills in the analysis, design and implementation of group support systems and knowledge management systems.
- Illustrate expert system as a subsystem of DSS.
- Track the knowledge representation methods.

UNIT I INTRODUCTION 9

Managerial decision making, system modeling and support - preview of the modeling process-phases of decision making process.

UNIT II ANALYSIS 9

DSS components- Data warehousing, access, analysis, mining and visualization-modeling and analysis-DSS development.

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT III TECHNOLOGIES 9

Group support systems- Enterprise DSS- supply chain and DSS - Knowledge management methods, technologies and tools.

UNIT IV EXPERT SYSTEMS 9

Artificial intelligence and expert systems - Concepts, structure, types - Knowledge acquisition and validation - Difficulties, methods, selection.

UNIT V SEMANTIC NETWORKS 9

Representation in logic and schemas, semantic networks, production rules and frames, inference techniques, intelligent system development, implementation and integration of management support systems.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

CO1: Make decisions in the semi structured and unstructured problem situations.
CO2: Able to apply data warehousing and data mining principles in basic applications.
CO3: Develop knowledge management system with simple tools and techniques.
CO4: Develop intelligent based DSS.
CO5: Able to use logical and analytical thinking

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			✓							✓	✓	
CO2		✓										
CO3				✓	✓						✓	
CO4			✓		✓							✓
CO5			✓		✓							✓

TEXT BOOK:

1. Efraim Turban and Jay E Aronson, “Decision Support and Business Intelligent Systems”, PHI, Eighth edition, 2010.

REFERENCES:

1. Elain Rich and Kevin Knight, “Artificial intelligence”, TMH,1993.
2. Mitra SS, “Decision support systems, tools and techniques”, John Wiley, 1996.

PROGRESS THROUGH KNOWLEDGE

AD5091 CONSTITUTION OF INDIA L T P C
3 0 0 0

COURSE OBJECTIVES:

- Teach history and philosophy of Indian Constitution.
- Describe the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Summarize powers and functions of Indian government.
- Explain emergency rule.
- Explain structure and functions of local administration.

UNIT I INTRODUCTION 9

History of Making of the Indian Constitution-Drafting Committee- (Composition & Working) - Philosophy of the Indian Constitution-Preamble-Salient Features

UNIT II CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES 9

Fundamental Rights-Right to Equality-Right to Freedom-Right against Exploitation Right to Freedom of Religion-Cultural and Educational Rights-Right to Constitutional Remedies Directive Principles of State Policy-Fundamental Duties

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT III ORGANS OF GOVERNANCE 9

Parliament-Composition-Qualifications and Disqualifications-Powers and Functions-Executive President-Governor-Council of Ministers-Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions

UNIT IV EMERGENCY PROVISIONS 9

Emergency Provisions - National Emergency, President Rule, Financial Emergency

UNIT V LOCAL ADMINISTRATION 9

District's Administration head- Role and Importance-Municipalities- Introduction- Mayor and role of Elected Representative-CEO of Municipal Corporation-Pachayati raj- Introduction- PRI- Zila Pachayat-Elected officials and their roles- CEO ZilaPachayat- Position and role-Block level-Organizational Hierarchy (Different departments)-Village level- Role of Elected and Appointed officials-Importance of grass root democracy

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Able to understand history and philosophy of Indian Constitution.
CO2: Able to understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
CO3: Able to understand powers and functions of Indian government.
CO4: Able to understand emergency rule.
CO5: Able to understand structure and functions of local administration.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									✓			✓
CO2									✓			✓
CO3									✓			✓
CO4									✓			✓
CO5									✓			✓

TEXT BOOKS:

1. Basu D D, Introduction to the Constitution of India, Lexis Nexis, 2015.
2. Busi S N, Ambedkar B R framing of Indian Constitution, 1st Edition, 2015.
3. Jain M P, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. The Constitution of India (Bare Act), Government Publication,1950

PROGRESS THROUGH KNOWLEDGE

AD5092 VALUE EDUCATION

L T P C
3 0 0 0

COURSE OBJECTIVES:

- Develop knowledge of self-development
- Explain the importance of Human values
- Develop the overall personality through value education
- Overcome the self destructive habits with value education
- Interpret social empowerment with value education

UNIT I INTRODUCTION TO VALUE EDUCATION 9

Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation, Standards and principles, Value judgements

UNIT II IMPORTANCE OF VALUES 9

Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness. Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT III INFLUENCE OF VALUE EDUCATION 9

Personality and Behaviour development - Soul and Scientific attitude. Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship Happiness Vs suffering, love for truth.

UNIT IV REINCARNATION THROUGH VALUE EDUCATION 9

Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation

UNIT V VALUE EDUCATION IN SOCIAL EMPOWERMENT 9

Equality, Non violence, Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively

TOTAL: 45PERIODS

COURSE OUTCOMES:

CO1 – Gain knowledge of self-development
CO2 – Learn the importance of Human values
CO3 – Develop the overall personality through value education
CO4 – Overcome the self destructive habits with value education
CO5 – Interpret social empowerment with value education

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							✓	✓				✓
CO2							✓	✓	✓			✓
CO3							✓	✓	✓			✓
CO4							✓	✓				✓
CO5							✓	✓				✓

REFERENCES:

1. Chakroborty , S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press ,New Delhi

AD5093 PEDAGOGY STUDIES L T P C
3 0 0 0

COURSE OBJECTIVES:

- Understand the methodology of pedagogy.
- Compare pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Infer how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Illustrate the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

UNIT I INTRODUCTION AND METHODOLOGY: 9

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions **-** Overview of methodology and Searching.

UNIT II THEMATIC OVERVIEW 9

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES 9

Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV PROFESSIONAL DEVELOPMENT 9

Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS 9

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- Understand the methodology of pedagogy.
- Understand Pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Find how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Know the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												✓
CO2												✓
CO3												✓
CO4												✓
CO5												✓

REFERENCES:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

AD5094 STRESS MANAGEMENT BY YOGA

L T P C
3 0 0 0

COURSE OBJECTIVES:

- Develop healthy mind in a healthy body thus improving social health also improve efficiency.
- Invent Do's and Don't's in life through Yam
- Categorize Do's and Don't's in life through Niyam
- Develop a healthy mind and body through Yog Asans
- Invent breathing techniques through Pranayam

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT I INTRODUCTION TO YOGA **9**

Definitions of Eight parts of yog. (Ashtanga)

UNIT II YAM **9**

Do`s and Don't's in life.

Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT III NIYAM **9**

Do`s and Don't's in life.

Ahinsa, satya, astheya, bramhacharya and aparigraha

UNIT IV ASAN **9**

Various yog poses and their benefits for mind & body

UNIT V PRANAYAM **9**

Regularization of breathing techniques and its effects-Types of pranayam

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1 – Develop healthy mind in a healthy body thus improving social health also improve efficiency
CO2 – Learn Do's and Don't's in life through Yam
CO3 – Learn Do's and Don't's in life through Niyam
CO4 – Develop a healthy mind and body through Yog Asans
CO5 – Learn breathing techniques through Pranayam

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							✓	✓				✓
CO2							✓	✓				✓
CO3							✓	✓				✓
CO4							✓	✓				✓
CO5							✓	✓				✓

REFERENCES:

1. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata
2. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur

PROGRESS THROUGH KNOWLEDGE

AD5095 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

L T P C
3 0 0 0

COURSE OBJECTIVES:

- Develop basic personality skills holistically
- Develop deep personality skills holistically to achieve happy goals
- Rewrite the responsibilities
- Reframe a person with stable mind, pleasing personality and determination
- Discover wisdom in students

UNIT I NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - I **9**

Verses- 19, 20, 21, 22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue)

UNIT II NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - II **9**

Verses- 52, 53, 59 (dont's) - Verses- 71,73,75,78 (do's)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT III APPROACH TO DAY TO DAY WORK AND DUTIES 9

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

UNIT IV STATEMENTS OF BASIC KNOWLEDGE – I 9

Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18

UNIT V PERSONALITY OF ROLE MODEL - SHRIMAD BHAGWADGEETA 9

Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 45PERIODS

COURSE OUTCOMES:

CO1: To develop basic personality skills holistically
CO2: To develop deep personality skills holistically to achieve happy goals
CO3: To rewrite the responsibilities
CO4: To reframe a person with stable mind, pleasing personality and determination
CO5: To awaken wisdom in students

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									✓			✓
CO2									✓			✓
CO3									✓			✓
CO4									✓			✓
CO5									✓			✓

REFERENCES:

1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari's ThreeSatakam , Niti-sringar-vairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram,Publication Department, Kolkata,2016

AD5097 ESSENCE OF INDIAN KNOWLEDGE TRADITION L T P C
3 0 0 0

COURSE OBJECTIVES

The course will introduce the students to

- get a knowledge about Indian Culture
- Know Indian Languages and Literature religion and philosophy and the fine arts in India
- Explore the Science and Scientists of Ancient, Medieval and Modern India
- Understand education systems in India

UNIT I INTRODUCTION TO CULTURE 9

Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India.

UNIT II INDIAN LANGUAGES AND LITERATURE 9

Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languages and Literature – II: Northern Indian Languages & Literature

UNIT III RELIGION AND PHILOSOPHY 9

Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only)

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT IV FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING) 9

Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India

UNIT V EDUCATION SYSTEM IN INDIA 9

Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India

TOTAL: 45 PERIODS

COURSE OUTCOMES

After successful completion of the course the students will be able to

- Understand philosophy of Indian culture.
- Distinguish the Indian languages and literature.
- Learn the philosophy of ancient, medieval and modern India.
- Acquire the information about the fine arts in India.
- Know the contribution of scientists of different eras.
- Understand education systems in India

REFERENCES:

1. Kapil Kapoor, “Text and Interpretation: The India Tradition”,ISBN: 81246033375, 2005
2. “Science in Samskrit”, Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, “Position paper on Arts, Music, Dance and Theatre”, ISBN 81-7450 494-X, 200
4. Narain, “Examinations in ancient India”, Arya Book Depot, 1993
5. Satya Prakash, “Founders of Sciences in Ancient India”, Vijay Kumar Publisher, 1989
6. M. Hiriyanna, “Essentials of Indian Philosophy”, Motilal Banarsidass Publishers, ISBN 13: 978- 8120810990, 2014

AD5098 SANGA TAMIL LITERATURE APPRECIATION L T P C
3 0 0 0

COURSE OBJECTIVES:

The main learning objective of this course is to make the students an appreciation for:

1. Introduction to Sanga Tamil Literature.
2. ‘Agathinai’ and ‘Purathinai’ in Sanga Tamil Literature.
3. ‘Attruppadai’ in Sanga Tamil Literature.
4. ‘Puranaanuru’ in Sanga Tamil Literature.
5. ‘Pathitrupaththu’ in Sanga Tamil Literature.

UNIT I SANGA TAMIL LITERATURE AN INTRODUCTION 9

Introduction to Tamil Sangam – History of Tamil Three Sangams – Introduction to Tamil Sangam Literature – Special Branches in Tamil Sangam Literature - Tamil Sangam Literature’s Grammar - Tamil Sangam Literature’s parables.

UNIT II ‘AGATHINAI’ AND ‘PURATHINAI’ 9

Tholkappiyar’s Meaningful Verses – Three literature materials – Agathinai’s message - History of Culture from Agathinai – Purathinai – Classification – Mesaage to Society from Purathinai.

UNIT III ‘ATTRUPPADAI’. 9

Attruppadai Literature – Attruppadai in ‘Puranaanuru’ - Attruppadai in ‘Pathitrupaththu’ – Attruppadai in ‘Paththupaattu’.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT IV 'PURANAANURU' 9

Puranaanuru on Good Administration, Ruler and Subjects – Emotion & its Effect in Puranaanuru.

UNIT V 'PATHITRUPATHTHU' 9

Pathitrupaththu in 'Ettuthogai' – Pathitrupaththu's Parables – Tamil dynasty: Valor, Administration, Charity in Pathitrupaththu - Mesaage to Society from Pathitrupaththu.

TOTAL (L: 45) = 45 PERIODS

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

1. Appreciate and apply the messages in Sanga Tamil Literature in their life.
2. Differentiate 'Agathinai' and 'Purathinai' in their personal and societal life.
3. Appreciate and apply the messages in 'Attruppadai' in their personal and societal life.
4. Appreciate and apply the messages in 'Puranaanuru' in their personal and societal life.
5. Appreciate and apply the messages in 'Pathitrupaththu' in their personal and societal life.

REFERENCES:

1. Sivaraja Pillai, The Chronology of the Early Tamils, Sagwan Press, 2018.
2. Hank Heifetz and George L. Hart, The Purananuru, Penguin Books, 2002.
3. Kamil Zvelebil, The Smile of Murugan: On Tamil Literature of South India, Brill Academic Pub, 1997.
4. George L. Hart, Poets of the Tamil Anthologies: Ancient Poems of Love and War, Princeton University Press, 2015.
5. Xavier S. Thani Nayagam, Landscape and poetry: a study of nature in classical Tamil poetry, Asia Pub. House, 1967.

	P												PS		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1									0.9						0.6
2									0.9						0.6
3									0.9						0.6
4									0.9						0.6
5									0.9						0.6

PROGRESS THROUGH KNOWLEDGE

HSMC– ELECTIVES – HUMANITIES I (ODD SEMESTER)

HU5171 LANGUAGE AND COMMUNICATION LT P C
3 0 0 3

COURSE DESCRIPTION

This course offers an introduction to language and communication. The primary goal of this course is to familiarize students with key ideas related to communication using language as well as non verbal means. Ideas related to the use of language and the underlying power structures are also examined. The course also examines the role of media in communication and in the dissemination of ideas as well as opinions.

OBJECTIVES

- ✓ To familiarize students with the concept of communication using linguistic and non linguistic resources.
- ✓ To help students ask critical questions regarding facts and opinions.
- ✓ To provide students with the material to discuss issues such as language and power structures.

DIRECTOR
Centre for Academic Courses

- ✓ To help students think critically about false propaganda and fake news.

LEARNING OUTCOMES

- ➢ Students will be able to use linguistic and non linguistic resources of language in an integrated manner for communication.
- ➢ Students will be able to analyse communication in terms of facts and opinions.
- ➢ Students will be able to discuss, analyse and argue about issues related to language and power.

UNIT I LINGUISTIC AND NON-LINGUISTIC RESOURCE OF COMMUNICATION: 9

a) Writing and Speech
b) Distinction between language structure and language use, form and function, acceptability and grammaticality
c) Gestures and Body language, pictures and symbols, cultural appropriacy
d) Communicative Competency, context and situation, combination of linguistic and non-linguistic elements of communication

UNIT II STRUCTURE OF WRITING/CONVERSATION: 9

a) Language skills and the communication cycle; speaking and listening, writing and reading
b) Initiating and closing conversations, intervention, turn taking
c) Writing for target reader, rhetorical devices and strategies
d) Coherence and Cohesion in speech and writing

UNIT III POWER STRUCTURE AND LANGUAGE USE: 9

a) Gender and language use
b) Politeness expressions and their use
c) Ethical dimensions of language use
d) Language rights as part of human rights

UNIT IV MEDIA COMMUNICATION: 9

a) Print media, electronic media, social media
b) Power of media
c) Manufacturing of opinion, fake news and hidden agendas

UNIT V PERSUASIVE COMMUNICATION AND MISCOMMUNICATION: 9

a) Fundamentals of persuasive communication
b) Persuasive strategies
c) Communication barriers

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Austin, 1962, J.L. How to do things with words. Oxford: Clarendon Press. Grice, P.1989. Studies in the way of words. Cambridge, M.A: Harvard University Press.
2. Chomsky, N.1966. Aspects of the theory of syntax, The MIT press, Cambridge. Chomsky, N.2006. Language and Mind, Cambridge University Press.
3. Hymes. D.N. 1972, On communication competence in J.B. Pride and J.Holmes (ed), Sociolinguistics, pp 269-293, London Penguin.
4. Gilbert, H.Harman, 1976. Psychological aspect of the theory of syntax in Journal of Philosophy, page 75-87.
5. Stephen. C. Levenson, 1983, Pragmatics, Cambridge University press.
6. Stangley, J. 2007. Language in Context. Clarendon press, Oxford. 7. Shannon, 1942. A Mathematical Theory of Communication. 8. Searle, J.R. 1969. Speech acts: An essay in the philosophy of language. Cambridge: Cambridge University Press.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

HU5172 **VALUES AND ETHICS** **L T P C**
3 0 0 3

OBJECTIVES:

- Teach definition and classification of values.
- Explain Purusartha.
- Describe Sarvodaya idea.
- Summarize sustenance of life.
- Conclude views of hierarchy of values.

UNIT I DEFINITION AND CLASSIFICATION OF VALUES 9

Extrinsic values- Universal and Situational values- Physical- Environmental-Sensuous- Economic-Social-Aesthetic-Moral and Religious values

UNIT II CONCEPTS RELATED TO VALUES 9

Purusartha-Virtue- Right- duty- justice- Equality- Love and Good

UNIT III IDEOLOGY OF SARVODAYA 9

Egoism- Altruism and universalism- The Ideal of Sarvodaya and Vasudhaiva Kutumbakam

UNIT IV SUSTENANCE OF LIFE 9

The Problem of Sustenance of value in the process of Social, Political and Technological Changes

UNIT V VIEWS ON HIERARCHY OF VALUES 9

The Problem of hierarchy of values and their choice, The views of Pt. Madan Mohan Malviya and Mahatma Gandhi

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Able to understand definition and classification of values.
CO2: Able to understand purusartha.
CO3: Able to understand sarvodaya idea.
CO4: Able to understand sustenance of life.
CO5: Able to understand views of hierarchy of values.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1								✓	✓			✓
CO2								✓	✓			✓
CO3								✓	✓			✓
CO4								✓	✓			✓
CO5								✓	✓			✓

TEXTBOOKS:

1. AwadeshPradhan :MahamanakeVichara. (B.H.U., Vanarasi-2007)
2. Little, William, : An Introduction of Ethics (Allied Publisher, Indian Reprint 1955)
3. William, K Frankena : Ethics (Prentice Hall of India, 1988)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

HU5173 **HUMAN RELATIONS AT WORK** **L T P C**
3 0 0 3

OBJECTIVES:

- Illustrate human relations at work its relationship with self.
- Explain the importance of interacting with people at work to develop teamwork.
- Infer the importance of physical health in maintaining human relations at work.
- Describe the importance of staying psychologically healthy.
- Identify the essential qualities for progressing in career.

UNIT I UNDERSTANDING AND MANAGING YOURSELF 9

Human Relations and You: Self-Esteem and Self-Confidence: Self-Motivation and Goal Setting; Emotional Intelligence, Attitudes, and Happiness; Values and Ethics and Problem Solving and Creativity.

UNIT II DEALING EFFECTIVELY WITH PEOPLE 9

Communication in the Workplace; Specialized Tactics for Getting Along with Others in the Workplace; Managing Conflict; Becoming an Effective Leader; Motivating Others and Developing Teamwork; Diversity and Cross-Cultural Competence.

UNIT III STAYING PHYSICALLY HEALTHY 9

Yoga, Pranayam and Exercise: Aerobic and anaerobic.

UNIT IV STAYING PSYCHOLOGICALLY HEALTHY 9

Managing Stress and Personal Problems, Meditation.

UNIT V DEVELOPING CAREER THRUST 9

Getting Ahead in Your Career, Learning Strategies, Perception, Life Span Changes, and Developing Good Work Habits.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to
CO1: Understand the importance of self-management.
CO2: Know how to deal with people to develop teamwork.
CO3: Know the importance of staying healthy.
CO4: Know how to manage stress and personal problems.
CO5: Develop the personal qualities essential for career growth.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						✓		✓	✓			✓
CO2									✓	✓		✓
CO3						✓		✓	✓			✓
CO4								✓				✓
CO5								✓	✓	✓		✓

TEXT BOOK:

1. Dubrien, A. J. (2017). Human Relations for Career and Personal Success: Concepts, Applications, and Skills, 11th Ed. Upper Saddle River, NJ: Pearson.

REFERENCES:

1. Greenberg, J. S. (2017). Comprehensive stress management (14th edition), New York: McGraw Hill.
2. Udai, Y. (2015). Yogasanaurpranayam. New Delhi: N.S. Publications.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

HU5174 **PSYCHOLOGICAL PROCESSES** **L T P C**
3 0 0 3

COURSE DESCRIPTION

Psychological Processes course is designed for students to be aware of the basic principles of psychology for the better understanding of people's psyche and behaviour around them. This course enables learners to use the optimal use of different forms of thinking skills and thereby results in effective communication in diverse situations. Every unit of the syllabus highlights the psychological process of people, the most powerful and constructive use of perceptions.

OBJECTIVES

The major objectives of this course is

- To develop students' awareness – on psychology, learning behavior and usage of perception effectively.
- To learn to use the various kinds of thinking in a formal context.
- To critically evaluate content and comprehend the message on the bases of perception, personality and intelligence.

UNIT I INTRODUCTION

What is psychology? - Why study psychology? - Psychology as science – Behavior and its role in human communication – socio-cultural bases of behaviour – Biological bases of behavior - Brain and its functions – Principles of Heredity – Cognition and its functions Fields of psychology – Cognitve and Perceptual – Industrial and Organizational.

UNIT II SENSORY & PERCEPTUAL PROCESSES

Some general properties of Senses: Visual system – the eye, colour vision – Auditory system – Hearing, listening, Sounds - Other senses - Selective attention; physiological correlates of attention; Internal influences on perception learning – set - motivation & emotion - cognitive styles; External influences on perception figure and ground separation – movement – organization – illusion; Internal- external interactions: Constancy - Depth Perception- Binocular & Monocular Perception; Perceptual defense & Perceptual vigilance; Sensory deprivation -Sensory bombardment; ESP - Social Perception.

UNIT III COGNITION & AFFECT

Learning and memory – philosophy of mind – concepts - words – images – semantic features – Association of words – Repetition – Retrieval – Chunking - Schemata - Emotion and motivation – nature and types of motivation – Biological & Psychosocial motivation – nature and types of emotions – physiological & cognitive bases of emotions – expressions of emotions – managing negative emotions - enhancing positive emotions.

UNIT IV THINKING, PROBLEM-SOLVING & DECISION MAKING

Thinking skills – Types of thinking skills – Concrete & Abstract thinking – Convergent & Divergent - Analytical & Creative thinking – Problem & Possibility thinking – Vertical & Lateral thinking – Problem solving skills – stages of problem solving skills – Decision making - intuition and reasoning skills - Thinking and language - The thinking process- concepts, problem solving, decision-making, creative thinking; language communication.

UNIT V PERSONALITY & INTELLIGENCE

Psychological phenomena & Attributes of humans - cognition, motivation, and behavior - thoughts, feelings, perceptions, and actions – personality dimensions, traits, patterns - Specialized knowledge, performance accomplishments, automaticity or ease of functioning, skilled performance under challenge - generative flexibility, and speed of learning or behavior change.

REFERENCES

1. Morgan, C.T.and King, R.A (1994) Introduction to Psychology, Tata McGraw Hill Co Ltd, New Delhi.
2. Robert A. Baron (2002), Psychology, 5th Edition, Prentice Hall, India.
3. Michael W.Passer, Ronald E.smith (2007), Psychology: The science of mind and Behavior,3rd Edition Tata McGraw-Hill Edition.
4. Robert S.Feldman (2004) Understanding Psychology 6th Edition Tata McGraw – Hill.
5. Endler, N. S., & Summerfeldt, L. J. (1995). Intelligence. personality. psychopathology. and adjustment. In D. H. Saklofske & M. Zeidner (Eds.). International handbook of personality

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

and intelligence (pp. 249-284). New York: Plenum Press.
6. Ford, M. E. (1994). A living systems approach to the integration of personality and intelligence. In R. J. Sternberg. & P. Ruzgis (Eds.). Personality and intelligence (pp. 188-21 7). New York: Cambridge University Press.
7. De Bono, E (1990) Lateral Thinking, Harper Perennial, New York.

HU5175 EDUCATION, TECHNOLOGY AND SOCIETY L T P C
3 0 0 3

COURSE DESCRIPTION

This course introduces students to multidisciplinary studies in Education, Technology and Society. Students will get an understanding of the relationship between education, technology and society. They will also learn about the long lasting impact of good education in a technologically advanced society.

COURSE OBJECTIVES:

The course aims

- To help learners understand the basics of different types of technology utilised in the field of education
- To make them realize the impact of education in society
- To make them evolve as responsible citizen in a technologically advanced society

LEARNING OUTCOMES

By the end of the course, learners will be able to

- Understand the various apps of technology apps and use them to access, generate and present information effectively.
- Apply technology based resources and other media formats equitably, ethically and legally.
- Integrate their technical education for betterment of society as well as their personal life.

UNIT I INDIAN EDUCATION SYSTEM

Gurukul to ICT education – Teacher as facilitator – Macaulay's Minutes – English medium vs Regional medium – Importance of Education in Modern India - Challenges in Education

UNIT II LEARNING THEORIES

Learning Theories – Behaviorism – Cognitivism – Social Constuctivism – Humanism Learning Styles – Multiple Intelligences – Emotional Intelligence – Blooms Taxonomy

UNIT III TECHNOLOGICAL ADVANCEMENTS

Web tools – Social media in education – elearning – MOOCs – Mobile assisted learning – Learning Apps – Blended learning - Self-directed learning

UNIT IV EDUCATIONAL TECHNOLOGY

Technological implications on Education – Teaching, Learning & Testing with Technology - Advantages and drawbacks – Critical analysis on the use of technology

UNIT V ETHICAL IMPLICATIONS

Plagiarism – Online Copyright issues – Ethical and value implications of education and technology on individual and society.

TOTAL:45 PERIODS

TEACHING METHODS

Teaching modes include guest lectures, discussion groups, presentations, visual media, and a practicum style of learning.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

EVALUATION

As this is course is not a content based course, it focuses more on the ethical use of technology in education and society, and so, evaluation can be based on assignments and discussions. So there is no need for an end semester examination. Internals marks can be taken for the total marks.

INTERNAL (100 % WEIGHTAGE)

(a) Written Test (40 marks)
(b) Assignment: Write a real time report of the technology use in any school / college (15 marks)
(c) Presentation: Students choose any one of the technological tools and present its relevance to education and society (15 marks)
(d) Group discussion: Students discuss in groups on case studies relating to various challenges in education and technology use in society (20 marks)
(e) Blog entry: Making weekly blog posts in Class Blog on the topics related to the course posted by the instructor and commenting on others' posts. (10 marks)

REFERENCES

1) Education and Social order by Bertrand Russel
2) Theories of learning by Bower and Hilgard
3) Technology and Society by Jan L Harrington

HU5176 PHILOSOPHY L T P C
3 0 0 3

OBJECTIVES

- To create a new understanding by teaching philosophy through a comparison of Indian and Western traditions.
- To Fosters critical thinking and imagination by dealing with inter-related concepts in literature and science.
- To bridge the gap between the sciences and humanities through introspective analyses.
- To nurture an understanding of the self and elucidates ways to progress towards a higher understanding of one's self and others.

UNIT I KNOWLEDGE 9

Knowledge (Vidya) Versus Ignorance (Avidya)- Brihadaranyaka Upanishad. Unity and Multiplicity – Isha Upanishad. What is True Knowledge? Ways to True Knowledge. Introduction to Philosophy of Yoga, Socratic Debate, Plato's Views. Asking and Answering Questions to Stimulate Critical Thinking and to Draw Ideas. Argumentative Dialogues. Dialectical Methods to Arrive at Conclusions.

UNIT II ORIGIN 9

Origin of Universe and Creation – 'Nasidiya Sukta' in Relation With Big Bang Theory. Greek Concept of Chaos. The Concept of Space – Space as the Final Goal – Udgitha. Relationship Between Teacher And Student – The Knowledge Of Combinations, Body And Speech – Siksha Valli – Taittriya Upanishad.

UNIT III WORD 9

Aum- Speech and Breath as Pair – Chandogya Upanishad and Brihadaryanaka Upanishad. Significance of Chants, Structure of Language and Cosmic Correspondences. The Non-Dual Word – Bhartrihari's Vakyapadiyam. Sphota-Ultimate Reality Expressed Through Language. Intention. Thought 'Sabdanaor' and Speaking.

UNIT IV KNOWLEDGE AS POWER/OPPRESSION 9

Power- as Self-Realization in Gita. Krishna's Advice to Arjuna on How to Conquer Mind. Francis Bacon – Four Idols – What Prevents One From Gaining Knowledge? Michel Foucault- Knowledge as Oppression. Panopticon. Rtam (Truth) and Satyam (Eternal Truth).

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT V SELF KNOWLEDGE/BRAHMAN 9

Knowledge about Self, Transcendental Self. The Different Chakras and the Stages of Sublimation. Philosophy of Yoga and Siva for Union of Mind and Body. Concept of Yin/Yang. Aspects of the Feminine / Masculine.

TOTAL : 45 PERIODS

OUTCOMES:

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

1. Think sceptically, ask questions and to arrive at deductions.
2. Connect and relate different branches of thought.
3. Comprehends the relation between language, thought and action.
4. Arrive at a better understanding of self and others and forms a new outlook.

REFERENCES:

1. Swami Nikhilananda: The Upanishads, Swami Nikhilananda, Advaita Ashrama, Kolkata.
2. Swamy Tapasyananda: Srimad Bhagavad Gita, The Scripture of Mankind, Sri Ramakrishna Math, Chennai.
3. Subrahmanyam, Korada: Vakyapadiyam of Bhartrhari Brahmakanda, Sri Garib Dass series.
4. Swami Lokeswarananda: Chandogya Upanishad, Swami Lokeswarananda, Ramakrishna Mission Institute of Culture, Kolkata.
5. Brahma, Apuruseya: The Four Vedas: Translated in English.
6. Haich, Elizabeth: Sexual Energy and Yoga.
7. Bacon, Francis: Power as Knowledge
8. Vlastos, Gregory: Socrates Ironist and Moral Philosopher.
9. Plato: The Republic, Penguin.
10. Gutting, Garry: Foucault A Very Short Introduction, Oxford.

HU5177 APPLICATIONS OF PSYCHOLOGY IN EVERYDAY LIFE L T P C

3 0 0 3

UNIT I INTRODUCTION 7

Nature and fields.

UNIT II PSYCHOLOGY IN INDUSTRIES AND ORGANIZATIONS 9

Job analysis; fatigue and accidents; consumer behavior.

UNIT III PSYCHOLOGY AND MENTAL HEALTH 11

Abnormality, symptoms and causes psychological disorders

UNIT IV PSYCHOLOGY AND COUNSELING 7

Need of Counseling, Counselor and the Counselee, Counseling Process, Areas of Counseling.

UNIT V PSYCHOLOGY AND SOCIAL BEHAVIOUR 11

Group, group dynamics, teambuilding, Prejudice and stereotypes; Effective Communication, conflict and negotiation.

TOTAL: 45 PERIODS

TEXTBOOKS

1. Schultz, D. & Schultz, S.E. (2009). Psychology and Work Today (10th ed.). New Jersey:Pearson/Prentice Hall
2. Butcher, J. N., Mineka, S., & Hooley, J. M. (2010). Abnormal psychology (14th ed.). New York: Pearson
3. Gladding, S. T. (2014). Counselling: A comprehensive profession. New Delhi: Pearson Education
4. Aronson, E., Wilson, T. D., & Akert, R. M. (2010). Social Psychology (7th Ed.). Upper Saddle River, NJ: Prentice Hall

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

HSMC– ELECTIVES – HUMANITIES II (EVEN SEMESTER)

HU5271 GENDER, CULTURE AND DEVELOPMENT L T P C
3 0 0 3

COURSE DESCRIPTION

This course offers an introduction to Gender Studies that asks critical questions about the meanings of sex and gender in Indian society. The primary goal of this course is to familiarize students with key issues, questions and debates in Gender Studies, both historical and contemporary drawing from Indian literature and media studies, to examine cultural assumptions about sex, gender, and sexuality. This course integrates analysis of current events through student presentations, aiming to increase awareness of contemporary and historical experiences of women, and of the multiple ways that sex and gender interact with class, caste and other social identities. This course also seeks to build an understanding of the concepts of gender, gender-based violence, sexuality, and rights and their impact on development through a number of discussions, exercises and reflective activities.

OBJECTIVES

- ✓ To familiarize students with the concepts of sex and gender through literary and media texts.
- ✓ To help students ask critical questions regarding gender roles in society.
- ✓ To provide students with the material to discuss gender issues such as gender based discrimination, violence and development.
- ✓ To help students think critically about gender based problems and solutions.

LEARNING OUTCOMES

- ➢ Students will be able to critically read literary and media texts and understand the underlying gender perspectives in them.
- ➢ Students will be able to analyse current social events in the light of gender perspectives.
- ➢ Students will be able to discuss, analyse and argue about issues related to gender and their impact on society, culture and development.

UNIT I INTRODUCTION TO GENDER

- Definition of Gender
- Basic Gender Concepts and Terminology
- Exploring Attitudes towards Gender
- Social Construction of Gender

Texts:

1. Sukhu and Dukhu (Amar Chitra Katha)
2. The Cat who Became a Queen (Folk tale, J. Hinton Knowles, Folk-Tales of Kashmir. London: Kegan Paul, Trench, Trübner, and Company, 1893, pp. 8-10.)

UNIT II GENDER ROLES AND RELATIONS

- Types of Gender Roles
- Gender Roles and Relationships Matrix
- Gender-based Division and Valuation of Labour

Texts:

1. Muniyakka (Short Story, Lakshmi Kannan, Nandanvan and Other Stories, Hyderabad: Orient Blackswan, 2011)
2. Video: Witness: Freeing Women From Cleaning Human Waste (2014, HRW, Manual Scavenging, India)

UNIT III GENDER DEVELOPMENT ISSUES

- Identifying Gender Issues
- Gender Sensitive Language
- Gender, Governance and Sustainable Development
- Gender and Human Rights
- Gender and Mainstreaming

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Texts:
1. The Many Faces of Gender Inequality (Essay, Amartya Sen, Frontline, Volume 18 - Issue 22, Oct. 27 - Nov. 09, 2001)
2. Tell Us Marx (Poem, Mallika Sengupta, Translated by Sanjukta Dasgupta)

UNIT IV GENDER-BASED VIOLENCE

- The concept of violence
- Types of Gender-based violence
- The relationship between gender, development and violence
- Gender-based violence from a human rights perspective

Texts:
1. Lights Out (Play, Manjula Padmanabhan)
2. Lights Out (Video of play enacted)

UNIT V GENDER AND CULTURE

- Gender and Film
- Gender, Media and Advertisement

Texts:
1. Mahanagar (Movie: Satyajit Ray)
2. Beti Bachao Beti Padhao Advertisements

READINGS: Relevant additional texts for readings will be announced in the class. Classes will consist of a combination of activities: dialogue-based lectures, discussions, collaborative learning activities, group work and in-class assignments.

ASSESSMENT AND GRADING:
Discussion & Classroom Participation: 20%
Project/Assignment: 30%
End Term Exam: 50%

HU5272 ETHICS AND HOLISTIC LIFE L T P C
3 0 0 3

OBJECTIVES:

- To emphasize the meaning and nature of ethics, human values and holistic life for leading a good, successful and happy life through continuous examination of thoughts and conduct in day to day life.
- To understand the status and responsible role of individual in abatement of value crisis in contemporary world in order to develop a civilized and human society. Understanding the process of ethical decision making through critical assessment of incidents/cases of ethical dilemmas in personal, professional and social life.
- To view the place of Ethics and Human Values in the development of individual and society through identification and cross examination of life values and world view of his/her role models in society.

UNIT I HUMAN LIFE, ITS AIM AND SIGNIFICANCE
The concept of a successful life, happy life and a meaningful life, Ethical and decision making capability and its development: Meaning of Ethical dilemma, sharing real life experiences.

UNIT II CREATIVE AND LEADERSHIP ABILITY AND THEIR DEVELOPMENT
Intellectual, Emotional, Creative, Ethico - spiritual development, Aesthetic sense, Self-dependency, Activeness, Development of positive attitude.

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT III HARMONY IN PERSONAL AND SOCIAL LIFE:

Concept of personal and group Ethics; Balance between - rights and duties-welfare of self and welfare of all, Creating a value based work culture in hostel, classroom and other places in the campus and society.

UNIT IV CHARACTER, RIGHTEOUSNESS AND VIRTUES FOR A MEANINGFUL LIFE

Egolessness, Humility, Righteousness, Purity, Truthfulness, Integrity, Self-restraint, Self-control, Sense of responsibility, Empathy, Love, Compassion, Maitri / Comradeship, Cooperation, Tolerance.

UNIT V DILEMMA BETWEEN MATERIALISTIC DEVELOPMENT AND HUMAN WELFARE

Science, Technology, Consumerism, Relation with Nature and Environment, New dimension of Global Harmony: Democracy, Equality, Social Justice

TOTAL:45 PERIODS

OUTCOMES:

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

1. Enable students to understand the concept of contemporary ethics at different levels: Individual, local and Global and enable them to cross examine the ethical and social consequences of the decisions of their life-view and world view.
2. Develop the ability of students to create a balance between their individual freedom and social responsibilities and enable them to identify the personal, professional and social values and integrate them in their personality after cross examination.
3. Enable students to cross examine their earlier decisions taken in life and understand the meaning of ethical dilemma to overcome the ethical dilemmas and engage in critical reflection.
4. Develop positive habits of thought and conduct and work cohesively with fellow beings who have variety of strengths, experiences, shortcomings and challenges, hence to enable them to handle diverse type of personalities.
5. Enable students to develop a method for making ethically sound decisions for themselves, within hostels, classrooms, university campus and society.

HU5273 LAW AND ENGINEERING L T P C

3 0 0 3

UNIT I THE LEGAL SYSTEM: SOURCES OF LAW AND THE COURT STRUCTURE 9

Enacted law -Acts of Parliament are of primary legislation, Common Law or Case law- Principles taken from decisions of judges constitute binding legal rules. The Court System in India and Foreign Courtiers. (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court) Arbitration: As an alternative to resolving disputes in the normal courts, parties who are in dispute can agree that this will instead be referred to arbitration.

UNIT II LAWS 9

Basic principles of contract law, sale of goods law, laws relating to industrial pollution, accident, environmental protection, health and safety at work, patent law, constitutional law: the supreme law of the land, Information technology law and cyber crimes.

UNIT III BUSINESS ORGANISATIONS 9

Sole traders (Business has no separate identity from you, all business property belongs to you).

Partnerships: Types of Partnerships - Limited Liability Partnership, General Partnership, Limited Partnerships. Companies: The nature of companies, Classification of companies, Formation of companies, Features of a public company, Carrying on business, Directors– Their Powers and Responsibilities/Liabilities.

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT IV LAW AND SOCIETY **9**

Interdisciplinary nature of law, legal ideologies/philosophy/ schools of jurisprudence**.**

UNIT V CASE STUDIES **9**

Important legal disputes and judicial litigations

TOTAL: 45 PERIODS

HU5274 FILM APPRECIATION **L T P C**
3 0 0 3

COURSE DESCRIPTION

This is an intensive course designed to promote comprehensive understanding and insights into the nature of cinema and other related forms and practices. Movies, though at times are used more as escapism, they are also a true art form and expressive tool used by writers, directors and actors. This course will explore the aesthetics of cinema, the concepts behind storytelling and various other elements of a film. It will also explore the impact of movies in our society and in our lives. It also encourages students to use films as a medium to analyse visual texts and read underlying messages.

OBJECTIVES:

- To help learners understand the various movie genres and its types.
- To understand various elements that contributes to film making.
- To make them realize the impact of film in society.
- To analyse the visual media and interpret the underlying messages.

UNIT I THE COMPONENTS OF FILMS **9**

Story, Screenplay & Script – Actors – Director – Crew Members – Mis En Scene – Structure of A Film – Narrative Elements – Linear & Non-Linear – Types of Movie Genres: Mysteries, Romantic Comedies, Horror Etc.

UNIT II EVOLUTION OF FILM **9**

History of Films – Early Cinema – Silent Movies – Talkies – Film Language, Form, Movement – Film Theories – Realist, Auteurists, Feminist, Psychonalyic, Idealogical Theories.

UNIT III FILMS ACROSS THE WORLD **9**

European Films – Russian Films – Japanese Films – Korean Films – Hollywood Film – Studio Culture – All Time Great Movies.

UNIT IV INDIAN FILMS **9**

The Early Era – History Of Indian Cinema – Movies for Social Change – Hindi Movies that Created Impact – Regional Movies – Documentaries – Cultural Identity.

UNIT V INTERPRETING FILMS **9**

Film Criticism & Appreciation – Censorship in Movies – Cultural Representation in Movies – Television – New Media & Online Media – Films Beyond Entertainment.

TOTAL: 45 PERIODS

OUTCOMES

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

- Recognize types of films, their impact on society and their roles in our lives.
- Have an understanding of the concepts of storytelling, Mise en Scene, and other elements of film making.
- Interpret the underlying messages in the movies.

TEACHING METHODS

- Each unit consists of reading materials, learning activities videos, websites. Students are expected to watch movies sometimes in class and at times at home and discuss in class.

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

EVALUATION

- As this is course is critical appreciation course on films, there is no written end semester examination. The course is more on learning how to critically analyse a movie and appreciate its finer elements. Therefore evaluation can be based on assignments and discussions. Internals marks can be taken for the total marks.

INTERNAL (100 % WEIGHTAGE)

- Assignment 1: Write a movie review with critical analysis (20 marks).
- Assignment 2 : Write a script for a scene taken from a short story / novella (20 marks).
- Presentation: Students choose any one topic related to films and present it to the audience. (25 marks)
- Group discussion: Students discuss in groups on the various aspects of movies and its impact on society. (25 marks)
- Blog entry: Making weekly blog posts in Class Blog on the topics related to the course posted by the instructor and commenting on others' posts. (10 marks)

REFERENCES

1. A Biographical Dictionary of Film by David Thomson, Secker & Warburg, 1975
2. Signs and Meaning in the Cinema by Peter Wollen, Secker & Warburg, 1969
3. The World Viewed by Stanley Cavell 1971
4. Film Style and Technology: History and Analysis by Barry Salt, Starword, 1983
5. The Encyclopedia of Indian Cinema Edited by Ashish Rajadhyaksha and Paul Willemen, BFI, 1994.

HU5275 FUNDAMENTALS OF LANGUAGE AND LINGUISTICS L T P C
3 0 0 3

OBJECTIVES

- To broadly introduce students to the formal and theoretical aspects of linguistics.
- To enable learners to understand the various practical applications of language and recent findings in the field of applied linguistics.

CONTENTS : -

UNIT I LANGUAGE AND LINGUISTICS: AN OVERVIEW 9

Language and Linguistics-Linguistic Knowledge-Knowledge of Sound Systems & Words – Creativity of Language – Relationship of form and meaning. Grammar – descriptive, prescriptive, universal-Human Language – Animal Language – Sign Language- Computers and Language.

UNIT II MORPHOLOGY - WORDS OF LANGUAGE 9

Content and function words – morphemes -free & bound –prefixes – suffixes – roots and stems – inflectional and derivational morphology-compound words and their formation – malapropisms – slips of the tongue.

UNIT III SYNTAX- THE SENTENCE PATTERNS OF LANGUAGE AND SEMANTICS-THE MEANING OF LANGUAGE 9

Syntax : Rules of Syntax- Sentence Structure-Structural Ambiguity-Syntactic Categories. Semantics: Lexical Semantics – Anomaly-Metaphors- Idioms- Synonyms – Antonyms – Homonyms -Pragmatics– Speech Acts

UNIT IV PHONETICS – THE SOUNDS OF LANGUAGE 9

Speech sounds- Introduction to branches of Phonetics- The Phonetic Alphabet – IPA – Consonants - Vowels – Diphthongs- Tone and Intonation.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT V APPLIED LINGUISTICS - THE PRACTICAL APPLICATIONS OF LANGUAGE 9

Language learning and teaching (ELT)- lexicography-translation studies-computational linguistics-neurolinguistics (speech pathology and language disorders)- forensic linguistics – sociolinguistics.

TOTAL : 45 PERIODS

TEACHING METHODS :

Lectures, discussion.

EVALUATION INTERNAL AND EXTERNAL :

Internal: 2 written tests + assignments, seminars, project (50+15+15+20).
External: A 3 hour written exam (50 marks)

REFERENCES :

1. Victoria Fromkin, Robert Rodman, Nina Hyams.2019. An Introduction to Language.USA.CENGAGE.11th edition
2. Cook. G, 2003. Applied linguistics.UK: Oxford University Press.

HU5276 UNDERSTANDING SOCIETY AND CULTURE THROUGH LITERATURE L T P C
3 0 0 3

OBJECTIVES

- To internalize the importance of language by understanding its role in the transformation of man.
- To look at language, literature and culture as locus of identity and change.
- To extract meaning from existing literatures and cultures.
- To identify meanings in modern life by reconnecting with lost cultures.

UNIT I INTRODUCTION

Why study literature? Tracing the origin – pictures. Tokens as precursors of writing. Movement from three dimensions to two dimensions- Pictography. From visual to oral -Logography. Reading out literature to young children- Edmund J Farrell.

UNIT II READING CULTURE

Reading culture through language, signs and consumables- Roland Barthes. Culture through poems- Nissim Ezekiel's ' The night of the Scorpion' . 'Nothing's Changed'- Tatamkhulu Afrika- Apartheid. Ruskin Bond- 'Night train at Deoli'- How real life is different from movies.

UNIT III IDENTIFYING MEANING

Searching and locating meaning through literature. Looking for order in a chaotic world. The Myth of Sisyphus (Albert Camus) and Adi Shankar's 'Jagat Mithya'- the world as an illusion. The Indian version as 'meaninglesss meaning'.

UNIT IV POST MODERNISM

'If on a winter's night a traveler'- Italo Calvino. The book about the reader- the experience of reading as reading. Metafiction. Selfie Culture. Visual Culture as purpose of modern life.

UNIT V RETURNING TO PICTURES

Literature of the present- Emphasis on the visual world. Twitterature. SMS. Whatsapp language. Consumer culture. Change in fixed gender notions. Interactive sessions. Introspection.

READING LIST

1. Bond, Ruskin: 'Night train at Deoli'
2. Ezekiel, Nissim: ' The Night of the Scorpion'
3. Afrika,Tatamkhulu: 'Nothing's Changed'

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

4. Barthes, Roland: *Mythologies*
5. Shankaracharya: *Viveka Chudamani*
6. Camus, Albert- *The Myth of Sisyphus*
7. Calvino, Italo: *If on a winter's night a traveler*
8. Farrell, Edmund J: 'Listen, my children, and you shall read'

OUTCOMES:

- Can identify the connections among language, literature and culture.
- Is able to relate between seemingly different aspects of life.
- Understands the fractions in modern life and can assimilate meanings.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025