ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

B.E. PRODUCTION ENGINEERING

REGULATIONS – 2015

CHOICE BASED CREDIT SYSTEM

VISION OF THE DEPARTMENT

To develop educational avenues for the students to emerge as disciplined researchers, technocrats, and entrepreneurs making transformative impact on establishing a world class society in the domain of Production, Manufacturing and Mechatronics Engineering.

MISSION OF THE DEPARTMENT

1. To impart students with knowledge on Production Engineering in critical thinking, leadership qualities, communication and interpersonal skills.
2. To create a conducive environment for exchange of ideas towards research, creativity, innovation and entrepreneurship.
3. To follow the values of integrity and honesty through curricular, co-curricular and extracurricular activities.

PROGRAMME EDUCATIONAL OBJECTIVES

1. Graduates would be able to apply knowledge of Production Engineering for leading their successful career.
2. Graduates would be experts to address technical and societal challenges in Production Engineering.
3. Graduates would be efficient in applying their consciousness of moral, professional and social responsibilities to endeavor in a teamwork environment.

PROGRAMME OUTCOMES

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES

1. **Knowledge on Production system**: Familiarization of basic, advanced systems and practices in Production Engineering.
2. **Knowledge on design, analysis and development:** Demonstration of functions, processes, design and automation of various systems in Production Engineering to enhance the quality of the product.
3. **Foundation of continuous improvement:** Knowledge on application of appropriated materials, production processes and production system and development of an optimal solution to achieve continuous improvement to cater the needs of industry and society.

MAPPING PEO WITH POs & PSOs:

	PO												PSO		
PEOs/ POs & PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
PEOs	3	3	3	2	3	2	3	1	1	1	1	3	3	3	3
	3	3	3	3	3	3	3	2	2	1	2	3	3	3	2
	2	2	2	1	1	3	3	3	3	2	2	3	1	2	3

MAPPING OF COURSES WITH PROGRAMME OUTCOMES & PROGRAMME SPECIFIC OUTCOMES
(I TO VIII SEMSTERS)

SEMESTER I

SL. NO.	COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
THEORY														
1.	Foundational English				✓		✓	✓	✓	✓				✓
2.	Mathematics - I	✓	✓	✓	✓	✓								
3.	Engineering Physics	✓	✓	✓	✓	✓			✓	✓	✓			
4.	Engineering Chemistry	✓	✓	✓	✓	✓			✓	✓	✓			
5.	Engineering Graphics		✓	✓	✓	✓				✓	✓			
PRACTICAL														
6.	Basic Sciences Laboratory	✓	✓	✓	✓	✓			✓	✓	✓	✓		
7.	Engineering practices Laboratory	✓	✓	✓	✓	✓			✓	✓	✓	✓		

SEMESTER II

SL. NO.	COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
THEORY														
1.	Mathematics II	✓	✓	✓	✓	✓			✓					
2.	Technical English				✓		✓	✓	✓	✓				✓
3.	Materials Science	✓	✓	✓	✓	✓			✓	✓	✓			
4.	Engineering Mechanics	✓	✓	✓	✓	✓				✓	✓			
5.	Machining Processes	✓	✓	✓	✓	✓			✓			✓	✓	
6.	Computing Techniques	✓	✓	✓	✓	✓			✓	✓	✓			
PRACTICAL														
7.	Drafting and Machining Laboratory	✓	✓	✓	✓							✓	✓	
8.	Computer Practices Laboratory	✓	✓			✓								

SEMESTER III

SL. NO.	COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
THEORY																
1.	Numerical methods	3.0	2.6	1.6	1.6	1.0	1.0	0.0	1.0	1.0	1.0	-	1.8	-	-	-
2.	Mechanics of Solids	3.0	3.0	2.0	2.0	3.0	1.0	1.0	-	-	1.0	2.0	2.0	2.6	2.4	2.4
3.	Engineering Thermodynamics and Thermal Engineering	3.0	3.0	2.0	1.8	1.0	1.4	1.0	1.0	1.0	1.0	1.0	1.0	2.0	1.0	2.0
4.	Engineering Fluid Mechanics and Machinery	3.0	3.0	2.0	3.0	2.0	1.0	1.0	-	-	1.0	2.0	2.0	2.6	2.4	2.4
5.	Metallurgy and Materials Testing	2.4	2.6	2.0	1.6	2.0	1.8	1.6	1.3	1.2	1.0	1.2	1.8	1.4	1.8	1.0
6.	Electrical, Electronics and Control systems	2.8	2.8	2.8	2.8	2.8	-	-	-	-	-	-	-	2.0	3.0	3.0
PRACTICAL																
7.	Metallurgy and Materials Testing Laboratory	2.4	2.6	2.0	1.6	2.0	1.8	1.6	1.3	1.2	1.0	1.2	1.8	1.4	1.8	1.0
8.	Electrical, Electronics and Control Systems Laboratory	2.7	2.7	2.7	-	2.7	-	-	-	2.0	2.0	-	-	2.0	3.0	3.0

SEMESTER IV

SL. NO.	COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
THEORY																
1.	Kinematics and Dynamics of Machines	3.0	3.0	1.8	2.0	2.2	-	1.0	-	3.0	-	2.0	3.0	2.0	2.0	1.4
2.	Quantitative Techniques in Management	3.0	-	2.5	3.0	-	-	-	2.5	-	-	1.0	2.0	1.7	2.0	2.0

3.	Metal Forming Processes	3.0	3.0	2.0	2.0	2.0	1.0	-	1.0	-	-	-	3.0	-	2.0	1.0
4.	Foundry and Welding Technology	3.0	3.0	2.0	-	-	-	-	-	-	-		2.0	2.0	-	1.0
5.	Metal Cutting and CNC Technology	3.0	3.0	3.0	2.0	2.0	-	3.0	2.0	3.0	-	3.0	3.0	3.0	2.0	2.0
6.	Environmental Science and Engineering	2.0	-	-	-	1.0	2.0	2.0	2.0	-	-	-	2.0	-	-	-
PRACTICAL																
7.	Metal Forming, Foundry and Welding Laboratory	2.3	3.0	-	2.7	2.7	-	-	1.3	-	-	1.7	3.0	2.3	1.3	1.0
8.	Metal Cutting and CNC Laboratory	3.0	3.0	2.0	-	3.0	-	3.0	-	2.0	-	3.0	2.0	3.0	3.0	2.0

SEMESTER V

SL. NO.	COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
THEORY																
1.	Engineering Metrology	2.4	2.6	2.8	2.0	3.0	2.0	2.0	-	2.2	2.0	2.0	2.6	3.0	2.0	2.0
2.	Machine Components Design	3.0	3.0	1.8	2.0	2.0	-	1.2	-	2.6	-	2.2	3.0	-	1.8	1.0
3.	Fluid Power Systems	3.0	2.2	2.4	1.8	2.4	1.0	1.0	1.0	1.2	2.8	2.4	2.4	2.6	3.0	2.6
4.	Statistical Quality Control and Reliability Engineering	2.6	2.6	2.2	2.4	2.0	1.0	1.0	-	-	2.2	1.0	-	2.0	2.4	2.6
5.	Professional Elective-I															
6.	Professional Elective-II															
PRACTICAL																
7.	Metrology and Quality Control Laboratory	3.0	3.0	2.0	-	3.0	-	3.0	-	2.0	-	3.0	2.0	3.0	3.0	2.0
8.	Fluid Power Systems Laboratory	3.0	2.7	2.3	2.7	2.3	1.0	1.0	1.0	2.0	2.0	1.0	2.0	2.3	2.7	2.0

SEMESTER VI

SL. NO.	COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
THEORY																
1.	Computer Aided Product Design	3.0	3.0	2.0	3.0	3.0	3.0	1.0	2.0	-	1.0	-	2.0	3.0	3.0	2.0
2.	Computer Integrated Manufacturing Systems	2.8	-	2.6	3.0	-	-	2.6	3.0	-	-	-	2.6	2.6	2.6	2.6
3.	Production of Automotive Components	2.6	-	2.4	-	-	-	2.8	2.2	-	-	-	2.6	2.6	2.6	2.6
4.	Finite Element Analysis in Manufacturing	2.2	1.8	2.2	1.6	-	1.4	-	-	-	-	-	-	1.8	1.0	1.8
5.	Professional Elective- III															
6.	Professional Elective-IV															
PRACTICAL																
7.	Modelling and Analysis Laboratory	2.0	1.7	1.7	1.7	1.7	-	-	1.0	-	-	-	1.7	1.3	1.7	1.0
8.	Creative and Innovative Project	3.0	3.0	3.0	1.0	2.0	1.0	-	-	2.0	1.0	2.0	3.0	3.0	3.0	3.0

SEMESTER VII

SL. NO.	COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
THEORY																	
1.	Industrial Engineering and Management	1.0	1.6	1.4	2.0	1.0	1.0	-	-	-	1.0	-	3.0	-	-	1.0	
2.	Robotic Technology	2.4	2.2	2.4	2.0	1.8	1.0	1.0	-	1.6	1.8	2.0	1.8	2.0	2.2	2.0	
3.	Mechatronics for Automation	3.0	-	3.0	2.0	-	-	-	-	-	-	-	3.0	3.0	2.0	-	
4.	Professional Elective- V																
5.	Open Elective- I																
PRACTICAL																	
6.	Industrial Training / Internship	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.0	3.0	2.0	3.0	3.0	3.0	3.0	

7.	Mechatronics and Robotics Laboratory	3.0	2.0	3.0	2.0	-	-	-	-	-	-	-	2.0	3.0	2.0	-	

SEMESTER VIII

SL. NO.	COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
THEORY																
1.	Professional Elective- VI															
2.	Open Elective- II															
PRACTICAL																
3.	Project Work	3.0	3.0	2.0	1.0	2.0	1.0	1.0	2.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0

PROFESSIONAL ELECTIVES (PE)

SL. NO.	COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1.	Design of Jigs, Fixtures and Dies	2.0	2.0	2.0	1.6	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.0	3.0
2.	Modern Production Techniques	2	3	2	1.6	3	2	2	1.6	1	1	1	2	2	1	3
3.	Micromachining and Fabrication	2.6	2.4	2.2	1.8	2.6	1.6	2	1.2	1.4	1.2	2	1.8	2.6	2.4	2.6
4.	Non Destructive Testing Methods	2	1	2	1	3						2	3	1	1	2
5.	Unconventional Machining Processes	3	1	1	-	1	1	-	2.6	3	-	-	-	-	-	-
6.	Design of Casting and Weldments	3	2	2.8	2	3	1	1	1	2	2	1	2	2	3	2.8
7.	Micro Electro Mechanical Systems and Nano Technology	2	2.4	1.6	1.8	1.8	1.6	1.6	1	1.2	1.4	1.25	1.4	2	1.8	2.6
8.	Production of Composites	2.2	1	2.8	1	2.6	2.2	2.6	-	-	2	2	2.6	2.4	2.6	2.4
9.	Processing of Plastics and Polymers	2	1.4	2.8	1	2.4	2.4	2.4	-	-	2	2	2.4	2.2	2.4	2.6
10.	Selection of Materials	2.4	2	2.6	2	1.8	2.4	3	2.4	2.4	2	2.75	2.6	2.6	2.2	3
11.	Applied Heat Transfer	3	3	3	2.2	1	1	1	-	1	1	-	2	3	2	1
12.	Lean Manufacturing	2.6	2.4	2.2	1.8	2.6	1.6	2	1.2	1.4	1.2	2	1.8	2.6	2.4	2.6
13.	Total Quality Management: Principles and Applications	3		3	2	2	3	3	2			3	3	2	3	3
14.	Advances in Operations Research	3	1.00	3	-	3	-	-	-	1.8	-	3	3	1.6	1	3

15.	Applied Probability and Statistics	2	2	1.6	2.6	2	1	-	-	-	1	1	1.5	1	1.8	2.25
16.	Purchasing and Materials Management	2.2	1	2.8	1	2.6	2.2	2.6	1.8	-	-	2	2.6	2.4	2.6	2.4
17.	Engineering Ethics and Human Values	1	1	1	1	1	2	3	3	2	1	2	3	1	1	3
18.	Concepts of Green Manufacturing	2.2	1.6	2.8	1	2.6	2.2	2.6	-	-	2	2	2.6	2.4	2.6	2.4
19.	Green Electronics Manufacturing	2	1	2	1	1	1	3	1	-	-	-	1	1	3	2
20.	Electronic Materials and Processing	2	1	1	1	1	1	1	1	-	-	-	2	1	1	1
21.	Surface Modification and Analytical Techniques	1.6	1.8	2.2	1.8	1.4	1.8	1.75	1	1.25	1	1	1.2	1.4	2	2.4
22.	Chemistry for Smart Materials Manufacturing	2.6	2.0	2.0	1.7	-	1.3	1.0	-	-	-	-	1.0	2.0	2.0	2.8
23.	Modern Concepts in Manufacturing	3	2	3	2	2	-	3	2	-	3	3	3	3	3	2
24.	Supply Chain Management	1	3	2	1	2	-	-	-	2		1	2	2	1	2
25.	Mini Project	2.8	2	2.2	2.4	2.2	2	1	2.2	2.8	2.2	1.8	2	3	3	2
26.	Disaster Management	1	3	2	1	2	2	2	2	1.6	-	2	2	2	1	2
27.	Human Rights	1	3	2	1	2	2	2	2	1.6	-	2	2	2	1	2

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SL. NO.	COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1.	Project Work	3.0	3.0	2.0	1.0	2.0	1.0	1.0	2.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0
2.	Creative and Innovative Project	3.0	3.0	3.0	1.0	2.0	1.0	-	-	2.0	1.0	2.0	3.0	3.0	3.0	3.0
3.	Industrial Training / Internship	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.0	3.0	2.0	3.0	3.0	3.0	3.0

ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

B.E. PRODUCTION ENGINEERING

REGULATIONS – 2015

CHOICE BASED CREDIT SYSTEM

CURRICULA AND SYLLABI I - VIII SEMESTERS

SEMESTER I

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS7151	Foundational English	HS	4	4	0	0	4
2.	MA7151	Mathematics - I	BS	4	4	0	0	4
3.	PH7151	Engineering Physics	BS	3	3	0	0	3
4.	CY7151	Engineering Chemistry	BS	3	3	0	0	3
5.	GE7152	Engineering Graphics	ES	5	3	2	0	4
PRACTICAL								
6.	BS7161	Basic Sciences Laboratory	BS	4	0	0	4	2
7.	GE7162	Engineering Practices Laboratory	ES	4	0	0	4	2
			TOTAL	**27**	**17**	**2**	**8**	**22**

SEMESTER II

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA7251	Mathematics II	BS	4	4	0	0	4
2.	HS7251	Technical English	HS	4	4	0	0	4
3.	PH7251	Materials Science	BS	3	3	0	0	3
4.	GE7153	Engineering Mechanics	ES	4	4	0	0	4
5.	PR7201	Machining Processes	PC	3	3	0	0	3
6.	GE7151	Computing Techniques	ES	3	3	0	0	3
PRACTICAL								
7.	PR7211	Drafting and Machining Laboratory	PC	4	0	0	4	2
8.	GE7161	Computer Practices Laboratory	ES	4	0	0	4	2
			TOTAL	**29**	**21**	**0**	**8**	**25**

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	AE7351	Engineering Fluid Mechanics and Machinery	ES	3	3	0	0	3
2.	AE7352	Mechanics of Solids	ES	3	3	0	0	3
3.	AU7303	Engineering Thermodynamics and Thermal Engineering	ES	3	3	0	0	3
4.	EI7307	Electrical, Electronics and Control Systems	ES	3	3	0	0	3
5.	MA7354	Numerical Methods	BS	4	4	0	0	4
6.	PR7301	Metallurgy and Materials Testing	PC	3	3	0	0	3
PRACTICAL								
7.	EI7313	Electrical, Electronics and Control Systems Laboratory	ES	4	0	0	4	2
8.	PR7311	Metallurgy and Materials Testing Laboratory	PC	4	0	0	4	2
			TOTAL	**27**	**19**	**0**	**8**	**23**

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	GE7251	Environmental Science and Engineering	HS	3	3	0	0	3
2.	PR7401	Foundry and Welding Technology	PC	3	3	0	0	3
3.	PR7402	Metal Cutting and CNC Technology	PC	3	3	0	0	3
4.	PR7403	Metal Forming Processes	PC	3	3	0	0	3
5.	PR7451	Kinematics and Dynamics of Machines	PC	4	4	0	0	4
6.	PR7452	Quantitative Techniques in Management	PC	4	4	0	0	4
PRACTICAL								
7.	PR7411	Metal Cutting and CNC Laboratory	PC	4	0	0	4	2
8.	PR7412	Metal Forming, Foundry and Welding Laboratory	PC	4	0	0	4	2
			TOTAL	**28**	**20**	**0**	**8**	**24**

SEMESTER V

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	PR7501	Engineering Metrology	PC	3	3	0	0	3
2.	PR7502	Fluid Power Systems	PC	3	3	0	0	3
3.	PR7503	Machine Components Design	PC	4	4	0	0	4
4.	PR7551	Statistical Quality Control and Reliability Engineering	PC	3	3	0	0	3
5.		Professional Elective-I	PE	3	3	0	0	3
6.		Professional Elective-II	PE	3	3	0	0	3
PRACTICAL								
7.	PR7511	Fluid Power Systems Laboratory	PC	4	0	0	4	2
8.	PR7512	Metrology and Quality Control Laboratory	PC	4	0	0	4	2
			TOTAL	**27**	**19**	**0**	**8**	**23**

SEMESTER VI

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	PR7601	Computer Aided Product Design	PC	3	3	0	0	3
2.	PR7602	Computer Integrated Manufacturing Systems	PC	3	3	0	0	3
3.	PR7603	Finite Element Analysis in Manufacturing	PC	3	3	0	0	3
4.	PR7651	Production of Automotive Components	PC	3	3	0	0	3
5.		Professional Elective- III	PE	3	3	0	0	3
6.		Professional Elective-IV	PE	3	3	0	0	3
PRACTICAL								
7.	PR7611	Creative and Innovative Project	EEC	4	0	0	4	2
8.	PR7612	Modelling and Analysis Laboratory	PC	4	0	0	4	2
			TOTAL	**26**	**18**	**0**	**8**	**22**

SEMESTER VII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	PR7701	Industrial Engineering and Management	HS	3	3	0	0	3
2.	PR7702	Mechatronics for Automation	PC	3	3	0	0	3
3.	PR7703	Robotic Technology	PC	3	3	0	0	3
4.		Professional Elective- V	PE	3	3	0	0	3
5.		Open Elective – I*	PE	3	3	0	0	3
PRACTICAL								
6.	PR7711	Mechatronics and Robotics Laboratory	PC	4	0	0	4	2
7.	PR7712	Industrial Training / Internship	EEC	4	0	0	4	2
			TOTAL	**23**	**15**	**0**	**8**	**19**

SEMESTER VIII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Professional Elective- VI	PE	3	3	0	0	3
2.		Open Elective – II*	PE	3	3	0	0	3
PRACTICAL								
3.	PR7811	Project Work	EEC	20	0	0	20	10
			TOTAL	**26**	**6**	**0**	**20**	**16**

TOTAL NO. OF CREDITS:174

***Course from the curriculum of other UG Programmes**

HUMANITIES AND SOCIAL SCIENCES (HS)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS7151	Foundational English	HS	4	4	0	0	4
2.	HS7251	Technical English	HS	4	4	0	0	4
3.	GE7251	Environmental Science and Engineering	HS	3	3	0	0	3
4.	PR7701	Industrial Engineering and Management	HS	3	3	0	0	3

BASIC SCIENCES (BS)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA7151	Mathematics – I	BS	4	4	0	0	4
2.	PH7151	Engineering Physics	BS	3	3	0	0	3
3.	CY7151	Engineering Chemistry	BS	3	3	0	0	3
4.	BS7161	Basic Sciences Laboratory	BS	4	0	0	4	2
5.	MA7251	Mathematics – II	BS	4	4	0	0	4
6.	PH7251	Materials Science	BS	3	3	0	0	3
7.	MA7354	Numerical Methods	BS	4	4	0	0	4

ENGINEERING SCIENCES (ES)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	GE7152	Engineering Graphics	ES	5	3	2	0	4
2.	GE7162	Engineering Practices Laboratory	ES	4	0	0	4	2
3.	GE7161	Computer Practices Laboratory	ES	4	0	0	4	2
4.	GE7151	Computing Techniques	ES	3	3	0	0	3
5.	GE7153	Engineering Mechanics	ES	4	4	0	0	4
6.	EI7307	Electrical, Electronics and Control Systems	ES	3	3	0	0	3
7.	EI7313	Electrical, Electronics and Control Systems Laboratory	ES	4	0	0	4	2
8.	AE7352	Mechanics of Solids	ES	3	3	0	0	3
9.	AU7303	Engineering Thermodynamics and Thermal Engineering	ES	3	3	0	0	3
10.	AE7351	Engineering Fluid Mechanics and Machinery	ES	3	3	0	0	3

PROFESSIONAL CORE (PC)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	PR7201	Machining Processes	PC	3	3	0	0	3
2.	PR7211	Drafting and Machining Laboratory	PC	4	0	0	4	2
3.	PR7301	Metallurgy and Materials Testing	PC	3	3	0	0	3

4.	PR7311	Metallurgy and Materials Testing Laboratory	PC	4	0	0	4	2
5.	PR7451	Kinematics and Dynamics of Machines	PC	4	4	0	0	4
6.	PR7452	Quantitative Techniques in Management	PC	4	4	0	0	4
7.	PR7403	Metal Forming Processes	PC	3	3	0	0	3
8.	PR7401	Foundry and Welding Technology	PC	3	3	0	0	3
9.	PR7402	Metal Cutting and CNC Technology	PC	3	3	0	0	3
10.	PR7412	Metal Forming, Foundry and Welding Laboratory	PC	4	0	0	4	2
11.	PR7411	Metal Cutting and CNC Laboratory	PC	4	0	0	4	2
12.	PR7501	Engineering Metrology	PC	3	3	0	0	3
13.	PR7503	Machine Components Design	PC	4	4	0	0	4
14.	PR7502	Fluid Power Systems	PC	3	3	0	0	3
15.	PR7551	Statistical Quality Control and Reliability Engineering	PC	3	3	0	0	3
16.	PR7512	Metrology and Quality Control Laboratory	PC	4	0	0	4	2
17.	PR7511	Fluid Power Systems Laboratory	PC	4	0	0	4	2
18.	PR7601	Computer Aided Product Design	PC	3	3	0	0	3
19.	PR7602	Computer Integrated Manufacturing Systems	PC	3	3	0	0	3
20.	PR7651	Production of Automotive Components	PC	3	3	0	0	3
21.	PR7603	Finite Element Analysis in Manufacturing	PC	3	3	0	0	3
22.	PR7612	Modelling and Analysis Laboratory	PC	4	0	0	4	2
23.	PR7703	Robotic Technology	PC	3	3	0	0	3
24.	PR7702	Mechatronics for Automation	PC	3	3	0	0	3
25.	PR7711	Mechatronics and Robotics Laboratory	PC	4	0	0	4	2

PROFESSIONAL ELECTIVES (PE)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CY7001	Chemistry for Smart Materials Manufacturing	PE	3	3	0	0	3
2.	CY7002	Surface Modifications and Analytical Techniques	PE	3	3	0	0	3
3.	GE7071	Disaster Management	PE	3	3	0	0	3
4.	GE7074	Human Rights	PE	3	3	0	0	3
5.	GE7351	Engineering Ethics and Human Values	PE	3	3	0	0	3
6.	MF7072	Electronic Materials and Processing	PE	3	3	0	0	3
7.	PR7001	Advances in Operations Research	PE	3	3	0	0	3
8.	PR7002	Applied Heat Transfer	PE	3	3	0	0	3
9.	PR7003	Applied Probability and Statistics	PE	3	3	0	0	3
10.	PR7004	Concepts of Green Manufacturing	PE	3	3	0	0	3
11.	PR7005	Design of Casting and Weldments	PE	3	3	0	0	3
12.	PR7006	Design of Jigs, Fixtures and Dies	PE	3	3	0	0	3
13.	PR7007	Green Electronics Manufacturing	PE	3	3	0	0	3
14.	PR7008	Lean Manufacturing	PE	3	3	0	0	3
15.	PR7009	Micro Electro Mechanical Systems and Nano Technology	PE	3	3	0	0	3
16.	PR7010	Micromachining and Fabrication	PE	3	3	0	0	3
17.	PR7011	Modern Concepts in Manufacturing	PE	3	3	0	0	3
18.	PR7012	Modern Production Techniques	PE	3	3	0	0	3
19.	PR7013	Non Destructive Testing Methods	PE	3	3	0	0	3
20.	PR7014	Processing of Plastics and Polymers	PE	3	3	0	0	3
21.	PR7015	Production of Composites	PE	3	3	0	0	3
22.	PR7016	Purchasing and Materials Management	PE	3	3	0	0	3
23.	PR7017	Selection of Materials	PE	3	3	0	0	3

24.	PR7018	Supply Chain Management	PE	3	3	0	0	3
25.	PR7019	Total Quality Management: Principles and Applications	PE	3	3	0	0	3
26.	PR7020	Unconventional Machining Processes	PE	3	3	0	0	3
27.	PR7022	Mini Project	PE	6	0	0	6	3
28.	GE7072	Foundation Skills in Integrated Product Development	PE	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	PR7611	Creative and Innovative Project	EEC	4	0	0	4	2
2.	PR7712	Industrial Training / Internship	EEC	4	0	0	4	2
3.	PR7811	Project Work	EEC	20	0	0	20	10

SUMMARY

SL. NO.	SUBJECT AREA	CREDITS AS PER SEMESTER								CREDITS TOTAL
		I	II	III	IV	V	VI	VII	VIII	
1.	HS	04	04	00	03	00	00	03	00	**14**
2.	BS	12	07	04	00	00	00	00	00	**23**
3.	ES	06	09	14	00	00	00	00	00	**29**
4.	PC	00	05	05	21	17	14	08	00	**70**
5.	PE	00	00	00	00	06	06	03	03	**18**
6.	OE	00	00	00	00	00	00	03	03	**6**
7.	EEC	00	00	00	00	00	02	02	10	**14**
	Total	**22**	**25**	**23**	**24**	**23**	**22**	**19**	**16**	**174**
8.	**Non Credit / Mandatory**									

HS7151 **FOUNDATIONAL ENGLISH** **L T P C**
4 0 0 4

COURSE DESCRIPTION:

This course aims at developing the language skills necessary for the first year students of Engineering and Technology.

OBJECTIVES:

- To develop the four language skills – Listening, Speaking, Reading and Writing.
- To improve the students' communicative competence in English.
- To teach students the various aspects of English language usage.

CONTENTS

UNIT I GREETING AND INTRODUCING ONESELF 12

Listening- Types of listening – Listening to short talks, conversations; **Speaking** – Speaking about one's place, important festivals etc. – Introducing oneself, one's family/ friend; **Reading** – Skimming a passage– Scanning for specific information; **Writing**- Guided writing - Free writing on any given topic (My favourite place/ Hobbies/ School life, writing about one's leisure time activities, hometown, etc.); **Grammar** – Tenses (present and present continuous) -Question types - Regular and irregular verbs; **Vocabulary** – Synonyms and Antonyms.

UNIT II GIVING INSTRUCTIONS AND DIRECTIONS 12

Listening – Listening and responding to instructions; **Speaking** – Telephone etiquette - Giving oral instructions/ Describing a process – Asking and answering questions; **Reading** – Reading and finding key information in a given text - Critical reading - **Writing –**Process description(non-technical)- **Grammar** – Tense (simple past& past continuous) - Use of imperatives – Subject – verb agreement – Active and passive voice; - **Vocabulary** – Compound words – Word formation – Word expansion (root words).

UNIT III READING AND UNDERSTANDING VISUAL MATERIAL 12

Listening- Listening to lectures/ talks and completing a task; **Speaking** –Role play/ Simulation – Group interaction; **Reading** – Reading and interpreting visual material; **Writing**- Jumbled sentences – Discourse markers and Cohesive devices – Essay writing (cause & effect/ narrative);**Grammar** – Tenses (perfect), Conditional clauses –Modal verbs; **Vocabulary** –Cause and effect words; Phrasal verbs in context.

UNIT IV CRITICAL READING AND WRITING 12

Listening- Watching videos/ documentaries and responding to questions based on them; **Speaking** Informal and formal conversation; **Reading** –Critical reading (prediction & inference); **Writing**–Essay writing (compare & contrast/ analytical) – Interpretation of visual materials; **Grammar** – Tenses (future time reference);**Vocabulary** – One word substitutes (with meanings) – Use of abbreviations & acronyms – Idioms in sentences.

UNIT V LETTER WRITING AND SENDING E-MAILS 12

Listening- Listening to programmes/broadcast/ telecast/ podcast; **Speaking** – Giving impromptu talks, Making presentations on given topics- Discussion on the presentation; **Reading** –Extensive reading; **Writing**- Poster making – Letter writing (Formal and E-mail) ;**Grammar** – Direct and Indirect speech – Combining sentences using connectives; **Vocabulary** –Collocation;

TEACHING METHODS:

Interactive sessions for the speaking module.
Use of audio – visual aids for the various listening activities.
Contextual Grammar Teaching.

EVALUATION PATTERN:
Internals – 50%
End Semester – 50%

TOTAL:60 PERIODS

OUTCOMES:

- Students will improve their reading and writing skills
- Students will become fluent and proficient in communicative English
- Students will be able to improve their interpersonal communication

TEXTBOOK:

1. Richards, Jack.C with Jonathan Hull and Susan Proctor **New Interchange : English for International Communication. (level2, Student's Book)** Cambridge University Press,New Delhi: 2010.

REFERENCES:

1. Bailey, Stephen. **Academic Writing: A practical guide for students**. New York: Rutledge,2011.
2. Morgan, David and Nicholas Regan. **Take-Off: Technical English for Engineering**. London: Garnet Publishing Limited, 2008.
3. Redston, Chris & Gillies Cunningham **Face2Face** (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005
4. Comfort, Jeremy, et al. **Speaking Effectively : Developing Speaking Skillsfor Business English.** Cambridge University Press, Cambridge: Reprint 2011.

MA7151	MATHEMATICS – I (Common to all branches of B.E. / B.Tech. Programmes in I Semester)	L	T	P	C
		4	0	0	4

OBJECTIVES:

- The goal of this course is for students to gain proficiency in calculus computations. In calculus, we use three main tools for analyzing and describing the behavior of functions: limits, derivatives, and integrals. Students will use these tools to solve application problems in a variety of settings ranging from physics and biology to business and economics.
- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

12

UNIT I DIFFERENTIAL CALCULUS

Representation of functions - New functions from old functions - Limit of a function - Limits at infinity - Continuity - Derivatives - Differentiation rules - Polar coordinate system - Differentiation in polar coordinates - Maxima and Minima of functions of one variable.

UNIT II 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 III 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 IV 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.

UNIT V DIFFERENTIAL EQUATIONS 12

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

TOTAL: 60 PERIODS

OUTCOMES:

- Understanding of the ideas of limits and continuity and an ability to calculate with them and apply them.
- Improved facility in algebraic manipulation.
- Fluency in differentiation.
- Fluency in integration using standard methods, including the ability to find an appropriate method for a given integral.
- Understanding the ideas of differential equations and facility in solving simple standard examples.

TEXTBOOKS:

1. James Stewart, "Calculus with Early Transcendental Functions", Cengage Learning, New Delhi, 2008.
2. Narayanan S. and Manicavachagom Pillai T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 9th Edition, New Delhi, 2014.
4. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.

REFERENCES:

1. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
4. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education, New Delhi, 2nd Edition, 5th Reprint, 2009.
5. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

PH7151 **ENGINEERING PHYSICS** **L T P C**

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

OBJECTIVE:

- To introduce the concept and different ways to determine moduli of elasticity and applications.
- To instill the concept of sound, reverberation, noise cancellation, and ultrasonic generation, detection and applications
- To inculcate an idea of thermal properties of materials, heat flow through materials and quantum physics
- To promote the basic understanding of interferometers, principles and applications of lasers, optical fibers and sensors
- To establish a sound grasp of knowledge on the basics, significance and growth of single crystals

UNIT I PROPERTIES OF MATTER 9

Elasticity – Poisson's ratio and relationship between moduli (qualitative) - stress-strain diagram for ductile and brittle materials, uses - factors affecting elastic modulus and tensile strength - bending of beams - cantilever - bending moment - Young's modulus determination - theory and experiment - uniform and non-uniform bending - I shaped girders - twisting couple - hollow cylinder - shaft - torsion pendulum - determination of rigidity modulus- moment of inertia of a body (regular and irregular).

UNIT II ACOUSTICS AND ULTRASONICS 9

Classification of sound - loudness and intensity - Weber-Fechner Law - standard intensity and intensity level - decibel - reverberation - reverberation time - calculation of reverberation time for different types of buildings – sound absorbing materials - factors affecting acoustics of buildings : focussing, interference, echo, echelon effect, resonance - noise and their remedies. Ultrasonics: production - magnetostriction and piezoelectric methods - detection of ultrasound - acoustic grating – ultrasonic interferometer - industrial applications – Non-destructive testing - ultrasonic method: scan modes and practice.

UNIT III THERMAL AND MODERN PHYSICS 9

Thermal expansion - thermal stress - expansion joints - bimetallic strips - thermal conductivity- heat conductions in solids – flow of heat through compound media - Forbe's and Lee's disc method: theory and experiment- Black body radiation – Planck's theory (derivation) – Compton effect – wave model of radiation and matter – Schrödinger's wave equation – time dependent and independent equations – Physical significance of wave function – particle in a one dimensional box.

UNIT IV APPLIED OPTICS 9

Interference - Michelson interferometer: construction, working, determination of wave length and thickness - anti-reflection coating - air wedge and its applications - Lasers – principle and applications – Einstein's coefficients – CO_2 and Nd:YAG laser - semiconductor lasers: homo junction and hetro junction - construction and working – applications. Optical fibres - classification (index & mode based) - principle and propagation of light in optical fibres - acceptance angle and numerical aperture - fibre optic communication system - active and passive sensors.

UNIT V CRYSTAL PHYSICS 9

Single crystalline, polycrystalline and amorphous materials – Single crystals: unit cell, crystal systems, Bravais lattices, ditections and planes in a crystal, Miller indices - interplanar distance for a cubic crystal - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - structure and significance of NaCl, CsCl, ZnS and graphite - crystal imperfections: point defects, line defects – Burger vectors, dislocations and stacking faults – Growth of single crystals: Bridgman and Czochralski methods.

TOTAL: 45 PERIODS

OUTCOME:

- The students will understand different moduli of elasticity, their determination and applications.
- The students will gain knowledge on the properties of sound, noise cancellation, and production, detection and applications of ultrasonics
- The students will acquire sound knowledge on thermal expansion and thermal conductivity of materials. Further they will gain an idea of quantum physics.
- The students will gain knowledge on interferometers, lasers and fiber optics
- The students will secure knowledge on the basics of crystal structures and their significance. Further they gain basic ideas of growing single crystals.

TEXTBOOKS:

1. Gaur R.K. and Gupta S.L., "Engineering Physics", Dhanpat Rai Publications (2013)
2. Palanisamy P.K., "Engineering Physics", Scitech Publications (P) Ltd. (2006).
3. Arumugam M., "Engineering Physics", Anuradha Publications (2000)

REFERENCES:

1. Serway R.A. and Jewett, J.W. "Physics for Scientists and Engineers with Modern Physics". Brooks/cole Publishing Co. (2010).
2. Tipler P.A. and Mosca, G.P., "Physics for Scientists and Engineers with Modern Physics". W.H.Freeman, (2007).
3. Markert J.T.,Ohanian, H. and Ohanian, M. "Physics for Engineers and Scientists". W.W.Norton & Co. (2007).

CY7151 ENGINEERING CHEMISTRY

L	T	P	C
3	0	0	3

OBJECTIVE

- To develop an understanding about fundamentals of polymer chemistry.
- Brief elucidation on surface chemistry and catalysis.
- To develop sound knowledge photochemistry and spectroscopy.
- To impart basic knowledge on chemical thermodynamics.
- To understand the basic concepts of nano chemistry.

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.

UNIT II SURFACE CHEMISTRYAND CATALYSIS **9**

Adsorption-Types of adsorption-adsorption of gases on solids- adsorption from solutions-Types of isotherms–Frendlich adsorption isotherm, Langmuir adsorption isotherm. Industrial applications of adsorption. Catalysis: Characteristics and types of catalysts-homogeneous and heterogeneous, auto catalysis. Enzyme catalysis -factors affecting enzyme catalysis, Michaelis-Menton equation. Industrial applications of catalysts.

UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY **9**

Photochemistry: Laws of photochemistry-Grotthuss-Draper law, Stark-Einstein law and Lambert-Beer Law. Photo processes-internal conversion, inter-system crossing, fluorescence, phosphorescence, chemiluminescence and photo-sensitization. Spectroscopy: Electromagnetic spectrum-absorption of radiation-electronic, vibrational and rotational transitions. Width and intensities of spectral lines. Spectrophotometric estimation of iron. UV-Vis and IR spectroscopy- principles, instrumentation (Block diagram) and applications.

9

UNIT IV CHEMICAL THERMODYNAMICS

Second law: Entropy-entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Free energy and work function: Helmholtz and Gibbs free energy functions; Criteria of spontaneity; Gibbs-Helmholtz equation; Clausius Clapeyron equation; Maxwell relations-Van't Hoff isotherm and isochore. Chemical potential; Gibbs-Duhem equation- variation of chemical potential with temperature and pressure.

UNIT V NANOCHEMISTRY 9

Basics-distinction between molecules, nanoparticles and bulk materials; size-dependent properties. Preparation of nanoparticles – sol-gel and solvothermal. Preparation of carbon nanotube by chemical vapour deposition and laser ablation.Preparation of nanowires by VLS growth, electrochemical deposition and electro spinning. Properties and uses of nanoparticles, nanoclusters, nanorods, nanotubes and nanowires.

TOTAL: 45 PERIODS

OUTCOME

- Will be familiar with polymer chemistry, surface chemistry and catalysis.
- Will know the photochemistry, spectroscopy and chemical thermodynamics.
- Will know the fundamentals of nano chemistry.

TEXTBOOKS

1. Jain P. C. & Monica Jain., "Engineering Chemistry", DhanpatRai Publishing Company (P) Ltd, New Delhi, 2014.
2. Kannan P., Ravikrishnan A., "Engineering Chemistry", Sri Krishna Hitech Publishing Company Pvt. Ltd. Chennai, 2014

REFERENCES

1. Pahari A., Chauhan B., "Engineering Chemistry", Firewall Media, New Delhi, 2012.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
3. AshimaSrivastava. Janhavi N N, Concepts of Engineering Chemistry", ACME Learning Private Limited., New Delhi., 2010.
4. Vairam S., Kalyani P., Suba Ramesh., "Engineering Chemistry", Wiley India Pvt Ltd., New Delhi., 2011.

GE7152 ENGINEERING GRAPHICS L T P C
3 2 0 4

OBJECTIVES

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

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION) 1

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I PLANE CURVES AND FREE HANDSKETCHING 14

Basic Geometrical constructions, Curves used in engineering practices-Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the 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 14

Orthographic projection- principles-Principal planes-First angle projection-Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes-Determination of true lengths and true inclinations by rotating line method and 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 14

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 14

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.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 15

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.

L=45+T=30, TOTAL: 75 PERIODS

OUTCOMES:

On Completion of the course the student will be able to

- Perform free hand sketching of basic geometrical shapes and multiple views of objects.
- Draw orthographic projections of lines, planes and solids
- Obtain development of surfaces.
- Prepare isometric and perspective views of simple solids.

TEXT BOOK:

1. N.D.Bhatt and V.M.Panchal, “Engineering Drawing”, Charotar Publishing House, 50th Edition, 2010.

REFERENCES:

1. K.R.Gopalakrishna., “Engineering Drawing” (Vol I&II combined) Subhas Stores, Bangalore, 2007
2. Luzzader, Warren.J., and Duff,John M.,,’’ Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production”, Eastern Economy Edition, Prentice Hall of India Pvt Ltd, New Delhi, 2005
3. M.B.Shah and B.C.Rana, “Engineering Drawing”, Pearson, 2nd Edition, 2009

4. K.Venugopal and V.Prabhu Raja, “Engineering Graphics”, New Age International (P)Limited ,2008.
5. K. V.Natarajan, “A text book of Engineering Graphics”, 28th Edition, Dhanalakshmi Publishers, Chennai, 2015.
6. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
7. N.S Parthasarathy and Vela Murali, “ Engineering Drawing”, Oxford University Press, 2015

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out ofdrawing 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. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day.

BS7161 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)

OBJECTIVE:

- 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, band gap determination and viscosity of liquids.

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. Viscosity of liquids - Determination of co-efficient of viscosity of a liquid by Poiseuille‟s flow

OUTCOME:

- 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)

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.
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 poly vinyl alcohol using Ostwald viscometer.
12. Pseudo first order kinetics-ester hydrolysis.
13. Corrosion experiment-weight loss method.
14. Determination of CMC.
15. Phase change in a solid.

TOTAL: 60 PERIODS

TEXTBOOKS

1. Vogel's Textbook of Quantitative Chemical Analysis (8^{TH} edition, 2014)
2. Laboratory Manual- Department of Chemistry, CEGC, Anna University (2014).

GE7162	**ENGINEERING PRACTICES LABORATORY**	**L**	**T**	**P**	**C**
	(Common to all Branches of B.E. / B.Tech. Programmes)	**0**	**0**	**4**	**2**

OBJECTIVES

To provide exposure to the students with hands-on experience on various Basic Engineering Practices in Civil, Mechanical, Electrical and Electronics Engineering.

GROUP – A (CIVIL & ELECTRICAL)

1. CIVIL ENGINEERING PRACTICES **15**

PLUMBING

Basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers, elbows and other components used in household fittings. Preparation of plumbing line sketches.

• Laying pipe connection to the suction side of a pump.
• Laying pipe connection to the delivery side of a pump.
• Practice in connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK

Sawing, planing and making joints like T-Joint, Mortise and Tenon joint and Dovetail joint.

STUDY

• Study of joints in door panels and wooden furniture
• Study of common industrial trusses using models.

2. ELECTRICAL ENGINEERING PRACTICES **15**

- Basic household wiring using Switches, Fuse, Indicator and Lamp etc.,
- Stair case light wiring
- Tube – light wiring
- Preparation of wiring diagrams for a given situation.
- Study of Iron-Box, Fan Regulator andEmergency Lamp

GROUP – B (MECHANICAL AND ELECTRONICS) **15**

3. MECHANICAL ENGINEERING PRACTICES

WELDING

- Arc welding of Butt Joints, Lap Joints, and Tee Joints
- Gas welding Practice.
- Basic Machining - Simple turning, drilling and tapping operations..
- Study and assembling of the following:
    a. Centrifugal pump
    b. Mixie
    c. Air Conditioner.

DEMONSTRATION ON FOUNDRY OPERATIONS.

4. ELECTRONIC ENGINEERING PRACTICES **15**

- Soldering simple electronic circuits and checking continuity.
- Assembling electronic components on a small PCB and Testing.
- Study of Telephone, FM radio and Low Voltage Power supplies.

TOTAL: 60 PERIODS

OUTCOMES

- Ability to fabricate carpentry components and to lay pipe connections including plumbing works.
- Ability to use welding equipments to join the structures
- Ability to do wiring for electrical connections and to fabricate electronics circuits.

HS7251 **TECHNICAL ENGLISH** **L T P C**
4 0 0 4

OBJECTIVES

- To enable students acquire proficiency in technical communication.
- To enhance their reading and writing skills in a technical context.
- To teach various language learning strategies needed in aprofessional environment.

CONTENTS

UNIT I ANALYTICAL READING **12**

Listening- Listening to informal and formal conversations; **Speaking** – Conversation Skills(opening, turn taking, closing)-explaining how something works-describing technical functions and applications;**Reading** –Analytical reading, Deductive and inductive reasoning; **Writing**- vision statement–structuring paragraphs.

UNIT II SUMMARISING **12**

Listening- Listening to lectures/ talks on Science & Technology;**Speaking** –Summarizing/ Oral Reporting, **Reading** – Reading Scientific and Technical articles; **Writing**- Extended definition –Lab Reports – Summary writing.

UNIT III DESCRIBING VISUAL MATERIAL 12

Listening- Listening to a panel discussion; **Speaking** – Speaking at formal situations; **Reading** – Reading journal articles - Speed reading;**Writing**-data commentary-describing visual material-writing problem-process- solution-the structure of problem-solution texts- writing critiques

UNIT IV WRITING/ E-MAILING THE JOB APPLICATION 12

Listening- Listening to/ Viewing model interviews; **Speaking** –Speaking at different types of interviews – Role play practice (mock interview); **Reading** – Reading job advertisements and profile of the company concerned;**Writing**- job application – cover letter –Résumé preparation.

UNIT V REPORT WRITING 12

Listening- Viewing a model group discussion;**Speaking** –Participating in a discussion - Presentation;**Reading** – Case study - analyse -evaluate – arrive at a solution;**Writing**– Recommendations- Types of reports (feasibility report)- designing and reporting surveys- – Report format.- writing discursive essays.

TEACHING METHODS:

Practice writing
Conduct model and mock interview and group discussion.
Use of audio – visual aids to facilitate understanding of various forms of technical communication.
Interactive sessions.

EVALUATION PATTERN:

Internals – 50%
End Semester – 50%

TOTAL:60 PERIODS

OUTCOMES

- Students will learn the structure and organization of various forms of technical communication.
- Students will be able to listen and respond to technical content.
- Students will be able to use different forms of communication in their respective fields.

TEXTBOOK:

1. Craig,Thaine**. Cambridge Academic English: An integrated skills course for EAP(Student's Book)Level: Intermediate** Cambridge University Press, New Delhi: 2012

REFERENCES:

1. Laws, Anne. **Presentations.** Hyderabad: Orient Blackswan, 2011.
2. Ibbotson, Mark. **Cambridge English for Engineering**. Cambridge University Press, Cambridge,New Delhi: 2008
3. Naterop, Jean B. and Rod Revell. **Telephoning in English**. Cambridge: Cambridge University Press, 2004.
4. Rutherford, Andrea J. **Basic Communication Skills for Technology**. New Delhi: Pearson Education, 2001.
5. Bailey, Stephen. **Academic Writing A practical Guide for Students**. Routledge, London: 2004
6. Hewings, Martin**. Cambridge Academic English: An integrated skills course for EAP(Student's Book)Level: Intermediate** Cambridge University Press, New Delhi: 2012.

MA7251 **MATHEMATICS - II** **L T P C**
(Common to all branches of B.E. / B.Tech. Programmes in II Semester) **4 0 0 4**

OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To acquaint the student with the concepts of vector calculus, needed for problems in all engineering disciplines.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow of the electric current.
- To make the student 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 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 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, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

UNIT III ANALYTIC FUNCTION **12**

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

UNIT IV 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 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

OUTCOMES:

- Upon successful completion of the course, students should be able to:
- Evaluate real and complex integrals using the Cauchy integral formula and the residue theorem
- Appreciate how complex methods can be used to prove some important theoretical results.
- Evaluate line, surface and volume integrals in simple coordinate systems
- Calculate grad, div and curl in Cartesian and other simple coordinate systems, and establish identities connecting these quantities
- Use Gauss, Stokes and Greens theorems to simplify calculations of integrals and prove simple results.

TEXTBOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 9th Edition, New Delhi, 2014.
2. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 43rd Edition, 2014.

REFERENCES:

1. Ramana, B.V. “Higher Engineering Mathematics”, Tata McGraw Hill, New Delhi, 2010.
2. Glyn James, “Advanced Modern Engineering Mathematics”, Pearson Education, New Delhi, 2007.
3. Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 3rd Edition, 2007.
4. Bali N., Goyal M. and Watkins C., “Advanced Engineering Mathematics”, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
5. Peter V. O’Neil , “Advanced Engineering Mathematics”, Cengage Learning India Pvt., Ltd, New Delhi, 2007.

PH7251 MATERIALS SCIENCE **L T P C**

(Common to Manufacturing, Industrial, Mining, Aeronautical, Automobile and Production Engineering) **3 0 0 3**

OBJECTIVE:

- To impart knowledge on the basics of binary phase diagrams and their applications
- To learn the phase diagram, effect of alloying elements and various transformations in the Fe-C system, and also the heat treatment of steels.
- To introduce various strengthening methods of materials, and also various mechanical properties and their measurement
- To instill the types, properties and applications of magnetic, dielectric and superconducting materials.
- To introduce the preparation, properties and applications of various new materials.

UNIT I PHASE DIAGRAMS **9**

Solid solutions - Hume Rothery's rules - The phase rule - single component system - one-component system of iron - binary phase diagrams - isomorphous systems - the tie-line rule - the lever rule - application to isomorphous system - eutectic phase diagram - peritectic phase diagram - other invariant reactions – free energy composition curves for binary systems - microstructural change during cooling.

UNIT II FERROUS ALLOYS AND HEAT TREATMENT **9**

The iron-carbon equilibrium diagram - phases, invariant reactions - microstructue of slowly cooled steels - eutectoid steel, hypo and hypereutectoid steels - effect of alloying elements on the Fe-C system - diffusion in solids - Fick's law - phase transformations - T-T-T-diagram for eutectoid steel – pearlitic, baintic and martensitic transformations - tempering of martensite - heat treatment of steels - annealing - normalizing - quenching and tempering - case hardening - induction, flame and laser hardening - carburizing, cyaniding, carbonitriding and nitriding.

UNIT III MECHANICAL PROPERTIES 9

Tensile test - plastic deformation mechanisms - slip and twinning - role of dislocations in slip - strengthening methods - strain hardening - refinement of the grain size - solid solution strengthening - precipitation hardening - creep resistance - creep curves - mechanisms of creep - creep-resistant materials - fracture - the Griffith criterion - critical stress intensity factor and its determination - fatigue failure - fatigue tests - methods of increasing fatigue life - hardness - Rockwell and Brinell hardness - Knoop and Vickers microhardness.

UNIT IV MAGNETIC, DIELECTRIC AND SUPERCONDUCTING MATERIALS 9

Ferromagnetism – Domain theory – types of energy – hysteresis – hard and soft magnetic materials – ferrites - dielectric materials – types of polarization – Langevin-Debye equation – frequency effects on polarization - dielectric breakdown – insulating materials – Ferroelectric materials - superconducting materials, properties, types and applications.

UNIT V NEW MATERIALS 9

Ceramics – types and applications – Composites: classification, role of matrix and reinforcement – processing of fiber reinforced plastics – Metallic glasses – types , glass forming ability of alloys – Inoue criteria – melt spinning process – applications - Shape memory alloys – phases, shape memory effect, pseudoelastic effect – NiTi alloy – applications- Nanomaterials – preparation: ball milling and chemical vapour deposition - properties and applications – carbon nanotubes - Biomaterials

TOTAL: 45 PERIODS

OUTCOME:

Upon completion of this course, the students will

- gain knowledge on the basics of binary phase diagrams and the use of lever rule
- learn about the Fe-C phase diagram, effect of alloying elements, TTT in the Fe-C system, and also the heat treatment of steels.
- understand the significance of dislocations, strengthening mechanisms, and tensile, creep, hardness and fracture behavior of materials
- acquire knowledge on the types, properties and applications of magnetic, dielectric and superconducting materials.
- get adequate understanding on the preparation, properties and applications of ceramics, composites, metallic glasses, shape-memory alloys and nanomaterials.

TEXTBOOKS:

1. Raghavan, V. “Physical Metallurgy: Principles and Practice”, Phi Learning (2009).
2. Balasubramaniam, R. “Callister's Materials Science and Engineering”, Wiley India Pvt. Ltd. (2014).
3. Palanisamy P.K., “Materials Science” , Scitech (2013).

REFERENCES:

1. Raghavan, V. “Materials Science and Engineering”, Printice Hall of India (2007).
2. Shackelford, J.F. “Introduction to Materials Science for Engineers”. Pearson India (2006).
3. Donald Askeland. “Materials Science and Engineering”, Brooks/Cole (2010).
4. Smith, W.F., Hashemi, J. and R.Prakash. “Materials Science and Engineering”,Tata Mcgraw Hill Education Private Limited (2014).

GE7153 ENGINEERING MECHANICS

L	T	P	C
4	0	0	4

OBJECTIVE :

- The objective of this course is to inculcate in the student the ability to analyze any problem in a simple and logical manner and to predict the physical phenomena and thus lay the foundation for engineering applications.

12

UNIT I STATICS OF PARTICLES

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.

UNIT II EQUILIBRIUM OF RIGID BODIES 12

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 16

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration , Theorems of Pappus-Guldinus, Distributed Loads on Beams, Center 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 8

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

UNIT V DYNAMICS OF PARTICLES 12

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.

L – 45 + T – 15 TOTAL: 60 PERIODS

OUTCOMES:

- Upon completion of this course, students will be able to construct meaningful mathematical models of physical problems and solve them.

TEXT BOOK

1. Beer,F.P and Johnson Jr. E.R, "Vector Mechanics for Engineers", McGraw-Hill Education (India) Pvt. Ltd. 10th Edition, 2013.

REFERENCES
1. Hibbeller, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition, Prentice Hall, 2013.
2. J.L. Meriam & L.G. Karige, Engineering Mechanics: Statics (Volume I) and Engineering Mechanics: Dynamics, 7th edition, Wiley student edition, 2013.
3. P. Boresi & J. Schmidt, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.
4. Irving H. Shames, G. Krishna Mohana Rao, Engineering Mechanics - Statics and Dynamics, Fourth Edition – PHI / Pearson Education Asia Pvt. Ltd., 2006.
5. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

PR7201 MACHINING PROCESSES L T P C
3 0 0 3

OBJECTIVES:
- To impart the knowledge on basic concepts of various machining Processes and Machine tools.
- Classes to be supported by demonstration in the workshop and screening of video film of the various operations of the machines.

UNIT I LATHE 10

Introduction to production processes – types of production (job, batch and mass) – production processes – Casting, Forming, Machining and Welding, Machine Tool – Lathe – Engine Lathe – block diagram – sketch – functions of each part – work holding devices in lathe – functions – Chuck, Centre, Dogs, Steady Rest and Follower Rest, mechanism of lathe – Apron, Feed, Tumbler Gear, various operations performed in Lathe – facing, turning, chamfering and knurling – relative positions of tool and job – Taper turning operations (three methods)_ thread cutting – RH and LH thread, single start and multi start with application – Method of thread cutting – selection and arrangement of tool and work. Problems in metric and inch thread conversion – Specifications o f Lathe – Burnishing.

UNIT II SHAPER, PLANER & SLOTTER 9

Purpose of shaping – block diagram – functions of each part. Purpose of planer – block diagram – functions of each part. Purpose of slotting machine – block diagram – functions and working principle. Operations carried out – horizontal plane, vertical plane, v type with relative position – Comparison of planer with shaper – work holding devices in shaper and planer – Quick return mechanism in shaper – mechanical and hydraulic – cross feed mechanism – Types of planer with application – Comparison of shaping with slotting – tool holding devices in shaper, planer and slotter – specifications of shaper, planer and slotter simple problems to calculate the velocity – speed, feed and depth of cut.

UNIT III DRILLING 8

Purpose of drilling – block diagram and function – types of drilling machines – portable drilling – bench type – sensitive drilling – radial arm drilling – functions of parts – purpose and operation – gang drilling, multiple drill head, upright drilling, relative operations – reaming, boring, tapping, counter boring, courses sinking, trepanning and spot facing (with simple sketch, purpose and application). Work holding devices – specification torque calculation – speed, feed and depth of cut.

UNIT IV MILLING **9**

Milling machine purpose – up and down milling – classification of milling machines – slot, keyway machining – methods of milling – single piece, string, rotary, index, gang, progressive, copy. Horizontal milling machine – block diagram – functions of each part-applications – Vertical milling machine – block diagram – functions of each part applications – Gear cutting using milling machine – procedure with neat sketch – milling cutters – peripheral, face, end T slot, form etc. – attachments and special accessories for milling – rotary, slotting attachment – indexing mechanism – methods of indexing – direct, plain, compound and differential indexing – problems – specifications – cutting conditions and parameters.

UNIT V GRINDING **9**

Purpose – classification – surface finish – applications – grinding wheel – types – specifications – selection – surface grinding machine – block diagram – functions of each part – cylindrical grinding – Centreless grinding – Comparison – infeed, end feed and through feed. Balancing, dressing, loading and Truing of wheel – special grinding machines – specification of machine – cutting condition.

TOTAL: 45 PERIODS

OUTCOMES:

- In a position to select and use the machine suitably
- Obtain the total knowledge about the machines
- Helps to improve (or) modify the design by combining the various operations.

TEXT BOOKS:

1. HMT Bangalore, “Production Technology”, Tata Mc-Graw Hill Publishing Company Limited, New Delhi, 2001.
2. P.C. Sharma, “A Text Book of Production Technology”, S.Chand and Company, 2001.

REFERENCES:

1. R.K. Jain, “Production Technology”, Khanna Publishers, New Delhi, 2001.
2. Hajra Choudhary etal, “Elements of Production Technology –Vol.II”, Asia Publishing House, 2000.
3. B.Kumar, “Manufacturing Technology”, Khanna Publishers, New Delhi 2000.
4. P.Radhakrishnan, “Manufacturing Technology, Vol.I”, Scitech Publications, 2002.
5. Kalpakjain ,”Manufacturing Process for Engineering Material”, Addison - Wesley Publication 2000.

GE7151	COMPUTING TECHNIQUES	L	T	P	C
	(Common to all branches of Engineering and Technology)	**3**	**0**	**0**	**3**

OBJECTIVE

- To learn programming using a structured programming language.
- To provide C programming exposure.
- To introduce foundational concepts of computer programming to students of different branches of Engineering and Technology.

UNIT I INTRODUCTION **9**

Introduction to Computers – Computer Software – Computer Networks and Internet - Need for logical thinking – Problem formulation and development of simple programs - Pseudo code - Flow Chart and Algorithms.

UNIT II C PROGRAMMING BASICS 9

Introduction to C programming – Fundamentals – Structure of a C program – Compilation and linking processes - Constants, Variables – Data Types – Expressions - Operators –Decision Making and Branching – Looping statements – Solving Simple Scientific and Statistical Problems.

UNIT III ARRAYS AND STRINGS 9

Arrays – Initialization – Declaration – One dimensional and two dimensional arrays - Strings- String operations – String Arrays - simple programs- sorting- searching – matrix operations.

UNIT IV POINTERS 9

Macros - Storage classes –Basic concepts of Pointers– Pointer arithmetic - Example Problems - Basic file operations

UNIT V FUNCTIONS AND USER DEFINED DATA TYPES 9

Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion –Enumerators – Structures - Unions

TOTAL : 45 PERIODS

OUTCOME

At the end of the course, the student should be able to:

- Write C program for simple applications
- Formulate algorithm for simple problems
- Analyze different data types and arrays
- Perform simple search and sort**.**
- Use programming language to solve problems.

TEXTBOOKS:

1. Pradip Dey, Manas Ghosh, “Computer Fundamentals and Programming in C”, Second Edition, Oxford University Press, 2013
2. Ashok N. Kamthane, “Computer programming”, Pearson Education, 2007.
3. Yashavant P. Kanetkar. “Let Us C”, BPB Publications, 2011.

REFERENCES:

1. Kernighan,B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2006
2. Byron S Gottfried, “Programming with C”, Schaums Outlines, Second Edition, Tata McGraw-Hill, 2006.
3. R.G. Dromey, “How to Solve it by Computer”, Pearson Education, Fourth Reprint, 2007

PR7211 DRAFTING AND MACHINING LAB

L	T	P	C
0	0	4	2

OBJECTIVES

- To get hands on experience in drafting of engineering components
- To get hands on experience in the conventional machines.
- To prepare the process planning sheets for all the operations and then follow the sequences during the machining processes.

LIST OF EXPERIMENTS

Machining Exercises

1. Preparation of part drawing to machine a raw material in a lathe – (involving facing, turning, stepped turning, knurling, taper turning, thread cutting and parting)

2. Preparation of part drawing to machine a blank material in a shaper – (involving horizontal, vertical surface machining, V-shape, dove-tail end)
3. Preparation of part drawing to machine the given part in drilling machine – (involving single hole, multi hole, equidistant, equi-pitch, reaming, boring, counter boring, counter sinking).
4. Preparation of part drawing to mill the groove part in a milling machine – (involving key way, slot, spur gear, patched milling, spline, gang milling).
5. Preparation of part drawing to grind the part in a grinding machine-(involving flat surface, cylindrical surface).
6. Preparation of part drawing to machine a part in combination of machine-(Lathe & Milling, Lathe &Grinding, Shaper & Grinding).

Drafting Exercises

Any CAD software with 2D modeling to used by students for drafting exercises

1. Practice on Drafting Software using Measuring commands; Basic Draw Commands; Display Commands GRID, SNAP, CIRCLE, LINE, ARC LIMITS, ZOOM, PAN.
2. Practice on using Editing commands; Creating layers: CHANGE,ERASE,EXTEND,TRIM,GRIPS. Construction Commands; ARRAY, COPY, MIRROR, MOVE, OFFSET, FILLET, CHAMFER, OSNAP.
3. Placing lettering on a drawing; Crosshatching a drawing TEXT BHATCH.
4. 2D drafting of automobile components like engine crank shaft , connecting rod etc.,
5. 2D drafting of machine components.
6. 2D drafting of machine shop drawing.
7. 2D drafting of pin joints, cotter joints and bearings.

The drafting exercise include process planning sheet where student shall fill up the data for producing the product as per drawing. As per the process planning sheet the machining operations are to be conducted.

1. Step turning, Taper Turning/ Threading and Knurling operations in Lathe.
2. Eccentric turning in a Lathe
3. Multi start Threading/ Burnishing operations in a Turret Lathe.
4. Machining to make a cube/ V-Block using shaper.
5. Counter sinking, Counter Boring and Tapping operation in a drilling machine.
6. Surfacing/Pocket Milling in a vertical milling machine.
7. Polygonal shape milling in a horizontal milling machine.
8. Flat surface grinding and cylindrical grinding operations.

TOTAL: 60 PERIODS

OUTCOMES

- Enable to interpret drawing of component, process sheet, etc.
- Trained to draft part drawing with use of CAD software and operate basic machining tools.
- Impart practical knowledge on the selection of machines and processes to manufacture components.

GE7161	**COMPUTER PRACTICES LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

OBJECTIVES

- To understand the basic programming constructs and articulate how they are used to develop a program with a desired runtime execution flow.
- To articulate where computer programs fit in the provision of computer-based solutions to real world problems.
- To learn to use user defined data structures.

LIST OF EXPERIMENTS

1. Search, generate, manipulate data using MS office/ Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem formulation, Problem Solving and Flowcharts
4. C Programming using Simple statements and expressions
5. Scientific problem solving using decision making and looping.
6. Simple programming for one dimensional and two dimensional arrays.
7. Solving problems using String functions
8. Programs with user defined functions
9. Program using Recursive Function
10. Program using structures and unions.

TOTAL: 60 PERIODS

OUTCOMES

At the end of the course, the student should be able to:

- Write and compile programs using C programs.
- Write program with the concept of Structured Programming
- Identify suitable data structure for solving a problem
- Demonstrate the use of conditional statement.

LABORATORY REQUIREMENTS FOR BATCH OF 30 STUDENTS

30 Systems with C compiler

AE7351 ENGINEERING FLUID MECHANICS AND MACHINERY L T P C
3 0 0 3

COURSE OBJECTIVES:

- To learn about the basic properties of fluids.
- To introduce the concept of incompressible and viscous flows.
- To have a thorough knowledge on dimensional analysis and model studies.
- To study the applications of conservation laws to flow through pipes and hydraulic machines.
- To learn the basics of water turbines, their classification and working principles.

UNIT I INTRODUCTION 8

Units and dimensions- Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity. Flow characteristics – concept of control volume - application of continuity equation, energy equation and momentum equation.

UNIT II FLOW THROUGH CIRCULAR CONDUITS 9

Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli- Boundary layer concepts – types of boundary layer thickness – Darcy Weisbach equation –friction factor- Moody diagram- commercial pipes- minor loses – Flow through pipes in series and parallel.

UNIT III DIMENSIONAL ANALYSIS 8

Need for dimensional analysis – methods of dimensional analysis – Similitude –types of similitude - Dimensionless parameters- application of dimensionless parameters – Model analysis.

UNIT IV TURBINES 10

Impact of jets - Euler's equation - Theory of roto-dynamic machines-Classification of turbines – heads and efficiencies – velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines- working principles - work done by water on the runner –. Specific speed - unit quantities – performance curves for turbines .

UNIT V PUMPS **10**

Various efficiencies– velocity components at entry and exit of the rotor- velocity triangles - Centrifugal pumps– working principle - work done by the impeller - performance curves - Reciprocating pump- working principle – Rotary pumps –classification.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, Students will be able to

CO1: Exhibit the basic understanding on fluid properties and fluid statics.
CO2: Demonstrate the understanding in fluid kinematics and governing equations.
CO3: Use the governing equations for fluid flow problems and understand the elementary plane flows.
CO4: Analyse laminar and turbulent flow problems.
CO5: Acquire knowledge on the various types of fluid machines

TEXT BOOKS:

1. Bansal, R.K., Fluid Mechanics and Hydraulics Machines, Laxmi Publications (P) Ltd., New Delhi, Ninth edition,2015.
2. Rathakrishnan. E, Fluid Mechanics, Prentice Hall of India (II Ed.), 2007.

REFERENCES:

1. Ramamurtham. S, Hydraulics, Fluid Mechanics and Fluid Machines, Dhanpat Rai Publishing Co Pvt., Ltd, 9th edition, 2012.
2. Kumar. K.L. Engineering Fluid Mechanics (VII Ed.) S Chand publishers Reprint Edition 2006 edition (1 December 2010)
3. Streeter. V. L., and Wylie, E.B., Fluid Mechanics, McGraw Hill, 1983.

AE7351 ENGINEERING FLUID MECHANICS AND MACHINERY																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Exhibit the basic understanding on fluid properties and fluid statics.	3	3	2	3	2	1	1	-	-	1	2	2	2	2	2
CO2	Demonstrate the understanding in fluid kinematics and governing equations.	3	3	2	3	2	1	1	-	-	1	2	2	3	2	3
CO3	Use the governing equations for fluid flow problems and understand the elementary plane flows.	3	3	2	3	2	1	1	-	-	1	2	2	3	2	3
CO4	Analyse laminar and turbulent flow problems.	3	3	2	3	2	1	1	-	-	1	2	2	2	3	2
CO5	Acquire knowledge on the various types of fluid machines.	3	3	2	3	2	1	1	-	-	1	2	2	3	3	2
PO & PSO (Average)		3.0	3.0	2.0	3.0	2.0	1.0	1.0	-	-	1.0	2.0	2.0	2.6	2.4	2.4

AE7352 **MECHANICS OF SOLIDS** **L T P C**
3 0 0 3

OBJECTIVES

- To know about how a solid (materials, structures) behaves when it is exposed to forces and deformations.
- To apply the fundamental concepts of principle of superposition, equilibrium, compatibility, force- deformation, and stress-strain relationships to the solid and structural mechanics problems
- To analyze determinate and indeterminate bars, beams, to determine axial forces, torques, shear forces, and bending moments
- To have physical insight into distribution of stresses and strains in structural members
- To identify the biaxial stresses in acting in a body or an element.

UNIT I STRESS-STRAIN – AXIAL LOADING 9

Definition of stress and strain- Stress-Strain relation- Relation between material constants.-Bar under axial loading- Statically determinate and indeterminate cases – Thermal stress-Impact Loading

UNIT II STRESSES IN BEAMS 9

Types of beams and loadings – Relation between shear force and bending moment - Shear force and bending moment diagrams – Euler beam theory - Bending stress in beams – Shear stress in beam – Composite beam.

UNIT III DEFLECTION OF BEAM 9

Various methods for statically determinate beams - Double integration method – Macaulay's method – Moment area method – Conjucate Beam method – Method of superposition

UNIT IV TORSION AND SPRINGS 9

Shear stress and twist relation for circular section – Comparison of hollow shaft and solid shaft – Compound shaft – Power transmission by circular shafts – Springs – Deflection expression for close coiled helical spring – Stress in springs.

UNIT V BIAXIAL STRESS 9

Thin walled cylinder under internal pressure – Principal stresses for general biaxial stress field – Mohr's circle - Stresses in combined loading

TOTAL : 45 PERIODS

OUTCOMES

At the end of the course, the students are expected to

CO1: Know about how a solid (materials, structures) behaves when it is exposed to forces and deformations.

CO2: Apply the fundamental concepts of principle of superposition, equilibrium, compatibility, force- deformation, and stress-strain relationships to the solid and structural mechanics problems

CO3: Analyze determinate and indeterminate bars, beams, to determine axial forces, torques, shear forces, and bending moments

CO4: Have physical insight into distribution of stresses and strains in structural members

CO5: Identify the biaxial stresses in acting in a body or an element.

TEXT BOOKS:

1. Stephen Timoshenko, 'Strength of Materials', Vol I & II, CBS Publishers and Distributors, 3rd edition, 2004.
2. William A. Nash, Merle C. Potter, "Schaum's Outline of Strength of Materials", 6th Edition, McGraw Hill Education, 2014

REFERENCES:

1. Clive L. Dym , Irving H. Shames, “Solid Mechanics : A Variational Approach, Augmented Edition”, Springer publishers, 2013
2. R.K.Rajput, ‘Strength of Materials’, S Chand; 4th Rev. Edition 2007.
3. Timothy A. Philpot, "Mechanics of Materials: An Integrated Learning System," 3rd Edition, Wiley, 2012.
4. Ferdinand P. Beer, E. Russell Johnston Jr., John T. Dewolf and David Mazurek, "Mechanics of Materials," seventh edition, McGraw-Hill, 2014
5. Russell C. Hibbeler, "Mechanics of Materials", Ninth Edition, Pearson education, 2013
6. Roy R Craig, "Mechanics of Materials", Third Edition, John Wiley & Sons, 2011
7. James M Gere, Barry J Goodno, "Mechanics of Materials", Eighth Edition, Cengage Learning, 2012

AE7352 MECHANICS OF SOLIDS																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Know about how a solid (materials, structures) behaves when it is exposed to forces and deformations.	3	3	2	2	3	1	1	-	-	1	2	2	2	2	2
CO2	Apply the fundamental concepts of principle of superposition, equilibrium, compatibility, force-deformation, and stress-strain relationships to the solid and structural mechanics problems	3	3	2	2	3	1	1	-	-	1	2	2	3	2	3
CO3	Analyze determinate and indeterminate bars, beams, to determine axial forces, torques, shear forces, and bending moments	3	3	2	2	3	1	1	-	-	1	2	2	3	2	3
CO4	Have physical insight into distribution of stresses and strains in structural members	3	3	2	2	3	1	1	-	-	1	2	2	2	3	2
CO5	Identify the biaxial stresses in acting in a body or an element.	3	3	2	2	3	1	1	-	-	1	2	2	3	3	2
PO & PSO (Average)		3.0	3.0	2.0	2.0	3.0	1.0	1.0	-	-	1.0	2.0	2.0	2.6	2.4	2.4

AU7303	ENGINEERING THERMODYNAMICS AND THERMAL ENGINEERING	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To understand the basics of Engineering Thermodynamics, the Thermodynamics properties and first law, second laws and concepts of entropy and its applications.
- To understand Air standard cycles of Otto, Diesel, Dual and Brayton, compressor working and its applications.
- To understand the steam properties, steam cycles and steam Nozzle, its applications.
- To understand the theory, classification and performance analysis of Refrigeration and Air Conditioning system.
- To understand the basics of Heat transfer, Heat transfer laws and its applications.

UNIT I BASIC THERMODYNAMICS 9

Systems, closed, open and isolated. Property, state, path and process, quasi-static process, Zeroth low, First law. Steady flow energy equation. Heat and work transfer in flow and non-flow processes. Second law, Kelvin-Planck statement – Clausius statement - Concept of Entropy, Clausius inequality, Entropy change in non-flow processes.

UNIT II AIR STANDARD CYCLES AND COMPRESSORS 9

Otto, Diesel, Dual combustion and Brayton cycles. Air standard efficiency. Mean effective pressure. Compressors, Classifications of compressors, Single stage and multi stage, Effect of intercooler in multi stage compressor, Perfect and imperfect intercooler, work done by the compressor, Reciprocating, Rotary, Axial, Vane compressors.

UNIT III STEAM AND JET PROPULSION 9

Properties of steam, Dryness fraction, Quality of steam by steam tables and Mollier chart – Rankine cycle, Work done, Steam rate – Steam Nozzles, Types of nozzles, Friction in nozzles - Simple jet propulsion system – Thrust rocket motor – Specific impulse.

UNIT IV REFRIGERATION AND AIR-CONDITIONING 9

Principles of refrigeration, Vapour compression – Vapour absorption types, comparison - Co-efficient of performance (COP), Properties of refrigerants – Basic Principle, Summer, winter and Year round Air conditioning.

UNIT V HEAT AND MASS TRANSFER 9

Modes of heat transfer, Heat conduction in parallel, radial and composite wall – Basics of Convective heat transfer. Fundamentals of Radiative heat transfer – Flow through heat exchangers, Logarithmic Mean Temperature Difference (LMTD) for parallel flow and Arithmetic Mean Temperature Difference (AMTD) counter flow heat exchangers.

TOTAL : 45 PERIODS

(Use of standard Steam tables with Mollier chart and Refrigerant tables are permitted)

COURSE OUTCOMES:

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

CO1: The students would have learned the fundamental Engineering Thermodynamics and its laws and to apply it in real application.

CO2: The students learned The Air standard cycles and compressor, analyzing the problem in engines.

CO3: The students learned the properties of steam, steam power plant cycles and steam Nozzles, analysis in various engineering problems.

CO4: The students learned and analysis the various types of Refrigeration systems and Air conditioning system.

CO5: The students would have learned the fundaments Heat transfer and its laws. analyzing the problem in Heat transfer.

TEXT BOOKS:

1. Chattopadhyay. P Engineering Thermodynamics", oxford University Press, New Delhi, 2010.
2. Nag.P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, 2007.
3. Rathakrishnan E., "Fundamentals of Engineering Thermodynamics" Prentice-Hall India, 2005.

REFERENCES:

1. Ramalingam K.K. "Thermodynamics", Sci-Tech Publications, 2006
2. Holman.J.P., "Thermodynamics", 3rd Ed. McGraw-Hill, 2007.
3. Venwylen and Sontag, "Classical Thermodynamics", Wiley Eastern, 1987
4. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.
5. Merala C, Pother, Craig W, Somerton, "Thermodynamics for Engineers", Schaum Outline Series, Tata McGraw-Hill, New Delhi, 2004.
6. Mathur& Sharma Steam Tables, Jain Publishers, New Delhi.

AU7303 ENGINEERING THERMODYNAMICS AND THERMAL ENGINEERING																
Course Outcome	**Statement**	**Programme Outcomes**												**Programme Specific Outcomes**		
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	The students would have learned the fundamental Engineering Thermodynamics and its laws and to apply it in real application.	3	3	2	1	1	2	1	1	1	1	1	1	2	1	2
CO2	The students learned The Air standard cycles and compressor, analyzing the problem in engines..	3	3	2	2	1	2	1	1	1	1	1	1	2	1	2
CO3	The students learned the properties of steam, steam power plant cycles and steam Nozzles, analysis in various engineering problems.	3	3	2	2	1	1	1	1	1	1	1	1	2	1	2
CO4	The students learned and analysis the various types of Refrigeration systems and Air conditioning system.	3	3	2	2	1	1	1	1	1	1	1	1	2	1	2
CO5	The students would have learned the fundaments Heat transfer and its laws. analyzing the problem in Heat transfer.	3	3	2	2	1	1	1	1	1	1	1	1	2	1	2
PO & PSO (Average)		3.0	3.0	2.0	1.8	1.0	1.4	1.0	1.0	1.0	1.0	1.0	1.0	2.0	1.0	2.0

EI7307 ELECTRICAL, ELECTRONICS AND CONTROL SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES:

- Gain knowledge on construction and working principle of AC and DC machines.
- Get exposed to basic electronic devices and their applications.
- Gain knowledge on logic gates and their applications in digital electronics
- Will be in a position to analyze open and closed loop control systems.
- Exposed to various types of measurement Systems.

UNIT I ELECTRICAL MACHINES 9

DC Generators: Construction-Principle of Operation-EMF Equation and Applications- DC Motors: Back EMF-Voltage and torque equation- Principle of transformer- EMF Equation - Tests on transformer - AC motors: Construction and basic Principle of Operation-Starting and Running torques.

UNIT II BASIC ELECTRONIC DEVICES 9

Semiconductor devices: Diodes, BJT, FET, UJT, SCR Principle of Operation and their characteristics and applications -Rectifier and power supply circuits.

UNIT III DIGITAL ELECTRONICS 9

Number systems – binary codes - logic gates - Boolean algebra, laws & theorems - simplification of Boolean expression - implementation of Boolean expressions using logic gates - Combinational circuits- Design of adder, subtractor, encoders, decoders, multiplexers and demultiplexers-Flip flops.

UNIT IV BASICS OF CONTROL SYSTEM 9

Introduction to control systems – open loop and closed loop- Block diagram and signal flow graph representation-realization of transfer functions-Time and Frequency response of dynamic systems-Stability analysis.

UNIT V MEASURING SYSTEMS 9

Measurements of Electrical quantities: voltmeter, ammeter, watt- meter, Digital Multi Meters-Cathode Ray Oscilloscopes: frequency, phase, amplitude measurements-Recorders: tape recorder, X-Y recorders, UV recorders- Data loggers-Virtual instruments.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Will be in a position to suggest suitable AC/DC machines for a given application.
CO2: Able to analyze the characteristics of electronic devices such as Diodes, Thyristors family.
CO3: Able to understand the fundamental concepts and solve problems applied to digital system.
CO4: Able to analyze and solve problems for open loop and closed loop control systems.
CO5: Will be in a position to suggest suitable measuring device for a given application.

TEXT BOOKS:

1. Theraja, B.L., " A Text Books of Electrical Technology ", S.S.Chand and Co., New Delhi, 1998.
2. Boylestad & Nashelsky, “Electronic Devices & Circuit Theory”, Eighth edition, Prentice Hall Of India (P) Ltd., 2003.
3. M. Morris Mano and Michael D. Ciletti, Digital Design, Pearson Education, 2013.
4. Nagrath. J.J. and Gopal, Control system engineering, New Age International Pvt Ltd., 2000.

REFERENCES:

1. Donald P Leach, Albert Paul Malvino and GoutamSaha, Digital Principles and Applications, Tata McGraw Hill,6th edition, 2006.
2. Helfrick.A.D., and Cooper.W.D., Electronic Instrumentation and Measurement techniques, Prentice Hall of India, 2nd edition, 2008.
3. Rajput R.K . Text book of Electrical Engineering, Firewell Media Publications,1st edition, 2004.

EI7307 ELECTRICAL, ELECTRONICS AND CONTROL SYSTEMS																
Course Outcome	**Statement**	**Programme Outcomes**												**Programme Specific Outcomes**		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Acquiring knowledge on construction and working principle of AC and DC machines.	3	3	3	3	3	-	-	-	-	-	-	-	2	3	3
CO2	Acquiring and Analysis of basic electronic devices and their applications	2	2	2	2	2	-	-	-	-	-	-	-	2	3	3
CO3	Acquiring knowledge on fundamental concepts and solve problems applied to digital system.	3	3	3	3	3	-	-	-	-	-	-	-	2	3	3
CO4	Acquiring and Analysis of open loop and closed loop control systems.	3	3	3	3	3	-	-	-	-	-	-	-	2	3	3
CO5	Acquiring knowledge on various types of measurement Systems	3	-	3	3	3	-	-	-	-	-	-	-	2	3	3
PO & PSO (Average)		2.8	2.8	2.8	2.8	2.8	-	-	-	-	-	-	-	2.0	3.0	3.0

MA7354 **NUMERICAL METHODS** **L T P C**
4 0 0 4

OBJECTIVE:

- To provide the mathematical foundations of numerical techniques for solving linear system, eigen value problems, interpolation, numerical differentiation and integration and the errors associated with them;
- To demonstrate the utility of numerical techniques of ordinary and partial differential equations in solving engineering problems where analytical solutions are not readily available.

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 12

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton-Raphson method- Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss-Jordan methods – Iterative methods of Gauss-Jacobi and Gauss-Seidel - Matrix Inversion by Gauss-Jordan method - Eigenvalues of a matrix by Power method and by Jacobi's method.

UNIT II INTERPOLATION AND APPROXIMATION 12

Interpolation with unequal intervals - Lagrange interpolation – Newton's divided difference interpolation – Cubic Splines - Interpolation with equal intervals - Newton's forward and backward difference formulae – Least square method - Linear curve fitting.

UNIT III NUMERICAL DIFFERENTATION AND INTEGRATION 12

Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 and Simpson's 3/8 rules – Romberg's method - Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 12

Single step-methods - Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first and second order equations - Multi-step methods - Milne's and Adams-Bashforth predictor-corrector methods for solving first order equations.

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 12

Finite difference methods for solving two-point linear boundary value problems - Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat-flow equation by explicit and implicit (Crank-Nicholson) methods - One dimensional wave equation by explicit method.

TOTAL:60 PERIODS

OUTCOMES:

- Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions.
- Apply numerical methods to obtain approximate solutions to mathematical problems.
- Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
- Analyse and evaluate the accuracy of common numerical methods

TEXT BOOKS:

1. Grewal, B.S. and Grewal,J.S., "Numerical methods in Engineering and Science", Khanna Publishers, New Delhi, 9th Edition, 2011.
2. Sankara Rao. K., "Numerical methods for Scientists and Engineers", Prentice Hall of India Private Ltd., New Delhi, 3rd Edition, 2007.

REFERENCES:

1. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education Asia, New Delhi, 1st Edition, 2007.
2. Gerald, C.F. and Wheatley, P.O., "Applied Numerical Analysis", Pearson Education Asia, New Delhi, 6th Edition, 2006.
3. Laurene V. Fausett, "Applied Numerical Analysis using MATLAB", Pearson Education, New Delhi, 1st print, 2nd Edition, 2009.
4. S. R. K. Iyengar, R. K. Jain, Mahinder Kumar Jain, "Numerical Methods for Scientific and Engineering Computation", 6th Edition, New Age International Publishers, New Delhi, 2012.

PR7301 METALLURGY AND MATERIALS TESTING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To impart knowledge on the structure, properties and applications of metallic materials.
- To illustrate the role of heat treatment on microstructure and properties.
- To describe the various non ferrous alloys and their applications.
- To introduce the concepts of mechanical behaviors of the materials.
- To familiarize property evaluation by various testing methods and fundamentals of characterization techniques.

UNIT I MICROSTRUCTURAL DEVELOPMENT AND METALLOGRAPHY 9

Basics of Metallographic microscopy -sample preparation – resolution – contrast – Metallographic microscope - quantitative techniques - Homogenous and Heterogeneous nucleation - grain growth- directional solidification- cast and weld microstructure- ingot and continuous casting - microstructures of Steels and Cast irons - spinodal decomposition - Pearlitic, bainitic and martensitic transformations - Effect of alloying elements on steel (P,S, Al, Pb, Mn, Si, Cr, Ni, Mo, V, Ti and W) – Specification and Standards, Properties and application -stainless and tool steels – HSLA steels – TRIP steel- maraging steels – Gray, white, malleable, spheroidal / graphite, alloy cast irons

UNIT II HEAT TREATMENT AND KINETICS 9

Diffusion in solids - Fick's law - - Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram CCR - Types and stages of annealing, stress relief, recrystallisation and spheroidizing – normalizing, Hardenability, Jominy end quench test - hardening and tempering of steel –Cryotreatment, Austempering, martempering – case hardening, carburizing, nitriding cyaniding, carbonitriding – Flame, Induction Laser and Electron beam and plasma phase hardening, Special and Duplex surface hardening processes - residual stress - Age hardening - Sintering- indentation (macro, micro and nano) for evaluation of hardness.

UNIT III NON FERROUS METALS 9

Specification, Properties and application: Copper and Copper alloys, Brass, Bronze and Cupronickel – Aluminium alloys and AI-Cu –precipitation strengthening treatment – Bearing alloys, Alloys of Titanium, Zinc, Magnesium and Nickel –Intermetallics - Ni, Ti Aluminides – Refractory alloys- Superalloys- Shape memory alloys- high entropy alloys- Bulk Metallic glasses- Basics of Inductively Coupled Plasma (ICP)- Optical Emission Spectrometry (OES) analytical technique for elemental analysis.

UNIT IV DEFORMATION AND FAILURE OF METALS 9

Elastic, anelastic and viscoelastic behaviour - Dislocation in FCC,BCC,HCP – stress field - interaction between dislocations -Strengthening mechanism- effect of temperature- deformation mechanism maps - cyclic loading - Types of Fracture – Fracture mechanics - fracture toughness ductile-brittle transition - types of wear - corrosion - Basics of Scanning electron microscope (SEM)- Energy Dispersive Spectroscopy (EDS)- Failure analysis

UNIT V TESTING OF MATERIALS 9

Testing of materials under tension, compression and shear- Fatigue -effect of metallurgical and design factors- low cyclic and high cyclic fatigue - NDE Technologies for Fatigue Crack Detection - Creep-Stress Rupture test - Predication of long time properties- creep-fatigue interaction- Wear Testing- Corrosion Testing -ASTM standard- Basics of X – Ray diffraction(XRD) techniques – determination of phases - crystal structure -lattice parameters and residual stress measurement .

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Identify the microstructural features of ferrous materials..
CO2: Relate the heat treatment, microstructure and properties.
CO3: Understand the properties and uses of nonferrous alloys.
CO4: Correlate the mechanical behavior with the mechanisms of strengthening.
CO5: Suggest suitable polymer and ceramic for a given application.

TEXT BOOKS:

1. Donald R. Askeland, Pradeep P. Fulay and Wendelin J. Wright, “The Science and Engineering of Materials”, 6th Edition, Cengage Learning, Inc. 2010.
2. Kenneth G.Budinski and Michael K.Budinski ,”Engineering Materials”, 9th Indian Reprint, Prentice-Hall of India Private Limited, 2009.

REFERENCES:

1. Sidney H. Avner, "Introduction to Physical Metallurgy", McGraw Hill Book Company, 2nd Edition, 2008.
2. Raghavan V., "Materials Science and Engg: A first Course", 6th Edition, Prentice Hall of India Pvt Ltd., 5th edition, 2004.
3. Dieter. G.E., "Mechanical Metallurgy", McGraw-Hill, 5th Edition, 2012.
4. Culity B.D., Stock S.R. and Stock S., "Elements of X-ray diffraction", PHI, 4th edition, 2005
5. Yang Leng, "Materials Characterization: Introduction to Microscopic and Spectroscopic Methods", John Wiley and Sons,2nd edition, 2013.

PR7301 METALLURGY AND MATERIALS TESTING																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Identify the microstructural features of ferrous materials.	2	2	2	1	2	1	2	-	1	1	1	2	1	2	1
CO2	Relate the heat treatment, microstructure and properties.	3	2	2	2	2	2	2	1	1	1	2	2	1	2	1
CO3	Understand the properties and uses of nonferrous alloys.	2	3	2	2	3	2	1	2	2	1	1	2	2	2	1
CO4	Correlate the mechanical behavior with the mechanisms of strengthening.	3	3	1	2	2	2	1	1	1	1	1	2	1	2	1
CO5	Suggest suitable polymer and ceramic for a given application.	2	3	3	1	1	2	2	1	1	1	1	1	2	1	1
PO & PSO (Average)		2.4	2.6	2.0	1.6	2.0	1.8	1.6	1.3	1.2	1.0	1.2	1.8	1.4	1.8	1.0

EI7313 ELECTRICAL, ELECTRONICS AND CONTROL SYSTEMS LABORATORY

L T P C
0 0 4 2

COURSE OBJECTIVES:

- Exposed to important characteristics of electrical machines.
- Will be in a position to design oscillators, signal generators using operational amplifiers.
- Able to handle measuring instruments for measuring electrical parameters.

LIST OF EXPERIMENTS

1. Load test on single phase transformer.
2. Load test on D.C Shunt motor.
3. Load test on generator.
4. Load test on three phase Induction motor.
5. Speed control of DC Shunt motor.
6. Verification of Ohm's law and Kirchhoff's laws.
7. Construction of Amplifier using Operational amplifiers.
8. Construction of Sinusoidal oscillators using Operational amplifiers.
9. Construction of Square wave generators using Operational amplifiers.
10. Realization of logic gates circuits.
11. Measurement of various electrical parameters using C .R.O.
12. Experiments with virtual instruments.

TOTAL: 60 PERIODS

OUTCOMES:

- Able to obtain and analyze the characteristics of electrical machines
- Ability to design and analyze electronic circuits using operational amplifiers
- Able to understand the basic of logic gates.
- Will be in a position to select proper measuring instruments for basic electrical and electronics applications.

EI 7313 ELECTRICAL, ELECTRONICS AND CONTROL SYSTEMS LABORATORY																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Analyzing the characteristis of electrical machines	3	3	3	-	3	-	-	-	2	2	-	-	2	3	3
CO2	Applying and Analyze electronic circuits using operational amplifier	2	2	2	-	2	-	-	-	2	2	-	-	2	3	3
CO3	Applying measuring instruments for basic electrical circuits , Applying and Analyze of basic logic gates, electronics applications.	3	3	3	-	3	-	-	-	2	2	-	-	2	3	3
PO & PSO (Average)		2.7	2.7	2.7	-	2.7	-	-	-	2	2	-	-	2.0	3.0	3.0

PR7311 METALLURGY AND MATERIALS TESTING LABORATORY

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

- To study the testing methods and quantifying techniques for the mechanical properties of engineering materials.
- To study the property changes by various heat treatment.
- To gain practical knowledge in Microstructural analysis of various steels, Cast iron, Non ferrous Materials and Heat Treated steels.

LIST OF EXPERIMENTS

1. Cooling curve- Pure metal and alloy (Pb-Sn).
2. Specimen preparation for macro – examination.
3. Specimen preparation for micro examination (steel/cast iron/non-ferrous alloys).
4. Quantitative metallography – Estimation of volume fraction, particle size, shape and distribution.
5. Heat treatments of Steel-Micro structural study: Annealing/ Normalising / Quench Hardening/ Tempering.
6. Jominy End Quench Test.
7. Tension test of mild steel.
8. Torsion test of mild steel.
9. Impact test- Izod and Charpy.
10. Hardness test – Vickers /Brinell.
11. Compression test for Helical spring.
12. Fatigue test
13. Creep test.
14. Pin on Disc Wear test.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

CO1: Awareness of procedure and methods of testing materials for evaluation of mechanical properties.

CO2: Experience in metallographic techniques and familiarization of microstructure of typical ferrous and non ferrous alloys.

CO3: Ability to interpret the experimental results in relation with the applications.

PR7311 METALLURGY AND MATERIALS TESTING LABORATORY																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Identify the microstructural features of ferrous materials.	3	-	2	-	3	-	-	-	3	-	-	2	1	-	1
CO2	Relate the heat treatment, microstructure and properties.	-	3	-	3	-	-	2	2	1	-	-	-	1	-	1
CO3	Understand the properties and uses of nonferrous alloys.	3	3	-	2	-	3	-	-	-	3	-	-	2	-	1
PO & PSO (Average)		2.4	2.6	2.0	1.6	2.0	1.8	1.6	1.3	1.2	1.0	1.2	1.8	1.4	1.8	1.0

GE7251	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

To the study of nature and the facts about environment.

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

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 – biogeographical 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 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 – consumerism and waste products – environment production 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

OUTCOMES:

Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.

- Public awareness of environment at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions.
- Development and improvement in standard of living has lead to serious environmental disasters.

TEXT BOOKS:

1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education 2004.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.

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.

PR7401 FOUNDRY AND WELDING TECHNOLOGY L T P C
3 0 0 3

COURSE OBJECTIVES:

- To impart knowledge about principles/methods of casting with detail design of gating/riser system needed for casting, defects in cast objects and requirements for achieving better casting.
- To understand the basic principle, procedure and applications of various Foundry and Welding methods.
- To inculcate the principle, thermal and metallurgical aspects during solidification of metal and alloys.
- To study SMAW, GMAW, GTAW, Oxy-acetylene welding and resistance spot welding processes
- To have a broad knowledge to design a casting and welding process and metallurgical and weld-ability aspects of different common engineering materials.

UNIT I CASTING PROCESSES 9

Introduction to casting – pattern – materials allowances – coding – types – moulds – mould making, sand – properties, types and testing of sands – core making – type of cores – single box, two box and three box moulding processes, runner, riser and gate and chills chaplets..

UNIT II SPECIAL CASTING PROCESSES 9

Pressure die casting – Centrifugal – continuous – investment – shell moulding – squeeze – electro slag casting – CO_2 moulding – Plaster Mould castings – Antioch process – Slush casting- Counter gravity low pressure casting - electro-magnetic casting.

UNIT III METAL JOINING PROCESSES 9

Introduction to soldering, brazing and welding Types of joints – plane of welding – edge preparation – filler material – flux – shielding gases – fusion welding – gas welding – flame types – Manual arc welding – arc theory – power supply – braze welding – Thermit welding – Resistance welding – spot, seam, projection, percussion and flash.

UNIT IV SPECIAL WELDING PROCESSES 9

Shielded Metal Arc welding, Gas Metal Arc Welding-Gas Tungsten Arc Welding – Submerged arc welding – Flux Cored Arc Welding – Electro slag welding – friction welding – explosive welding – Underwater welding – Diffusion bonding – EBW – LBW – PAW – Stud welding – welding of dissimilar materials – Friction stir welding – High frequency induction welding.

UNIT V TESTING OF CASTINGS AND WELDMENTS 9

Causes and remedies for casting defects – welding defects – Destructive testing – Non Destructive Testing (NDT) methods– Testing: Dye penetrant – magnetic particle – X-ray - Radiography - ultrasonic - Case studies in testing of welded joints and castings.

TOTAL:45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the process of Pattern making, Moulding and core making

CO2: Analyze the thermal, metallurgical aspects during solidification in casting and welding and their role on quality of cast or weld objects

CO3: Analyze the welding process behavior for common and newer welding techniques

CO4: Have generalized knowledge on various welding technology used in manufacturing.

CO5: Design the gating and riser system needed for casting and requirements to achieve defect free casting.

PR 7401 FOUNDRY AND WELDING TECHNOLOGY																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Identify the microstructural features of ferrous materials.	3	2	3									1	2		1
CO2	Relate the heat treatment, microstructure and properties.	3	2	3									1	2		1
CO3	Understand the properties and uses of nonferrous alloys.	3	2	2									1	2		1
CO4	Correlate the mechanical behavior with the mechanisms of strengthening.	3	2	2									1	2		1
CO5	Suggest suitable polymer and ceramic for a given application.	3	3	2									1	2		1
PO & PSO (Average)		3.0	3.0	2.0	-	-	-	-	-	-	-		2.0	2.0	-	1.0

TEXT BOOK:

1. Jain .P.L., "Principle of Foundry Technology" , Tata McGraw Hill ,4th edition, 2004.
2. Parmer .R.S , "Welding Engineering and Technology", Khanna Publishers , 2004.

REFERENCES:

1. Curry .B. , "Modern Welding Technology" , Prentice Hall ,2008.
2. Taylor HF Fleming, "Foundry Engineering", M.C. and Wiley Eastern Ltd., 2003.
3. Little, "Welding Technology", Tata McGraw Hill, 2008.
4. Heime, Looper and Rosenthal , "Principle of metal casting" , Tata McGraw Hill, 2nd edition 2002.

PR7402 METAL CUTTING AND CNC TECHNOLOGY L T P C
3 0 0 3

COURSE OBJECTIVES:

The main objectives of this course are to prepare the students

- To familiarize with the principles of mechanics of metal cutting
- To learn about the thermal aspects of machining and the usage of cutting fluids
- To attain knowledge about the various gear cutting methods
- To understand the concepts of CNC machine and its construction
- To impart the knowledge in CNC programming

UNIT I TOOL MATERIAL, TOOL WEAR AND TOOL LIFE 9

Tool materials – Properties – Types - Selection of tool materials - Machinability – types of chips – cutting fluids – Types - Tool wear – Types – Mechanisms of tool wear **-** Tool life – Illustrative Problems.

UNIT II MECHANICS OF METAL CUTTING 9

Tool Nomenclature - Single point and multi point cutting tools – Orthogonal cutting and oblique cutting – Chip thickness ratio - Merchant circle diagram – Force relationships - shear angle - shear stress - shear strain – velocity relationships – Illustrative Problems – Force Measurement - Dynamometers – Thermal aspects of machining - Temperature measurement.

UNIT III GEAR MANUFACTURING 9

Methods of gear manufacture – Gear Generation Methods; Gear shaping - gear planning - gear hobbing – kinematics - Bevel gear generation – Gear finishing methods – burnishing - shaving – grinding - lapping and gear honing.

UNIT IV CNC MACHINES 9

Overview of NC, CNC and DNC – Types of CNC machines – Constructional features of CNC machines - Work and Tool holding devices - feedback devices – Tooling of CNC Machines – Machining center – Turning center – Turn mill center.

UNIT V CNC PROGRAMMING 9

Manual part programming – sample programs for lathe and milling – Canned cycles - Computer aided part programming - CAM packages.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Apply the principles of metal cutting theory
CO2: Employ the various aspects of mechanics of metal cutting in manufacturing activities
CO3: Employ the most suitable gear cutting operation for the given application

CO4: Understand the working principle of CNC machine and its construction
CO5: Write the CNC program for given components

TEXT BOOKS:

1. Juneja.B.L., Sekhon.G.S., Niting Seth, “Fundamentals of Metal Cutting and Machine Tools”, New Age International Publishers, 2007.
2. Jonathan Lin. S.C., “Computer Numerical Control from Programming to Networking”, Delmar Publishers, 3rd edition 2009.

REFERENCES:

1. Groover, M.P., "Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall, 2006.
2. Thyer. G.E., “Computer Numerical Control of Machine Tools”, BH, Newners, 2007.
3. Hajra Choudhury C.J., “Elements of Workshop Technology”, Vol.I and Vol.II, Asia Publishing House, 2009.
4. Nagpal G.R., “Machine Tool Engineering”, Khanna Publishers, 2011.
5. Geoffrey Boothroyd, Winston A. Knight , “Fundamentals of Machining and Machine Tools” 2015.

PR7402 METAL CUTTING AND CNC TECHNOLOGY																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Apply the principles of metal cutting theory.	3	3	3	2	2		3	2	3		3	3	3	3	2
CO2	Employ the various aspects of mechanics of metal cutting in manufacturing activities.	3	3	3	2	2		3	2	3		3	3	3	3	2
CO3	Employ the most suitable gear cutting operation for the given application.	3	3	3	2	2		3	2	3		3	3	3	3	2
CO4	Understand the working principle of CNC machine and its construction	3	3	3	2	2		3	2	3		3	3	3	3	2
CO5	Write the CNC program for given components.	3	3	3	2	2		3	2	3		3	3	3	3	2
PO & PSO (Average)		3.0	3.0	3.0	2.0	2.0	-	3.0	2.0	3.0	-	3.0	3.0	3.0	2.0	2.0

PR7403 METAL FORMING PROCESSES L T P C
3 0 0 3

COURSE OBJECTIVE:

- Students will gain knowledge on the mechanism involved in plastic deformation and parameter representation.
- Students will read and understand various bulk forming process and its recent technology.
- Student will have a knowledge on various sheet metal forming process
- Students will study the powder metallurgy techniques and Special metal forming processes.
- Student will understand the significance of heat treatment based on the application.

UNIT I FUNDAMENTALS OF METAL FORMING 9

State of stress – Components of stress, symmetry of stress tensor, principle stresses – Stress deviator – Von-Mises, Tresca yield criteria – Octahedral shear stress and shear strain theory – Flow stress determination – Temperature in metal forming – Hot, cold and warm working – strain rate effects – metallurgical structures – residual stresses – Spring back.

UNIT II FORGING AND ROLLING 9

Principle – classification – equipment – tooling – processes parameters and calculation of forces during forging and rolling processes – Ring compression test – Post forming heat treatment – defects causes and remedies – applications – Roll forming.

UNIT III EXTRUSION AND DRAWING PROCESSES 9

Classification of extrusion processes – tool, equipment and principle of these processes – influence of friction – extrusion force calculation – defects, causes and remedies – Rod / Wire drawing – tool, equipment and principle – defects – Tube drawing and sinking processes – Mannessmann process of seamless pipe manufacturing – Tube bending.

UNIT IV SHEET METAL FORMING PROCESSES 9

Classification – conventional and High Energy Rate Forming processes – presses – types and selection of presses – formability studies – Formability Limit Diagram, Limiting Draw ratio – processes: Deep drawing, spinning, stretch forming, plate bending, Rubber pad forming, bulging and press brake forming – Explosive forming, electro hydraulic forming, Magnetic pulse forming and Super plastic forming.

UNIT V POWDER FORGING AND RECENT ADVANCES 9

Metal Powder and fabrication procedures, Applications, Preparation of powders, Compaction and sintering, Yield criteria and flow rules, Hot and cold pressing – Electro forming – fine blanking – Hydro forming – Peen forming – Laser Forming – Micro forming – Isothermal forging – high speed for forging and extrusion near net shape forming – Ultra fine grained materials by severe plastic deformation CAD and CAM in forming.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Represent the state of stress in metal forming process.
CO2: Identify the appropriate bulk forming process based on the application.
CO3: Understand the conventional sheet metal forming process and grasp the significance of various high energy rate forming techniques.
CO4: Really understand the powder metallurgy technique.
CO5: Select appropriate surface heat treatment technique based on the application

TEXT BOOKS:

1. Dieter G.E., “Mechanical Metallurgy”, McGraw Hill, Co., S.I. 5th Edition, 2012.
2. Nagpal G.R. ,”Metal forming processes”, Khanna Publishers, New Delhi, 2nd edition 2009.

REFERENCES:

1. Serope Kalpakjian, Steven R Schmid, “Manufacturing Process for Engineering Materials”, Pearson Education, 7th Edition, 2007.
2. Rao, P.N., “Manufacturing Technology”, TMH Ltd., 3rd edition, 2014.
3. Edward M. Mielink, “Metal working science engineering”, McGraw Hill, Inc, 2007
4. Metal Hand book Vol 14, “Forming and Forging”, Metal Park, Ohio, USA, 2006.

PR7403 METAL FORMING PROCESSES																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Represent the state of stress in metal forming process	3	3	2	3	3	1		1				3		1	1
CO2	Identify the appropriate bulk forming process based on the application..	2	3	1	2	3	1		1				3		1	1
CO3	Understand the conventional sheet metal forming process and grasp the significance of various high energy rate forming techniques.	2	3	2	3	2	2		2				3		2	1
CO4	Really understand the powder metallurgy technique.	2	3	2	1	1	1		1				3		1	1
CO5	Select appropriate surface heat treatment technique based on the application	3	3	2	1	1	1		1				3		2	1
PO & PSO (Average)		3.0	3.0	2.0	2.0	2.0	1.0	-	1.0	-	-	-	3.0	-	2.0	1.0

PR7451 KINEMATICS AND DYNAMICS OF MACHINES

L	T	P	C
4	0	0	4

COURSE OBJECTIVES:

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

- To impart knowledge on various types of mechanisms and synthesis.
- To impart skills and analyze the position, velocity and acceleration of mechanisms.
- To understand the effects of friction in motion in transmission and machine components.
- To familiarize higher pairs like cams and gears.
- To study the undesirable effects of unbalances resulting from prescribed motions in mechanisms.

UNIT I MECHANISMS **12**

Definition – Machine and Structure – Kinematic link, pair and chain – classification of Kinematic pairs – Constraint and motion – Degrees of freedom - Slider crank – single and double – Crank rocker mechanisms – Inversions, applications – Introduction to Kinematic analysis and synthesis of simple mechanisms – Determination of velocity and acceleration of simple mechanisms.

UNIT II FRICTION **12**

Types of friction – friction in screw and nut – screw jack – pivot, collar and thrust bearings – plate and cone clutch – belt (Flat and V) and rope drives – creep in belts – open and crossed belt drives – Ratio of tensions – Effect of centrifugal and initial tensions – condition for maximum power transmission.

UNIT III GEARS AND CAMS **12**

Gear – Types and profile – nomenclature of spur and helical gears – laws of gearing – interference – requirement of minimum number of teeth in gears – gear trains – simple, compound and reverted gear trains – determination of speed and torque in epicyclic gear trains – cams different types of followers – Cam – Types of cams and followers – Cam design for different follower motions.

UNIT IV VIBRATION **12**

Free, forced and damped vibrations of single degree of freedom systems – force transmitted to supports – vibration Isolation – vibration absorption – torsional vibration of shafts – single and multirotor systems – geared shafts – critical speed of shafts.

UNIT V BALANCING **12**

Static and dynamic balancing – single and several masses in different planes – primary and secondary balancing of reciprocating masses – Balancing of single and multi cylinder engines – Governors and Gyroscopic effects.

TOTAL:60 PERIODS

COURSE OUTCOMES:

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

CO1: Apply the kinematics and dynamics of machinery in design and analysis of engineering problems.
CO2: Demonstrate the ability to synthesize and analysis mechanisms.
CO3: Determine the parameters of gears and gear trains and cam profile analysis.
CO4: Examine the effect of vibration under the conditions of free, forced and damped
CO5: Balance the rotating and reciprocating parts in the machines, to control the speed variation using governors and to study the effect of gyroscopic couple in automobiles.

TEXT BOOKS:

1. Bansal R.K., “Theory of Machines”, Laxmi Publications Pvt Ltd., New Delhi, 20th edition 2009.
2. Rattan S.S., “Theory of machines”, Tata McGraw Hill publishing Co., New Delhi, 2nd edition 2011.

REFERENCES:

1. Rao J.S. and Dukkipati R.V., “Mechanism and Machine Theory”, Second Edition, Wiley Eastern Limited, 2006.
2. Malhotra D.R. and Gupta H.C , “The Theory of machines”, Satya Prakasam, Tech. India Publications, 2008.
3. Gosh A and Mallick A.K., “Theory of Machines and Mechanisms”, Affiliated East West press, 2009.
4. Shigley J.E. and Uicker J.J., “Theory of Machines and Mechanisms”, McGraw Hill, 2006.

PR7451 KINEMATICS AND DYNAMICS OF MACHINES																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Apply the kinematics and dynamics of machinery in design and analysis of engineering problems.	3	3	2	3	3	-	1	-	3	-	2	3	2	3	3
CO2	Demonstrate the ability to synthesize and analysis mechanisms	3	3	1	2	3	-	1	-	3	-	2	3	2	1	1
CO3	Determine the parameters of gears and gear trains and cam profile analysis.	3	3	2	3	3	-	1	-	3	-	2	3	2	3	1
CO4	Examine the effect of vibration under the conditions of free, forced and damped	3	3	2	1	1	-	1	-	3	-	2	3	2	1	1
CO5	Balance the rotating and reciprocating parts in the machines, to control the speed variation using governors and to study the effect of gyroscopic couple in automobiles	3	3	2	1	1	-	1	-	3	-	2	3	2	2	1
PO & PSO (Average)		3.0	3.0	1.8	2.0	2.2	-	1.0	-	3.0	-	2.0	3.0	2.0	2.0	1.4

PR7452 QUANTITATIVE TECHNIQUES IN MANAGEMENT L T P C
4 0 0 4

COURSE OBJECTIVES:

- To familiarize the students with concepts of Linear Programming so that they can be used in industry.
- To introduce the replacement models to students so that optimal replacement policy on machine can be made.
- To enable the students to utilize the queuing models for application to waiting line problems.
- To stress on importance on forecasting and sequencing models and their use in industry.
- To familiarize project network and decision tree problems to students so that they can use them in project management.

UNIT I LINEAR PROGRAMMING 12

Problem formulation - Graphical method – simplex method – Special cases – transportation and assignment method – applications**.**

UNIT II REPLACEMENT MODELS AND GAME THEORY 12

Basic replacement model – individual and group replacement problems – applications – game theory – terminology – decision criteria – solution to a 2 x 2 and 2 x n games – applications of LP in game theory – applications.

UNIT III QUEUING MODELS AND SIMULATION 12

Elements of queue – queue discipline – Poisson arrival and exponential service – queue length – waiting time – steady state conditions – applications – concept of simulation – Monte Carlo method – applications.

UNIT IV FORECASTING, SEQUENCING AND LINE BALANCING 12

Forecasting – purpose – methods – measures of forecast error; scheduling – priority rules - sequencing – methods of sequencing – Johnson's rule – Heuristic approach, line balancing – applications.

UNIT V PROJECT NETWORK ANALYSIS AND DECISION TREE ANALYSIS 12

Network – CPM/PERT – Project time estimation – critical path – crashing of network, Decision tree analysis – applications

TOTAL: 60 PERIODS

COURSE OUTCOMES:

To students will be able to

CO1: Use the simplex method to solve problems in industry
CO2: Identify a suitable replacement model so that replacement of equipment can be done optimally
CO3: Utilize the knowledge on queuing models for banking industry
CO4: Identify forecasting model for a specific industry
CO5: Identify a suitable project network technique for project management

TEXT BOOKS:

1. Panneerselvam R., "Operation Research", Prentice Hall of India, 2008.
2. Hamdy A.Taha, "Operations Research – An Introduction", Prentice Hall of India, 8th edition 2008.

REFERENCES:

1. Guptha. P.K. and Man-Mohan, "Problems in Operations Research", Sultan chand and Sons, 2014.
2. Monks. J.G, "Operations Management theory and Practice", McGraw Hill, 2nd edition 1996.

3. Ravindran, Philips and Sojberg, “Operations Research Principles and Practice”, John Wiley and Sons, Singapore, 2nd edition,2007.
4. Sharma J.K., “Operations Research Theory and Applications”, Macmillan India Ltd., 4th edition, 2009.

PR7452 QUANTITATIVE TECHNIQUES IN MANAGEMENT																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Use the simplex method to solve problems in industry	3		2					2			1	2	2	2	
CO2	Identify a suitable replacement model so that replacement of equipment can be done optimally	3			2								2	1	2	2
CO3	Utilize the knowledge on queuing models for banking industry	3							3				2		2	
CO4	Identify forecasting model for a specific industry	3		3									2	2	2	
CO5	Identify a suitable project network technique for project management	3			3				2			1	2		2	
PO & PSO (Average)		3.0	-	2.5	3.0	-	-	-	2.5	-	-	1.0	2.0	1.7	2.0	2.0

PR7411 METAL CUTTING AND CNC 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:

- Selecting appropriate machining process, equipment and cutting tool to machine a given job.
- Perform various secondary and finishing machining processes.
- Select the appropriate process parameters for a given machining process.
- Manufacture gears using different processes
- Write CNC milling and turning part programmes for a given component

LIST OF EXPERIMENTS

1. Tool life study on a single point turning tool.
2. Measurement of cutting forces in turning using lathe tool dynamometer.
3. Acceptance test on RAM type milling machine as per ISI test chart and Measurement of tool angles.
4. Temperature measurement in machining.
5. Spur Gear generation using gear shaper.
6. Programming and machining of step turning and taper turning operation in CNC Lathe.
7. Programming and machining of thread cutting and grooving operation in CNC Lathe.
8. Programming and simulation for canned cycle in CNC lathe.
   (i) Stock removing in facing cycle.
   (ii) Stock removing in turning cycle.
   (iii) Grooving cycle.
   (iv) Thread cutting cycle.
9. Programming for milling operations in a CNC milling simulation.
10. Programming for mirroring / scaling function / Pocket milling and drilling cycle in a CNC milling.
11. Programming for spur gear cutting operation and Programming for hexagonal cutting operation.
12. Programming and Simulation in CNC Router.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Use various machining processes to manufacture a given component
CO2: Select the suitable machine tool and cutting tool for a given workpiece
CO3: Decide the appropriate process parameter for a given machining application

PR7411 METAL CUTTING AND CNC LABORATORY																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Use various machining processes to manufacture a given component	3	3	2		3		3		2		3	2	3	3	2
CO2	Select the suitable machine tool and cutting tool for a given workpiece	3	3	2		3		3		2		3	2	3	3	2

CO3	Decide the appropriate process parameter for a given machining application	3	3	2		3		3		2		3	2	3	3	2
PO & PSO (Average)		3.0	3.0	2.0	-	3.0	-	3.0	-	2.0	-	3.0	2.0	3.0	3.0	2.0

PR7412 METAL FORMING, FOUNDRY AND WELDING LABORATORY **L T P C**
0 0 4 2

COURSE OBJECTIVES:

- To train the students in the area of non-ferrous metal casting with the simple shapes.
- To train the students to make the simple joints by various welding techniques.
- To study the basic requirements of given moulding sand by standard tests. To train the students for various heat treatment processes.

LIST OF EXPERIMENTS:

METAL FORMING LABORATORY

1. Construction Flow Stress – Strain curve.
2. Erichsen cupping Test.
3. Determination of interface friction factor using ring compression test.
4. Construction of FLD of a sheet metal.
5. Water hammer forming.
6. Determination of Power consumption in sheet rolling process and wire drawing process.
7. Determination of strain rate sensitivity index of given specimen.
8. Superplastic forming studies on Pb-Sn alloys.
9. Deep drawing.
10. Forward Extrusion process.
11. Micro-forming.
12. Simulation studies on metal forming.

WELDING

1. Welding of basic joints using gas and arc welding.
2. Welding of pipes in different positions.
3. GTAW / GMAW of ferrous and non - ferrous metals.
4. Spot welding of plates.
5. Brazing practice – Dissimilar metals.
6. Welding of standard grill structures.

FOUNDRY

1. Green and Dry Strength of Moulding sand.
2. Permeability testing.
3. Determining the clay content.
4. Sieve analysis of dry silica sand.
5. Determining the moisture content.
6. Melting any non-ferrous metal and making simple castings – Demonstration.

TOTAL:60 PERIODS

COURSE OUTCOMES:

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

CO1: The students would gain practical knowledge on Metal forming, Welding and Foundry

CO2: Understand the casting procedure of different methods. Find the quality of moulding sand

CO3: Understand the concept of phase diagrams and metallographic techniques

PR7412 METAL FORMING, FOUNDRY AND WELDING LABORATORY																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	The students would gain practical knowledge on Metal forming, Welding and Foundry	3	3		3	3			1			2	3	3	1	1
CO2	Understand the casting procedure of different methods. Find the quality of moulding sand	2	3		2	3			1			1	3	2	1	1
CO3	Understand the concept of phase diagrams and metallographic techniques	2	3		3	2			2			2	3	2	2	1
PO & PSO (Average)		2.3	3.0	-	2.7	2.7	-	-	1.3	-	-	1.7	3.0	2.3	1.3	1.0

PR7501 ENGINEERING METROLOGY L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the concept of engineering metrology.
- To familiarize the metrology instruments used for linear and angular measurements.
- To learn about the surface texture and measuring instruments
- To learn about the metrology of screw threads and gears
- To introduce the concepts of Laser and computer applications in metrology.

UNIT I FUNDAMENTALS OF MEASUREMENT 9

Definition of Engineering metrology – Line, end and wave length standards of measurement – Errors in measurements – Limits, fits, tolerance and guage design – Inter changeability and selective assembly – Accuracy, precision and Calibration of instruments – Light interference and interferometry – Measurement of absolute length using interferometers.

UNIT II LINEAR AND ANGULAR MEASURING SYSTEMS 9

Linear and Angular measuring systems. Slip gauges, micrometers, verniers, dial gauges and surface plates – Concept of comparators mechanical, electrical, optical and pneumatic comparators – Angular measuring systems – angle gauges – Sine bar – Precision spirit level, Auto collimators – Angle dekkor – Clinometers – Straightness and flatness measurement using precision level and auto collimators.

UNIT III MEASUREMENT OF SURFACE TEXTURE AND MEASURING INSTRUMENTS 9

Surface texture – Definitions – types of surface texture – surface texture measurement methods Comparison – Profilometer – Surface texture measuring instruments – Measurement of run-out and concentricity straightness, flatness and alignment errors – Tool makers microscope – Optical and Laser Alignment telescope – Metroscope.

UNIT IV METROLOGY OF SCREW THREADS AND GEARS 9

Metrology of screw threads and gears Internal and external screw threads – terminology - measurement of various elements of screw threads – thread micrometer two wire and three wire - methods, gear terminology measurement of various elements of gears pitch circle method, constant chord method, base tangent method – plug method – Rolling gear tester.

UNIT V LASER METROLOGY AND COMPUTER AIDED METROLOGY 9

Co-ordinate measuring machines – Probe sensors – Errors – Environmental factors – Laser micrometer Laser interferometer – Testing of geometric features of machine tools using laser interferometer – non contact and in-process inspection using laser – machine tool metrology – vision systems – Atomic force microscope - Scanning tunneling microscope.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the principles of Engineering Metrology.

CO2: Identify appropriate metrology equipment for measuring linear and angular measurements.

CO3: Apply the suitable equipment to measure the surface textures

CO4: Identify appropriate methodology to measure the parameters of screw threads and gears

CO5: Employ the advanced metrology equipment

TEXT BOOKS:

1. Jain.R.K., “Engineering Metrology”, Khanna Publishers, 20th edition, 2009.
2. Rajput R.K., “Engineering Metrology and Instrumentation”, Kataria and Sons Publishers, 2013.

REFERENCES:

1. Gupta.I.C., “A text book of Engineering Metrology”, Dhanpat Rai and Sons, 7th edition 2012.
2. Gayler G.N. and Shotbolt C.R., “Metrology for Engineers”, ELBS 2000.
3. “ASTE Hand book of Industrial Metrology”, Prentice Hall of India Limited 2002.

PR7501 ENGINEERING METROLOGY																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Understand the principles of Engineering Metrology.	3	2	3	2	3	2	2	-	2	2	2	2	3	2	2
CO2	Identify appropriate metrology equipment for measuring linear and angular measurements.	2	3	3	2	3	2	2	-	2	2	2	2	3	2	2
CO3	Apply the suitable equipment to	2	2	2	2	3	2	2	-	2	2	2	3	3	2	2

	measure the surface textures															
CO4	Identify appropriate methodology to measure the parameters of screw threads and gears	2	3	3	2	3	2	2	-	3	2	2	3	3	2	2
CO5	Employ the advanced metrology equipment	3	3	3	2	3	2	2	-	2	2	2	3	3	2	2
PO & PSO (Average)		2.4	2.6	2.8	2.0	3.0	2.0	2.0	-	2.2	2.0	2.0	2.6	3.0	2.0	2.0

PR7502 FLUID POWER SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the basic principles of fluid power.
- Know the different properties of hydraulic fluids and their effects
- Explain the working principles of various pumps
- To understand the working principle of hydraulic and pneumatic components and its selection.
- To design hydraulic and pneumatic circuits for different applications.

UNIT I BASICS OF FLUID POWER 9

Introduction to fluid power controls – Hydraulics and pneumatics – Selection criteria, Application of Fluid power, Application of Pascal's Law, Transmission and multiplication of force – Pressure Losses – Fluids, selection and properties – Gas laws- properties of air with pressure and temperature - ISO symbols.

UNIT II FLUID POWER SOURCES 9

Fluid Power drives – Pumps – working principle and construction details of Gear, vane and piston pumps, Hydraulic motors, Hydrostatic transmission drives and characteristics, Hydraulic supply components Pneumatic power supply – compressors, air distribution, air motors.

UNIT III FLUID POWER ACTUATORS AND ELEMENTS 9

Control valves – pressure, flow, direction - working principle and construction – Special type - valves – Cartridge, modular, proportional, and servo – Selection and actuation methods.
Actuators – Selection and specification, cylinders, mounting, cushioning, pipe fittings – Fluid conditioning elements – Accumulators- Intensifier.

UNIT IV HYDRAULIC AND PNEUMATIC CIRCUITS DESIGN 9

Regenerative, speed control, synchronizing circuits -Design of Hydraulic and pneumatic circuits for automation, selection and specification of circuit components, sequencing circuits, cascade, and Karnaugh – Veitch map method – Circuits for industrial application - grinding, milling, shaping, press, material handling, etc

UNIT V ELECTRO PNEUMATICS AND PLC CIRCUITS 9

Moving part logic circuits - Use of electrical timers, switches, solenoid, relays, proximity sensors etc. electro pneumatics sequencing Ladder diagram – PLC – elements, functions and selection – PLC programming– Ladder and different programming methods - Sequencing circuits.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

CO1: Acquire the knowledge on principles and applications of fluid power.

CO2: Acquire knowledge on working principle of pump, actuators, control elements of fluid power system

CO3: Understand the principles of accumulators and circuits.

CO4: Design circuit for typical applications like material handling, press, shaping, milling, grinding.

CO5: Design electro pneumatics and PLC Circuits.

TEXT BOOKS:

1. Anthony Esposito, "Fluid power with applications", Pearson education, 7th edition, 2014.
2. Srinivasan R, "Hydraulics and Pneumatic Controls", Vijay Nicole Imprints, 2nd edition, 2008.

REFERENCES:

1. William W.Reaves, "Technology of Fluid Power", Delmer Publishers, 2007.
2. Peter Rohner, "Fluid Power Logic circuit Design", Macmillan Press Ltd., 2000.
3. Andrew Parr, "Hydraulics and Pneumatics", Jaico Publishing House,3rd edition, 2011.
4. Majumdar, "Oil hydraulics: Principles and Maintenance", Tata McGraw Hill,13th edition, 2006.
5. Majumdar, "Pneumatic system: Principles and Maintenance", Tata McGraw Hill, 7th edition 2008.
6. Jagadeesha T, "Pneumatics:Concepts, Design and Applications", University Press, 2015

PR7502 -FLUID POWER SYSTEMS																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Exemplify the principles, functions and working of fluid power systems.	3	2	2	1	2	1	1	1	1	3	2	2	2	3	3
CO2	Use the pump, actuators, and control elements in the fluid power system.	3	3	2	2	2	1	1	1	1	2	2	2	3	3	2
CO3	Integrate the pump, actuators, and other control elements for automation	3	2	2	2	2	1	1	1	1	1	2	2	2	3	2
CO4	Design circuit for typical applications like material handling, press, shaping, milling, grinding.	3	2	3	2	3	1	1	1	2	3	3	3	3	3	3
CO5	Construct fluid power circuits including electro pneumatics and PLC Circuits for automation	3	2	3	2	3	1	1	1	1	3	3	3	3	3	3
PO & PSO (Average)		3.0	2.2	2.4	1.8	2.4	1.0	1.0	1.0	1.2	2.8	2.4	2.4	2.6	3.0	2.6

PR7503 MACHINE COMPONENTS DESIGN L T P C
4 0 0 4

COURSE OBJECTIVES:

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

1. To introduce the students to the fundamentals of machine design, material selection and to solve the basic design problems.
2. To introduce the design of bolts & joints and selection of keys.
3. To introduce the design of shafts, coupling & brakes.
4. To give information about design of gears and belt drives.
5. To provides knowledge on various springs and bearings.

UNIT I INTRODUCTION 12

Fundamentals of Machine Design-Engineering Design, Phases of Design, Design Consideration - Standards and Codes - Selection of Materials –Design against Static and Dynamic Load –Modes of Failure, Factor of Safety, Principal Stresses, Theories of Failure-Stress Concentration, Stress Concentration Factors, Variable Stress, Fatigue Failure, Endurance Limit, Design for Finite and Infinite Life, Soderberg and Goodman Criteria.

UNIT II JOINTS 12

Design of Bolts under Static Load, Design of Bolt with tightening / Initial Stress, Design of Bolts subjected to Fatigue – Keys -Types, Selection of Square and Flat Keys-Design of Riveted Joints and Welded Joints.

UNIT III SHAFTS, COUPLINGS AND BRAKES 12

Design of Shaft –Static and Varying Loads, Strength and Rigidity- Design of Coupling-Types, Flange, Muff and Flexible Rubber Bushed Coupling-Design of Brakes-Block and Band Brakes.

UNIT IV GEARS AND BELT DRIVES 12

Design of Spur, Helical, Bevel and Worm Gear drives- Design of Belt drives- Flat and V Belts.

UNIT V SPRINGS AND BEARINGS 12

Design of Helical Spring-Types, Materials, Static and Variable Loads- Design of Leaf Spring-Design of Journal Bearing -Antifriction Bearing-Types, Life of Bearing, Reliability Consideration, Selection of Ball and Roller Bearings.

TOTAL:60 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the fundamentals of Engineering design, Failure theories and solve the basic machine problems

CO2: Implement their ideas onto design bolts & joints and exposes them to selection of keys

CO3: Acquire knowledge on design of shafts, various types of couplings and brakes

CO4: Develop in-depth knowledge on design of different types of gears and belt drives.

CO5: Gain knowledge on design of various springs and bearings.

TEXT BOOKS:

1. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, 2015.
2. Prabhu. T.J., “Design of Machine Elements”, Kasthuri Publications, Chennai, 2003.

REFERENCES:

1. Joseph Edward Shigley, Charles R. Mischke, “Mechanical Engineering Design”, McGraw Hill, International Edition, 4th edition 2011.
2. Bhandari. V.B., “Design of Machine Elements”, Tata McGraw-Hill Publishing Company Limited, 3rd edition, 2010.

3. Robert L.Norton, “Machine Design – An Integrated Approach”, Prentice Hall International Edition, 5th edition, 2013.
4. Jalaludeen. S.Md., “Machine Design Vol - I & Vol - II”, Anuradha publications,2006.
5. “P.S.G.Design Data Hand Book”, PSG College of Tech Coimbatore.
6. Robert C. Juvinall and Kurt M Marshek , “Fundamentals of Machine Component Design”, Wiley India Pvt. Ltd., New Delhi, 3rd Edition, 2007.
7. Sharma. C.S. and Kamlesh Purohit, “Design of Machine Elements”, Prentice Hall of India Private Limited,1st edition, 2006

PR7503 MACHINE COMPONENTS DESIGN																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Understand the fundamentals of Engineering design, Failure theories and solve the basic machine problems	3	3	2	3	3	-	1	-	3	-	2	3	-	-	1
CO2	Implement their ideas onto design bolts & joints and exposes them to selection of keys	3	3	1	2	3	-	1	-	3	-	2	3	-	1	1
CO3	Acquire knowledge on design of shafts, various types of couplings and brakes	3	3	2	3	2	-	2	-	2	-	3	3	-	2	1
CO4	Develop in-depth knowledge on design of different types of gears and belt drives.	3	3	2	1	1	-	1	-	3	-	2	3	-	2	1
CO5	Gain knowledge on design of various springs and bearings.	3	3	2	1	1	-	1	-	2	-	2	3	-	2	1
PO & PSO (Average)		3.0	3.0	1.8	2.0	2.0	-	1.2	-	2.6	-	2.2	3.0	-	1.8	1.0

PR7551 STATISTICAL QUALITY CONTROL AND RELIABILITY ENGINEERING **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To impart the knowledge of the quality control, control charts and application and construction of various quality control charts and the selection.
- To impart the knowledge sampling plan types, characteristics and design procedure
- To study the significance of design of experiments and its application.
- To train the students in the field of reliability and its estimation.
- To introduce various distributions and its mathematical functions used in failure data analysis

UNIT I STATISTICAL PROCESS CONTROL 9

Quality control – Definition – Quality Assurance Variation in process – Factors – control charts – variables X_R and X_σ, - Attributes P, C and U-Chart Establishing and interpreting control charts process capability – Quality rating – Short run SPC.

UNIT II ACCEPTANCE SAMPLING 9

Lot by lot sampling types – probability of acceptance in single, double, multiple sampling plans – OC curves – Producer's risk and consumer's risk. AQL, LTPD, AOQ, AOQL, Concepts Design of sampling plan – single, double, multiple- standard sampling plans for AQL and LTPD – Use of standard sampling plans – Sequential sampling plan.

UNIT III EXPERIMENTAL DESIGN AND TAGUCHI METHOD 9

Fundamentals – fractional, factorial experiments – random design, Latin square design – Taguchi method –Quality Loss function – experiments – S/N ratio and performance measure – Orthogonal array.

UNIT IV RELIABILITY AND ITS PREDICTION 9

Life testing – Failure characteristics – Meantime to failure – maintainability and availability – reliability – system reliability – OC curves – reliability improvement techniques – Reliability testing techniques – Pareto analysis. MTBF, MTTF, MTTR – System reliability – OC curve Availability and Maintainability – Reliability Improvement techniques.

UNIT V FAILURE DATA ANALYSIS 9

Real time distribution, exponential,normal, log normal, gamma and weibull – reliability data requirements – Graphical evaluation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Able to create and interpret different statistical process control charts
CO2: Capacity to generate and compare various sampling plans
CO3: Able to apply design of experiments tool
CO4: Generate reliability testing plans and Evaluate reliability of a component or system
CO5: Select suitable distribution for reliability data analysis and integrate reliability concepts in new product design and development

TEXT BOOKS:

1. Amitava Mitra, "Fundamentals of Quality Control and Improvement", Pearson Education Asia, Delhi 2002.
2. Modares, "Reliability and Risk Analysis", Marcel Decker Inc. 4th edition 2014.

REFERENCES:

1. Besterfield D.H., "Quality Control", Prentice Hall, 3rd edition 2011.
2. Manohar Mahajan, "Statistical Quality Control", Dhanpat Rai and Sons, 2007.
3. Sharma S.C., "Inspection Quality Control and Reliability", Khanna Publishers, 1998.

PR7551 - STATISTICAL QUALITY CONTROL AND RELIABILITY ENGINEERING																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Able to create and interpret different statistical process control charts	2	3	2	3	2	-		-	-	2	1	-	2	2	3
CO2	Capacity to generate and compare various sampling plans	3	2	2	2	2	-		-	-	2	1	-	2	2	3

CO3	Able to apply design of experiments tool	3	3	2	3	2			-	-	2	-	-	2	3	2
CO4	Generate reliability testing plans and Evaluate reliability of a component or system	3	2	3	1	2	1	1	-	-	2	-	-	2	2	3
CO5	Select suitable distribution for reliability data analysis and integrate reliability concepts in new product design and development	2	3	2	3	2	1	1	-	-	3	1	-	2	3	2
PO & PSO (Average)		2.6	2.6	2.2	2.4	2.0	1.0	1.0	-	-	2.2	1.0	-	2.0	2.4	2.6

PR7511 FLUID POWER SYSTEMS LABORATORY L T P C
0 0 4 2

COURSE OBJECTIVES:

Aspects of different hydraulic components and its use in circuits

- To train the student in designing different pneumatics for different applications.
- To train the student in designing different hydraulics for different applications.
- To train the student in designing of PLC circuits using hydraulic circuit applications

LIST OF EXPERIMENTS

1. Study and use of pneumatic and hydraulic elements.
2. Simulation of speed control circuits in a hydraulic trainer.
3. Simulation of hydraulic circuits in a hydraulic trainer.
4. Simulation of single and double acting cylinder circuits using different directional control valves.
5. One shot and regenerative pneumatic circuits.
6. Sequencing of pneumatic circuits.
7. Simulation of Electro-pneumatic circuits.
8. Simulation of Logic pneumatic circuits.
9. Simulation of electro pneumatic sequencing circuits.
10. Simulation of PLC based electro pneumatic sequencing circuits.
11. Simulation of pneumatic circuits using PLC.
12. Design and simulate the circuits for the given applications.
13. Simulation of ladder diagram for electrical and PLC control for the given sequence.
14. Simulation of circuit for the given sequence using software.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1: To study the functional aspects of different pneumatic Components and its use in circuits.
CO2: To study the functional aspects of different hydraulic components and its use in circuits &tp design different pneumatics for different applications.
CO3: Design the PLC based hydraulic circuit applications

PR7511 -FLUID POWER SYSTEMS LABORATORY																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Understand the concepts of different pneumatic, hydraulic and PLC Components and its use in circuits.	3	3	2	2	2	1	1	1	2	2	1	2	2	2	2
CO2	Analyze the functional aspects of different hydraulic components and its use in circuits & design different pneumatics for different applications.	3	2	2	3	2	1	1	1	2	2	1	2	3	3	2
CO3	Design the PLC based hydraulic circuit applications	3	3	3	3	3	1	1	1	2	2	1	2	2	3	2
PO & PSO (Average)		3.0	2.7	2.3	2.7	2.3	1.0	1.0	1.0	2.0	2.0	1.0	2.0	2.3	2.7	2.0

PR 7512 METROLOGY AND QUALITY CONTROL LABORATORY L T P C
0 0 4 2

COURSE OBJECTIVES:

- To practice various measurement methods.
- To get acquainted with the instruments used for linear and angular measurements, form measurements and surface texture measurement
- To get acquainted with the advanced instruments such as machine vison system and CMM.

LIST OF EXPERIMENTS

1. Measurement of angle using Sine bar/bevel protractor.
2. Measurement of external taper angle.
3. Measurement of internal taper angle
3. Measurement of Bore Diameter.
4. Calibration of a Dial gauge.
5. Measurement of Roundness.
6. Inspection of screw thread parameters using three wire method.
7. Measurement of gear tooth thickness
8. Measurements using Tool makers microscope.
9. Measurements using profile projector.
10. Straightness measurement using Autocollimator
11. Measurements using Vision Measuring System.
11. Study on CMM.
12. Study on surface roughness measuring machine
13. Determination of process capability from given components and plotting variable control chart/attribute chart.
14. Analyzing the fault in given batch of specimens by using quality control tools.
15. Usage of MINITAB software with respect to quality control.
16. Case studies related to quality control.

TOTAL :60 PERIODS

COURSE OUTCOMES:

Carry out various types of measurements using different instruments.

CO1: Select and handle the most appropriate equipment for the given application.

CO2: Able to handle instruments used for linear and angular measurements, form measurements and surface texture measurement.

CO3: Able to handle advanced equipment such as machine vision system and CMM.

PR 7512 METROLOGY AND QUALITY CONTROL LABORATORY																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Select and handle the most appropriate equipment for the given application.	3	3	2		3		3		2		3	2	3	3	2
CO2	Able to handle instruments used for linear and angular measurements, form measurements and surface texture measurement.	3	3	2		3		3		2		3	2	3	3	2
CO3	Able to handle advanced equipment such as machine vision system and CMM.	3	3	2		3		3		2		3	2	3	3	2
PO & PSO (Average)		3.0	3.0	2.0	-	3.0	-	3.0	-	2.0	-	3.0	2.0	3.0	3.0	2.0

PR7601 COMPUTER AIDED PRODUCT DESIGN **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To introduce the general design process and software tools being used in the academics and Industries.
- To introduce the computer graphics and concepts related to the design.
- To introduce the concepts on geometric modelling and applications of CAD.
- To give information about product design and process tools.
- To exhibit the knowledge in product data management and product life cycle

UNIT I INTRODUCTION TO COMPUTER AIDED DESIGN **9**

Introduction to Engineering Design – Various phases of systematic design – sequential engineering and concurrent engineering – Computer hardware and Peripherals – software packages for design and drafting.

UNIT II COMPUTER GRAPHICS FUNDAMENTALS 9

Computer graphics – applications – principals of interactive computer graphics – 2D 3D transformations – projections – curves – Bezier, B-Spline and NURBS – Concepts.

UNIT III GEOMETRIC MODELING 9

Geometric Modeling – types – Wire frame surface and solid modeling – Boundary Representation, constructive solid geometry – Graphics standards – assembly modeling – use of software packages

UNIT IV PRODUCT DESIGN CONCEPTS 9

Design for product life cycle - Product modeling – types of product models; product development process tools – TRIZ – Altshuller's inventive principles – Modeling of product metrics – Design for reliability – design for manufacturability – machining, casting, and metal forming – design for assembly and disassembly – Design for Ergonomics - Design for environment; Bench marking – FMEA – QFD – DOE – Taguchi method of DOE – Quality loss functions .

UNIT V PRODUCT DATA MANAGEMENT 9

Product Data Management – concepts – Collaborative product design and commerce – Information Acquisition – Sourcing factor – manufacturing planning factor – Customization factor – Product life cycle management.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of this course students could be able to

CO1: Understand the basic design process and features of modern design tools.
CO2: Get exposure in fundamentals of computer graphics and its concepts.
CO3: Acquire knowledge on geometric modelling and usage of CAD software packages.
CO4: Develop in-depth knowledge on product design and process tools.
CO5: Gain knowledge on data handling and product life cycle management

TEXT BOOKS:

1. Kevin Otto, Kristin Wood, "Product Design", Pearson Education, 7th Reprint , 2011.
2. Ibrahim Zeid, "CAD/CAM theory and Practice", Tata McGraw Hill, 2nd edition, 2008

REFERENCES:

1. Biren Prasad, "Concurrent Engineering Fundamentals Vol.II", Prentice Hall, 1st edition, 2007.
2. James G.Bralla, "Handbook of Product Design for Manufacturing", McGraw Hill, 2nd edition, 2004
3. David F.Rogers.J, Alan Adams, "Mathematical Elements for Computer Graphics", McGraw Hill, 2nd edition, 2009.

PR7601 - COMPUTER AIDED PRODUCT DESIGN																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Understand the basic design process and features of modern design tools.	3	3	2	3	3	3	1	2	-	1	-	2	3	3	2
CO2	Get exposure in fundamentals of computer graphics and its concepts.	3	3	2	3	3	3	1	2	-	1	-	2	3	3	2

CO3	Acquire knowledge on geometric modelling and usage of CAD software packages.	3	3	2	3	3	3	1	2	-	1	-	2	3	3	2
CO4	Develop in-depth knowledge on product design and process tools.	3	3	2	3	3	3	1	2	-	1	-	2	3	3	2
CO5	Gain knowledge on data handling and product life cycle management	3	3	2	3	3	3	1	2	-	1	-	2	3	3	2
PO & PSO (Average)		3.0	3.0	2.0	3.0	3.0	3.0	1.0	2.0	-	1.0	-	2.0	3.0	3.0	2.0

PR7602 COMPUTER INTEGRATED MANUFACTURING SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES:

The objective of this course is

1. To understand the various automated manufacturing activities and to study the application of computer Technology in the manufacturing activities
2. To familiarize the various material handling equipment
3. To learn about the concepts of cellular manufacturing
4. To introduce the concepts of Flexible Manufacturing System
5. To study about the principles of automated assembly system

UNIT I INTRODUCTION TO AUTOMATED PRODUCTION SYSTEMS 9

Product design – General Design Process – Elements of CAD, CAM and CIM – Functions of CIM – Benefits of CIM - Three step process for implementation of CIM – Types of Automation - Automation strategies – USA Principle – Ten strategies for automation – Automation Migration Strategy - Automated Production Lines – System Configurations – Work part Transfer Mechanisms – Storage Buffers.

UNIT II MATERIAL HANDLING AND STORAGE SYSTEM 9

Factors influencing material handling system – Ten principles of Material handling – Types of Material Transport Equipments; Industrial Trucks – conveyors - cranes and Hoists – Automated guided vehicle system – Mono-rails and other rail-guided vehicles – Types - Automated Storage and Retrieval systems – carousel storage systems.

UNIT III CELLULAR MANUFACTURING 9

Group Technology - Part families – Parts classification and coding – Production flow analysis – Types of Process Planning - Cellular Manufacturing – Composite part concept – Machine cell design – Key machine concept - quantitative analysis in cellular manufacturing using Holier Method.

UNIT IV FLEXIBLE MANUFACTURING SYSTEM 9

Flexible Manufacturing System - Types – FMS components – Workstations, Material Handling and storage system – types of FMS Layouts - computer control system- Human resource – Dead lock in FMS – FMS application and benefits – FMS planning and implementation issues.

UNIT V AUTOMATED ASSEMBLY AND SHOP FLOOR CONTROL 9

Automated assembly – Fundamentals – system configurations - Parts delivery at work stations - Applications - Shop floor control – Three phases – Factory data collection system – manual data input techniques – Automated and semi automated data collection (ADC) systems – Bar code technologies and other ADC Technologies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students are expected to

CO1: Gain and apply the knowledge using computers for various manufacturing activities

CO2: Employ the most suitable material handling equipment to accomplish the given task

CO3: Employ the principles of cellular manufacturing.

CO4: Gain and apply the knowledge using flexible manufacturing system

CO5: Identify the appropriate ADC technology

TEXT BOOKS:

1. Mikell P.Groover, "Automation, Production Systems and Computer-integrated Manufacturing", Prentice Hall of India Private Limited,4th edition 2014.
2. Kant Vajpayee.S, "Principles of Computer-Integrated Manufacturing" , Prentice Hall of India Private Limited,1st edition, 2006.

REFERENCES:

1. Radhakrishnan.P, Subramanyan.S and Raju.V, "CAD/CAM/CIM", New Age International Publishers, 2nd edition 2008.
2. James A.Retrg and Henry W. Kraebher, "Computer Integrated Manufacturing", Pearson Education, Asia, 2001.
3. Viswanathan.N and Narahari.Y, "Performance modelling of automated manufacturing system", Prentice Hall of India Private Limited, 1st edtion ,2008.

PR7602 COMPUTER INTEGRATED MANUFACTURING SYSTEMS																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Gain and apply the knowledge using computers for various manufacturing activities	2	-	2	3	-	-	2	3	-	-	-	2	2	2	2
CO2	Employ the most suitable material handling equipment to accomplish the given task	3	-	2	3	-	-	2	3	-	-	-	2	2	2	2
CO3	Employ the principles of cellular manufacturing.	3	-	3	3	-	-	3	3	-	-	-	3	3	3	3

CO4	Gain and apply the knowledge using flexible manufacturing system	3	-	3	3	-	-	3	3	-	-	-	3	3	3	3
CO5	Identify the appropriate ADC technology	3	-	3	3	-	-	3	3	-	-	-	3	3	3	3
PO & PSO (Average)		2.8	-	2.6	3.0	-	-	2.6	3.0	-	-	-	2.6	2.6	2.6	2.6

PR7603 FINITE ELEMENT ANALYSIS IN MANUFACTURING L T P C
3 0 0 3

COURSE OBJECTIVES:

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

- To introduce the concepts and applications of CAD.
- To introduce the various concepts and techniques used for product design and to develop product design skills
- To analyse a given problem using finite element techniques.
- To impart knowledge about various factors, pre-processing and post-processing steps with implementation of computer in FEA.
- To introduce the concepts of FEA and to apply in the field of manufacturing.

UNIT I INTRODUCTION 9

General field problems in engineering-Discrete and continuous models-Characteristics-the relevance and place of finite element method- variational calculus- variational formulation of boundary value problems-The method of weighted residuals-Rayleigh-Ritz and Galerkin methods-Solution of large system of equations- Choleski Decomposition-Gaussian elimination procedures.

UNIT II GENERAL PROCEDURE OF FEA 9

Discretization of Domain selection of interpolation polynomials-Convergence requirements-Formulation of element characteristics matrices and load vectors – Assembly of element characteristics matrices-Solution of finite element equations-Post processing of results.

UNIT III FINITE ELEMENT ANALYSIS OF ONE DIMENSIONAL AND TWO DIMENSIONAL PROBLEMS 9

One dimensional finite element analysis-Linear bar element-Quadratic bar element-Beam element-Frame elements-One dimensional heat transfer-Two dimensional finite element analysis approximation of geometry and field variables-Three nodded triangular element-Four nodded rectangular element-Six nodded triangular element-Natural coordinates and coordinate transformation – Numerical integration-Incorporation of boundary conditions

UNIT IV VIBRATIONAL ANALYSIS 9

Dynamic analysis-Equations of motion using Lagrange's approach-Consistent and Lumped mass matrices-Formulation of FE equations for vibration problems- Solution of Eigen value problems-Transient vibration analysis-Thermal transients- Isoparametric elements.

UNIT V APPLICATION OF FINITE ELEMENT ANALYSIS 9

Finite element analysis of Machine elements - Axisymmetric FEA of a pressure vessel-Application of FEM in various metal forming processes – Solid formulation and flow formulation – FEA simulation of Metal cutting, Solidification of castings and Weldments.

TOTAL: 45 PERIODS

COURSE OUTCOME:

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

CO1: Understand the features of modern design tools and data handling product development.

CO2: Develop depth knowledge on techniques of FEA and tools for analysis of typical manufacturing processes.

CO3: Get idea of implementation of computer on solving FEA based problems.

CO4: Discretize and solve one-dimensional solid mechanics and heat transfer problems in FEA.

CO5: Analyze a production process through FEA and control it's parameters

TEXT BOOKS:

1. Chandraputla T.R., and Belegundu A.D., "Introduction of Finite Element in Engineering", Prentice Hall of India, Fourth Edition, 2012.
2. Reddy. J.N., "An Introduction to Finite Element Method", McGraw Hill, Third Edition, 2005.

REFERENCES:

1. Rao.S.S., "The Finite Element Method in Engineering", Butterworth-Heinemann, fourth edition, 2004.
2. Segarland. L.J., "Applied Finite Element Analysis", John Wiley and Sons, second edition, 1984.
3. Seshu.P., "Text Book of Finite Element Analysis", Prentice Hall of India, tenth print, 2010.
4. Dhanraj, R. and Prabhakaran Nair**,** K, Finite Element Method, 1/e, Oxford University Press India, 2015

PR7603 - FINITE ELEMENT ANALYSIS IN MANUFACTURING																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Understand the features of modern design tools and data handling product development.	1	1	1	1	-	1	-	-	-	-	-	-	1	1	2
CO2	Develop depth knowledge on techniques of FEA and tools for analysis of typical manufacturing processes.	2	2	2	1	-	2	-	-	-	-	-	-	2	1	2
CO3	Get idea of implementation of computer on solving FEA based problems.	2	2	2	1	-	2	-	-	-	-	-	-	2	1	3
CO4	Discretize and solve one-dimensional solid mechanics and heat transfer problems in FEA.	3	3	3	2	-	1	-	-	-	-	-	-	3	1	1
CO5	Analyze a production process through FEA and control it's parameters	3	1	3	3	-	1	-	-	-	-	-	-	1	1	1
PO & PSO (Average)		2.2	1.8	2.2	1.6	-	1.4	-	-	-	-	-	-	1.8	1.0	1.8

PR7651 PRODUCTION OF AUTOMOTIVE COMPONENTS L T P C
3 0 0 3

COURSE OBJECTIVES:

The objective of this course is

- 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 PARTS 9

Working principle of crank shaft – Cam shaft – valve operating mechanisms – carburetors - spark plug 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.

UNIT V RECENT ADVANCES 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.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students are expected 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. Mohamed A.Omar, “The Automotive Body Manufacturing System and Processes”, John Wiley Publications,USA, 2011.
2. Hiroshi yamagata, “The Science and Technology of materials in Automotive Engines”, CRC Press Wordhead publishing Limited ,Cambridge, England, 2005.

REFERENCES:

1. Kirpal Singh, “Automobile Engineering.,Vol.Iand II”, Standard Publishers, New Delhi,13th edition, 2012.
2. Garrett. T.K., Newton. K., Steeds. W., "The Motor Vehicle", Butterworth-Heinemann, 13th edition, 2001
3. Serope Kalpakjian and Steven R. Schmid, “Manufacturing Processes for Engineering Materials”, Fourth Edition – Pearson Education publications, 2003.
4. Brian Cantor, “Automotive Engineering”, CRC Press ,Taylor and Francis Group, London, 2008.

PR 7651 PRODUCTION OF AUTOMOTIVE COMPONENTS																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Acquire knowledge of production of various automotive components	2	-	3	-	-	-	3	2	-	-	-	2	2	3	2
CO2	Learn the working principles of engines	3	-	3	-	-	-	3	2	-	-	-	3	3	2	3
CO3	Get knowledge about various engine components	3	-	2	-	-	-	3	3	-	-	-	3	2	2	3
CO4	Learn working of Fuel and Transmission System and its types	2	-	2	-	-	-	3	2	-	-	-	2	3	3	2
CO5	Acquire knowledge of recent development in automobile industries	3	-	2	-	-	-	2	2	-	-	-	3	3	3	3
PO & PSO (Average)		2.6	-	2.4	-	-	-	2.8	2.2	-	-	-	2.6	2.6	2.6	2.6

PR7611 CREATIVE AND INNOVATIVE PROJECT L T P C
0 0 4 2

COURSE OBJECTIVES

1. Stimulate creativity in themselves and learn the impact of innovation creation.
2. Understand several innovation concepts/ methodologies.
3. Apply creative and design thinking to real-world business situations.

The main objective of this course is to help the students to identify innovative projects which promotes and enhances creativity to explore the variables. The goal is to improve the creative and innovative aspects in the design, fabrication and implementation of real time problems related to social/industrial and campus based.

This course will help the students to learn concepts, models, frameworks, tools, etc., in a world where creativity and innovation is fast becoming a precondition for competitive advantages.

The students will be grouped into 3 or 4 (max) students as a batch and work under a faculty member as project supervisor. The progress of project work will be continuously evaluated by a committee constituted by the Head of the Department. The project report is to be submitted by the group.

The final end semester exam will be conducted by an external member in a Viva Voce mode.

Student has to take a project involving minimum of TWO areas as given below:

i. Design and fabrication of jigs/ fixtures/ press tool (involving total design, cost estimation and prototype)
ii. Automation using fluid power and electrical (design and fabrication of a proto type model)
iii. Design for manufacturability (To study an assembly based tolerance and fits, preparation of machine and assembly drawing)
iv. Software development (To computerize the activity with proper algorithm as a application software for problems faced in Production Engg. as office automation or e-governance)
v. Virtual Reality (To develop software based on any one production process explaining the concept and working principles)
vi. Automation of manual related task (To design, fabricate and to complement the model for the task selected).

TOTAL:60 PERIODS

COURSE OUTCOMES:

Upon completion of this course students able

CO1: To understand and analyze the problem which needs engineering solution.
CO2: To design and simulate the creative solution for the required applications.
CO3: To fabricate, analyze and evaluate the developed solution for the suitability of desired applications.

PR7611 - CREATIVE AND INNOVATIVE PROJECT																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	To understand and analyze the problem which needs engineering solution.	3	3	3	1	2	1	-	-	2	1	2	3	3	3	3
CO2	To design and simulate the creative solution for the required applications.	3	3	3	1	2	1	-	-	2	1	2	3	3	3	3
CO3	To fabricate, analyze and evaluate the developed solution for the suitability of desired applications.	3	3	3	1	2	1	-	-	2	1	2	3	3	3	3
PO & PSO (Average)		3.0	3.0	3.0	1.0	2.0	1.0	-	-	2.0	1.0	2.0	3.0	3.0	3.0	3.0

PR7612 MODELLING AND ANALYSIS LABORATORY L T P C
0 0 4 2

COURSE OBJECTIVES:

1. To perform finite element modeling in manufacturing applications and analysis package using various analysis packages available.
2. Enable the student to perform finite element modeling analysis for solid mechanics, heat transfer problems, vibration problems, shell and contact problems in 2D and 3D simulation.
3. Carry out dynamic analysis and finding natural frequencies for various boundary conditions and also analyze with forcing function and using the modern tools to formulate the problem, and able to create geometry, discretize, apply boundary condition to solve problems of bars, truss, beams, plate to find stress with different loading condition.

LIST OF EXPERIMENTS

1. One Dimensional FEA Problem.
   a. Truss structure analysis.
   b. Cantilever beam analysis.
   c. Temperature distribution problem.
2. Two Dimensional FEA Problems.
   a. Plane stress analysis.
   b. Axisymmetric analysis.
   c. Vibration Analysis.
3. Three Dimensional FEA Problems.
   a. 3D Shell Analysis.
   b. 3D Contact Analysis.
4. FEA Application in metal forming, Metal cutting, Casting process etc.

TOTAL:60 PERIODS

COURSE OUTCOMES:

Upon the completion of the course the student will be able:

CO1: Perform finite element modeling in manufacturing applications and analysis package using various analysis packages available.

CO2: Enable the student to perform finite element modeling analysis for solid mechanics, heat transfer problems, vibration problems, shell and contact problems in 2D and 3D simulation

CO3: Carry out dynamic analysis and finding natural frequencies for various boundary conditions and also analyze with forcing function and using the modern tools to formulate the problem, and able to create geometry, discretize, apply boundary condition to solve problems of bars, truss, beams, plate to find stress with different loading condition

PR7612 - MODELLING AND ANALYSIS LABORATORY																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Perform finite element modeling in manufacturing applications and analysis package using various analysis packages available.	1	1	1	1	1	-	-	1	-	-	-	1	1	1	1
CO2	Enable the student to perform finite element modeling analysis for solid mechanics, heat transfer problems, vibration problems, shell and contact problems in 2D and 3D simulation	2	2	2	2	2	-	-	1	-	-	-	2	1	2	1

CO3	Carry out dynamic analysis and finding natural frequencies for various boundary conditions and also analyze with forcing function and using the modern tools to formulate the problem, and able to create geometry, discretize, apply boundary condition to solve problems of bars, truss, beams, plate to find stress with different loading condition	3	2	2	2	2	-	-	1	-	-	-	2	2	2	1
PO & PSO (Average)		2.0	1.7	1.7	1.7	1.7	-	-	1.0	-	-	-	1.7	1.3	1.7	1.0

PR7701 INDUSTRIAL ENGINEERING AND MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVES:

- To familiarize student about the Human Resource Management.
- To familiarize student about the concepts of inventory management.
- To introduce the students about Production Management Techniques such as work study, Plant location, Layout, Materials handling.
- To introduce Profit Planning and management as a concept to plan for profit.
- To familiarize the students and Marketing concepts and techniques.

UNIT I PRINCIPLES OF MANAGEMENT AND PERSONNEL MANAGEMENT 9

General principles of management – Management functions – Organization – types – comparison – functions of personnel management – recruitment – training – leadership/motivation – communication – conflict – Industrial relations – trace union.

UNIT II INVENTORY MANAGEMENT 9

Purpose of Inventory – Cost related to inventory – Basic EOQ model – variations in EOQ model – Finite Production, quantity discounts – ABC Analysis – MRP.

UNIT III OPERATIONS MANAGEMENT 9

Plant location – Layout – Materials Handling – Method study – Time study – Ergonomics – Aggregate Planning – Value Analysis.

UNIT IV FINANCIAL MANAGEMENT 9

Capital – Types – sources – break even analysis – financial statements – income statement – balance sheet – capital budgeting – working capital management – inventory pricing.

UNIT V MARKETING MANAGEMENT 9

Functions of marketing – Sales promotion methods – advertising – product packaging – marketing variables – distribution channels – organization –market research – market research techniques.

TOTAL:45 PERIODS

COURSE OUTCOMES:

CO1: Understanding of managerial functions like HR skills.
CO2: Design a suitable inventory system for a given situation.
CO3: Understand work study and develop Layout and materials handling system.
CO4: Prepare financial statement such as balance sheet, income statement and Break Even Analysis
CO5: Understanding the benefits of marketing, selling and its functions.

TEXT BOOKS:

1. Kesavan. R, Elanchezhian. C and Sundar Selwyn. T , "Engineering Management" ,Eswar Press, 2005.
2. Panneerselvam. R , "Production and Operations Management" , Prentice Hall of India, 2012.

REFERENCES:

1. Koontz and Odonnel , "Principles of Management", McGraw Hill 2011.
2. Philips Kotler,,"Principles of marketing", Pearson 2013.
3. Pandey. I.M., "Financial Management", Vikas Publishing House, 2009
4. Ahuja. K.K., "Human Resource Management", Kalyane Publication 2005
5. Martand. T, "Telesand , Industrial and Business Management, S.Chand & Co., 2001
6. Kesavan. R., Elanchezian. C. and Vijayaramnath. B., "Production Planning and Control", Anuratha Publishing Co., Ltd., Chennai - 2008.

PR7701- INDUSTRIAL ENGINEERING AND MANAGEMENT																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Understanding of managerial functions like HR skills.	1	1	1		1	2	1	3	3	3	2	1	1	1	1
CO2	Design a suitable inventory system for a given situation.	1		2	1	2	2	2	1	1	1	2	1	3	3	3
CO3	Understand work study and develop Layout and materials handling system.	1	2	1	2	2	2	1	1	2	1	2	1	3	3	3
CO4	Prepare financial statement such as balance sheet, income statement and Break Even Analysis	1	2	1	1	1	1	1	1	2	1	3	1	2	1	1
CO5	Understanding the benefits of marketing, selling and its functions.	1	2	1	1	3	2	2	1	2	3	2	1	1	1	1
PO & PSO (Average)		1.0	1.6	1.4	2.0	1.0	1.0	-	-	-	1.0	-	3.0	-	-	1.0

PR7702 MECHATRONICS FOR AUTOMATION L T P C
3 0 0 3

COURSE OBJECTIVES:

- To acquire overview of multi-domain engineering integration and make the students get acquainted with the sensors and transducers and its interfacing.
- To understand and apply the various types of signal conditioning units and control systems.
- To understand and apply the various types of actuators and its drives for interfacing.
- To impart knowledge about the fundamentals of microcontroller to realize the interfacing and control.
- To apply the design and development of mechatronics systems.

UNIT I MECHATRONICS SYSTEMS AND SENSORS 9

Introduction to mechatronics systems, key elements, ways of integration – hardware and software. sensors – characteristics – static and dynamic, types - linear, rotational, velocity acceleration, force, torque, flow, temperature, proximity, optical, Micro and Nano sensors, selection of sensors.

UNIT II SIGNAL CONDITIONING AND CONTROL SYSTEM 9

Analog and Digital Signals - Signal condition module – Amplifiers - inverting amplifier, non-inverting amplifier, instrumentation amplifier, Filters, A/D and D/A converter. Open loop and closed loop control systems. P, PD, PI, PID controllers and its use for stable system design.

UNIT III ACTUATORS 9

Electrical actuators and its characteristics – DC Motor, servo motor and stepper motor. H-bridge circuits and stepper motor driving circuits. Switching devices – mechanical, solenoids, relays. Types and characteristics of Micro and Nano actuators.

UNIT IV MICROCONTROLLERS 9

8051 Microcontrollers – Architecture, Address modes, Instruction sets, programming exercises - Memories – different types – Different I/O devices, Stepper and servo motor interface. Overview of advanced microcontrollers and its typical applications.

UNIT V MECHATRONICS SYSTEM 9

Stages in Designing Mechatronics Systems – Traditional and Mechatronic Design –Case studies mechatronics system in CNC machine, Engine management system, Car production and its assembly line automation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Identify suitable sensors and transducers to develop mechatronics systems.

CO1: Identify suitable sensors and transducers to develop mechatronics systems.
CO2: Select and apply the appropriate signal conditioning units and control systems
CO3: Apply and interface the appropriate drives and actuators for systems.
CO4: Use the microcontroller for input and output interfacing.
CO5: Demonstrate the mechatronic system integration in various applications.

TEXT BOOKS:

1. Bolton .W., “Mechatronics” ,Pearson Education Limited, 5th Edition, 2011.
2. Rajput .R.K., “A Text Book of Mechatronics”, Chand and Co, 5th Edition, 2013.

REFERENCES:

1. Devadas Shetty, Richard A. Kolk, “Mechatronics System Design”, CENGAGE Learning Custom Publishing, 2nd International student edition, 2010.
2. Mazidi. M.A and Mazidi .M.J., MCkinlay.R.D, “The 8051 Microcontroller and Embedded Systems Using Assembly and C”, Pearson India, 2nd Edition, 2008.
3. Patranabis D., “Sensor and Actuators”, Prentice Hall of India Pvt Ltd., 2nd edition 2005.
4. A. Nagoor Kani, “Control Systems”, RBA Publications Pvt Ltd., 2014.

PR7702- MECHATRONICS FOR AUTOMATION																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Identify suitable sensors and transducers to develop mechatronics systems.	3	-	3	2	-	-	-	-	-	-	-	2	3	2	-
CO2	Select and apply the appropriate signal conditioning units and control systems .	3	-	3	2	-	-	-	-	-	-	-	2	3	2	-
CO3	Apply and interface the appropriate drives and actuators for systems.	3	-	3	2	-	-	-	-	-	-	-	2	3	2	-
CO4	Use the microcontroller for input and output interfacing.	3	-	3	2	-	-	-	-	-	-	-	2	3	2	-
CO5	Demonstrate the mechatronic system integration in various applications.	3	-	3	2	-	-	-	-	-	-	-	3	3	2	-
PO & PSO (Average)		3.0	-	3.0	2.0	-	-	-	-	-	-	-	3.0	3.0	2.0	-

PR 7703 ROBOTIC TECHNOLOGY L T P C
3 0 0 3

COURSE OBJECTIVES:

- To Understand the fundamentals of robotics
- To understand the different kinematics and different mathematical methods used in robot control.
- To study the different types of grippers and thir and to calculate the different gripping forces in robotics.
- To learn the different types of sensors and machine vision systems in robotics
- To learn about different programming languages involved , commands used and applications of robots

UNIT I FUNDAMENTALS OF ROBOT 9

Robot – Definition – Robot Anatomy – Co-ordinate 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.

UNIT II ROBOT KINEMATICS 9

Forward kinematics, inverse kinematics and the difference: forward kinematics and inverse Kinematics of Manipulators with two, three degrees of freedom (in 2 dimensional), four degrees of freedom (in 3 dimensional) – derivations and problems. Homogeneous transformation matrices, translation and rotation matrices Dennavit and Hartenberg transformation.

UNIT III ROBOT DRIVE SYSTEMS AND END EFFECTORS 9

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of All These Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic grippers, vacuum grippers, two fingered and three fingered grippers, internal grippers and external grippers, selection and design considerations of a gripper - gripper force calculation and analysis.

UNIT IV SENSORS IN ROBOTICS 9

Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors, safety considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and compliance mechanism. Machine vision system - camera, frame grabber, sensing and digitizing image data – signal conversion, image storage, lighting techniques, image processing and analysis – data reduction, segmentation, feature extraction, object recognition, other algorithms, applications – Inspection, identification, visual serving and navigation.

UNIT V PROGRAMMING AND APPLICATIONS OF ROBOT 9

Teach pendant programming, lead through programming, robot programming languages – VAL programming – Motion Commands, Sensors commands, End-Effector Commands, and simple programs - Role of robots in inspection, assembly, material handling, underwater, space and medical fields.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Apply the basic engineering knowledge and laws for the design of robotics.
CO2: Explain the concept of kinematics, degeneracy, dexterity and trajectory planning.
CO3: The student will be able to compare various end effectors and grippers and tools and calculate the different gripping forces
CO4: Demonstrate the image processing and image analysis techniques by machine vision system.
CO5: Interpret the features of robots and technology involved in the control.

TEXT BOOKS:

1. Mikell.P.Groover , “Industrial Robotics – Technology, Programming and applications”, McGraw Hill 2th edition 2012.
2. Ganesh.S.Hedge ,”A textbook of Industrial Robotics”, Lakshmi Publications, 2006.

REFERENCES:

1. Fu K.S. Gonalz R.C. and ice C.S.G.”Robotics Control, Sensing, Vision and Intelligence”, McGraw Hill book co. 2007.
2. YoramKoren, “Robotics for Engineers”, McGraw Hill Book, Co., 2002.
3. Janakiraman P.A., “Robotics and Image Processing”, Tata McGraw Hill 2005.

PR7703- ROBOTIC TECHNOLOGY																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Apply the basic engineering knowledge and laws for the design of robotics.	2	2	3	2	2	1	1	-	2	2	2	2	2	3	2
CO2	Explain the concept of kinematics, degeneracy, dexterity and trajectory planning.	3	3	2	3	2	1	1	-	1	2	2	2	2	3	2

CO3	Compare various end effectors and grippers and tools and calculate the different gripping forces	2	2	3	1	1	1	1	-	2	2	2	1	2	1	2
CO4	Demonstrate the image processing and image analysis techniques by machine vision system.	3	2	2	2	3	1	1	-	2	1	2	2	2	2	2
CO5	Interpret the features of robots and technology involved in the control.	2	2	2	2	1	1	1	-	1	2	2	2	2	2	2
PO & PSO (Average)		2.4	2.2	2.4	2.0	1.8	1.0	1.0	-	1.6	1.8	2.0	1.8	2.0	2.2	2.0

PR7711 MECHATRONICS AND ROBOTICS LABORATORY L T P C
0 0 4 2

COURSE OBJECTIVES:

- To understand the behaviors and operations of sensors, transducers, and actuators.
- To exercise microcontroller programming for mechatronic and Robotic system.
- To practice the simulation software for system modelling and microcontroller programming.

LIST OF EXPERIMENTS:

1. Study of characteristics of optical sensors.
2. Study of characteristics of temperature transducers.
3. Experiments on LVDT and ultrasonic transducer.
4. 8 bit and 16 bit Arithmetic operation in 8051 microcontroller.
5. I/O port programming of 8051 microcontroller.
6. PC parallel port and microcontroller interfacing of a unipolar stepper motor.
7. Modeling and Simulation of mechanisms using simulation software.
8. Kinematic analysis and verification of 2 DOF RR Configuration robot.
9. Analysis and synthesis of two degree of freedom planar robot.
10. Robot control with stepper motor interfacing.
11. Experimental verification of Freudenstein equation for 1 DOF robot.
12. Characterization of DC brush servo motor.
13. Study of Servo Motor Control in a linear slide base.
14. Study of AC and DC power control.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

CO1: Select and use suitable sensors and actuators more confidently for interfacing.
CO2: Able to simulate the various mechanism for system development.
CO3: Use microcontroller for automation in various applications

PR7711 - MECHATRONICS AND ROBOTICS LABORATORY																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Select and use suitable sensors and actuators more confidently for interfacing.	3	2	3	2	-	-	-	-	-	-	-	2	3	2	-
CO2	Able to simulate the various mechanism for system development.	3	2	3	2	-	-	-	-	-	-	-	2	3	2	-
CO3	Use microcontroller for automation in various applications	3	2	3	2	-	-	-	-	-	-	-	2	3	2	-
PO & PSO (Average)		3.0	2.0	3.0	2.0	-	-	-	-	-	-	-	2.0	3.0	2.0	-

PR7712 **INDUSTRIAL TRAINING / INTERNSHIP** **L T P C**
0 0 4 2

COURSE OBJECTIVES:

1. To develop skills in the application of theory to practical work situations.
2. To expose students to real work environment experience gain knowledge in writing report in technical works/projects.
3. To build a good communication skill with group of workers and learn to learn proper behavior of corporate life in industrial sector.

DESCRIPTION

The main objective of the industrial training / internship is to experience and understand the real life situations in any industrial organization and their related environmental aspects. The students are advocated to take a small project during the training / internship.

The students have to undergo practical training for FOUR weeks (during 5th or 6th semester holidays) in recognized industrial establishments. The student has to submit a report about the training / internship with the following information.

1. Industry profile.
2. Organization structure.
3. Plant layout.
4. Process/ Machines/ Equipment/ Devices details.
5. Labor welfare schemes.
6. Training schedule.
7. Project work carried out.
8. Learning points.

The assessment will be based equally on the report in the prescribed format and Viva Voce examination by a committee nominated by the Head of the Department.

TOTAL:60 PERIODS

COURSE OUTCOMES:

CO1: Knack to be a multi-skilled engineer with good technical knowledge, management, leadership and entrepreneurship skills.

CO2: Ability to identify, formulate and model problems and find engineering solution based on systematic approach.

CO3: Expose the students to future employers.

PR7712- INDUSTRIAL TRAINING / INTERNSHIP																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Knack to be a multi-skilled engineer with good technical knowledge, management, leadership and entrepreneurship skills.	3	3	3	3	3	3	3	3	2	3	2	3	3	3	3
CO2	Ability to identify, formulate and model problems and find engineering solution based on systematic approach.	3	3	3	3	3	3	3	3	2	3	2	3	3	3	3
CO3	Expose the students to future employers.	3	3	3	3	3	3	3	3	2	3	2	3	3	3	3
PO & PSO (Average)		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.0	3.0	2.0	3.0	3.0	3.0	3.0

PR7811 **PROJECT WORK** **L T P C**
0 0 20 10

COURSE OBJECTIVES:

- A project topic may be selected based on the literature survey as well as on the creative ideas of the students in consultation with their project supervisor.
- The topic should be so chosen that it will improve and develop the skills of the students to design, fabricate, analyse and test.
- To improve the research and development activities of the students.

A project area must be selected by the students in consultation with the faculty members who act as a guide. The objective of the project work is to deepen comprehension of principles by applying them to a problem which may be; design and fabrication of a device / a research project with a focus on the application needed by the industry; a software oriented project involving design and analysis; a management project to apply the latest technique for an industrial problem; material characterization (or) any inter- disciplinary topic of due weightage / continued work of internship in a company etc.,

The progress of this project is evaluated based on a minimum of two reviews. The review committee will be constituted by the Head of the Department. A project report is to be submitted at the end of the project. The final end semester exam will be evaluated jointly by external and internal examiners based on oral presentation and the demonstration of the project work.

TOTAL: 300 PERIODS

COURSE OUTCOMES:

The students would be able to:

CO1: Apply the knowledge gained from theoretical and practical courses in solving problems

CO2: Attain confidence towards design and fabrication

CO3: Plan and create the products, organize the work schedule and coordinate among themselves

PR7811-PROJECT WORK																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Apply the knowledge gained from theoretical and practical courses in solving problems	3	3	2	1	2	1	1	2	3	2	3	3	3	3	3
CO2	Attain confidence towards design and fabrication	3	3	2	1	2	1	1	2	3	2	3	3	3	3	3
CO3	Plan, Organize, Create the products and, Coordinate among themselves.	3	3	2	1	2	1	1	2	3	2	3	3	3	3	3
PO & PSO (Average)		3.0	3.0	2.0	1.0	2.0	1.0	1.0	2.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0

CY7001 CHEMISTRY FOR SMART MATERIALS MANUFACTURING L T P C
3 0 0 3

OBJECTIVES:

- Basic concepts, types and industrial application of shape memory alloys
- To emphasize the importance of cutting fluids and its effect in the manufacturing process
- To understand the efficiency of electrochemical energy systems for industrial application
- To familiarize the stages, measurement and control of wear
- To know about battery technology and disseminate the student about clean and green alternate energy sources

UNIT I SHAPE MEMORY ALLOYS 9

Shape Memory Alloys – Introduction, one way memory effect, two way memory effect – Types (copper-aluminium-nickel, and nickel-titanium (Ni-Ti) alloys), manufacturing methods, properties, crystal structures, applications and limitations.

UNIT II CUTTING FLUIDS 9

Cutting Fluids – definition, types - oil, water, emulsion fluid as coolant and lubricant, selection parameters for cutting fluids, functions of cutting fluid- shear – strength reduction mechanism, applications, preparation of demineralized water (ion exchange method and permanganate method).

UNIT III ELECTROCHEMICAL ENERGY SYSTEMS 9

Electrochemical cell, definition, types – difference between a galvanic cell and an electrolytic cell – a Daniel cell – electrochemical cell notations – the origin of the electrode potential – measurement of electrode potential – derivation of Nernst equation – applications (EMF measurement) – Electrodes – types – ion selective electrodes – principle and applications – reference electrode – primary and secondary electrodes – Determination of pH of a solution using glass and calomel electrodes – concentration cells.

UNIT IV WEAR MECHANISM 9

Wear – definition, stages of wear (primary, secondary, tertiary), types – adhesive, abrasive, surface fatigue, fretting, erosion wear, measurement – Tribometry (Pin/ball on disc method), control of wear – Lubrication – theory, mechanism, types of lubricants (liquid, semi-solid, solid and gaseous), selection of lubricants.

UNIT V BATTERY TECHNOLOGY AND ENERGY SOURCES 9

Battery technology: Principle, characteristics – classification – applications – Dry cells, Lead - acid, alkaline, Nickel – cadmium and Lithium batteries, discharging and recharging mechanism. Fuel cells – merits – types – H_2 – O_2 Fuel cells, alkaline fuel cells, PEMFC, MCFC, SOFC. Alternate energy sources – nuclear energy, hydro energy, wind energy, bio energy and solar cells, UPS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Gain knowledge about shape memory alloys and identify new areas of applications.

CO1: Gain knowledge about shape memory alloys and identify new areas of applications

CO2: Able to prepare , categorize different types of cutting fluids and choose suitable type for a given manufacturing process

CO3: Capacity to describe the working principle, parts and application of an electrochemical cell and distinguish its types

CO4: Able to measure wear rate, identify its type and select lubricants to control it

CO5: Able to compare and select batteries based on their working principle, functional characteristics and application .Review alternate energy sources

TEXT BOOKS:

1. Kannan P, Ravikrishnan A, “Engineering Chemistry”, Sri Krishna Hitech Publishing Company Pvt. Ltd. Chennai, Revised Edition, 2014.
2. Jain P.C. and Monika Jain., “Engineering Chemistry”, Dhanpat Rai Publishing Company Pvt Ltd, New Delhi, Revised Paper Back edition, 2014.

REFERENCES

1. Sivasankar, B., “Engineering Chemistry”, Tata McGraw-Hill Publications Co Ltd, New Delhi, 1st edition, 2008.
2. Sharma, B. K., “Engineering Chemistry”, Krishna Prakasan Media Pvt Ltd., Meerut, 7th edition, 2005.
   Alexander Thaler, Daniel Watzenig, “Automotive Battery Technology” , Springer International Publishing 2014.
3. Dara S.S, Umare S.S., “Engineering Chemistry”, S. Chand and Company Ltd., New Delhi,1st edition, 2014

CY7001 CHEMISTRY FOR SMART MATERIALS MANUFACTURING																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Gain knowledge about shape memory alloys and identify new areas of applications	3	-	2	-	-	-	-	-	-	-	-	1	-	3	3
CO2	Able to prepare , categorize different types of cutting fluids and choose suitable type for a given manufacturing process	2	2	3	2	-	1	1	-	-	-	-	-	3	2	3
CO3	Capacity to describe the working principle, parts and application of an electrochemical cell and distinguish its types	2	-	2	-	-	-	-	-	-	-	-	-	1	1	-
CO4	Able to measure wear rate, identify its type and select lubricants to control it	3	2	2	1	-	1	1	-	-	-	-	-	2	2	3
CO5	Able to compare and select batteries based on their working principle, functional characteristics and application .Review alternate energy sources	3	2	1	2	-	2	1	-	-	-	-	1	-	2	2
PO & PSO (Average)		2.6	2.0	2.0	1.7	-	1.3	1.0	-	-	-	-	1.0	2.0	2.0	2.8

CY7002 SURFACE MODIFICATIONS AND ANALYTICAL TECHNIQUES **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To provide overview of in the fields of corrosion and its control
- To create awareness on types, properties and applications of abrasives and refractories.
- To introduce to various metallic coatings processes
- To educate on various types of chemical conversion and organic coatings
- To introduce to various surface characterization tools.

UNIT I CORROSION AND ITS CONTROL **9**

Introduction- chemical and electrochemical corrosions- mechanism of electrochemical and galvanic corrosions- concentration cell corrosion- passivity- soil, pitting, inter-granular, water line, stress and microbiological corrosions- galvanic series- factors influencing corrosion - measurement of corrosion rate. Corrosion control – material selection and design - electrochemical protection – sacrificial anodic protection and impressed current cathodic protection.

UNIT II ABRASIVES AND REFRACTORIES 9

Abrasives: definition, classification or types, grinding wheel, abrasive paper and cloth. Refractories: definition, characteristics, classification, properties – refractoriness and RUL, dimensional stability, thermal spalling, thermal expansion, porosity; Manufacture of refractories – general method; acidic refractories – fire clay, silica; basic refractories – magnesite, dolomite; neutral refractories – silicon carbide, zircon.

UNIT III METALLIC COATINGS 9

Definition – methods of metallic coating, hot dipping - galvanizing, tinning, metal cladding, electroplating, electroless plating. Various other metallic coatings – displacement plating- Kanigen process – metal spraying or metallised coating – cementation or diffusion coatings.

UNIT IV CHEMICAL CONVERSION AND ORGANIC COATINGS 9

Chemical Conversion coatings- Types- phosphate, chromate, chemical oxide and anodized (Aluminium) coatings -Organic coatings- paint, vehicle or drying oil, thinners, driers- Formulation of paints, failure of paint film- Varnishes, Enamels, Lacquers, Epicoating, Emulsion Paints-types, advantages and disadvantages – Special paint.

UNIT V SURFACE CHARACTERIZATION 9

Surface–Interface–Bulk–Definition,– Principle- instrumentation- block diagram-data analysis and applications of Scanning Electron Microscopy (SEM) and Transmission electron microscopy (TEM) – Atomic Force Microscopy (AFM), Surface Analysis by Brunauer–Emmett–Teller (BET) Method – X-Ray Photoelectron Spectroscopy, Surface coating thickness measurements (thin and thick – Profilometry).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of course, the student will be able

CO1: To review the various corrosion and methods to combat corrosion.

CO2: To compare the properties and typical applications of abrasives and refractories.

CO3: To discuss on the various metallic coatings processes.

CO4: To choose a type of chemical conversion and organic coating for typical applications

CO5: To state the various surface characterization tools and their capability

TEXT BOOKS

1. Kannan P., Ravikrishnan A., “Engineering Chemistry”, Sri Krishna Hitech Publishing Company Pvt. Ltd. Chennai, 2014
2. Jain P.C. & Monica Jain., “Engineering Chemistry”, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2014.

REFERENCE

1. Dara S.S, Umare S.S. “Engineering Chemistry”, S. Chand & Company Ltd., New Delhi, 2014.

CY7002 SURFACE MODIFICATIONS AND ANALYTICAL TECHNIQUES																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	To review the various corrosion and methods to combat corrosion.	2	2	3	2	2	2	3	1	1	1	1	1	1	2	2
CO2	To compare the properties and typical applications of abrasives and refractories.	1	1	2	1	1	2	1	1	-	1	-	1	1	1	3
CO3	To discuss on the various metallic coatings processes.	2	2	2	2	1	2	1	1	1	1	-	1	2	3	3
CO4	To choose a type of chemical conversion and organic coating for typical applications	2	3	3	2	1	2	2	1	2	1	1	1	2	3	3
CO5	To state the various surface characterization tools and their capability	1	1	1	2	2	1	-	1	1	1	-	2	1	1	1
PO & PSO (Average)		1.6	1.8	2.2	1.8	1.4	1.8	1.75	1	1.25	1	1	1.2	1.4	2	2.4

GE7071 DISASTER MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I INTRODUCTION TO DISASTERS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies

.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources

UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as
- mitigation.
- Draw the hazard and vulnerability profile of India, Scenarious in the Indian context,
- Disaster damage assessment and management.

TEXT BOOKS:

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

REFERENCES

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

GE7074 **HUMAN RIGHTS** **L T P C**
3 0 0 3

OBJECTIVE:

- To sensitize the Engineering students to various aspects of Human Rights.

UNIT I **9**

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

UNIT II **9**

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

UNIT III **9**

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV **9**

Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V **9**

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.

TOTAL : 45 PERIODS

OUTCOME :

- Engineering students will acquire the basic knowledge of human rights.

REFERENCES:

1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.
2. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.

GE7351 **ENGINEERING ETHICS AND HUMAN VALUES** **L T P C**
3 0 0 3

OBJECTIVES

- To emphasise into awareness on Engineering Ethics and Human Values.
- To understand social responsibility of an engineer.
- To appreciate ethical dilemma while discharging duties in professional life.

UNIT I HUMAN VALUES **3**

Morals, Values and Ethics – Integrity – Work Ethic – Honesty – Courage –Empathy – Self-Confidence – Discrimination- Character.

UNIT II ENGINEERING ETHICS **9**

Senses of 'Engineering Ethics' - variety of moral issues - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest –Professional Ideals and Virtues - uses of ethical theories. Valuing Time – Co-operation – Commitment

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as experimentation - engineers as responsible experimenters - codes of ethics – Importance of Industrial Standards - a balanced outlook on law – anticorruption- occupational crime -the challenger case study.

UNIT IV ENGINEER'S RIGHTS AND RESPONSIBILITIES ON SAFETY 12

Collegiality and loyalty – Respect for authority – Collective Bargaining – Confidentiality- Conflict of interest – Occupational Crime – Professional Rights – IPR- Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the Three Mile Island, Bhopal Gas plant and Chernobyl as case studies.

UNIT V GLOBAL ISSUES 12

Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership-Sample code of conduct.

TOTAL : 45 PERIODS

OUTCOMES

- Students will have the ability to perform with professionalism , understand their rights , legal , ethical issues and their responsibilities as it pertains to engineering profession with engaging in life-long learning with knowledge of contemporary issues.

TEXT BOOKS

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York 2005.
2. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics –Concepts and Cases", Wadsworth Thompson Leatning, United States, 2000 (Indian
3. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

REFERENCES

1. Charles D. Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey, 2004
2. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Leatning, United States, 2000
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford Press , 2000
5. R.Subramanian , "Professional Ethics ",Oxford University Press ,Reprint ,2015.

MF7072 ELECTRONIC MATERIALS AND PROCESSING L T P C

3 0 0 3

COURSE OBJECTIVES:

- To describe the basic processes of materials that are used to fabricate semiconductor and MEMS devices.
- To gather the knowledge on organic material and its manufacturing techniques.
- To acquire the basics of micro-electromechanical system integration on chip
- To understand the process electronics fabrication in packing and assembly.
- To learn the thermal considerations of electronic materials for reliability.

UNIT I INTRODUCTION 9

Overview of semiconductors and other basic materials - Plastics, Elastomers, and Composites - tables with material properties, terms and definitions, trade names, and material structure correlation, basic electronic components and its metallurgical structure. Carrier generation and recombination; junctions; photovoltaic materials and devices.

UNIT II ORGANIC MATERIALS AND PROCESSES 9

Types and properties of organic materials, manufacturing technique –Vacuum Metallization, Vapour phase deposition, Thermal Imaging, Digital Lithography, Application areas.

UNIT III MEMS MATERIALS AND PROCESS 9

MEMS design process- Methods, Selection of materials for process, Optimization techniques in design, Over view of additive process of Semiconductors, Dielectric materials, Metals, and Polymer Materials, Piezoelectric materials, Shape memory alloys , Micromachining techniques, packaging methods.

UNIT IV MATERIALS SYSTEMS 9

Solder technologies for electronic packaging and assembly, Electroplating and Deposited metallic coatings, Printed circuit board fabrication, Materials and Processes for Hybrid Microelectronics and Multichip modules. Adhesives under fills, and Coatings in electronics assemblies.

UNIT V THERMAL MANAGEMENT OF MATERIALS AND SYSTEMS 9

Temperature effects on circuit operation and physical construction. Laws of heat transfer mechanism and their considerations in the manufacturing process. Thermal management in packaging of electronic materials

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1:Familiarize the various electronic materials and its fundamentals.
CO2:Know the use of organic materials and processes in electronics
CO3:Describe the MEMS materials and process.
CO4:Explain the packaging and assembly of electronics
CO5:Aware and apply the concepts of thermal effects of electronic materials

TEXT BOOKS:

1. Charles A. Harper , “Electronic Materials and Processes Hand book”, McGraw-Hill, 2010.
2. Reza Ghodssi, Pinyen Lin, “MEMS Materials and Process Handbook”, Springer, 2011.

REFERENCES:

1. Hagen Klauk, Organic Electronics, “Materials, Manufacturing and Applications”, Wiley - VCH VerlagGmbh and Co, 2006.
2. Merrill L. Minges, “Electronic Materials Handbook”, ASM international, 1989.
3. Franky So, “Organic Electronics: Materials, Processing, Devices and Applications”, CRC Press, 2009.

MF7072 ELECTRONIC MATERIALS AND PROCESSING																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Familiarize the various electronic materials and its fundamentals.	2	1	1	1	1	1	1	1	-	-	-	2	1	1	1
CO2	Know the use of organic materials and processes in electronics	2	1	1	1	1	1	1	1	-	-	-	2	1	1	1
CO3	Describe the MEMS materials and process.	2	1	1	1	1	1	1	1	-	-	-	2	1	1	1
CO4	Explain the packaging and assembly of	2	1	1	1	1	1	1	1	-	-	-	2	1	1	1

	electronics															
CO5	Aware and apply the concepts of thermal effects of electronic	2	1	1	1	1	1	1	1	-	-	-	2	1	1	1
PO & PSO (Average)		2	1	1	1	1	1	1	1	-	-	-	2	1	1	1

PR7001 ADVANCES IN OPERATIONS RESEARCH L T P C
3 0 0 3

COURSE OBJECTIVES:

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

- To understand the basics of operation research and its engineering application
- To gain knowledge on linear and its techniques
- To gain knowledge on non- linear programming and its techniques
- To apply basic concepts of mathematics to formulate an integer programming.
- To gain the basic concepts of networking techniques

UNIT I INTRODUCTION 9

Optimization – Historical Development – Engineering applications of optimization – Statement of an Optimization problem – classification of optimization problems.

UNIT II CLASSIC OPTIMIZATION TECHNIQUES 9

Linear programming– simplex method – dual simplex method – revised simplex method – duality in LP – Sensitivity Analysis - Parametric Linear programming.

UNIT III NON-LINEAR PROGRAMMING 9

Introduction – Lagrangian Method – Kuhn-Tucker conditions – Quadratic programming – Separable programming – Stochastic programming

UNIT IV INTEGER PROGRAMMING 9

Cutting plane algorithm – Branch and bound technique - Zero-one implicit enumeration; Goal programming – geometric programming; Network Techniques – Shortest Path Model – Minimum Spanning Tree Problem – Maximal flow problem.

UNIT V DYNAMIC PROGRAMMING 9

Formulation – Application to capital budgeting, reliability improvement, shortest path, solution of LP using DP.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Apply the basic and advanced techniques of operations research
CO2: Provide a formal quantitative approach to problem solving and an intuition about situations where such an approach is appropriate
CO3: Introduce some widely used advanced operations research models.
CO4: Identify and develop operational research models from the verbal description of the real system.
CO5: Solve operation research problems using algorithms

TEXT BOOKS:

1. Panneerselvam. R., "Operations Research", Prentice Hall of India Private Limited, New Delhi ,2005.
2. Sharma.S.D., "Operations Research: Theory, Methods and Applications", KedarNath Ram Nath publisher, 15th edition, 1972.

REFERENCES:

1. Gupta. P.K. and Man-Mohan, "Problems in Operations Research", Sultan chand and Sons, 1994.
2. Ravindran, Philips and Solberg, "Operations Research Principles and Practice", John Wiley and Sons, Singapore, 1992.
3. Sharma.J.K., "Operations Research Theory and Applications" – Macmillan India Ltd.,1997.
4. Hamdy A. Taha, "Operations Research – An Introduction", Prentice Hall of India, 1997.

PR7001 ADVANCES IN OPERATIONS RESEARCH																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Apply the basic and advanced techniques of operations research	3	1	3		3	2			1		3	3	1	1	3
CO2	Provide a formal quantitative approach to problem solving and an intuition about situations where such an approach is appropriate	3	1	3		3	2			2		3	3	1	1	3
CO3	Introduce some widely used advanced operations research models.	3	1	3		3	2			2		3	3	2	1	3
CO4	Identify and develop operational research models from the verbal description of the real system.	3	1	3		3	2			2		3	3	1	1	3
CO5	Solve operation research problems using algorithms	3	1	3		3	2			2		3	3	3	1	3
PO & PSO (Average)		3	1.00	3	-	3	-	-	-	1.8	-	3	3	1.6	1	3

PR7002 **APPLIED HEAT TRANSFER** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To introduce the basic concepts and the science behind heat transfer.
- To understand the mechanism of steady and unsteady conduction heat transfer and extended surfaces
- To learn the convective heat transfer
- To understand the concepts of radiation heat transfer
- To learn the thermal analysis and sizing of heat exchangers

UNIT I MODES OF HEAT TRANSFER 9

Modes of heat transfer - effect of temperature on thermal conductivity of different solids, liquids and gases- derivation of generalized equation in Cartesian ,cylindrical and spherical coordinates and its reduction to specific cases- General laws

UNIT II CONDUCTION 9

Fourier's law- One dimensional steady state conduction- heat conduction through plane and composite walls, cylinders and spheres-electrical analogy-critical radius of insulation for cylinder and sphere, overall heat transfer coefficient- Transient heat conduction- lumped heat capacity analysis, time constant, transient heat conduction in solids with finite conduction and convective resistances -Heat transfer from extended surface-Types of fin, heat flow through rectangular fin, infinitely long fin, fin insulated at the tip and fin losing heat at the tip-efficiency and effectiveness of fin-Biot number-Estimation of error in temperature measurement in a thermometer well.

UNIT III CONVECTION 9

Newton's law of cooling-Dimensional analysis applied to forced and free convection- dimensionless numbers and their physical significance-empirical correlations for free and forced convection - Continuity, momentum and energy equations-thermal and hydrodynamic boundary layer-Blasius solution for laminar boundary layer- General solution of Von-Karman integral momentum equation

UNIT IV RADIATION 9

Absorptivity, reflectivity and transmissivity- black, white and grey body-emissive power and emissivity-laws of radiation – Planck, Stefan-Boltzmann, Wein's displacement, Kirchhoff's law, intensity of radiation and solid angle- Lambert's cosine law

Radiation heat exchange between black bodies, shape factor, heat exchange between non-black bodies- infinite parallel planes and infinite long concentric cylinders- radiation shield- heat exchange between two grey surfaces- electrical analogy

UNIT V HEAT EXCHANGER 9

Classification- heat exchanger analysis- LMTD for parallel and counter flow exchanger- condenser and evaporator- overall heat transfer coefficient- fouling factor- correction factors for multi pass arrangement- effectiveness and number of transfer unit for parallel and counter flow heat exchanger- introduction of heat pipe and compact heat exchanger

TOTAL:45 PERIODS

OUTCOMES:

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

CO1: Understand basic concept of heat transfer and write the general governing equation
CO2: Do calculation for steady and transient heat conduction problems
CO3: Model convective heat transfer and solve problems
CO4: Apply scientific and engineering principles in the radiative heat transfer solve problems.
CO5: Analyze and design aspects heat exchanger and solve problems

TEXT BOOKS:

1. Nag. P.K., “Heat and Mass Transfer” ,McGraw Hill, 3rd edition, 2011.
2. Yunus Cengel, “Heat and Mass Transfer: Fundamentals and Application”, McGraw Hill, 5th edition, 2014.

REFERENCES:

1. Incropera and Dewitt, “Fundamental of Heat and Mass Transfer”, Wiley Publication, 7th edition.
2. Mills and Ganesan, “Heat Transfer”, Pearson Education , 2nd edition, 2009.
3. Holman. J P , “Heat Transfer”, McGraw Hill , 10th edition, 2011.
4. Rajput. R. K, “Heat and Mass Transfer”, S.Chand Publication, 2007.
5. Dutta, Binay K, “Heat Transfer: Principles and Applications” , PHI Publication , 1st edition, 2006.

PR7002 APPLIED HEAT TRANSFER																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Understand basic concept of heat transfer and write the general governing equation	3	3	3	2	1	1	1		1	1		2	3	2	1
CO2	Do calculation for steady and transient heat conduction problems	3	3	3	3	1	1	1		1	1		2	3	2	1
CO3	Model convective heat transfer and solve problems	3	3	3	2	1	1	1		1	1		2	3	2	1
CO4	Apply scientific and engineering principles in the radiative heat transfer solve problems.	3	3	3	2	1	1	1		1	1		2	3	2	1
CO5	Analyze and design aspects heat exchanger and solve problems	3	3	3	2	1	1	1		1	1		2	3	2	1
PO & PSO (Average)		3	3	3	2.2	1	1	1	-	1	1	-	2	3	2	1

PR7003 APPLIED PROBABILITY AND STATISTICS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce the concept of probability so that they can be used for industrial applications.
- To stress upon the importance of the sampling theory and its usefulness in industrial quality control.
- To make students familiarize with the concepts of estimation theory and its applications.
- To help students the usefulness of test of significance and its applications in industry and research.
- To train the students so that students will be able to design experimental designs and use these concepts for research design.

UNIT I PROBABILITY THEORY 9

Random variables – probability density and distribution functions-moment generating and characteristic functions – Binomial, Poisson, Normal distributions and their applications.

UNIT II SAMPLING THEORY 9

Sampling distributions – Standard error – t, F, Chi square distributions – applications.

UNIT III ESTIMATION THEORY 9

Interval estimation for population mean, standard deviation, difference in means, difference in proportions, ratio of standard deviations – point estimation.

UNIT IV TESTING OF HYPOTHESIS 9

Hypothesis testing – Small samples – Tests concerning proportion, means, standard deviations – Tests based on chi square.

UNIT V ANOVA 9

One, two factor models – Design of experiments, MANOVA.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Able to analyze the performance in terms of probabilities and distributions achieved by the determined solution
CO2: Aware of various test statistics for the samples
CO3: Able to develop an ability to apply statistical tests in experiments as well as to analyze and interpret data
CO4: Able to use the statistical tools for their project and future research
CO5: Able to use the concepts in design of experiments in real life problems

TEXT BOOKS:

1. Richard I.Levin and David S. Rubin, “Statistics for Management”, Pearson India, 2013.
2. John E.Freunds, “Mathematical statistics”, Pearson Education, 8th edition, 2012

REFERENCES:

1. Hooda.R.P., “Statistics for business and economics”, Vikas 2013
2. Gupta.S.C. and Kapoor.V.K, “Fundamentals of Mathematical Statistics”, Sultanchand, 2014.

PR7003 APPLIED PROBABILITY AND STATISTICS																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Able to analyze the performance in terms of probabilities and distributions achieved by the determined solution	1	3	1	2	3	1				1	1			2	2
CO2	Aware of various test statistics for the samples	1	1	1	2	1								1	1	
CO3	Able to develop an ability to apply statistical tests in experiments as well as to analyze and interpret data	3	2	1	3	2					1				2	2
CO4	Able to use the statistical tools for their project and future research	3	2	2	3	2	1					1	1		2	2
CO5	Able to use the concepts in design of experiments in real life problems	2	2	3	3	2	1						2		2	3
PO & PSO (Average)		2	2	1.6	2.6	2	1	-	-	-	1	1	1.5	1	1.8	2.25

PR7004 CONCEPTS OF GREEN MANUFACTURING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To expose the students to the basics of environmental sustainability and impact assessment objectives.
- To incorporate knowledge about the environmental based improvements towards lean manufacturing systems.
- To analyze various machineries with intent to conserve energy
- To analyze hazardous and solid wastes with intent to point out areas of adverse environmental impact and how this impact could be minimized or prevented.
- To impart the knowledge about environmentally sustainable practices.

UNIT I ENVIRONMENTAL SUSTAINABILITY AND IMPACT ASSESSMENT 9

Environmental impact assessment objectives – Legislative development – European community directive – Hungarian directive. Strategic environmental assessment and sustainability appraisal. Regional spatial planning and environmental policy.

UNIT II LEAN MANUFACTURING AND GREEN ENERGY SYSTEM 9

Conventional Manufacturing versus Lean Manufacturing – Principles of Lean Manufacturing. World energy consumption – Green house effect, Global warming. Energy conservation and measurement principles with their applicability in engineering and process industries.

UNIT III ENERGY SAVING MACHINERY AND COMPONENTS 9

Electricity Billing: Components and Costs – kVA – Need and Control – Determination of kVA demand and Consumption. Selection of fans, pumps and Compressors – Performance Evaluation – Cause for inefficient operation – scope for energy conservation.

UNIT IV HAZARDOUS AND SOLID WASTE MANAGEMENT 9

Hazardous waste : definition, terminology, classification and Sources – Need for hazardous waste management: Need, Handling, methods of collection, storage and transport with suitable examples. Solid waste management : Need, Waste prevention and Life cycle assessment. Collection, storage, reuse and recycling of solid waste with suitable examples.

UNIT V SUSTAINABILITY PRACTICE 9

The origins of sustainable development – Nature preservation and emergence of sustainable development. Environmental degradation, over population and intensification. Risk society – Risk and environment – Environmental pollution – Manufacturing pollution.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the Concepts of environmental sustainability and environmental impact assessment objectives are well known to the students

CO2: Apply suitable schemes towards design of green manufacturing requirements

CO3: Analyze manufacturing processes towards conservation of energy

CO4: Analyze manufacturing processes towards minimization or prevention of hazardous and solid wastes

CO5: Acquire Knowledge about environmentally sustainable practices

TEXT BOOKS:

1. Ronald G. Askin and Jeffrey B. Goldberg, “Design and Analysis of Lean Production Systems”, John Wiley and Sons, 2003.
2. Stephen Doven, “Environment and Sustainability Policy : Creation, implementation, Evaluation”, The Federation Press, 2005.

REFERENCES:

1. Clive George, Collin.C, Kirkpolarice.H, “Impact Assessment and sustainable development”, Edward Elgar Publishing 2007.
2. “Green Manufacturing: Case Studies in Lean and Sustainability, Association for Manufacturing Excellence”, CRC press, 2007.
3. Chaigier N.A. “Energy Consumption and Environment”, McGraw Hill, 2007.
4. Hamies, “Energy Auditing and Conservation, Methods Measurements, management and Case Study”, Hemisphere, Washington, 1980.
5. Bhide A.D., Sundaresan B.B., “Solid Waste Management – Collection Processing and Disposal”, Mudrashilpa offset printers, Nagpur, 2001.
6. Gunther Seliger, Marwan, Khraisheh.K, Jawahir.I.S., “Advances in Sustainable Manufacturing”, 2011.

PR7004 CONCEPTS OF GREEN MANUFACTURING																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Understand the Concepts of environmental sustainability and environmental impact assessment objectives are well known to the students	1	1	2	1	2	2	2	-	-	2	2	2	2	2	3
CO2	Apply suitable schemes towards design of green manufacturing requirements	2	1	3	1	2	3	2	-	-	2	2	2	2	2	3
CO3	Analyze manufacturing processes towards conservation of energy	3	2	3	1	3	2	3	-	-	2	2	3	2	3	2
CO4	Analyze manufacturing processes towards minimization or prevention of hazardous and solid wastes	2	2	3	1	3	2	3	-	-	2	2	3	3	3	2
CO5	Acquire Knowledge about environmentally sustainable practices	3	2	3	1	3	2	3	-	-	2	2	3	3	3	2
PO & PSO (Average)		2.2	1.6	2.8	1	2.6	2.2	2.6	-	-	2	2	2.6	2.4	2.6	2.4

PR7005 DESIGN OF CASTING AND WELDMENTS **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To impart knowledge to the students about the principles of melting and pouring
- To impart knowledge on casting design
- To impart knowledge on weld design
- To understand the knowledge on physical metallurgy of welding
- To learn the mechanization of foundry and automation in welding

UNIT I MELTING AND POURING 9

Principles of melting practice-fluxing- Degasification and inoculation- Types of furnaces- Crucibles, Cupola, Oil fired furnaces – Electric arc and induction furnaces –Melting practice of cast iron, SG iron, steel, aluminum and copper alloys.

UNIT II CASTING DESIGN 9

Solidification of pure metals and alloys-shrinkage in cast metals-design of sprue, runner, gate and risers-problems in design and manufacture of thin and unequal sections - design for directional solidification, minimum distortion and for overall economy - design problems of L,T,V,X and Y junctions.

UNIT III WELD DESIGN 9

Design of welded components-symbolic representation of welds on drawings- residual stresses in welds-weld distortions-design consideration-strength consideration of welded joints-analysis of statistically loaded welded joints-welded structures subjected to fatigue loads

UNIT IV PHYSICAL METALLURGY OF WELDING 9

Welding of ferrous materials: Formation of different micro structural zones in welding of carbon steels. Welding of C-Mn and low-alloy steels, phase transformations in weld and heat - affected zones, cold cracking, role of hydrogen and carbon equivalent, formation of acicular ferrite and effect on weld metal toughness.

UNIT V AUTOMATION 9

Layout of mechanized foundry – sand reclamation – material handling in foundry pollution control in foundry — Computer aided design of casting and Automation in welding – robot welding – safety norms.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The student will be able to melt and pour metals.

CO1: The student will be able to melt and pour metals.
CO2: The student will be able design cast alloys.
CO3: The student will be able to design weldments.
CO4: The student will be able to find physical metallurgy of weldments.
CO5: The student will be able to mechanize foundry and automate welding processes.

TEXT BOOKS:

1. Parmar,R.S., Welding Processes and Technology, Khanna Publishers, 2006.
2. Jain,P.L., Principles of Foundry Technology, Tata McGraw Hill, 2006.

REFERENCES:

1. A.S.M Hand book, vol 15, casting, ASM international, 1988.
2. Klas Weman, welding processes hand book, CRC press, 2003.
3. Cary and Howard,B., Modern Welding Technology, Prentice-Hall, 1989.
4. Heine, R.W., Loper.L.R., and Rosenthal,C, Principles of Metal Casting, Tata McGraw Hill, 1986.
5. ASM Handbook vol.6, welding Brazing & Soldering, 2003.

PR7005 DESIGN OF CASTING AND WELDMENTS																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	The student will be able to melt and pour metals.	3	2	2	2	3	1	1	1	2	2	1	2	2	3	2
CO2	The student will be able design cast alloys.	3	2	3	2	3	1	1	1	2	2	1	2	2	3	3
CO3	The student will be able to design weldments.	3	2	3	2	3	1	1	1	2	2	1	2	2	3	3
CO4	The student will be able to find physical metallurgy of weldments.	3	2	3	2	3	1	1	1	2	2	1	2	2	3	3
CO5	The student will be able to mechanize foundry and automate welding processes.	3	2	3	2	3	1	1	1	2	2	1	2	2	3	3
PO & PSO (Average)		3	2	2.8	2	3	1	1	1	2	2	1	2	2	3	2.8

PR 7006 DESIGN OF JIGS, FIXTURES AND DIES L T P C
3 0 0 3

COURSE OBJECTIVES:

- To select proper location and clamping of the components.
- To study principles of designing jigs, fixtures and dies for industrial applications.
- To design and manufacturing of tools, Jigs & fixture, dies & moulds, press tools.
- To Develop and design of progressive and compound dies for simple sheet metal operations Calculate bending force, number of draw for the required cup shape, blank size for forged components.
- To Design and drafting various Jigs and Fixtures and Dies using appropriate software package.

UNIT I LOCATION AND CLAMPING DEVICES IN JIGS AND FIXUTRES 9

Principles of Jigs and Fixture – Design concepts – Different types of locating devices – different types of clamps – Drill bushes – types – Elements of fixtures.

UNIT II DESIGN OF JIGS AND FIXTURES 9

Design concepts of Template Jig, Plate Jig, Sandwich Jig, Vice Jaw Jig, Latch Jig, Turnover Jig, Box Jig – Design of Jigs, Fixtures for Milling, Grinding, Turning, Welding, and Assembly – Modular fixtures.

UNIT III CONCEPTS OF DIES AND ITS ELEMENTS 9

Design concepts of the following elements of progressive, compound and Combination dies – Die block – Die shoe – Bolster plate – punch – punch plate – punch holder – guide pins and guide bushes – strippers – knockouts – stops - pilots – selection of standard die sets – strip layout and development.

UNIT IV DESIGN OF DIES 9

Design of Blanking, Piercing, lancing, notching and bending dies, Design features of dies for drawing, extrusion, wire drawing and forging, Design of Progressive die – compound die – combination die- Bending and drawing dies

UNIT V CASE STUDIES IN JIGS, FIXTURES AND DIES 9

Drill Jigs – Milling fixtures- Progressive die – compound die –combination die- Bending and drawing dies

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completing this course, students should be able to

CO1: Acquire knowledge about the Locating and Clamping Devices.

CO2: Design and develop the jigs and fixtures for a given component.

CO3: Understand the press working operations, design the strip layout and various elements of dies and design the blank development for bending, forming and drawing operations.

CO4: Develop and design of progressive, combination and compound dies for simple sheet metal operations

CO5: Understand the modern techniques of tool engineering and the various phases in computer aided fixture deign.

TEXT BOOKS:

1. Edward G.Hoffman, “Jigs and Fixtures Design”,Thomson-Delmar Learning, Singapore,2004.
2. Venkataraman.K ,”Design of Jigs Fixtures and Press Tools” ,Wiley press, Ane Books, Pvt Ltd, 2015.

REFERENCES:

1. Jones.E.J.H. “Jigs and Tool Design”, Ballou Press, 2009.
2. Paquin.J.R.,Crowley.R.E.,”Die Design Fundamentals”, Industrial Press Inc, New York, 1987.
3. Henriksen, Erik karl, “Jigs and Fixtures Design Manual”, Industrial Press Inc, New York, 1973.
4. Joshi.P.H., ”Design of Jigs and Fixtures”, McGraw-Hill Education India, 2013.
5. Balachandran.V., “Design of Jigs Fixtures and Press Tools”, Motion Press, India, 2015.

PR 7006 DESIGN OF JIGS, FIXTURES AND DIES																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Acquire knowledge about the Locating and Clamping Devices.	2	3	2	2	3	2	2	2	1	1	1	2	2	1	3
CO2	Design and develop the jigs and fixtures for a given component.	2	3	2	1	3	2	2	1	1	1	1	2	2	1	3

CO3	Understand the press working operations, design the strip layout and various elements of dies and design the blank development for bending, forming and drawing operations.	2	3	2	2	3	2	2	2	1	1	1	2	2	1	3
CO4	Develop and design of progressive, combination and compound dies for simple sheet metal operations	2	3	2	1	3	2	2	1	1	1	1	2	2	1	3
CO5	Understand the modern techniques of tool engineering and the various phases in computer aided fixture deign.	2	3	2	2	3	2	2	2	1	1	1	2	2	1	3
PO & PSO (Average)		2	3	2	1.6	3	2	2	1.6	1	1	1	2	2	1	3

PR7007 GREEN ELECTRONICS MANUFACTURING L T P C
3 0 0 3

COURSE OBJECTIVES:

- Familiarize the various standards and legislation of modern electronic manufacturing.
- Know the conventional electronic processing and lead free electronic manufacturing techniques.
- Recognize the steps involved in assembly process and understand the need of recycle of electronics
- Implement reliability and product life cycle estimation tools in green electronic manufacturing.
- Demonstrate the green electronic manufacturing procedure in applications.

UNIT I INTRODUCTION TO GREEN ELECTRONICS 9

Environmental concerns of the modern society- Overview of electronics industry and their relevant regulations in China, European Union and other key countries- global and regional strategy and policy on green electronics industry. Restriction of Hazardous substances (RoHS) - Waste Electrical and electronic equipment (WEEE - Energy using Product (EuP) and Registration - Evaluation, Authorization and Restriction of Chemical substances (REACH).

UNIT II GREEN ELECTRONICS MATERIALS ANDPRODUCTS 9

Introduction to green electronic materials and products - Lead (Pb) -free solder pastes, conductive adhesives, halogen-free substrates and components. Substitution of non-recyclable thermosetting polymer based composites with recyclable materials X-Ray Fluorescence (XRF) for identifying hazardous substances in electronic products

UNIT III GREEN ELECTRONICS ASSEMBLY AND RECYCLING 9

Various processes in assembling electronics components - the life-cycle environmental impacts of the materials used in the processes - substrate interconnects . Components and process equipments used. Technology and management on e-waste recycle system construction, global collaboration, and product disassembles technology.

UNIT IV PRODUCT DESIGN AND SUSTAINABLE ECO-DESIGN 9

Stages of product development process in green design: Materials- Manufacturing - Packaging and use - End of Life and disposal - Design for recycling - Life Cycle Assessment (LCA), and Eco-design tools - Environmental management systems, and International standards - Eco-design in electronics industry

UNIT V CASE STUDIES 9

Reliability of green electronics systems , Reuse and recycle of End-of-Life(EOL) electrical and electronic equipment for effective waste management – Introduction of Green Supply Chain, and Modeling green products from Supply Chain point of view - A life-cycle assessment for eco-design of Cathode Ray Tube Recycling.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Implement concise awareness of standards and legislation of modern electronic manufacturing for green environment.
CO2: Explain the conventional electronic processing and lead free electronic manufacturing techniques.
CO3: Realize the assembly process and the need of recycle of electronics
CO4: Use reliability and product life cycle estimation tools for electronic manufacturing
CO5: Validate the green electronic manufacturing procedures in applications

TEXT BOOKS:

1. Lee H.Goldberg and Wendy Middleton, “Green Electronics/ Green Bottom Line”, Newnes Publications ,2000.
2. Sammy G. Shina, “Green Electronics Design and Manufacturing”, McGraw Hill., 2008.

REFERENCES:

1. David Austen, “Green Electronic Morning”, Ingleby Gallery, 2006.
2. Yuhang yang and Maode Ma, “Green Communications and Networks”, Springer Publication., 2014.
3. John Hu. Mohammed Ismail, “CMOS High Efficiency on – Chip Power Management”, Springer Publications 4th edition, 2011.

PR7007 GREEN ELECTRONICS MANUFACTURING																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Implement concise awareness of standards and legislation of modern electronic manufacturing for green environment.	2	1	2	1	1	1	3	1	-	-	-	1	1	3	2

CO2	Explain the conventional electronic processing and lead free electronic manufacturing techniques.	2	1	2	1	1	1	3	1	-	-	-	1	1	3	2
CO3	Realize the assembly process and the need of recycle of electronics	2	1	2	1	1	1	3	1	-	-	-	1	1	3	2
CO4	Use reliability and product life cycle estimation tools for electronic manufacturing	2	1	2	1	1	1	3	1	-	-	-	1	1	3	2
CO5	Validate the green electronic manufacturing procedures in applications	2	1	2	1	1	1	3	1	-	-	-	1	1	3	2
PO & PSO (Average)		2	1	2	1	1	1	3	1	-	-	-	1	1	3	2

PR7008 LEAN MANUFACTURING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce the lean manufacturing and identify the waste.
- To study the various tools for lean manufacturing (LM).
- To apply the above tools to implement LM system in an organization.
- To provide knowledge on perfect value creation process that has zero waste.
- To apply the lean manufacturing tools and techniques through case studies.

UNIT I INTRODUCTION TO LEAN MANUFACTURING 9

Conventional Manufacturing versus Lean Manufacturing – Identification and Elimination of wastes in all forms - Principles of Lean Manufacturing – Basic elements of lean manufacturing – Introduction to LM Tools.

UNIT II CELLULAR MANUFACTURING, JIT and TPM 9

Cellular Manufacturing – Types of Layout, Principles of Cell layout, Implementation. JIT – Principles of JIT and Implementation of Kanban. TPM – Pillars of TPM, Principles and implementation of TPM.

UNIT III SET UP TIME REDUCTION, TQM, 5S and VSM 9

Set up time reduction – Definition, philosophies and reduction approaches. TQM – Principles and implementation. 5S Principles and implementation - Value stream mapping - Procedure and principles, EOQ, EPQ.

UNIT IV SIX SIGMA 9

Six Sigma – Definition, statistical considerations, variability reduction, design of experiments – Six Sigma implementation

UNIT V CASE STUDIES **9**

Various case studies of implementation of lean manufacturing at industries.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Identify the waste in various manufacturing process.
CO2: Understand the principles of cellular manufacturing ,JIT AND TPM
CO3: Reduce the manufacturing time by applying concepts of TQM, 5S and VSM.
CO4: Get the knowledge on six sigma approach.
CO5: Get the knowledge on applying the lean manufacturing tools and techniques.

TEXT BOOKS:

1. Ronald G. Askin and Jeffrey B. Goldberg, "Design and Analysis of Lean Production Systems", John Wiley and Sons, 2003.
2. Lonnie Wilson, **"**How to Implement Lean Manufacturing", McGraw-Hill Professional; 1 edition, 2009.

REFERENCES:

1. Rother M. and Shook J, "Learning to See: Value Stream Mapping to Add Value and Eliminate Muda" , Lean Enterprise Institute, Brookline, MA.1999.
2. Mikell P. Groover, "Automation, Production Systems and Computer-Integrated Manufacturing", 3rd Edition, 2007.

PR7008 LEAN MANUFACTURING																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Identify the waste in various manufacturing process.	3	2	3	3	2	1	1	1	2	1	-	2	2	2	3
CO2	Understand the principles of cellular manufacturing ,JIT AND TPM	2	2	2	1	2	2	2	1	1	1	2	2	2	3	2
CO3	Reduce the manufacturing time by applying concepts of TQM, 5S and VSM.	2	2	1	1	3	3	3	1	1	1	2	1	3	2	2
CO4	Get the knowledge on six sigma approach.	3	3	2	2	3	1	2	1	1	1	-	2	3	3	3
CO5	Get the knowledge on applying the lean manufacturing tools and techniques.	3	3	3	2	3	1	2	2	2	2	2	2	3	2	3
PO & PSO (Average)		2.6	2.4	2.2	1.8	2.6	1.6	2	1.2	1.4	1.2	2	1.8	2.6	2.4	2.6

PR7009 MICRO ELECTRO MECHANICAL SYSTEMS AND NANO TECHNOLOGY **L T P C 3 0 0 3**

COURSE OBJECTIVES:

- To introduce the changes in properties of materials with dimension reduction and materials for MEMS.
- To provide overview of microfabrication processes applicable for MEMS.
- To introduce students on the working principle of typical micro-sensors, micro-actuators and MEMS devices and the role of packaging.
- To apply knowledge on strength of materials, thermal and design engineering in design of MEMS devices.
- To familiarize the properties and method of synthesis of nanomaterials and progress of MEMS to nano system.

UNIT I MATERIALS FOR MEMS AND MINIATURISATION 9

Definition – historical development – fundamentals – Scaling laws in miniaturization – Rigid Body dynamics, Electrostatic Forces, Electromagnetic properties, Electricity, diffusion property, optical property and Heat Transfer, Materials for MEMS and Microsystems – Si, Si compounds, Si Piezoresistors, GaAs, Quartz, Piezoelectric Crystals and Polymers – Doping of semiconductors – diffusion process.

UNIT II FABRICATION PROCESSES 9

Photolithography – photo resist applications, light sources and postbaking – Ion implantation – diffusion process – oxidation – thermal oxidation, silicon dioxide, oxidation rate, oxide thickness by colour – chemical vapour deposition – enhanced CVD – Physical vapour deposition – sputtering – deposition by epitaxy – etching – chemical and plasma etching. Bulk micromanufacturing – wet etching, dry etching and etch stop – surface micromachining – LIGA process – SLIGA process.

UNIT III MICROSYSTEM – WORKING PRINCIPLE AND PACKAGING 9

Microsensors – Optical, Pressure, Acoustic wave and Thermal sensors – Microactuation – thermal forces, shape memory alloys, piezoelectric crystals and Electrostatic Forces – MEMS with microactuators – Microgripper, Micromotor, microvalves and micropumps – Microaccelerometers – Microfluidics – micromirror array for video projection – Microsystem packaging – die level, device level and system level – Interfaces – Die preparation – surface bonding- wire bonding – sealing – Assembly of Microsystems – selection of packaging materials – signal mapping and transduction – pressure sensors packaging.

UNIT IV MICROSYSTEMS DESIGN 9

Static bending of thin plates – Mechanical Vibration – thin film mechanics – Design considerations – constraints, selection of materials, selection of Manufacturing processes, selection of signal transduction, electromechanical system and packaging – Process design – Mechanical Design Thermomechanical loading, Thermomechanical stress analysis, Dynamic Analysis and Interfacial fracture Analysis – simulation of Microfabrication process – Design of a Si die for a micropressure sensor – Fluid resistance in Microchannels – capillary electrophoresis network systems – Design of MEMS cell gripper – MOEMS – CMOS.

UNIT V NANO TECHNOLOGY 9

Classification of nano structures – effect of the nanometer length scale effects of nano scale dimensions on various properties – structural, thermal, chemical, mechanical, magnetic, optical and electronic properties – effect of nanoscale dimensions on biological systems. Fabrication methods – Top down processes – bottom up process – nano positioning systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the changes in properties of materials with reduction of dimensions by Scaling laws and choice of materials for MEMS.

CO2: Overview of principles of microfabrication techniques applicable for MEMS.

CO3: Familiarize on typical MEMS sensors, actuators and devices as well as packaging.

CO4: Apply knowledge on strength of materials, design and thermal engineering for development of MEMS

CO5: Understand on properties and method of synthesis of nanomaterials and their role in nano systems

TEXT BOOKS:

1. Tai– Ran Hsu, "MEMS and Microsystems Design and Manufacture", Tata-McGraw Hill, New Delhi, 2002.
2. Norio Taniguchi, "Nano Technology Oxford University Press", New York, 2003

REFERENCES:

1. Mark Madou, "Fundamentals of Microfabrication", CRC Press, New York, 1997.
2. "The MEMS Hand book", Mohammed Gad-el-Hak, CRC Press, New York
3. Charles P Poole, Frank J Owens, "Introduction to Nano Technology", John Wiley and Sons, 2003
4. Julian W. Hardner, "Micro Sensors, Principles and Applications", CRC Press 1993.
5. Ananthasuresh G.K. Vinoy K.J. Gopalakrishnan S. Bhat K.N and Aatre V.K., "Micro
6. and smart systems", Wiley India Pvt. Ltd., New Delhi, 2010
7. AkhleshLakhtakia , "The Hand Book of Nano Technology, Nanometer
8. Structure", Theory, Modeling and Simulations, Prentice-Hall of India (P) Ltd., New Delhi, 2007.
9. Rai-choudhury. P, "MEMS and MOEMS Technology and Application", PHI, New Delhi, 2009.

PR7009 MICRO ELECTRO MECHANICAL SYSTEMS AND NANO TECHNOLOGY																
Course Outcome	Statement	Programme Outcome												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Understand the changes in properties of materials with reduction of dimensions by Scaling laws and choice of materials for MEMS.	3	2	1	2	1	1	1	1	1	1	1	3	2	1	3
CO2	Overview of principles of microfabrication techniques applicable for MEMS.	1	2	1	2	2	3	2	1	1	1	1	1	3	2	3
CO3	Familiarize on typical MEMS sensors, actuators and devices as well as packaging.	2	3	2	1	2	1	2	1	1	1	-	1	1	1	2
CO4	Apply knowledge on strength of materials, design and thermal engineering for development of MEMS	3	3	3	3	3	1	1	1	2	3	2	1	3	3	3
CO5	Understand on properties and method of synthesis of nanomaterials and their role in nano systems	1	2	1	1	1	2	2	1	1	1	1	1	1	2	2
PO & PSO (Average)		2	2.4	1.6	1.8	1.8	1.6	1.6	1	1.2	1.4	1.25	1.4	2	1.8	2.6

PR7010 MICROMACHINING AND FABRICATION L T P C
3 0 0 3

COURSE OBJECTIVES:

- To educate on mechanism of machining in micro and nano level based on molecular dynamics.
- To introduce to various methods of microfabrication based on material addition.
- To introduce to various methods of micromachining with aid of high rate energy input.
- To introduce to micromachining processes based on abrasive flow and enhanced rheology.
- To introduce the concepts of hybrid machining for high material removal and surface finish.

UNIT I INTRODUCTION 9

Introduction to micromachining process – Classification of micromachining and nanomachining processes – Molecular dynamics (MD), principle of molecular dynamics simulation potential energy function – Boundary condition – MD simulation procedure.

UNIT II MICROFABRICATION METHODS 9

Methods of microfabrication — Electro deposition, Chemical vapour deposition, physical vapour deposition – Electro Chemical spark deposition – LIGA (Lithographie, Galvanoformung, Abformung) process.

UNIT III MECHANICAL MICROMACHINING 9

Ultrasonic machining – Abrasive jet machining – Abrasive water jet machining, water jet machining – Beam energy micromachining – Electron beam machining, electro discharge machining, ion beam machining, focused ion beam machining.

UNIT IV MICROMACHINING AND NANO FUNCTIONING WITH ABRASIVE FLOW 9

Process principle and description – Process Technology Selection of machine Effect of process parameter on performance – Mechanism of materials removal Magneto Rheological Nanofunctioning Process. Nano functioning – Smart Rheological fluids – Magneto Rheological polishing fluid – Rheological characteristics of MR fluid – MR Abrasive Flow Finishing Process – MR Jet Finishing technology .

UNIT V HYBRID MICRO MACHINING 9

Chemical Mechanical polishing – Electro chemical spark micro machining – Electro discharge grinding – Electrolytic in process dressing – Application.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand on the molecular dynamics mechanism in micro-nano machining
CO2: Familiarize on various methods of microfabrication based on material addition.
CO3: Get the Overview of various methods of micromachining with aid of high rate energy input.
CO4: Acquire Knowledge on micromachining processes based on rheology of abrasive medium.
CO5: Realize hybrid machining for better material removal and surface finish.

TEXT BOOKS:

1. Jain.V.K.,"Introduction to Micromachining", Narrosa Publishing house, 2nd edition 2014.
2. Mojtaba Kahrizi, "Micromachining Techniques for Fabrication of Micro and Nano Structures", InTech, Chapters published, 2012.

REFERENCES:

1. Sami Franssito, "Introduction to Micro fabrication", John wiley and sons, 2nd edition 2010.
2. Jain V.K., "Advanced machining process", Allied Publisher, Delhi, 2002.
3. Mohammed Gad-el-Hat,"The MEMS Hand book", CRC Press, 2nd edition, 2006.

PR7010 MICROMACHINING AND FABRICATION																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Understand on the molecular dynamics mechanism in micro-nano machining	3	2	3	3	2	1	1	1	2	1	-	2	2	2	3
CO2	Familiarize on various methods of microfabrication based on material addition.	2	2	2	1	2	2	2	1	1	1	2	2	2	3	2
CO3	Get the Overview of various methods of micromachining with aid of high rate energy input.	2	2	1	1	3	3	3	1	1	1	2	1	3	2	2
CO4	Acquire Knowledge on micromachining processes based on rheology of abrasive medium.	3	3	2	2	3	1	2	1	1	1	-	2	3	3	3
CO5	Realize hybrid machining for better material removal and surface finish.	3	3	3	2	3	1	2	2	2	2	2	2	3	2	3
PO & PSO (Average)		2.6	2.4	2.2	1.8	2.6	1.6	2	1.2	1.4	1.2	2	1.8	2.6	2.4	2.6

PR7011 MODERN CONCEPTS IN MANUFACTURING **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To learn the lean tools to attain optimum level in quality.
- To learn agile manufacturing to maintain high standards of quality and control the overall costs
- To develop the students to conserve energy and natural resources, and to ensure that they have minimal impact on the environment and society.
- To introduce students the basics of additive manufacturing/rapid prototyping and its applications in various fields
- To give students an introduction to the advanced intelligent manufacturing techniques.

UNIT I LEAN MANUFACTURING 9

Objectives of lean manufacturing-key principles and implications of lean manufacturing -traditional Vs lean manufacturing- flow-continuous improvement/Kaizen –worker involvement- 5S principles-elements of JIT - uniform production rate - Kanban system - Lean implementation, Reconciling lean with other systems - lean six sigma- lean and ERP - lean with ISO 9001:2000.

UNIT II AGILE MANUFACTURING 9

The Agile Production Paradigm – Agile Manufacturing Vs Mass Manufacturing - Agile Practices - Agile practice for product development - Manufacturing agile practices - Implementing new technology - A checklist, technology applications that enhance agility - agile technology make or buy decisions. - Costing for Agile Manufacturing practices - Creating the learning factory: Imperative for success, factory becoming a learning factory, building a road map for becoming a learning factory

UNIT III GREEN MANUFACTURING 9

Introduction to Green Manufacturing- impact of manufacturing in environmental ecology - green manufacturing strategies - Principles of green manufacturing and its efficiency – System model architecture and module- design and planning- control or tools for green manufacturing.(Qualitative Analysis, Consumption Analysis, Life Cycle Analysis, Efficiency, Sustainability tools). - Enabling techniques for assuring green manufacturing - Carbon footprint analysis and management of manufacturing processes

UNIT IV ADDITIVE MANUFACTURING 9

Overview- Additive Manufacturing Technology in product Development - CAD and Reverse Engineering - Data Processing for Additive Manufacturing Technology: CAD model preparation – Stereolithography – Stereo lithography Apparatus (SLA)- Principle, process, advantages and applications - Powder Based Additive Manufacturing Systems - Selective Laser Sintering – Principles of SLS process - Process, advantages and applications

UNIT V INTELLIGENT MANUFACTURING 9

Goals of AI in manufacturing- Methods for production equipment selection and layout, Heuristic scheduling of multiple resources, Fuzzy multiple attribute decision making methods- Application of neural networks and fuzzy sets to machining and metal forming.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Demonstrate the knowledge of Additive Manufacturing and Rapid Prototyping technologies

CO2: Apply the concepts of JIT, Lean Manufacturing, and Agile Manufacturing methodologies

CO3: Assess the product life cycle, impact on environment and development of green manufacturing processes

CO4: Implement variety of Additive Manufacturing (AM) technologies, their potential to support design and manufacturing

CO5: Apply artificial intelligence (AI) and data mining (DM) techniques to improve the efficiency Of manufacturing systems

TEXT BOOKS

1. Kusiak, Andrew , “Intelligent Manufacturing Systems”, Prentice Hall ,1st edition, 1990.
2. Badiru A.B., “Expert Systems Applications in Engineering and Manufacturing”, Prentice-Hall, New Jersey, 1st edition, 1992.

REFERENCES

1. Black .J.T. and Kohser R.A, "DeGarmo's Materials and Processes in Manufacturing", Published by Wiley, 11th edition, 2011.
2. John Schey, "Introduction to Manufacturing Processes", Tata McGraw-Hill Education ,3rd edition,1999 .
3. Christian N. Madu, "Handbook of environmentally conscious manufacturing", Springer US Publishers, 1st edition, 2001.
4. Rao R. V, "Advanced Modeling and Optimization of Manufacturing Processes", 2nd edition, 2006.
5. Ronald G. Askin and Jeffrey B. Goldberg, "Design and Analysis of Lean Production Systems", John Wiley and Sons, 2003.
6. Chowdiah.M.P., "Agile Manufacturing", IK International Publishing House Pvt Ltd, 2011.

PR7011 MODERN CONCEPTS IN MANUFACTURING																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Demonstrate the knowledge of Additive Manufacturing and Rapid Prototyping technologies	3	2	3	2	2		3	2		3	3	3	3	3	2
CO2	Apply the concepts of JIT, Lean Manufacturing, and Agile Manufacturing methodologies	3	2	3	2	2		3	2		3	3	3	3	3	2
CO3	Assess the product life cycle, impact on environment and development of green manufacturing processes	3	2	3	2	2		3	2		3	3	3	3	3	2
CO4	Implement variety of Additive Manufacturing (AM) technologies, their potential to support design and manufacturing	3	2	3	2	2		3	2		3	3	3	3	3	2
CO5	Apply artificial intelligence (AI) and data mining (DM) techniques to improve the efficiency Of manufacturing systems	3	2	3	2	2		3	2		3	3	3	3	3	2
PO & PSO (Average)		3	2	3	2	2		3	2		3	3	3	3	3	2

PR7012 MODERN PRODUCTION TECHNIQUES L T P C
3 0 0 3

COURSE OBJECTIVES:

- To fabricate quickly a scale model of a physical part or assembly using three-dimensional computer aided design (CAD) data.
- To impart knowledge of various casting, joining process used in manufacturing and provide adequate knowledge of quality test methods conducted on welded and casted components.
- To make the students to understand the various aspects of manufacturing of P/M components and the potential application of modern materials processing technique.
- To operate the production facilities efficiently and design the processes and equipment, plan and control the production orders, and satisfy product quality requirements.
- To improve quality of products by applying the quality concepts,

UNIT I RAPID PROTOTYPING AND RAPID TOOLING 9

Introduction-need- Development of Rapid Prototyping (RP) systems-RP process chain – Stereolithography -Fused Deposition Modeling- Laminated Object Manufacturing – 3 D Printing – Working Principle – Process Parameters – Advantages – Disadvantages – Applications – Rapid Tooling – Classification – Fabrication processes –Applications .

UNIT II ADVANCED CASTING AND WELDING PROCESSES 9

Stir Casting – Squeeze casting –process parameters -advantages-disadvantages – applications - Application of Ultrasonic Cavitations in Stir casting and Squeeze casting to produce metal matrix nanocomposites - Friction stir welding – Under water welding – Explosive welding – Metallizing – Hard facing – Spray welding - process parameters-advantages-disadvantages-applications.

UNIT III POWDER METALLURGY 9

Conventional methods and modern methods of metal powder manufacture - Blending techniques - Powder characterization -Powder compaction - Mechanical, thermal and thermo-mechanical compacting processes - Sintering mechanisms - Types of sintering furnaces -Manufacturing and application of powder metallurgy components - Bearings, Metallic filters, Magnets and Friction materials.

UNIT IV MANUFACTURING SUPPORT SYSTEMS 9

Advanced Manufacturing Planning -Aggregate Production Planning and the Master Production Schedule – Material Requirements Planning I - Material Requirements Planning II - Enterprise Resource Planning - Capacity Planning - Inventory Control.

UNIT V QUALITY MANAGEMENT 9

Software Quality Management – Metrics used for Software Quality Management – Capability Maturity Model Integration (CMII) – Case studies - Six Sigma – Concepts and Implementation – Case studies –Service Quality Management – Case studies.

TOTAL:45 PERIODS

COURSE OUTCOMES:

The students should have ability to select different types of manufacturing for various geometrical shapes of product.

CO1: The students should have ability to select different types of manufacturing for various geometrical shapes of product.
CO2: The students are familiarized with the recent advances in casting and welding techniques.
CO3: The student will be able to optimize economic aspects of production of components using powder metallurgy, developing a controlled microstructure and including the conservation of materials and energy.
CO4: The Student familiarized with the planning, scheduling and inventory control processes.
CO5: The students acquire the ability to apply the modern production techniques in industries.

TEXT BOOKS:

1. Andreas Gebhardt, “Rapid prototyping”, Hanser Gardener Publications,1st edition, 2003
2. John Campbell, ”Complete casting-Handbook”, Elsevier publication, 2011

REFERENCES:

1. Ali K. Kamrani, EmadAbouel Nasr, “Rapid Prototyping: Theory and practice”, Springer, 2010.
2. Henry Ericsson Thesis,”Handbook of metal forming Processes”, CRC press, 1999.
3. John Norrish ,”Advanced Welding Processes: Technologies and Process Control”, Woodhead Pub., 2006.
4. Randall German, “A-Z of Powder Metallurgy”, Elsevier, 2005.
5. Kanishka Bedi, ”Quality Management”, Oxford University Press, 2008.

PR7012 MODERN PRODUCTION TECHNIQUES																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	The students should have ability to select different types of manufacturing for various geometrical shapes of product.	2	3	2	2	3	2	2	2	1	1	1	2	2	1	3
CO2	The students are familiarized with the recent advances in casting and welding techniques.	2	3	2	1	3	2	2	1	1	1	1	2	2	1	3
CO3	The student will be able to optimize economic aspects of production of components using powder metallurgy, developing a controlled microstructure and including the conservation of materials and energy.	2	3	2	2	3	2	2	2	1	1	1	2	2	1	3
CO4	The Student familiarized with the planning, scheduling and inventory control processes.	2	3	2	1	3	2	2	1	1	1	1	2	2	1	3
CO5	The students acquire the ability to apply the modern production techniques in industries.	2	3	2	2	3	2	2	2	1	1	1	2	2	1	3
PO & PSO (Average)		2	3	2	1.6	3	2	2	1.6	1	1	1	2	2	1	3

PR 7013 NON DESTRUCTIVE TESTING METHODS L T P C
3 0 0 3

COURSE OBJECTIVES:

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

1. To understand principle behind various NDT techniques.
2. To learn working procedures of various NDT techniques.
3. To understand the concepts of NDT in various manufacturing processes.
4. To impart the knowledge in selection of required NDT for specific applications.
5. To learn the importance of inspection and its techniques.

UNIT I NON-DESTRUCTIVE TESTING: AN INTRODUCTION 9

Introduction to various non-destructive methods – Comparison of Destructive and Non destructive Tests, Visual Inspection, Optical aids used for visual inspection, Applications.

UNIT II LIQUID PENETRANT TESTING AND MAGNETIC PARTICLE TESTING 9

Physical principles, procedure for penetrant testing, Pentrant testing materials, Penetrant testing methods – Applications Principle of MPT, Magnetising technical and procedure used for testing a component, Equipment used for MPT, Applications

UNIT III EDDY CURRENT TESTING AND ACOUSTIC EMISSION TESTING 9

Principles, Instrumentation for ECT, Various Techniques – High sensitivity Techniques, Single, Multi and high frequency ECT, Applications Principle of AET, AE signal parameters, Applications.

UNIT IV ULTRASONIC TESTING 9

Principle, Ultrasonic transducers, Inspection Methods – Normal incident pulse-echo Inspection, through – transmission testing, angle Beam Pulse-echo testing, Techniques A-Scan, B-Scan , C-Scan – Applications.

UNIT V RADIOGRAPHY, COMPARISON AND SELECTION OF NDT METHODS 9

Basic principle, Effect of radiation of Film, Radiographic Imaging – Inspection Techniques – Single wall single image, Double wall Penetration and Multiwall Penetration technique – Comparison and selection of various NDT techniques.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: The students should have ability to select different types of manufacturing for various geometrical shapes of product.

CO2: The students are familiarized with the recent advances in casting and welding techniques.

CO3: The student will be able to optimize economic aspects of production of components using powder metallurgy, developing a controlled microstructure and including the conservation of materials and energy.

CO4: The Student familiarized with the planning, scheduling and inventory control processes.

CO5: The students acquire the ability to apply the modern production techniques in industries.

TEXT BOOKS:

1. Baldev Raj, Jeyakumar. T, Thavasimuthu. M. , “Practical Non-Destructive Testing”, Narosa Publishing house, New Delhi, 3rd edition, 2015.
2. Peter J. Shull, “Non Destructive Evaluation: Theory, Techniques and Application”, Marcel Dekker, Inc., New York, 2nd edition, 2002

REFERENCES:

1. Krautkramer.J, “Ultrasonic Testing of Materials”, 4th Edition, Springer – Verlag Publication, New York, 1996.
2. Baldev Raj and B.Venkataraman, “Practical Radiology”, Narosa Publishing House, 2011.
3. Birchan.B, “Non-Destructive Testing”, Oxford, London, 1975.

PR7013 NON DESTRUCTIVE TESTING METHODS																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Understand the concepts of non-destructive testing and its applications.	2	1	1	1	2						2	1	1	1	1
CO2	Understand the procedures of Liquid Penetrant Testing and Magnetic	2	1	1	1	2						2	1	1	1	2
CO3	Apply the concepts of non-destructive techniques in various manufacturing processes.	2	1	2	1	2						2	3	1	1	1
CO4	Understand the principle of ultrasonic testing and various scanning techniques.	2	1	2	1	2						2	3	1	1	1
CO5	Select the required NDT for specific applications	2	1	2	1	3						1	3	1	1	2
PO & PSO (Average)		2	1	2	1	3						2	3	1	1	2

PR7014 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.

UNIT V POLYMER TESTING 9

Mechanical-static and dynamic: tensile, flexural, compressive, abrasion, endurance, fatigue, hardness, tear, 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.

REFERENCES:

1. Krishnan K Chawla , “Composite Material Science and Engineering”, International Edition, Springer, 2006.
2. Horald Belofsky, " Plastics Product design and Process Engineering”, Hanser Publications,2002.
3. Charles A. Harper,”Modern Plastics HandBook”, McGraw-Hill, New York,1999.
4. Anand. J.S, ”Applications of Plastics”, CIPET,Chennai,1997

PR 7014 -PROCESSING OF PLASTICS AND POLYMERS																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Acquire knowledge of plastics and their applications are well known to the students.	1	1	2	1	2	2	2	-	-	2	2	2	2	2	3

CO2	Acquire knowledge of polymers and their applications are well known to the students	2	1	3	1	2	3	2	-	-	2	2	2	2	2	3
CO3	Acquire knowledge of uses and techniques of plastics and polymer processing are well known to the students	3	2	3	1	3	2	3	-	-	2	2	3	2	3	2
CO4	Expose about various polymer mixing and blending techniques is well known to the students	2	2	3	1	3	2	3	-	-	2	2	3	3	3	2
CO5	collect Information of various properties of polymers and its testing methods are well known to the students.	2	1	3	1	2	3	2	-	-	2	2	2	2	2	3
PO & PSO (Average)		2	1.4	2.8	1	2.4	2.4	2.4	-	-	2	2	2.4	2.2	2.4	2.6

PR7015 PRODUCTION OF COMPOSITES L T P C
3 0 0 3

COURSE OBJECTIVES:

1. To introduce the concept of composites and various types of composites.
2. To enlighten the students about the different types of fibres and matrix materials
3. To analyze the different polymer matrix composites processing methods and their applications
4. To expose the students to the various metal matrix composite processing methods
5. To analyze the various processing techniques of various ceramic matrix composites.

UNIT I INTRODUCTION TO COMPOSITES 9

Definition and fundamentals of composites – need for composites – enhancement of properties - Reinforcement, classification, general characteristics, rule of mixture – Theory of composites – Mechanical behavior – Stress strain relationships. Applications of various types of composites.

UNIT II INTRODUCTION TO FIBRES AND COMPOSITE MATERIALS 9

Fibres – Types, Fabrication, Structure, properties and applications – Glass, Boron, carbon, polyethylene, Kevlar, Aramid, Alumina, SiC ,Si_3N_4, B_4 C, ceramic and metallic fibers whiskers – Matrix materials structure – Polymers – metals and ceramics – Physical and chemical properties.

UNIT III POLYMER MATRIX COMPOSITES 9

Open mould process, bag moulding, Hand layup and spray up techniques filament winding, compression and transfer moulding, BMC and SMC– pultrusion – centrifugal casting – injection moulding – structure, properties and application of PMC's – Carbon Matrix Composites – Interfaces – Properties – recycling of PMC.

UNIT IV METAL MATRIX COMPOSITES 9

Processing of MMCs: Types, Important metallic materials, Processing – solid state, Liquid state, deposition, insitu fabrication methods. Interfaces – diffusion bonding – powder metallurgy technique - properties - Applications.

UNIT V CERAMIC MATRIX COMPOSITES 9

Ceramic matrix materials – Processing – Hot pressing, liquid infiltration techniques lanxide process, Insitu, solgel, chemical reaction techniques - CVD, CVI process. Interface in CMCs. Thermal shock resistance. Applications. Properties. Surface treatment.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Acquire Knowledge about various composites and their properties are well known to the students.

CO2: Acquire Knowledge about various types of fibres and matrix materials are well known to the students

CO3: Exposure of the various polymer matrix composites, processing method are well known to the students.

CO4: Analyse the various processing methods of metal matrix composites.

CO5: Analyze the various processing techniques of ceramic matrix composites

TEXT BOOKS:

1. Mallick P.K., "Fiber-Reinforced Composites: Materials, Manufacturing, and Design", Third Edition, CRC Press, Taylor & Francis group, 2007.
2. Krisnan K Chawla, “Composite materials science and engineering”, International edition, Springer, 2006

REFERENCES:

1. T.W.Clync and P.J. Withers, “Introduction to Metal Matrix Composites”. Cambridge University Press, 1993.
2. B.Strong, “Fundamentals of composite manufacturing”, SME, 1989 S.C.Sharma, “Composite materials”, Narosa publications, 2000
3. “Short term course on advances in composite materials”, “composite technology centre, Department of Metallurgy, IIT – Madras, December 2001.
4. Weatherhead R.G. “FRP technology” (Fibre Reinforced Resin System), Applied Science Publishers Limited, London, 1990.
5. Chawla K.K. “Composite Materails”, Springer Verlag, 1987
6. Mathews F.L. and Rawlings R.D., “Composite materials, Engineering and Science”, Chapman. Woodhead Publishing, 1999.
7. Kenneth G.Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of India pvt ltd., 4th Indian reprint, 2002.

PR7015 PRODUCTION OF COMPOSITES																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Acquire Knowledge about various composites and their properties are well known to the students.	1	-	2	1	2	2	2	-	-	2	2	2	2	2	3

CO2	Acquire Knowledge about various types of fibres and matrix materials are well known to the students	2	-	3	1	2	3	2	-	-	2	2	2	2	2	3
CO3	Exposure of the various polymer matrix composites, processing method are well known to the students.	3	1	3	1	3	2	3	-	-	2	2	3	2	3	2
CO4	Analyse the various processing methods of metal matrix composites.	2	1	3	1	3	2	3	-	-	2	2	3	3	3	2
CO5	Analyze the various processing techniques of ceramic matrix composites	3	1	3	1	3	2	3	-	-	2	2	3	3	3	2
Po & pso (average)		2.2	1	2.8	1	2.6	2.2	2.6	-	-	2	2	2.6	2.4	2.6	2.4

PR7016 PURCHASING AND MATERIALS MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce the functions of materials managements
- To enlighten the students about the Purchasing policies and procedures
- To enlighten the students about the Inventory pricing stores management
- To analyze the Inventory pricing stores management
- To expose the students to the various quantitative techniques in management.

UNIT I FUNCTIONS OF MATERIALS MANAGEMENT 9

Introduction to materials management – objectives – organization – Functions operating cycle – value analysis – make or buy decisions.

UNIT II PURCHASING MANAGEMENT 9

Purchasing policies and procedures – Selection of sources of supply – Vendor development – Vendor evaluation and rating – Methods of purchasing – Imports – Buyer – Seller relationship – Negotiations.

UNIT III STORES MANAGEMENT 9

Store function – Location – Layout – Stock taking – Materials handling – Transportation – Insurance – Codification – Inventory pricing stores management – safety – warehousing.

UNIT IV INVENTORY MANAGEMENT 9

Forecasting – ABC analysis – Materials requirements planning – systems – Quantity – periodic – deterministic and probabilistic models – Aggregate planning – JIT.

UNIT V QUANTITATIVE TECHNIQUES IN MATERIAL MANAGEMENT 9

Finite Production – Lot size under constraints – Application of O.R. Techniques in Materials Management.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Acquire Knowledge about various the functions of materials managements
CO2: Acquire Knowledge about the Purchasing policies and procedures are well known to the students.
CO3: Exposure of the Inventory pricing stores management
CO4: Analysis of various techniques of inventory management.
CO5: Analysis of the various quantitative techniques in management.

TEXT BOOKS:

1. Lamar Lee and Donald W.Dobler, "Purchasing and Material Management", Texland cases, Tata McGraw Hill, 1996.
2. Kesavan.R, Elanchezhian.C and Vijaya Ramnath.B, "Engineering Management", Eswar Press. 2005.

REFERENCES:

1. Gopalakrishnan P., "Handbook of Materials Management", Prentice Hall of India, 1996.
2. Gupta P.K. and Man Mohan, "Problems in Operations Research", Sultan chand and Sons, 1994.

PR7016 PURCHASING AND MATERIALS MANAGEMENT																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Acquire Knowledge about various the functions of materials managements	1	-	2	1	2	2	2	1	-	-	2	2	2	2	3
CO2	Acquire Knowledge about the Purchasing policies and procedures are well known to the students.	2	-	3	1	2	3	2	1	-	-	2	2	2	2	3
CO3	Exposure of the Inventory pricing stores management	3	1	3	1	3	2	3	1	-	-	2	3	2	3	2
CO4	Analysis of various techniques of inventory management.	2	1	3	1	3	2	3	3	-	-	2	3	3	3	2
CO5	Analysis of the various quantitative techniques in management.	3	1	3	1	3	2	3	3	-	-	2	3	3	3	2
PO & PSO (Average)		2.2	1	2.8	1	2.6	2.2	2.6	1.8	-	-	2	2.6	2.4	2.6	2.4

PR7017 **SELECTION OF MATERIALS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To introduce the role of materials in the evolution of engineering.
- To illustrate the various factors to be considered in materials selection.
- To indicate the various methods and steps to be adopted in materials selection.
- To inform the need and emergence of alternate materials.
- To train in performing specific case studies in selection of materials.

UNIT I MATERIALS AND PROPERTIES 9

Classes of engineering materials - Evolution of Engineering Materials-Definition of materials properties- Displaying material properties using materials selection charts- Forces for change in materials selection and design, Materials and the environment.

UNIT II FACTORS IN SELECTION PROCESS 9

Design process - types of design, design requirements, function, Material attributes. Shape and Manufacturing processes - Materials processing and design processes and their influence on design, Process attributes, Systematic process selection, Process selection diagrams, Process cost, Energy consumption for production, Material costs, availability and recyclability, Environmental consideration.

UNIT III MATERIALS SELECTION PROCESS 9

Materials selection methods: Screening, Ranking - weighted ranking, Performance indices - Materials selection charts, Deriving property limits and material indices, Structural indices. Shape factors, Efficiency of standard sections, Material limits for shape factors, Material indices which include shape-microscopic or micro structural shape factor, Co-selecting material and shape.

UNIT IV ALTERNATE MATERIALS 9

Environmental design, Economics and environmental impact of materials, Hybrid materials: composites, sandwich structure, lattices and segmented structure, applications of hybrid materials, polymer foams.

UNIT V CASE STUDIES 9

Automobile materials (Body and Crank shaft), Marine structural materials (Hull and Propeller), Aircraft structural materials (Wings and landing gears), Materials for space (Gas turbines and Nose), Materials for power generation machinery (Boilers and Pressure vessels), Materials for medical applications (Surgical knives and Bone replacements), Chemical and petrochemical industries (Acid storage tanks and Fuel carrying pipes).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the relationship between the evolution of materials and the development in engineering.
CO2: Find out the various factors governing the materials selection.
CO3: Adapt suitable method and essential steps in materials.
CO4: Identify suitable alternate materials for various engineering applications.
CO5: Suggest and select appropriate materials in an engineering industry.

TEXT BOOKS:

1. Ashby. M.F., “Materials Selection in Mechanical Design”, Third edition, Butterworth- Heineman, New York, 16th edition, 2012.
2. Charles. J. A. and Crane. F. A. A, “Selection and Use of Engineering Materials”, second edition, Butterworth-Heinemann Ltd., 3rd edition 2005.

REFERENCES:

1. Dieter. G. E, "Engineering Design: A Materials and Processing Approach", 5th Edition, McGraw-Hill, 2007.
2. "ASM Handbook, Volume 20: Materials Selection and Design", ASM International, 2010.
3. Petroski. H, "Invention by Design", Harvard University Press, 1997.
4. Budinski. K. G., Budinski. M. K., "Engineering Materials: Properties and Selection", 2th edition, Prentice Hall, 9th edition, 2010.
5. Mahmoud M.Farag, "Materials and Process Selection for Engineering Design", CRC Press, New York, 2nd edition, 2007.

PR7017 SELECTION OF MATERIALS																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Understand the relationship between the evolution of materials and the development in engineering	3	2	3	3	2	2	3	1	2	1	-	2	3	1	3
CO2	Find out the various factors governing the materials selection.	3	2	2	1	1	2	3	3	3	2	2	3	2	2	3
CO3	Adapt suitable method and essential steps in materials	2	1	2	1	1	2	3	2	2	1	3	2	2	2	3
CO4	Identify suitable alternate materials for various engineering applications	2	3	3	2	2	3	3	3	3	3	3	3	3	3	3
CO5	Suggest and select appropriate materials in an engineering industry	2	2	3	3	3	3	3	3	2	3	3	3	3	3	3
PO & PSO (Average)		2.4	2	2.6	2	1.8	2.4	3	2.4	2.4	2	2.75	2.6	2.6	2.2	3

PR7018 **SUPPLY CHAIN MANAGEMENT** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

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

- Describe the role and drivers of and supply chain management in achieving competitiveness.
- Explain about Supply Chain Network Design.
- Illustrate about the issues related to Logistics in Supply Chain .
- Appraise about Sourcing and Coordination in Supply Chain.
- Application of Information Technology and Emerging Concepts in Supply Chain.

UNIT I INTRODUCTION 9

Role of Logistics and Supply chain Management: Scope and Importance – Evolution of Supply Chain – Decision Phases in Supply Chain – Competitive and Supply chain Strategies – Drivers of Supply Chain Performance and Obstacles.

UNIT II SUPPLY CHAIN NETWORK DESIGN 9

Role of Distribution in Supply Chain – Factors influencing Distribution network design – Design options for Distribution Network Distribution Network in Practice-Role of network Design in Supply Chain – Framework for network Decisions.

UNIT III LOGISTICS IN SUPPLY CHAIN 9

Role of transportation in supply chain – factors affecting transportations decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation.

UNIT IV SOURCING AND COORDINATION IN SUPPLY CHAIN 9

Role of sourcing supply chain supplier selection assessment and contracts – Design collaboration – sourcing planning and analysis – supply chain co-ordination – Bull whip effect – Effect of lack of co-ordination in supply chain and obstacles – Building strategic partnerships and trust within a supply chain.

UNIT V SUPPLY CHAIN AND INFORMATION TECHNOLOGY 9

The role IT in supply chain – The supply chain IT frame work Customer Relationship Management – Internal supply chain management – supplier relationship management – future of IT in supply chain – E-Business in supply chain.

TOTAL:45 PERIODS

COURSE OUTCOMES:

After undergoing this course, students will acquire

CO1: Ability to understand the scope of Supply Chain Management and the Drivers of SC performance

CO2: Ability to design suitable SC network for a given situation.

CO3: Ability to solve the issues related to Logistics in SCM.

CO4: Ability to understand Sourcing, Coordination and current issues in SCM.

CO5: Ability to appraise about the applications of IT in SCM and apply SCM concepts in selected enterprise

TEXT BOOKS:

1. Sunil Chopra, Peter Meindl, “Supply Chain Management, Strategy, Planning and operation”, Pearson Education, 2015.
2. Srinivasan G, “Quantitative models in Operations and Supply Chain management”, PHI 2010.

REFERENCES:

1. Jeremy F. Shapiro, “Modeling the supply chain”, 2nd edition, Thomson Duxbury 2006.
2. James B. Ayers, “Handbook of supply chain management”, Auerbach Publications, 2nd edition, 2006.

PR7018 SUPPLY CHAIN MANAGEMENT																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Ability to understand the scope of Supply Chain Management and the Drivers of SC performance	1	3	2	1	2				1		2	2	2	1	2
CO2	Ability to design suitable SC network for a given situation.	1	3	2	1	2				1		2	2	2	1	2
CO3	Ability to solve the issues related to Logistics in SCM.	1	3	2	1	2				2		2	2	2	1	2
CO4	Ability to understand Sourcing, Coordination and current issues in SCM.	1	3	2	1	2				2		2	2	2	1	2
CO5	Ability to appraise about the applications of IT in SCM and apply SCM concepts in selected enterprise	1	3	2	1	2				2		2	2	2	1	2
PO & PSO (Average)		1	3	2	1	2				2		1	2	2	1	2

PR7019 TOTAL QUALITY MANAGEMENT: PRINCIPLES AND APPLICATIONS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To learn about the evolution and the basic concepts of quality
- To understand the various principles, practices of TQM to achieve quality.
- To learn the various statistical approaches for Quality control.
- To understand the TQM tools for continuous process improvement.
- To learn the importance of ISO and Quality systems

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality - Basic concepts of TQM – TQM Framework - Contributions of Quality Gurus – Barriers to TQM – Cost of Quality.

UNIT II TQM PRINCIPLES 9

Quality statements - Customer focus –Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Continuous process improvement – PDCA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS & TECHNIQUES I 9

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT IV TQM TOOLS & TECHNIQUES II 9

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

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing QS 9000 – ISO 14000 – Concepts, Requirements and Benefits –Quality Council – Leadership, Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

CO1: Apply basic concepts of quality gurus
CO2: Gain and apply the knowledge of TQM principles
CO3: Identify the appropriate the statistical tool to achieve the quality control
CO4: Employ the principles of continuous process improvement tools
CO5: Gain and apply the knowledge of quality systems

TEXT BOOK:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.

REFERENCES:

1. James R. Evans and William M. Lindsay, “The Management and Control of Quality”, (6thEdition), South-Western (Thomson Learning), 2005.
2. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, Third Edition ,2003.
3. Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd., 2006 .
4. Janakiraman,B and Gopal, R.K, “Total Quality Management – Text and Cases”,Prentice Hall (India) Pvt. Ltd., 2006.

PR7019 TOTAL QUALITY MANAGEMENT: PRINCIPLES AND APPLICATIONS																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Apply basic concepts of quality gurus	3		3	2	2	3	3	2			3	3	2	3	3
CO2	Gain and apply the knowledge of TQM principles	3		3	2	2	3	3	2			3	3	2	3	3

CO3	Identify the appropriate the statistical tool to achieve the quality control	3		3	2	2	3	3	2			3	3	2	3	3
CO4	Employ the principles of continuous process improvement tools	3		3	2	2	3	3	2			3	3	2	3	3
CO5	Gain and apply the knowledge of quality systems	3		3	2	2	3	3	2			3	3	2	3	3
PO & PSO (Average)		3		3	2	2	3	3	2			3	3	2	3	3

PR7020 UNCONVENTIONAL MACHINING PROCESSES L T P C
3 0 0 3

COURSE OBJECTIVES:

- To impart knowledge to the students about various non-traditional machining processes.
- To select suitable finishing operations and to perform them with the help of suitable machine tools, compare conventional with non-conventional production processes and use them depending on the need
- Understand the principle, mechanism of metal removal of various non-traditional machining processes.
- Identify the various process parameters and their effect on the component machined on various non-traditional machining processes.
- Understand the un-conventional machining process for improving the quality of the product

UNIT I MECHANICAL ENERGY BASED PROCESSES 9

Abrasive Jet Machining (AJM) – Water Jet machining (WJM) - Abrasive Water Jet Machining (AWJM) –Working Principle – equipments used – Process parameters – MRR – Applications - Ultrasonic machining (USM) – Grain throwing and Grain hammering mechanisms.

UNIT II CHEMICAL AND ELECTRO CHEMICAL ENERGY BASED PROCESSES 9

Chemical machining - Etchants – maskants - techniques of applying maskants – Process Parameters – MRR – Applications – Chemical blanking – Chemical milling - Electro-Chemical machining (ECM) –Principles of ECM – Equipments – MRR – Electrochemical Grinding (ECG) and Electrochemical Honing (ECH) – Applications- Micro ECM.

UNIT III ELECTRICAL ENERGY BASED PROCESSES 9

Electric Discharge Machining (EDM) – working principle – equipments –Process Parameters – MRR – Electrode- Power circuits – Tool Wear – Dielectric – Flushing – Wire cut – EDM – Applications – Micro EDM.

UNIT IV THERMAL ENERGY BASED PROCESSES 9

Laser Beam machining (LBM) - Plasma Arc machining (PAM) - Electron Beam Machining (EBM) – Ion Beam Machining (IBM) - Principle – Parameters – Equipment – Types– MRR -Applications.

UNIT V HYBRID MACHINING 9

Abrasive based hybrid machining processes - Thermal based hybrid machining processes - Electro based hybrid machining processes – Vibration assisted EDM - Vibration assisted ECM.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: The students will be in a position to select and employ an appropriate unconventional machining process for a specific application in industries
CO2: Illustrate the principles of non-conventional machining and testing
CO3: Analyse the mechanism of material removal in non-conventional machining processes
CO4: Evaluate the performance of non-conventional machining processes
CO5: Justify non-conventional machining and non-destructive testing technique

TEXT BOOKS:

1. Jain.V.K, "Advanced Machining Processes", Allied Publishers Pvt.Ltd., New Delhi, 2002.
2. Hassan Abdel ,Gawad El, Hofy ,"Advanced Machining Processes", Tata McGraw Hill, 2005.

REFERENCES:

1. Serope Kalpakjian, "Manufacturing Engineering and Technology", Third Edition, Addison-Wesley Publication, Co, 1995.
2. Brahem, T.Smith, "Advanced Machining", I.F.S., U.K. 1989.
3. Amstead B.H., Ostwald Physics and Bageman, R.L., "Manufacturing Processes", John Wileys Songs 1987.
4. Benediet, G.F. Nontraditional Manufacturing Processes, Marcel Dekker Inc., New York 1987.
5. Pandey P.C. and Shan H.S., Modern Machining Processes, Tata McGraw Hill, New Delhi ,1980.

PR7020 UNCONVENTIONAL MACHINING PROCESSES																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	The students will be in a position to select and employ an appropriate unconventional machining process for a specific application in industries	3					1		3	3						
CO2	Illustrate the principles of non-conventional machining and testing	3	1	1		1	1		3	3						
CO3	Analyse the mechanism of material removal in non-conventional machining processes	3					1		2	3						

CO4	Evaluate the performance of non-conventional machining processes	3					1			3						
CO5	Justify non-conventional machining and non-destructive testing techniques	3					1			3						
PO & PSO (Average)		3	1	1	-	1	1	-	2.6	3	-	-	-	-	-	-

PR7022 **MINI PROJECT** **L T P C**
0 0 6 3

COURSE OBJECTIVES:

- To acquaint with the process of understanding literature survey/ Industrial visit and identifying the problem
- To encourage creative thinking process
- To familiarize the process of solving the problem in a group
- To acquaint with the process of applying basic engineering fundamental in the domain of practical applications
- To acquire and apply fundamental principles of planning and carrying out the work plan of the project through observations, discussions and decision making process.

Description

1. The students in batches (not exceeding three in a batch) have to take up a project in the area of Production engineering.
2. Each batch is guided by a faculty member. The students have to select a suitable problem/ design, prepare the drawings, produce the components, assemble and commission the project/develop a software with analysis.
3. The students have to prepare and present a detailed project report at the end of the VIII Semester
4. The evaluation will be made for the continuous internal assessment for the Project by a committee nominated by the Head of the Department.

TOTAL: 90 PERIODS

COURSE OUTCOMES:

After completing the course, students will be able to:

CO1: Identify a topic in advanced areas of engineering to generate and implement innovative ideas for social benefit.

CO2: Review literature to identify gaps and define objectives & scope of the work.

CO3: Identify methods and materials to carry out experiments/develop code

CO4: Analyse and discuss the results to draw valid conclusions.

CO5: Prepare a report as per recommended format and defend the work.

PR 7022 Mini Project																
Course Outcome	Statement	Programme Outcomes												Programme Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Identify a topic in advanced areas of engineering to generate and implement innovative ideas for social benefit.	3	2	1	3	2	3	1	3	3	2	2	2	3	3	2
CO2	Review literature to identify gaps and define objectives & scope of the work.	3	1	3	2	2	2	1	2	3	2	2	2	3	3	2
CO3	Identify methods and materials to carry out experiments/develop code	3	3	3	3	3	2	1	2	3	2	2	2	3	3	2
CO4	Analyse and discuss the results to draw valid conclusions.	3	3	3	3	3	2	1	2	3	2	2	2	3	3	2
CO5	Prepare a report as per recommended format and defend the work.	2	1	1	1	1	1	-	2	2	3	1	2	3	3	2
PO & PSO (Average)		2.8	2	2.2	2.4	2.2	2	1	2.2	2.8	2.2	1.8	2	3	3	2

GE7072 FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the global trends and development methodologies of various types of products and services
- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
- To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT 9

Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends **- Introduction to Product Development Methodologies and Management -** Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies **-** Product Life Cycle – Product Development Planning and Management.

UNIT II REQUIREMENTS AND SYSTEM DESIGN 9

Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - **System Design & Modeling -** Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

UNIT III DESIGN AND TESTING 9

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – **Challenges in Integration of Engineering Disciplines** - Concept Screening & Evaluation - **Detailed Design -** Component Design and Verification – **Mechanical, Electronics and Software Subsystems** - High Level Design/Low Level Design of S/W Program **-** Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – **Prototyping -** Introduction to Rapid Prototyping and Rapid Manufacturing - **System Integration, Testing, Certification and Documentation**

UNIT IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT 9

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - **Sustenance -**Maintenance and Repair – Enhancements - **Product EoL -** Obsolescence Management – Configuration Management - EoL Disposal

UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9

The Industry - Engineering Services Industry - Product Development in Industry versus Academia –**The IPD Essentials -** Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Define, formulate and analyze a problem
- Solve specific problems independently or as part of a team
- Gain knowledge of the Innovation & Product Development process in the Business Context
- Work independently as well as in teams
- Manage a project from start to finish

TEXT BOOKS:

1. Book specially prepared by NASSCOM as per the MoU.
2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
3. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.

REFERENCES:

1. Hiriyappa B, “Corporate Strategy – Managing the Business”, Author House, 2013.
2. Peter F Drucker, “People and Performance”, Butterworth – Heinemann [Elsevier], Oxford, 2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, “Enterprise Resource Planning – Concepts”, Second Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013