ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

REGULATIONS – 2015

CHOICE BASED CREDIT SYSTEM

B.E. MECHANICAL ENGINEERING

THE VISION OF THE DEPARTMENT OF MECHANICAL ENGINEERING

Department of Mechanical Engineering strives to be recognized globally for excelling in Engineering education and research leading to innovative, entrepreneurial and competent graduates in Mechanical Engineering and allied disciplines.

THE MISSION OF THE DEPARTMENT OF MECHANICAL ENGINEERING

1. To provide a world-class education through the conduct of pioneering and cutting-edge research that inculcate professional, technical, critical-thinking, and communication skills necessary for students and faculty to make impactful contributions to society.
2. To create future leaders in the science and art of mechanical and allied engineering streams.
3. To expand the frontiers of engineering science and to encourage technological innovation while fostering academic excellence and scholarly learning in a collegial environment.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The PEOs of the Mechanical Engineering Programme are to make our graduates

1. To achieve success in careers that deal with the design, simulation and analysis of engineering systems, experimentation and testing, manufacturing, technical services, and research.
2. To communicate effectively with peers, and updating and adapting their core knowledge and abilities to ethically compete in the ever-changing multicultural global enterprise.
3. To conduct multi-disciplinary research and development (via graduate study or industry) resulting in tangible applications that advance technology and foster innovation in order to compete successfully in the global economy.
4. To exchange and apply knowledge to create new opportunities that advance our society and proactively address through team efforts to solve a variety of technical, environmental and societal problems.
5. To actively embrace impactful leadership roles in the practice of Mechanical Engineering in industry and government organizations (including both traditional and emerging technical areas) as well as in public service organizations.

PROGRAMME OUTCOMES (POs):

On successful completion of the Mechanical Engineering Degree programme, the Graduates shall exhibit the following:

PO	Graduate Attribute	Programme Outcome
1	Engineering knowledge	Apply knowledge of mathematics, basic science and engineering science.
2	Problem analysis	Identify, formulate and solve engineering problems.
3	Design/development of solutions	Design a system or process to improve its performance, satisfying its constraints.
4	Conduct investigations of complex problems	Conduct experiments & collect, analyze and interpret the data.
5	Modern tool usage	Apply various tools and techniques to improve the efficiency of the system.
6	The Engineer and society	Conduct themselves to uphold the professional and social obligations.
7	Environment and sustainability	Design the system with environment consciousness and sustainable development.
8	Ethics	Interacting industry, business and society in a professional and ethical manner.
9	Individual and team work	Function in a multidisciplinary team.
10	Communication	Proficiency in oral and written Communication.
11	Project management and finance	Implement cost effective and improved system.
12	Life-long learning	Continue professional development and learning as a life-long activity.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

On successful completion of the Mechanical Engineering Degree programme, the Graduates shall exhibit the following:

1. Understand, apply, analyze, design and develop engineering systems adopting thermal, design and manufacturing concepts.
2. Utilize computational and design tools for efficient product development.
3. Apply the acquired knowledge for innovative solutions to cater societal needs and industrial problems.

Mapping PEO with POs:

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

MAPPING OF COURSE OUTCOMES WITH POs and PSOs:

COURSE NAME	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
YEAR-1/SEM-1															
Foundational English															
Mathematics I															
Engineering Physics															
Engineering Chemistry															
Engineering Graphics	✓		✓		✓					✓		✓	✓	✓	✓
Basic Sciences Laboratory															
Engineering Practices Laboratory	✓	✓	✓	✓									✓	✓	
YEAR-1/SEM-2															
Technical English															
Mathematics II															
Computing Techniques															
Engineering Mechanics	✓		✓									✓	✓		✓
Manufacturing Technology–I	✓		✓		✓	✓	✓	✓	✓			✓	✓	✓	✓
Manufacturing Technology Laboratory - I	✓						✓					✓	✓	✓	✓
Computer Practices Laboratory															
YEAR-2/SEM-3															
Strength of Materials	✓	✓	✓										✓	✓	
Fluid Mechanics and Machinery	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Electronics Engineering	✓	✓	✓	✓	✓										
Basic Electrical Engineering and Measurements															
Partial Differential Equations	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓
Engineering Thermodynamics	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓	✓	✓
Fluid Mechanics and Strength of Materials Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Electrical and Electronics Engineering Laboratory															

YEAR-2/SEM-4															
Environmental Science and Engineering	✓	✓	✓		✓	✓	✓	✓				✓			
Numerical Methods	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓
Manufacturing Technology–II	✓	✓	✓	✓	✓		✓				✓	✓	✓	✓	✓
Kinematics of Machines	✓	✓	✓	✓	✓			✓				✓	✓		✓
Thermal Engineering–I	✓	✓	✓	✓		✓	✓	✓				✓	✓	✓	✓
Engineering Materials and Metallurgy	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓
Manufacturing Technology Laboratory–II	✓	✓	✓	✓	✓		✓		✓			✓	✓	✓	✓
Thermal Engineering Laboratory–I	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
YEAR-3/SEM-5															
Dynamics of Machines	✓	✓	✓	✓	✓			✓				✓	✓		✓
Metrology and Measurements	✓	✓	✓	✓	✓			✓	✓	✓		✓	✓	✓	✓
Thermal Engineering–II	✓	✓	✓	✓			✓					✓	✓		✓
Design of Machine Elements	✓	✓	✓	✓	✓			✓				✓	✓		✓
Hydraulics and Pneumatics	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Metrology and Dynamics Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Computer Aided Machine Drawing	✓	✓	✓		✓			✓	✓	✓	✓	✓	✓		✓
YEAR-3/SEM-6															
Mechatronics	✓	✓	✓	✓	✓	✓	✓		✓			✓	✓	✓	✓
Computer Aided Design	✓	✓	✓	✓	✓			✓		✓	✓	✓	✓	✓	✓
Design of Transmission Systems	✓	✓	✓	✓	✓			✓				✓	✓		✓
Heat and Mass Transfer	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓
Communication Skills and Soft Skills							✓	✓							
Thermal Engineering Laboratory–II	✓	✓		✓			✓		✓				✓		
YEAR-4/SEM-7															
Power Plant Engineering	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
Computer Integrated Manufacturing	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓
Finite Element Analysis	✓	✓	✓	✓	✓			✓			✓	✓	✓		✓
Creative and Innovative Project[#]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Simulation and Analysis Laboratory	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓
Mechatronics Laboratory	✓	✓	✓	✓	✓	✓			✓			✓	✓	✓	✓
YEAR-4/SEM-8															
Project Work	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

B.E. MECHANICAL ENGINEERING

REGULATIONS – 2015

CHOICE BASED CREDIT SYSTEM

CURRICULA AND SYLLABI I - VIII SEMESTERS

SEMESTER I

SL. 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

SL. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS7251	Technical English	HS	4	4	0	0	4
2.	MA7251	Mathematics II	BS	4	4	0	0	4
3.	GE7151	Computing Techniques	ES	3	3	0	0	3
4.	GE7153	Engineering Mechanics	ES	4	4	0	0	4
5.	ME7252	Manufacturing Technology–I	PC	3	3	0	0	3
PRACTICAL								
6.	ME7261	Manufacturing Technology Laboratory - I	PC	4	0	0	4	2
7.	GE7161	Computer Practices Laboratory	ES	4	0	0	4	2
			TOTAL	**26**	**18**	**0**	**8**	**22**

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	CE7251	Strength of Materials	ES	3	3	0	0	3
2.	CE7352	Fluid Mechanics and Machinery	ES	3	3	0	0	3
3.	EC7354	Electronics Engineering	ES	3	3	0	0	3
4.	EE7251	Basic Electrical Engineering and Measurements	ES	3	3	0	0	3
5.	MA7302	Partial Differential Equations	BS	4	4	0	0	4
6.	ME7301	Engineering Thermodynamics	PC	4	4	0	0	4
PRACTICAL								
7.	CE7312	Fluid Mechanics and Strength of Materials Laboratory	ES	4	0	0	4	2
8.	EE7261	Electrical and Electronics Engineering Laboratory	ES	4	0	0	4	2
			TOTAL	**28**	**20**	**0**	**8**	**24**

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.	MA7354	Numerical Methods	BS	4	4	0	0	4
3.	ME7352	Manufacturing Technology–II	PC	3	3	0	0	3
4.	ME7401	Kinematics of Machines	PC	3	3	0	0	3
5.	ME7402	Thermal Engineering–I	PC	3	3	0	0	3
6.	ML7451	Engineering Materials and Metallurgy	PC	3	3	0	0	3
PRACTICAL								
7.	ME7361	Manufacturing Technology Laboratory–II	PC	4	0	0	4	2
8.	ME7411	Thermal Engineering Laboratory–I	PC	4	0	0	4	2
			TOTAL	**27**	**19**	**0**	**8**	**23**

SEMESTER V

SL. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	ME7501	Dynamics of Machines	PC	4	4	0	0	4
2.	ME7502	Metrology and Measurements	PC	3	3	0	0	3
3.	ME7503	Thermal Engineering–II	PC	3	3	0	0	3
4.	ME7552	Design of Machine Elements	PC	4	4	0	0	4
5.	ME7553	Hydraulics and Pneumatics	PC	3	3	0	0	3
6.		Professional Elective-I	PE	3	3	0	0	3
PRACTICAL								
7.	ME7511	Metrology and Dynamics Laboratory	PC	4	0	0	4	2
8.	ME7561	Computer Aided Machine Drawing	ES	4	0	0	4	2
			TOTAL	**28**	**20**	**0**	**8**	**24**

SEMESTER VI

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	ME7354	Mechatronics	PC	3	3	0	0	3
2.	ME7551	Computer Aided Design	PC	3	3	0	0	3
3.	ME7601	Design of Transmission Systems	PC	4	4	0	0	4
4.	ME7602	Heat and Mass Transfer	PC	4	4	0	0	4
5.		Professional Elective - II	PE	3	3	0	0	3
6.		Open Elective-I*	OE	3	3	0	0	3
PRACTICAL								
7.	HS7561	Communication Skills and Soft Skills	HS	3	1	0	2	2
8.	ME7611	Thermal Engineering Laboratory–II	PC	4	0	0	4	2
			TOTAL	**27**	**21**	**0**	**6**	**24**

SEMESTER VII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	ME7355	Power Plant Engineering	PC	3	3	0	0	3
2.	ME7701	Computer Integrated Manufacturing	PC	3	3	0	0	3
3.	ME7751	Finite Element Analysis	PC	3	3	0	0	3
4.		Professional Elective-III	PE	3	3	0	0	3
5.		Professional Elective-IV	PE	3	3	0	0	3
6.		Open Elective-II*	OE	3	3	0	0	3
PRACTICAL								
7.	ME7711	Creative and Innovative Project[#]	EEC	4	0	0	4	2
8.	ME7712	Simulation and Analysis Laboratory	PC	4	0	0	4	2
9.	ME7761	Mechatronics Laboratory	PC	4	0	0	4	2
			TOTAL	**30**	**18**	**0**	**12**	**24**

SEMESTER VIII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Professional Elective-V	PE	3	3	0	0	3
2.		Professional Elective-VI	PE	3	3	0	0	3
PRACTICAL								
3.	ME7811	Project Work	EEC	20	0	0	20	10
			TOTAL	**26**	**6**	**0**	**20**	**16**

TOTAL NO. OF CREDITS:179

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

The contact periods will not appear in the slot time table

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.	HS7561	Communication Skills and Soft Skills	HS	3	1	0	2	2

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.	MA7302	Partial Differential Equations	BS	4	4	0	0	4
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.	GE7151	Computing Techniques	ES	3	3	0	0	3
4.	GE7161	Computer Practice Laboratory	ES	4	0	0	4	2
5.	GE7153	Engineering Mechanics	ES	4	4	0	0	4
6.	CE7251	Strength of Materials	ES	3	3	0	0	3
7.	CE7352	Fluid Mechanics and Machinery	ES	3	3	0	0	3
8.	EC7354	Electronics Engineering	ES	3	3	0	0	3
9.	EE7251	Basic Electrical Engineering and Measurements	ES	3	3	0	0	3
10.	CE7312	Fluid Mechanics and Strength of Materials Laboratory	ES	4	0	0	4	2
11.	EE7261	Electrical and Electronics Engineering Laboratory	ES	4	0	0	4	2
12.	ME7561	Computer Aided Machine Drawing	ES	4	0	0	4	2

PROFESSIONAL CORE (PC)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	ME7252	Manufacturing Technology–I	PC	3	3	0	0	3
2.	ME7261	Manufacturing Technology Laboratory - I	PC	4	0	0	4	2
3.	ME7301	Engineering Thermodynamics	PC	4	4	0	0	4
4.	ME7401	Kinematics of Machines	PC	3	3	0	0	3
5.	ME7402	Thermal Engineering–I	PC	3	3	0	0	3
6.	ME7352	Manufacturing Technology–II	PC	3	3	0	0	3
7.	ML7451	Engineering Materials and Metallurgy	PC	3	3	0	0	3
8.	ME7411	Thermal Engineering Laboratory–I	PC	4	0	0	4	2
9.	ME7361	Manufacturing Technology Laboratory–II	PC	4	0	0	4	2
10.	ME7552	Design of Machine Elements	PC	4	4	0	0	4
11.	ME7502	Metrology and Measurements	PC	3	3	0	0	3
12.	ME7503	Thermal Engineering–II	PC	3	3	0	0	3
13.	ME7553	Hydraulics and Pneumatics	PC	3	3	0	0	3
14.	ME7501	Dynamics of Machines	PC	4	4	0	0	4
15.	ME7511	Metrology and Dynamics Laboratory	PC	4	0	0	4	2
16.	ME7601	Design of Transmission Systems	PC	4	4	0	0	4
17.	ME7602	Heat and Mass Transfer	PC	4	4	0	0	4
18.	ME7354	Mechatronics	PC	3	3	0	0	3
19.	ME7551	Computer Aided Design	PC	3	3	0	0	3
20.	ME7761	Mechatronics Laboratory	PC	4	0	0	4	2
21.	ME7611	Thermal Engineering Laboratory–II	PC	4	0	0	4	2
22.	ME7355	Power Plant Engineering	PC	3	3	0	0	3
23.	ME7701	Computer Integrated Manufacturing	PC	3	3	0	0	3
24.	ME7751	Finite Element Analysis	PC	3	3	0	0	3
25.	ME7712	Simulation and Analysis Laboratory	PC	4	0	0	4	2

PROFESSIONAL ELECTIVES (PE)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	GE7071	Disaster Management	PE	3	3	0	0	3
2.	GE7074	Human Rights	PE	3	3	0	0	3
3.	IE7451	Production and Operations Management	PE	3	3	0	0	3
4.	MA7352	Applied Statistics	PE	4	4	0	0	4
5.	ME7001	Advanced Internal Combustion Engineering	PE	3	3	0	0	3
6.	ME7002	Advanced Metrology	PE	3	3	0	0	3

7.	ME7003	Casting and Welding Processes	PE	3	3	0	0	3
8.	ME7004	Composite Materials and Mechanics	PE	3	3	0	0	3
9.	ME7006	Engineering Management	PE	3	3	0	0	3
10.	ME7007	Gas Dynamics and Space Propulsion	PE	3	3	0	0	3
11.	ME7008	Machine Vision	PE	3	3	0	0	3
12.	ME7009	Measurements and Controls	PE	3	3	0	0	3
13.	ME7010	Mechanical Vibrations and Noise Control	PE	3	3	0	0	3
14.	ME7011	MEMS and Microsystems	PE	3	3	0	0	3
15.	ME7012	Microcontroller and Embedded Systems	PE	3	3	0	0	3
16.	ME7013	New and Renewable Sources of Energy	PE	3	3	0	0	3
17.	ME7014	Non-Destructive Materials Evaluation	PE	3	3	0	0	3
18.	ME7015	Principles of Robotics	PE	3	3	0	0	3
19.	ME7016	Refrigeration and Air Conditioning	PE	3	3	0	0	3
20.	ME7017	Statistical Process Control and Reliability Engineering	PE	3	3	0	0	3
21.	ME7018	Theory of Metal Forming	PE	3	3	0	0	3
22.	ME7019	Turbo Machinery	PE	3	3	0	0	3
23.	ME7071	Automobile Engineering	PE	3	3	0	0	3
24.	ME7072	Computational Techniques for Fluid Dynamics	PE	3	3	0	0	3
25.	ME7073	Design for Manufacturing	PE	3	3	0	0	3
26.	ME7074	Design of Heat Exchangers	PE	3	3	0	0	3
27.	ME7075	Design of Pressure Vessels and Piping	PE	3	3	0	0	3
28.	ME7076	Energy Conservation in Industries	PE	3	3	0	0	3
29.	ME7077	Entrepreneurship Development	PE	3	3	0	0	3
30.	ME7078	Introduction to Operations Research	PE	3	3	0	0	3
31.	ME7079	Lean Six Sigma	PE	3	3	0	0	3
32.	ME7080	Marketing Management	PE	3	3	0	0	3
33.	ME7081	Process Planning and Cost Estimation	PE	3	3	0	0	3
34.	ME7082	Product Design and Development	PE	3	3	0	0	3
35.	ME7083	Sustainable and Green Manufacturing	PE	3	3	0	0	3
36.	ME7351	Design Concepts in Engineering	PE	3	3	0	0	3
37.	ME7603	Design of Jigs, Fixtures and Press Tools	PE	3	3	0	0	3
38.	MF7071	Additive Manufacturing Technology	PE	3	3	0	0	3
39.	MF7651	Non-Traditional Machining Processes	PE	3	3	0	0	3
40.	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.	ME7711	Creative and Innovative Project	EEC	4	0	0	4	2
2.	ME7811	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	4	4	-	3	-	-	-	-	**11**
2.	BS	12	4	4	4	-	-	-	-	**24**
3.	ES	6	9	16	-	2	-	-	-	**33**
4.	PC	-	5	4	16	19	16	13	-	**73**
5.	PE	-	-	-	-	3	3	6	6	**18**
6.	OE	-	-	-	-	-	3	3	-	**6**
7.	EEC	-	-	-	-	-	2	2	10	**14**
	Total	**22**	**22**	**24**	**23**	**24**	**24**	**24**	**16**	**179**
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

TEXT BOOK:

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.

UNIT I DIFFERENTIAL CALCULUS 12

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 funns – 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.

TEXT BOOKS:

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.

TEXT BOOKS:

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.

UNIT IV CHEMICAL THERMODYNAMICS 9

Second law: Entropy-entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Free energy and work function: Helmholtzand 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

OUTCOMES

- 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.

TEXT BOOKS

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

COURSE OBJECTIVES:

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

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

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION) 1

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

UNIT I PLANE CURVES AND FREE HANDSKETCHING 14

Basic Geometrical constructions, Curves used in engineering practices-Conics – Construction of ellipse, parabola and hyperbola by 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

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

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

TEXT 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) SubhasStores, Bangalore, 2007
2. Luzzader, Warren.J., and Duff,John M.,,’’ Fundamentals of Engineering Drawingwith 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. BasantAgarwal 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

TEXT BOOKS

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

COURSE OBJECTIVES:

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

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

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 and Emergency 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

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

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

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

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 (Common to all branches of B.E. / B.Tech. Programmes in II Semester)	L	T	P	C
		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.

TEXT BOOKS:

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.

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

OBJECTIVES

- 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

OUTCOMES

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.

TEXT BOOKS:

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

GE7153 ENGINEERING MECHANICS

L	T	P	C
4	0	0	4

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

1. Applying the various methods to determine the resultant forces and its equilibrium acting on a particle in 2D and3D.
2. Applying the concept of reaction forces (non-concurrent coplanar and noncoplanar forces) and moment of various support systems with rigid bodies in 2D and 3D in equilibrium. Reducing the force, moment, and couple to an equivalent force - couple system acting on rigid bodies in 2D and3D.
3. Applying the concepts of locating centroids/center of gravity of various sections / volumes and to find out area moments of inertia for the sections and mass moment of inertia ofsolids.
4. Applying the concepts of frictional forces at the contact surfaces of various engineering systems.
5. Applying the various methods of evaluating kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

UNIT I STATICS OF PARTICLES 12

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

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

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

TEXT 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)

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

ME7252 **MANUFACTURING TECHNOLOGY – I** **L T P C**
3 0 0 3

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

1. Applying the working principles of various metal casting processes.
2. Applying the working principles of various metal joining processes.
3. Analyzing the working principles of bulk deformation of metals.
4. Applying the working principles of sheet metal forming process.
5. Applying the working principles of plastics molding.

UNIT I METAL CASTING PROCESSES 9

Sand Casting – Sand Mould – Type of patterns - Pattern Materials – Pattern allowances – Moulding sand Properties and testing – Cores –Types and applications – Moulding machines – Types and applications– Melting furnaces – Principle of special casting processes- Shell, investment – Ceramic mould – Pressure die casting – Centrifugal Casting - CO casting - Defects in Sand casting process – Stir casting - Defects in Sand casting.

UNIT II METAL JOINING PROCESSES 9

Fusion welding processes – Type of Gas welding – Flame characteristics – Filler and Flux materials – Arc welding, Electrodes, Coating and specifications – Principles and types of Resistance welding – Gas metal arc welding – Submerged arc welding – Electro slag welding – Gas Tungsten arc welding – Principle and application of special welding processes – Plasma arc welding – Thermit Welding – Electron beam welding – Friction welding – Diffusion welding – Weld defects – Brazing and soldering – methods and process capabilities – Adhesive bonding, Types and application

UNIT III BULK DEFORMATION PROCESSES 9

Hot working and cold working of metals – Forging processes – Open, impression and closed die forging – Characteristics of the processes – Typical forging operations – rolling of metals – Types of Rolling – Flat strip rolling – shape rolling operations – Defects in rolled parts – Principle of rod and wire drawing – Tube drawing – Principles of Extrusion – Types – Hot and Cold extrusion.

UNIT IV SHEET METAL PROCESSES 9

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

UNIT V MANUFACTURE OF PLASTIC COMPONENTS 9

Types and characteristics of plastics – Moulding of thermoplastics – working principles and typical applications – injection moulding – Plunger and screw machines – Compression moulding, Transfer Moulding – Typical industrial applications – introduction to blow moulding – Rotational moulding – Film blowing – Extrusion – Thermoforming – Bonding of Thermoplastics.

TOTAL: 45 PERIODS

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

1. Explain the principle of different metal casting processes.
2. Describe the various metal joining processes.
3. Illustrate the different bulk deformation processes.
4. Outline the various sheet metal forming process.
5. Apply suitable molding technique for manufacturing of plastics components.

TEXT BOOKS:

1. Kalpakjian. S, “Manufacturing Engineering and Technology”, Pearson Education India Edition, 2006
2. S. Gowri P. Hariharan, A.Suresh Babu, Manufacturing Technology I, Pearson Education, 2008

REFERENCES:

1. Roy. A. Lindberg, Processes and materials of manufacture, PHI / Pearson education, 2006.
2. Hajra Chouldhary S.K and Hajra Choudhury. AK., Elements of workshop Technology, volume I and II, Media promoters and Publishers Private Limited, Mumbai, 1997.
3. Paul Degarma E, Black J.T and Ronald A. Kosher, Eligth Edition, Materials and Processes, in Manufacturing prentice – Hall of India, 1997.
4. Sharma, P.C., A Text book of production Technology, S.Chand and Co. Ltd., 2004. 5. P.N. Rao, Manufacturing Technology Foundry, Forming and Welding, TMH-2003; 2 nd Edition, 2003.

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

ME7261 MANUFACTURING TECHNOLOGY LAB I

L	T	P	C
0	0	4	2

COURSE OBJECTIVE:

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

1. Selecting appropriate tools, equipment and machines to complete a given job.
2. Performing various welding process using GMAW.
3. Performing various machining process
4. Understanding the casting process by hands on training
5. Analyzing the defects in the cast and machined components.

LIST OF EXPERIMENTS

1. Fabrication of simple structural shapes using Gas Metal Arc Welding
2. Joining of plates and pipes using Submerged arc welding
3. Friction stir welding of aluminium plates
4. Preparation of green sand moulds
5. Casting of aluminium components
6. Die casting of aluminium components
7. Stir casting of aluminium components
8. Open and closed die forging of light metal components
9. Reducing the thickness of the plates using two-high rolling process
10. Reducing the diameter of using Wire drawing
11. Extrusion of metal components of simple shapes
12. Manufacturing of simple sheet metal components using shearing and bending operations.
13. Drawing of cup shaped products
14. Manufacturing of sheet metal components using metal spinning on a lathe
15. Forming of simple sheet metal parts by Water hammer forming process
16. Extrusion of plastic components

TOTAL: 60 PERIODS

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

1. Select appropriate tools, equipment and machines to complete a given job.
2. Perform various welding process using GMAW.
3. Perform various machining operations
4. Perform casting process
5. Analyze the defects in the cast and machined components.

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

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

CE7251 STRENGTH OF MATERIALS

L	T	P	C
3	0	0	3

OBJECTIVE:

- To understand the stresses developed in bars, compounds bars, beams, shafts, cylinders and spheres.

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic constants – Volumertric strains – Stresses on inclined planes – principal stresses and principal planes – Mohr's circle of stress.

UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM 9

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

UNIT III TORSION 9

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

UNIT IV DEFLECTION OF BEAMS 9

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

9

UNIT V THIN CYLINDERS, SPHERES AND THICk CYLINDERS

Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lame's theory – Application of theories of failure.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to apply mathematical knowledge to calculate the deformation behavior of simple structures.
- Critically analyse problem and solve the problems related to mechanical elements and analyse the deformation behavior for different types of loads.

TEXT BOOkS:

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

REFERENCES:

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

CE 7352 FLUID MECHANICS AND MACHINERY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the applications of the conservation laws to flow through pipes and hydraulic machines.
- To understand the importance of dimensional analysis.
- To understand the importance of various types of flow in pumps and turbines.

UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS 9

Units and dimensions- Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, capillarity and surface tension. Flow characteristics – concept of control volume - application of control volume to 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 losses – Flow through pipes in series and parallel.

UNIT III DIMENSIONAL ANALYSIS 9

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

UNIT IV PUMPS 9

Impact of jets - Euler's equation - Theory of rotodynamic machines – various efficiencies– velocity components at entry and exit of the rotor- velocity triangles - Centrifugal pumps– working principle - work done by the impeller - performance curves - Reciprocating pump- working principle – indicator diagram – work saved by fitting air vessels – Rotary pumps – classification – comparison of working principle with other pumps – advantages.

UNIT V TURBINES 9

Classification of turbines – heads and efficiencies – velocity triangles – axial, radial and mixed flow turbines – Pelton wheel and Francis turbine - working principles - work done by water on the runner – draft tube - specific speed - unit quantities – performance curves for turbines – governing of turbines.

TOTAL : 45 PERIODS

OUTCOMES:

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

- Apply mathematical knowledge to predict the properties and characteristics of a fluid.
- Critically analyse the performance of pumps and turbines.

TEXT BOOKS:

1. Streeter, V. L. and Wylie E. B., Fluid Mechanics, McGraw Hill Publishing Co.(2010)
2. Kumar K. L., Engineering Fluid Mechanics, Eurasia Publishing House(p) Ltd. New Delhi (2004).
3. Modi P.N. and Seth, S.M. Hydraulics and Fluid Mechanics, Standard Book House (2002), New Delhi

REFERENCES:

1. Robert .Fox, Alan T. McDonald, Philip J.Pritchard, "Fluid Mechanics and Machinery", ISBN 978-0-470-54755-7, 2011..

EC 7354 ELECTRONICS ENGINEERING L T P C
3 0 0 3

OBJECTIVE:

- To provide knowledge in the basic concepts of Electronics Engineering including semiconductors, transistors, electronic devices, signal generators, transducers and digital electronics.

UNIT I SEMICONDUCTORS AND RECTIFIERS 9

P-N junction, VI Characteristics of PN junction diode, Zener diode, Zener diode Characteristics, Zener diode as a regulator, BJT and N-MOSFET working and V-I characteristics.

UNIT II AMPLIFIERS AND OSCILLATORS 9

BJT CE amplifier with and without feedback and frequency response, CS MOSFET amplifier and its frequency response, Current series feedback amplifier. Positive feedback, Sinusoidal oscillators –Wein bridge oscillators, Hartley, Colpitts, and Crystal oscillator.

UNIT III LINEAR INTEGRATED CIRCUITS 9

Operational amplifier –Inverting and Non-inverting amplifiers, Adder, integrator and differentiator, Instrumentation amplifier, Digital to Analog converters - R-2R and weighted resistor types, Analog to Digital converters - Successive approximation and Flash types, IC 555 based Astable and Monostable Multivibrators,

UNIT IV DIGITAL ELECTRONICS 9

Boolean algebra, Logic Gates, Half and Full adders, Decoder, Encoder, Multiplexer, Demultiplexer, Flip flops, Counters and Registers.

UNIT V TRANSDUCERS AND DISPLAY DEVICES 9

Thermistors, Semiconductor strain gauges, LVDT, Tachometer, Ultrasonic and Thermal flow meter, pressure force and weight measurement, Seven segment display, LED and LCD

TOTAL : 45 PERIODS

OUTCOME:

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

- Identify and apply electronics components to design circuits.

TEXT BOOK:

1. Malvino, ‘Electronic Principles’, McGraw Book Co., 1993.

REFERENCES:

1. Grob. B and Schultz. M.E. ‘Basic Electronics’, Tata Mcgraw Hill, 2003.
2. Thomas L. Floyd, ‘Electronics Devices’, Pearson Education, 2002.
3. Thomas L. Floyd, ‘Digital Fundamentals’, Pearson Education, 2003.
4. Millman, Halkias Jacob, Jit Christos and Satyabrata, ‘Electronic devices and Circuits’, Tata McGraw Hill, 2 nd Edition.
5. Transducers in Mechanical and Electronic Design by Trietley

EE 7251 BASIC ELECTRICAL ENGINEERING AND MEASUREMENTS L T P C
3 0 0 3

OBJECTIVES:

To impart knowledge on

- Electric circuit laws
- Principle of Electrical Machines
- Various measuring instruments

UNIT I ELECTRICAL CIRCUITS 9

Ohms Law – Kirchhoff's Law-Mesh analysis – Superposition and Thevenin's theorem - Introduction to AC circuits – waveforms, RMS and average value – Power and power factor-Three phase balanced circuits-Three phase Power measurement.

UNIT II ELECTRICAL MACHINES 9

Principle of operation DC machines- Characteristics of DC motor - Single phase transformers, three-phase and single-phase induction motors – Speed Control.

UNIT III SPECIAL ELECTRICAL COMPONENTS 9

Synchronous machine – Brushless DC Motor - Stepper motor – Switched reluctance motor-Electromechanical Relays.

UNIT IV ELECTRICAL MEASUREMENTS 9

Classification of instruments – moving coil and moving iron meters – Induction type, dynamometer type wattmeters – Energy meter – Megger – Instrument transformers (CT & PT) –Wheatstone's bridge for measurement of unknown resistance ,Maxwell's bridge for unknown inductance and Schering Bridge for unknown capacitance –Instrumentation Amplifiers.

UNIT V MECHANICAL MEASUREMENTS 9

Classification of transducers, strain, RTD, thermocouples, Piezo-electric transducer, LVDT, Turbine and electromagnetic flow meters, level transducers ultrasonic and fiber optic transducers, type of sensors, elastic sensors, viscosity, moisture and pH sensors, Digital transducers, vibrating wire instruments like load cells, stress meter, etc.

TOTAL : 45 PERIODS

OUTCOME:

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

- Explain different types of electrical machines and their performance.

TEXT BOOKS:

1. Del Toro 'Electrical Engineering Fundamentals' Pearson Education, New Delhi, 2007.
2. Alan S. Moris, Principles of Measurements and Instruments, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
3. T.Kenjo and S.Nagamori, Permanent magnet and Brushless DC motors, Clarendon 125 press, London, 1988.
4. Sunil S.Rao, Switchgear and Protection, Khanna publishers, New Delhi, 2008.

REFERENCES:

1. Rajendra Prasad 'Fundamentals of Electrical engineering' Prentice Hall of India, 2006.
2. Sanjeev Sharma 'Basics of Electrical Engineering' S.K International Publishers, New Delhi 2007.
3. John Bird, Electrical Circuits theory and Technology, Elsevier, First India Edition, 2006.
4. Doebeling, E.O., Measurements Systems – Application and Design', McGrawHill Publishing Co, 1990.
5. D.P.Kothari and I.J.Nagrath, Electric machines, Tata Mc Graw hill publishing company, New Delhi, Third Edition, 2004.

MA 7302 PARTIAL DIFFERENTIAL EQUATIONS

L	T	P	C
4	0	0	4

OBJECTIVES :

- To introduce the effective mathematical tools for the solutions of partial differential equations that model physical processes;
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems;
- To demonstrate the utility of numerical techniques of partial differential equations in solving engineering problems where analytical solutions are not readily available. The focus will be on finite difference methods.
- To solve PDEs in one or more "space" dimensions using finite difference methods and to discuss the stability limits for these numerical schemes.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 12

Formation – Solutions of first order equations – Standard types and Equations reducible to standard types – Singular solutions – Lagrange's linear equation – Integral surface passing through a given curve – Classification of partial differential equations - Solution of linear equations of higher order with constant coefficients – Linear non-homogeneous
partial differential equations.

UNIT II FOURIER SERIES 12

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

UNIT III FOURIER SERIES SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12

Method of separation of variables – Solutions of one dimensional wave equation and one-dimensional heat equation – Steady state solution of two-dimensional heat equation – Fourier series solutions in Cartesian coordinates.

UNIT IV FINITE DIFFERENCE SOLUTION TO HEAT EQUATION 12

Numerical differentiation by finite differences: Second order differences for first and second derivatives – Solution of linear system of equations: Gauss elimination method, Thomas algorithm – Explicit and Crank-Nicholson schemes for one space dimensional heat equation – Alternating Direction and Implicit method (ADI Method) for two space heat equation.

UNIT V FINITE DIFFERENCE SOLUTION TO POTENTIAL AND WAVE EQUATIONS 12

Iterative solution of linear system of equations: Gauss-Jacobi, Gauss-Seidel and SOR methods -- Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – Leibmann's method – Lax-Wendroff
scheme for first order hyperbolic equation - Explicit finite difference scheme for one space dimensional wave equation.

TOTAL : 60 PERIODS

OUTCOMES:

- Students acquire basic understanding of the most common partial differential equations, and to learn some methods for solving them. The main goal of the course is that the student, after finished studies, should be able to solve boundary value problems for Laplace's equation, the heat equation, the wave equation.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Jain M.K, Iyengar S.R.K and Jain R.K., "Computational Methods for Partial Differential Equations", New-Age International, Reprint , 2002.

REFERENCES:
1. Glyn James, “Advanced Modern Engineering Mathematics”, Pearson Education, 2007.
2. Peter V. O’Neil, “Advanced Engineering Mathematics”, Cengage Learning, 2007.
3. Grewal,B.S. and Grewal,J.S., “Numerical methods in Engineering and Science”, Khanna Publishers, New Delhi, 9th Edition, 2007.
4. G.D.Smith,” Numerical Solutions of Partial Differential Equations”, Oxford University Press, 3rd Edition,1987.
5. Gerald, C.F. and Wheatley, P.O., “Applied Numerical Analysis”, Pearson Education Asia, New Delhi, 6th Edition, 2006.

ME 7301	ENGINEERING THERMODYNAMICS	L	T	P	C
		4	0	0	4

COURSE OBJECTIVES: The main learning objective of this course is to prepare the students for:
1. Applying the zeroth and first law of thermodynamics by formulating temperature scales and calculating the property changes in closed and open engineering systems.
2. Applying the second law of thermodynamics in analyzing the performance of thermal devices through energy and entropy calculations.
3. Applying the second law of thermodynamics in evaluating the various properties of steam through steam tables and Mollier chart.
4. Applying the properties of pure substance in computing the macroscopic properties of ideal and real gases using gas laws and appropriate thermodynamic relations.
5. Applying the properties of gas mixtures in calculating the properties of gas mixtures and applying various thermodynamic relations to calculate property changes.

UNIT I BASIC CONCEPTS AND FIRST LAW 12

Basic concepts - continuum, Microscopic and Macroscopic approaches. Path and point functions. Intensive and extensive properties, total and specific quantities. System, surrounding, boundary and their types. Thermodynamic Equilibrium. State, path and process. Quasi-static, reversible and irreversible processes. Heat and work transfer - definition and comparison, sign convention. Displacement work, P-V diagram and other modes of work. Zeroth law – concept of temperature and thermal equilibrium. First law – application to closed and open systems – steady and unsteady flow processes.

UNIT II SECOND LAW 12

Heat Reservoir - source and sink. Heat Engine, Refrigerator, Heat pump. Statements of second law and its corollaries. Carnot cycle, Reversed Carnot cycle, Performance. Clausius inequality. Concept of entropy, T-s diagram, Tds Equations - entropy change for a pure substance, ideal gases undergoing different processes, principle of increase in entropy. Applications of II Law. High and low grade energy. Availability and Irreversibility analysis for open and closed systems, I and II law Efficiency.

UNIT III PURE SUBSTANCES AND STEAM POWER CYCLE 12

Steam - formation and its thermodynamic properties - p-v, p-T, T-v, T-s, h-s diagrams. PVT surface. Determination of dryness fraction. Calculation of work done and heat transfer in non-flow and flow processes using Steam Table and Mollier Chart. Ideal and actual Rankine cycles.

UNIT IV IDEAL AND REAL GASES THERMODYNAMIC RELATIONS 12

Properties of Ideal gas, real gas, and their comparison. Equations of state for ideal and real gases. van der Waal's relation, Reduced properties, Compressibility factor, Principle of Corresponding states. Generalised Compressibility Chart and its use. Maxwell relations, Tds Equations, heat capacities relations, Energy equation, Joule-Thomson experiment, Phase Change Processes, Clausius-Clapeyron equation. Simple Calculations.

UNIT V GAS MIXTURES AND PSYCHROMETRY 12

Mole and mass fractions – Dalton's and Amagat's laws, properties of ideal gas mixtures. Psychrometric properties – Property calculations using Psychrometric chart and expressions. Psychrometric processes – adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing.

TOTAL : 60 PERIODS

(Use of Steam tables, Mollier chart and Psychrometric chart permitted)

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

1. Analyze the problems associated with zeroth and first laws of thermodynamics.
2. Apply the concept of second law of thermodynamics in analyzing the thermal systems.
3. Computethe properties of pure substancesand analyze energy transfer invapor power cycles.
4. Summarize the thermodynamic relations and evaluate the applications in thermal systems.
5. Compute the thermodynamic properties of gas mixtures andanalyse the Psychrometric processes in real time applications.

TEXT BOOKS:

1. Nag.P.K, "Engineering Thermodynamics", 5th Edition, Tata McGraw Hill (2013), New Delhi
2. Natarajan .E, "Engineering Thermodynamics: Fundamentals and Applications", 2nd Edition (2014) Anuragam Publications, Chennai.

REFERENCES:

1. Y. Cengel and M. Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill,7th Edition, 2011.
2. Chattopadhyay, P, "Engineering Thermodynamics",2nd Ed. Oxford University Press, 2014.
3. Venkatesh. A, "Basic Engineering Thermodynamics", Universities Press (India) Limited, 2007.
4. E. Rathakrishnan, "Fundamentals of Engineering Thermodynamics", 2nd Edition, Prentice Hall of India Pvt. Ltd, 2006.
5. Van Wylen and Sonntag, "Classical Thermodynamics", Wiley Eastern, 1987.
6. Arora .C.P., "Refrigeration and Air Conditioning", Tata McGraw Hill, 1994.

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CE 7312 FLUID MECHANICS AND STRENGTH OF MATERIALS LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

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

UNIT – I STRENGTH OF MATERIALS 30

LIST OF EXPERIMENTS

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

UNIT – II FLUID MECHANICS AND MACHINES LABORATORY 30

LIST OF EXPERIMENTS

A. FLOW MEASUREMENT

1. Flow through Venturimeter

B. PUMPS

2. Characteristics of Centrifugal pumps
3. Characteristics of Gear pump
4. Characteristics of Submersible pump
5. Characteristics of Reciprocating pump

C. TURBINES

6. Characteristics of Francis turbine

D. DETERMINATION OF METACENTRIC HEIGHT

7. Determination of Metacentric height

TOTAL:60

PERIODS

OUTCOMES:

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

- Perform Tension, Torsion, Hardness, Compression, and Deformation test on Solid materials.
- Use the measurement equipments for flow measurement.
- Perform test on different fluid machinery.

REFERENCES:

1. Strength of Materials Laboratory Manual, Anna University, Chennai – 600 025, 2010
2. Hydraulic Laboratory Manual, Centre for Water Resources, Anna University, 2004.
3. Modi P.N. and Seth S.M., Hydraulics and Fluid Mechanics. Standard Book House. New Delhi, 2000.
4. Subramanya, K.. Flow in open channels, Tata McGraw - Hill pub. Co., 1992.
5. Subramanya, K. Fluid mechanics, Tata McGraw- Hill pub. Co., New Delhi,1992.

EE7261 ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY L T P C 0 0 4 2

OBJECTIVE:

- To train the students in performing various tests on electrical drives, sensors and circuits.

LIST OF EXPERIMENTS:

1. Load test on separately excited DC shunt generator
2. Load test on DC shunt moor
3. Load test on S Transformer
4. Load test on Induction motor
5. Regulation of 3 Alternator
6. Study of CRO
7. Logic gates
8. Operational amplifiers
9. Time constant of RC circuit
10. Characteristics of LVDT
11. Calibration of Rotometer

12. RTD and Thermistor
13. Flapper Nozzle system

TOTAL: 60 PERIODS

OUTCOMES:

- Ability to perform speed characteristic of different electrical machine
- Ability to use of diodes, transistors for rectifiers
- Ability to use of operational amplifiers

GE 7251	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.

MA7354	NUMERICAL METHODS	L	T	P	C
		4	0	0	4

OBJECTIVES:

- 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 – Eigen values 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:

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

- 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, 2007.
2. Sankara Rao . K, " Numerical Methods for Scientists and Engineers" PHI, Learning Pvt Ltd. New Delhi, 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
5. Scientific and Engineering Computation", 6th Edition, New Age International Publishers, New Delhi, 2012.

ME 7352 MANUFACTURING TECHNOLOGY – II

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the concept and basic mechanics of metal cutting, working of standard machine tools such as lathe, shaping and allied machines, milling, drilling and allied machines, grinding and allied machines and broaching.
- To understand the basic concepts of Computer Numerical Control (CNC) of machine tools and CNC Programming.

UNIT I THEORY OF METAL CUTTING 9

Mechanics of chip formation, single point cutting tool, forces in machining, Types of chip, cutting tools – nomenclature, orthogonal, oblique metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability.

UNIT II TURNING MACHINES 9

Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes- tool layout – automatic lathes: semi automatic – single spindle: Swiss type, automatic screw type – multi spindle.

UNIT III RECIPROCATING, MILLING AND GEAR CUTTING MACHINES 9

Reciprocating machine tools: shaper, planer, slotter: Types and operations- Hole making: Drilling, reaming, boring, tapping, type of milling operations-attachments- types of milling cutter– machining time calculations - Gear cutting, gear hobbing and gear shaping – gear finishing methods.

UNIT IV ABRASIVE PROCESSES AND BROACHING 9

Abrasive processes: grinding wheel – specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centreless grinding, internal grinding - micro finishing methods - Typical applications – concepts of surface integrity, broaching machines: broach construction – push, pull, surface and continuous broaching machines.

UNIT V COMPUTER NUMERICAL CONTROL MACHINE TOOLS 9

Numerical Control (NC) machine tools – CNC types, constructional details, special features, machining centre and part programming fundamentals – manual part programming and computer assisted part programming.

TOTAL: 45 PERIODS

OUTCOME:

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

1. Apply the fundamental concepts of metal cutting to analyse the traditional machining processes.
2. Demonstrate the basicworking of various types of turning machines.

3. Explain the working principles and operations ofreciprocating, milling and gear cutting machines.
4. Classify theabrasive andbroaching processes and their applications.
5. Explain the constructional features ofNC/CNC machine tools and part programming.

TEXT BOOKS:

1. Roy. A.Lindberg, "Process and materials of manufacture," PHI/Pearson Education fourth, Edition 2006.
2. Serope Kalpakjian, Steven Schmid, "Manufacturing processes for engineering materials", Pearson Education, 3rd Edition, 2009.

REFERENCES:

1. Richerd R Kibbe, John E. Neely, Roland O.Merges and Warren J.White "Machine Tool Practices", Prentice Hall of India, 1998
2. HMT – "Production Technology", Tata McGraw Hill, 1998.
3. Hajra Choudhury. "Elements of Workshop Technology – Vol.II". Media Promoters
4. Geofrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", McGraw Hill, 1984
5. Rao. P.N "Manufacturing Technology," Metal Cutting and Machine Tools, Tata McGraw- Hill, New Delhi, 2003.

ME7401	KINEMATICS OF MACHINES	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

1. Applying the basic components of mechanisms and layout of linkages in the assembly of a system / machine
2. Analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism
3. Applying the design of cam mechanisms for specified output motions
4. Applying the basic concepts of toothed gearing and kinematics of gear trains
5. Analyzing the effects of friction in machine elements

UNIT I BASICS OF MECHANISMS 9

Introduction- resistant bodies- kinematic link- kinematic pair- kinematics constraints- kinematic chain- mechanism- structure – Inversion of four bar chain- inversion of single slider crank chain – inversion of double crank chain – Grashof's law – Degrees of freedom – Kutzbach criterion – Grubler's criterion. Classification of mechanisms- Ratchets and Escapement mechanisms- Indexing mechanisms- Analysis of Hooke's joint – Double Hooke's joint- Pantograph – Straight line motion Mechanisms (Exact and Approximate)- Steering gear mechanisms.

UNIT II KINEMATICS OF LINKAGE MECHANISMS 9

Displacement, velocity and acceleration analysis of mechanisms – Velocities and accelerations by relative velocity method -Velocity analysis using instantaneous centre method- Velocities and accelerations by Analytical method -Coriolis Acceleration.

UNIT III KINEMATICS OF CAM MECHANISMS 9

Classification of cams and followers – law of cams-Terminology and definitions – Displacement diagrams – Uniform velocity, parabolic, simple harmonic, Cycloidal – Derivatives of follower motions – Layout of plate cam profiles – Specified contour cams – Circular arc and tangent cams – Pressure angle and undercutting – sizing of cams.

UNIT IV GEARS AND GEAR TRAINS 9

Law of gearing – Spur Gear terminology and definitions – Involutes and cycloidal tooth profiles Gear tooth action – Contact ratio – Interference and undercutting – corrected and uncorrected gear teeth – Gear terminology and definitions -Helical, Bevel, Worm, Rack and Pinion gears– Gear trains – Speed ratio, train value – Epicyclic Gear Trains – Differentials – Automobile gear box

UNIT V FRICTION IN MACHINE ELEMENTS 9

Surface contacts - Sliding and Rolling friction - Friction drives - Friction in screw threads - Bearings and lubrication - Friction clutches - Belt and rope drives - Friction aspects in brakes - Friction in vehicle propulsion and braking.

TOTAL:45 PERIODS

OUTCOME:

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

1. Understand the basic components of mechanisms and layout of linkages in the assembly of a system / machine
2. Analyze the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism
3. Design of cam mechanisms for specified output motions
4. Express the basic concepts of toothed gearing and kinematics of gear trains
5. Report the effects of friction in machine elements

TEXT BOOKS:

1. Uicker, J.J., Pennock G.R and Shigley, J.E., “Theory of Machines and Mechanisms”, 3rd Edition, Oxford University Press, 2009.
2. Rattan, S.S, “Theory of Machines”, 3rd Edition, Tata McGraw-Hill, 2009.

REFERENCES:

1. Thomas Bevan, “Theory of Machines”, 3 rd Edition, CBS Publishers and Distributors, 2005.
2. Robert L. Norton, “Kinematics and Dynamics of Machinery”, Tata McGraw-Hill, 2010.
3. Sadhu Singh, Theory of machines, Pearson, 2013
4. Ghosh. A and Mallick, A.K., “Theory of Mechanisms and Machines”, Affiliated East-West Pvt. Ltd., New Delhi, 1988.
5. Rao.J.S. and Dukkipati.R.V. “Mechanisms and Machine Theory”, Wiley-Eastern Ltd., New Delhi, 1992.
6. John Hannah and Stephens R.C., “Mechanics of Machines”, Viva Low-Prices Student Edition, 1999.
7. V.Ramamurthi, “Mechanics of Machines”, Narosa Publishing House, 2002.
8. Khurmi, R.S.,”Theory of Machines”,14th Edition, S Chand Publications 2015.

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ME 7402	THERMAL ENGINEERING - I	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

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

1. Applying the concepts and laws of thermodynamics to predict the operation of thermodynamic cycles and performance of Internal Combustion (IC) engines and Gas Turbines.
2. Analyzing the performance of steam nozzle, calculate critical pressure ratio
3. Evaluating the performance of steam turbines through velocity triangles, understand the need for governing and compounding of turbines
4. Analyzing the working of IC engines and various auxiliary systems present in IC engines
5. Evaluating the various performance parameters of IC engines

UNIT I GAS AND STEAM POWER CYCLES 9

Air Standard Cycles - Otto, Diesel, Dual, Brayton – Cycle Analysis, Performance and Comparison – Rankine, reheat and regenerative cycle.

UNIT II RECIPROCATING AIR COMPRESSOR 9

Classification and comparison, working principle, work of compression - with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency. Multistage air compressor with Intercooling. Working principle and comparison of Rotary compressors with reciprocating air compressors.

UNIT III INTERNAL COMBUSTION ENGINES AND COMBUSTION 9

IC engine – Classification, working, components and their functions. Ideal and actual : Valve and port timing diagrams, p-v diagrams- two stroke & four stroke, and SI & CI engines – comparison. Geometric, operating, and performance comparison of SI and CI engines. Desirable properties and qualities of fuels. Air-fuel ratio calculation – lean and rich mixtures. Combustion in SI & CI Engines – Knocking – phenomena and control.

UNIT IV INTERNAL COMBUSTION ENGINE PERFORMANCE AND SYSTEMS 9

Performance parameters and calculations. Morse and Heat Balance tests. Multipoint Fuel Injection system and Common Rail Direct Injection systems. Ignition systems – Magneto, Battery and Electronic. Lubrication and Cooling systems. Concepts of Supercharging and Turbocharging – Emission Norms.

UNIT V GAS TURBINES 9

Gas turbine cycle analysis – open and closed cycle. Performance and its improvement - Regenerative, Intercooled, Reheated cycles and their combinations. Materials for Turbines.

TOTAL:45

PERIODS

COURSE OUTCOMES:

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

1. Identify and perform thermodynamical analysis of various gas and steam power cycles.
2. Evaluate performance of air compressors.
3. Explain the working, air fuel ratio requirements and combustion in SI and CI engines.
4. Describe the procedures for various engine tests and working of auxiliary systems.
5. Compare the open and closed cycle for gas turbines configuration and predict its performance.

TEXT BOOKS:

1. Mahesh. M. Rathore, “Thermal Engineering”, 1st Edition, Tata McGraw Hill, 2010.
2. Ganesan.V , " Internal Combustion Engines" 4th Edition, Tata McGraw Hill, 2012.

REFERENCES:

1. Rudramoorthy R, “Thermal Engineering”, Tata McGraw Hill, New Delhi, 2003.
2. Holman .J.P., “Thermodynamics”, McGraw Hill, 1985.
3. Rajput .R.K, “Thermal Engineering”, Laxmi, 8th Edition, 2013.

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2	1	3	2	2			1	1				1	2	1	2
3	2	2	2	1		1	2	2				1	2	1	2
4	1	2	1	1		1	2	2				1	2	1	2
5	2	3	1	1		1		1				1	2	2	1

ML 7451 ENGINEERING MATERIALS AND METALLURGY L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS 9

Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, Iron – Iron carbide phase diagram. Classification of steel and cast Iron- microstructure, properties and application.

UNIT II HEAT TREATMENT 9

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

UNIT III FERROUS AND NON-FERROUS METALS 9

Effect of alloying additions on steel (Mn, Si, Cr, Mo, V, Ti & W) – stainless and tool steels – HSLA - Maraging steels – Grey, white, malleable, spheroidal and alloy cast irons, Copper and its alloys – Brass, Bronze and Cupronickel – Aluminium and its alloys; Al-Cu – precipitation strengthening treatment – Titanium alloys, Mg-alloys, Ni-based superalloys –Properties and Applications.

UNIT IV NON-METALLIC MATERIALS 9

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS,PAI, PPO, PPS, PEEK, PTFE, Thermo set polymers – Urea and Phenol formaldehydes - Engineering Ceramics – Properties and applications of Al_2O_3, SiC, Si_3N_4, PSZ and SIALON – Composites- Matrix and reinforcement

Materials- applications of Composites - Nano composites.

UNIT V MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS 9

Mechanisms of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), Micro and nano-hardness tests, Impact test - Izod and Charpy, Fatigue and Creep failure mechanisms.

TOTAL:45 PERIODS

OUTCOMES:

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

1. Construct the phase diagram and interpret the various phases.
2. Identify suitable heat treatment process to achieve the desired properties.
3. Choose proper ferrous and non-ferrous alloys for an engineering application.
4. Select appropriate polymer, ceramics and composites for an engineering application.
5. Examine the mechanical properties of materials by adopting varioustesting procedures.

TEXT BOOKS:

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

REFERENCES:

1. Rahavan.V, "Materials Science and Engineering", Prentice Hall of India Pvt.Ltd. 1999.
2. G.S. Upadhyay and Anish Upadhyay, "Materials Science and Engineering", Viva Books Pvt.Ltd, New Delhi, 2006.
3. Williams D Callister, "Materials Science and Engineering" Wiley India Pvt Ltd, Revised Indian edition 2007.

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ME 7361 MANUFACTURING TECHNOLOGY LABORATORY - II L T P C

0 0 4 2

OBJECTIVE:

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

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

LIST OF EXPERIMENTS

1. Taper Turning and Eccentric Turning using lathe
2. External and Internal Thread cutting using lathe
3. Knurling
4. Shaping – Square and Hexagonal Heads

5. Drilling and Reaming
6. Contour milling - vertical milling machine
7. Spur and helical gear cutting using milling machine
8. Gear generation using gear hobber
9. Gear generation using gear shaper
10. Grinding – Cylindrical, Surface and Centerless grinding
11. Tool angle grinding with tool and Cutter Grinder
12. Spline Broaching
13. Measurement of cutting forces in Milling /Turning Process
14. CNC Part Programming

TOTAL: 60

PERIODS

OUTCOMES:

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

- Make use of various machining processes to manufacture a component.
- Select the suitable machine tool and cutting tool for a given workpiece.
- Choose appropriate process parameters for a given machining application.
- Analyse machining processes by measuring the cutting forces.
- Develop CNC part programmes.

ME 7411	THERMAL ENGINEERING LABORATORY – I	L	T	P	C
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COURSE OBJECTIVES: The main learning objective of this course is to provide hands on training to the students in:

1. Analyzing the performance characteristics of various engines
2. Applying for proper valve and port timing in IC engines
3. Conducting boiler operation and performance test on a boiler and steam turbine

UNIT – I IC ENGINE LAB **30**

LIST OF EXPERIMENTS:

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

UNIT – II STEAM LAB **30**

LIST OF EXPERIMENTS:

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

TOTAL:60

PERIODS

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

1. Test the performance of the IC engines under various operating conditions
2. Determine the port, valve opening and overlap periods of the IC engines
3. Assess the characteristics of various fuels and lubricants used in IC engines
4. Prepare the heat balance sheet for a boiler

5. Evaluate the performance of steam turbine and arrive at various losses.

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ME 7501 DYNAMICS OF MACHINES

L	T	P	C
4	0	0	4

OBJECTIVES:

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

1. Analyzing the force-motion relationship in components subjected to external forces and in standard mechanisms.
2. Studying the undesirable effects of unbalances resulting from prescribed motions in mechanism.
3. Analyzing the effect of dynamics of undesirable free vibrations.
4. Analyzing the effect of dynamics of undesirable forced vibrations.
5. Learning the principles in mechanisms used for governing of machines.

UNIT I FORCE ANALYSIS 12

Applied and constraint forces – Free body diagrams – Static equilibrium conditions – force equilibrium analysis of simple mechanisms - friction in mechanisms– Dynamic force analysis – Inertia force and Inertia torque – D Alembert's principle –Dynamic Analysis in reciprocating engines – Gas forces – Inertia effect of connecting rod– Bearing loads – Crank shaft torque – Turning moment diagrams – Flywheels for engines and punching presses.

UNIT II BALANCING 12

Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder engine – Balancing of Multi-cylinder inline engines, V-engines – Partial balancing in engines – Balancing of linkages – Balancing machines- Balancing standards - Field balancing of single disc.

UNIT III FREE VIBRATION 12

Basics of vibratory systems – Degrees of freedom – Natural frequency -Spring mass system- Equations of motion — Viscously damped free vibration- Logarithmic decrement- Transverse vibration – Dunkerley's method- Critical speed of shafts -Two and three rotor torsional vibration.

UNIT IV FORCED VIBRATION 12

Response of one degree freedom system to Harmonic excitation force – Vibration Isolation - rotating unbalance - support motion – Transmissibility - Energy dissipated by damping- Vibration measuring instruments.

UNIT V MECHANISMS FOR CONTROL 12

Governors – Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors – Characteristics – Effect of friction – Controlling force. Gyroscopes – Gyroscopic forces and torques – Gyroscopic stabilization – Gyroscopic effects in Automobiles, ships and airplanes.

TOTAL:60 PERIODS

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

1. Examine the force-motion relationship in components subjected to external forces

and in standard mechanisms.
2. Determine the undesirable effects of unbalances resulting from prescribed motions in mechanism.
3. Evaluate the effect of dynamics of undesirable free vibrations.
4. Estimate the effect of dynamics of undesirable forced vibrations.
5. Decide the mechanisms used for governing of machines.

TEXT BOOKS:

1. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms",3rd Edition, Oxford University Press, 2009.
2. Rattan, S.S, "Theory of Machines", 3rd Edition, Tata McGraw-Hill, 2009.

REFERENCES:

1. Thomas Bevan, "Theory of Machines", 3 rd Edition, CBS Publishers and Distributors, 2005.
2. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.
3. Ghosh. A andMallick, A.K., "Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., New Delhi, 1988.
4. Rao.J.S. and Dukkipati.R.V. "Mechanisms and Machine Theory", Wiley-Eastern Ltd., New Delhi, 1992.
5. Grover. G.T., "Mechanical Vibrations", Nem Chand and Bros., 1996
6. V.Ramamurthi, "Mechanics of Machines", Narosa Publishing House, 2002.
7. Khurmi, R.S.,"Theory of Machines",14th Edition, S Chand Publications 2015

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ME 7502 METROLOGY AND MEASUREMENTS L T P C
3 0 0 3

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

1. Explaining the importance of measurements in engineering and the factors affecting measurements and to estimate measurement uncertainty.
2. Applying the working principle and applications of various linear and angular measuring instruments and basic concepts of measurement of assembly and transmission elements.
3. Interpreting the various tolerance symbols given in engineering drawings to choose the appropriate manufacturing process.
4. Applying the principles and methods of form and surface metrology.
5. Applying the advances in measurements for quality control in manufacturing Industries

UNIT I BASICS OF METROLOGY 9

Need for Metrology, Role in quality control, Factors affecting measurement - SWIPE; Errors in Measurements – Types – Control – Measurement uncertainty – Types, Estimation, Problems on Estimation of Uncertainty, Statistical analysis of measurement data, Calibration of measuring instruments, ISO standards.

UNIT II LINEAR AND ANGULAR MEASUREMENTS 9

Linear Measuring Instruments – Vernier caliper, Micrometer, Vernier height gauge, Depth Micrometer, Bore gauge, Telescoping gauge; Tolerance – Interchangeability, Selective assembly,

Terminology, Limits and Fits, Problems; Design of Limit gauges, Problems, Gauge blocks – Use and precautions, Comparators – Working and advantages; Toolmaker's microscope – Profile projector - Angular measuring instruments – Bevel protractor, Clinometer, Angle gauges, Precision level, Sine bar, Autocollimator, Angle dekkor, Alignment telescope.

UNIT III METROLOGY OF SURFACES 9

Fundamentals of GD & T- Measurement of straightness, flatness and roundness, Simple problems – Measurement of Surface finish – Functionality of surfaces, Parameters, Comparative, Stylus based and Optical Measurement techniques, Filters, Introduction to 3D surface metrology.

UNIT IV METROLOGY OF ASSEMBLY AND TRANSMISSION ELEMENTS 9

Measurement of Screw threads – purpose – Dimensioning – Limit gauging – Size limits – Single element measurements – Pitch Diameter, Lead, Pitch.

Measurement of Gears – purpose – Analytical measurement – Runout, Pitch variation, Tooth profile, Tooth thickness, Lead – Functional checking – Rolling gear test.

UNIT V ADVANCES IN METROLOGY 9

Lasers in metrology - Advantages of lasers – Laser scan micrometers; Laser interferometers – Applications – Straightness, Alignment; Ball bar tests, Computer Aided Metrology - Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Multisensor CMMs.

Machine Vision - Basic concepts of Machine Vision System – Elements – Applications - On-line and in-process monitoring in production - Computed tomography – White light Scanners.

TOTAL: 45

PERIODS

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

1. Explain the factors affecting measurements and estimate measurement uncertainty.
2. Outline the working principles and applications of various linear and angular measuring instruments.
3. Interpret the GD&T symbols given in engineering drawings and explain the different methods of surface finish measurement.
4. Explain the principles and methods for measurement of assembly and transmission elements.
5. Apply measurements for quality control in manufacturing Industries.

TEXT BOOKS:

1. Dotson Connie, "Dimensional Metrology", Cengage Learning, First edition, 2012.
2. Mark Curtis, Francis T. Farago, "Handbook of Dimensional Measurement", Industrial Press, Fifth edition, 2013.

REFERENCES:

1. J.F.W. Galyer, Charles Reginald Shotbolt, "Metrology for Engineers", Cengage Learning EMEA; 5th revised edition, 1990.
2. Toru Yoshizawa, "Handbook of Optical Metrology: Principles and Applications", CRC Press, 2009.
3. James G. Bralla, "Handbook of Product Design for Manufacture", McGraw Hill Book Co., 2004.
4. S. P. Venkateshan, "Mechanical Measurements", Second edition, John Wiley & Sons, 2015.
5. Balasubramanian Muralikrishnan and Jayaraman Raja, "Computational Surface and Roundness Metrology", Springer-Verlag London Ltd., 2009.
6. Robert J. Hocken (Editor) and Paulo H. Pereira, "Coordinate Measuring Machines and Systems", Second Edition (Manufacturing Engineering and Materials Processing), 2nd Edition, CRC Press, 2011.
7. Ammar Grous, "Applied Metrology for Manufacturing Engineering", Wiley-ISTE, 2011.
8. N.V. Raghavendra and L. Krishnamurthy, Engineering Metrology and Measurements, Oxford University Press, 2013.
9. NPL Measurement good practice guides relevant to the syllabus – No. 40, No. 41, No. 42, No. 43, No. 80, No. 118, No. 130, No. 131.

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ME 7503 THERMAL ENGINEERING - II L T P C
3 0 0 3

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

1. Evaluating the critical pressure ratio of a CD nozzle.
2. Analyzing different types of boilers and compute their performance parameters.
3. Evaluating velocity triangle and theoretical work of a steam turbine.
4. Applying the working principles of various refrigeration systems and perform cop calculations.
5. Analyzing the psychrometric properties and how they are utilized in arriving at calculations to determine heating loads.

UNIT I STEAM NOZZLE 9

Types and Shapes of nozzles, Flow of steam through nozzles, Critical pressure ratio, Variation of mass flow rate with pressure ratio. Effect of friction. Metastable flow.

UNIT II BOILERS 9

Types and comparison. Mountings and Accessories. Fuels - Solid, Liquid and Gas. Performance calculations, Boiler trial.

UNIT III STEAM TURBINES 9

Types, Impulse and reaction principles, Velocity diagrams, Work done and efficiency – optimal operating conditions. Multi-staging, compounding and governing.

UNIT IV COGENERATION AND RESIDUAL HEAT RECOVERY 9

Cogeneration Principles, Cycle Analysis, Applications, Source and utilisation of residual heat. Heat pipes, Heat pumps, Recuperative and Regenerative heat exchangers. Economic Aspects.

UNIT V REFRIGERATION AND AIR – CONDITIONING 9

Vapour compression refrigeration cycle, Effect of Superheat and Sub-cooling, Performance calculations, Working principle of air cycle, vapour absorption system, and Thermoelectric refrigeration. Air conditioning systems, concept of RSHF, GSHF and ESHF, Cooling load calculations. Cooling towers – concept and types.

TOTAL:45 PERIODS

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

1. Understand and apply the concept of critical pressure ratio in designing nozzles.
2. Evaluate the performance of boilers adopting direct and indirect approach.
3. Develop relevant velocity triangles of steam turbines and analyze parametric influences.

4. Appraise the waste heat of industrial processes and adoption of relevant cogeneration technologies.
5. Design and develop suitable refrigeration and air conditioning systems accounting all heat loads.

TEXT BOOKS:

1. Mahesh. M. Rathore, "Thermal Engineering", 1st Edition, Tata Mc Graw Hill Publications, 2010.
2. Kothandaraman, C.P., Domkundwar .S and Domkundwar A.V.,"A course in Thermal Engineering", Dhanpat Rai & Sons, 7th Edition, 2010.

REFERENCES:

1. Ballaney. P.L ." Thermal Engineering", Khanna publishers, 24th Edition 2012
2. Arora .C.P., "Refrigeration and Air Conditioning", Tata Mc Graw Hill, 1994
3. Donald Q. Kern, " Process Heat Transfer", Tata Mc Graw Hill, 1997.
4. Charles H Butler : Cogeneration" McGraw Hill, 1984.
5. Sydney Reiter "Industrial and Commercial Heat Recovery Systems" Van Nostrand
6. Reinhols, 1985.
7. David Gunn, Robert Horton, "Industrial Boilers – Longman Scientific and Technical" Publication, 1986.

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ME 7552 DESIGN OF MACHINE ELEMENTS

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

1. Designing machine members subjected to static and variable loads.
2. Designing shafts and couplings for various applications.
3. Analyzing bolted and welded joints for various kinds of loads.
4. Designing helical, leaf springs and flywheels for various applications.
5. Designing and select sliding and rolling contact bearings

UNIT I FUNDAMENTAL CONCEPTS IN DESIGN 12

Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers, fits and tolerances – Direct, Bending and torsional loading- Modes of failure - Factor of safety – Combined loads – Principal stresses – Impact and shock loading – Eccentric loading – curved beams – crane hook and 'C' frame- theories of failure – Design based on strength and stiffness – stress concentration – Fluctuating stresses – Endurance limit – Notch sensitivity - Design for finite and infinite life under variable loading - Exposure to standards.

UNIT II SHAFTS AND COUPLINGS 12

Shafts and Axles - Design of solid and hollow shafts based on strength, rigidity and critical speed – Keys and splines – Rigid and flexible couplings.

UNIT III TEMPORARY AND PERMANENT JOINTS 12

Threaded fasteners - Bolted joints – Simple and eccentrically loaded bolted joints, Knuckle joints, Cotter joints, Welded joints – Butt, Fillet and parallel transverse fillet welds – welded joints subjected to bending, torsional and eccentric loads, riveted joints for structures –Caulking and fullering – efficiency of joints – Strength equations.

UNIT IV ENERGY STORING ELEMENTS AND ENGINE COMPONENTS 12

Types of springs, design of helical and concentric springs–surge in springs, Design of laminated springs - Flywheels considering stresses in rims and arms for engines and presses - Solid and Rimmed flywheels - Connecting Rods and crank shafts.

UNIT V BEARINGS 12

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number, Raimondi & Boyd graphs, -- Selection of Rolling Contact bearings -Seals and Gaskets.

TOTAL:60

PERIODS

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

1. Design machine members subjected to static and variable loads.
2. Design shafts and couplings for various applications.
3. Choose the bolted, weldedand riveted joints for various kinds of loads.
4. Design helical, leaf springs and flywheels for the required mechanical systems.
5. Select sliding and rolling contact bearings.

TEXT BOOKS:

1. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett “Mechanical Engineering Design”, 8th Edition, Tata McGraw-Hill , 2008.
2. Bhandari V, “Design of Machine Elements”, 15thReprint, Tata McGraw-Hill Book Co, 2014.

REFERENCES:

1. Sundararajamoorthy T. V. Shanmugam .N, “Machine Design”, Anuradha Publications, Chennai, 2003.
2. Mohammed. Jalaludeen “Machine Design, Volume I”, “Design of Machine Elements”, 4th edition, Anuradha Publications, 2014.
3. Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine component Design”,5th Edition, Wiley, 2011
4. Orthwein W, “Machine Component Design”, Jaico Publishing Co, 2006.
5. Ansel Ugural, “Mechanical Design – An Integral Approach”, 1st Edition, Tata McGraw-Hill Book Co, 2003.
6. M F. Spotts, Terry E. Shoup and Lee E. Hornberger, “Design of Machine Elements” 8th Edition, Printice Hall, 2003.
7. “Design Data Hand Book”, PSG College of Technology, 2013- Coimbatore.

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ME 7553 HYDRAULICS AND PNEUMATICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

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

1. Applying the working principles of fluid power systems and hydraulic pumps.
2. Applying the working principles of hydraulic actuators and control components.
3. Designing and develop hydraulic circuits and systems.
4. Applying the working principles of pneumatic power system and its components.
5. Solving problems and troubles in fluid power systems.

UNIT I FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS 9

Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of Hydraulics – Pascal's Law – Principles of flow - Friction loss – Work, Power and Torque Problems, Sources of Hydraulic power : Pumping Theory – Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of Linear and Rotary – Fixed and Variable displacement pumps – Problems.

UNIT II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS 9

Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Hydraulic motors - Control Components : Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Servo and Proportional valves – Applications – Accessories : Reservoirs, Pressure Switches – Applications – Fluid Power ANSI Symbols – Problems.

UNIT III HYDRAULIC CIRCUITS AND SYSTEMS 9

Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double-Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

UNIT IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS 9

Properties of air – Perfect Gas Laws – Compressor – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – Cascade method – Electro Pneumatic System – Elements – Ladder diagram – Problems, Introduction to fluidics and pneumatic logic circuits.

UNIT V TROUBLE SHOOTING AND APPLICATIONS 9

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for Pick and Place applications and tool handling in CNC Machine tools – Low cost Automation – Hydraulic and Pneumatic power packs.

TOTAL:45 PERIODS

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

1. Make use of the principles of fluid mechanics and thermodynamics to develop fluid power systems.
2. Discuss the working principles of hydraulic actuators and control components.
3. Design and develop hydraulic circuits and systems.
4. Develop solutions for industrial automation with pneumatic circuits.
5. Troubleshoot and provide solutions for the problems in Hydraulic and Pneumatic systems.

TEXT BOOKS:

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

REFERENCES:

1. Shanmugasundaram.K, “Hydraulic and Pneumatic Controls”. Chand & Co, 2006.
2. Majumdar, S.R., “Oil Hydraulics Systems – Principles and Maintenance”, Tata McGRaw Hill, 2001.
3. Majumdar, S.R., “Pneumatic Systems – Principles and Maintenance”, Tata McGRaw Hill, 2007.
4. Dudley, A. Pease and John J Pippenger, “Basic Fluid Power”, Prentice Hall, 1987
5. Srinivasan.R, “Hydraulic and Pneumatic Controls”, Vijay Nicole Imprints, 2008
6. Joshi.P, Pneumatic Control”, Wiley India, 2008.
7. Jagadeesha T, “Pneumatics Concepts, Design and Applications “, Universities Press, 2015.

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ME 7511 METROLOGY AND DYNAMICS LABORATORY

L	T	P	C
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COURSE OBJECTIVES: The main learning objective of this course is to provide handson training to the students in:

1. Demonstrating the calibration of simple linear measuring instruments used in manufacturing industries.
2. Demonstrating the important linear and angular measurements carried out in manufacturing industries.
3. Demonstrating the measurement of prismatic components using contact and non-contact methods and surface metrology.
4. Applying the principles of kinematics involved in various mechanisms.
5. Applying the principles of Dynamics involved in various experiments

UNIT I METROLOGY AND MEASUREMENTS 30

LIST OF EXPERIMENTS

1. Calibration and use of measuring instruments – Vernier caliper, micrometer, Vernier height gauge – using gauge blocks
2. Calibration and use of measuring instruments – depth micrometer, bore gauge, telescopic gauge
3. Measurement of linear dimensions using Comparators
4. Measurement of angles using bevel protractor and sine bar
5. Measurement of screw thread parameters – Screw thread Micrometers, Three wire method, Toolmaker’s microscope
6. Measurement of gear parameters – Micrometers, Vernier caliper, Gear tester
7. Measurement of features in a prismatic component using Coordinate Measuring Machine (CMM)
8. Programming of CNC Coordinate Measuring Machines for repeated measurements of identical components
9. Non-contact (Optical) measurement using Measuring microscope / Profile projector and Video measurement system
10. Measurement of form parameters – Straightness, Flatness, Roundness, Cylindricity, Perpendicularity, Runout, Concentricity – in the given component using Roundness tester.
11. Measurement of Surface finish in components manufactured using various processes (turning, milling, grinding, etc.,) using stylus based instruments

12. Machine tool metrology – Level tests using precision level; Testing of straightness of a machine tool guide way using Autocollimator, spindle tests.

UNIT II DYNAMICS MEASUREMENTS 30

LIST OF EXPERIMENTS

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

TOTAL:60 PERIODS

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

- Select a suitable instrument for the measurement of linear and angular dimensions.
- Demonstrate the Calibration of linear measuring instruments.
- Make use of advanced equipment for linear, GD&T and surface finish measurements.
- Measure the various kinematic parameters.
- Evaluate the vibration parameters of different mechanical systems.

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ME 7561 COMPUTER AIDED MACHINE DRAWING

L	T	P	C
0	0	4	2

OBJECTIVES:

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

1. Applying standard drawing practices using fits and tolerances.
2. Modeling 2D views of machine components
3. Modeling 3D views of machine components
4. Preparing assembly drawings both manually and using standard CAD packages.
5. Gaining practical experience in handling 2D drafting and 3D modeling software systems.

UNIT I DRAWING STANDARDS & FITS AND TOLERANCES 12

Code of practice for Engineering Drawing, BIS specifications – Welding symbols, riveted joints, keys, fasteners – Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc. - Limits, Fits – Tolerancing of individual dimensions – Specification of Fits – Preparation of production drawings and reading of part and assembly drawings, basic principles of geometric dimensioning & tolerancing.

UNIT II INTRODUCTION TO 2D DRAFTING 16

- Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailing, Detailed drawing.
- Bearings - Bush bearing, Plummer block
- Valves – Safety and non-return valves.

UNIT III 3D GEOMETRIC MODELING AND ASSEMBLY 32

Sketcher - Datum planes – Protrusion – Holes - Part modeling – Extrusion – Revolve – Sweep – Loft – Blend – Fillet - Pattern – Chamfer - Round - Mirror – Section - Assembly

- Couplings – Flange, Universal, Oldham's, Muff, Gear couplings
- Joints – Knuckle, Gib & cotter, strap, sleeve & cotter joints
- Engine parts – Piston, connecting rod, cross-head (vertical and horizontal), stuffing box, multi-plate clutch
- Miscellaneous machine components – Screw jack, machine vice, tail stock, chuck, vane and gear pumps

TOTAL:60

PERIODS

Total:20% of classes for theory classes and 80% of classes for practice

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

OUTCOMES:

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

1. Practice drawing standards using fits and tolerances.
2. Develop and visualize 2D views of machine components
3. Develop and visualize3D Views of machine components
4. Construct part drawings, sectional views and assembly drawings as per standards
5. Create standard drawing for modeled parts or assemblies using modeling software.

TEXT BOOK:

1. Gopalakrishna K.R., "Machine Drawing", 22nd Edition, Subhas Stores Books Corner, Bangalore, 2013.

REFERENCES:

1. N. D. Bhatt and V.M. Panchal, "Machine Drawing", 48th Edition, Charotar Publishers,2013
2. Junnarkar, N.D., "Machine Drawing", 1st Edition, Pearson Education, 2004
3. N. Siddeshwar, P. Kanniah, V.V.S. Sastri, "Machine Drawing" , published by Tata Mc GrawHill,2006

4. S. Trymbaka Murthy, “A Text Book of Computer Aided Machine Drawing”, CBS Publishers, New Delhi, 2007

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ME 7354 MECHATRONICS **L T P C**
3 0 0 3

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Selecting sensors to develop mechatronics systems.
2. Explaining the architecture and timing diagram of microprocessor, and also interpret and develop programs.
3. Designing appropriate interfacing circuits to connect I/O devices with microprocessor.
4. Applying PLC as a controller in mechatronics system.
5. Designing and develop the apt mechatronics system for an application.

UNIT I INTRODUCTION **9**
Introduction to Mechatronics – Systems – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and Dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance Sensors – Strain Gauges – Eddy Current Sensor – Hall Effect Sensor –Temperature Sensors – Light Sensors.

UNIT II 8085 MICROPROCESSOR **9**
Introduction – Pin Configuration - Architecture of 8085 – Addressing Modes – Instruction set, Timing diagram of 8085.

UNIT III PROGRAMMABLE PERIPHERAL INTERFACE **9**
Introduction – Architecture of 8255, Keyboard Interfacing, LED display – Interfacing, ADC and DAC Interface, Temperature Control – Stepper Motor Control – Traffic Control Interface.

UNIT IV PROGRAMMABLE LOGIC CONTROLLER **9**
Introduction – Architecture – Input / Output Processing – Programming with Timers, Counters and Internal relays – Data Handling – Selection of PLC.

UNIT V ACTUATORS AND MECHATRONICS SYSTEM DESIGN **9**
Types of Stepper and Servo motors – Construction – Working Principle – Characteristics, Stages of Mechatronics Design Process – Comparison of Traditional and Mechatronics Design Concepts with Examples – Case studies of Mechatronics Systems – Pick and Place Robot – Engine Management system – Automatic Car Park Barrier.

TOTAL:45 PERIODS

COURSE OUTCOMES: Upon completion of this course, the students will be able to:
1. Identify suitable sensors to develop mechatronics systems.
2. Explain the architecture and timing diagram of microprocessor, and also interpret and develop programs.

3. Design appropriate interfacing circuits to connect I/O devices with microprocessor.
4. Apply PLC as a controller in mechatronics system.
5. Design and develop an appropriate mechatronics system for the given application

TEXT BOOKS:

1. Bolton W., "Mechatronics", Pearson Education, 4th Edition, 2011.
2. Ramesh S Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", Penram International Publishing Private Limited, 6th Edition, 2015.

REFERENCES:

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

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ME 7551 COMPUTER AIDED DESIGN

L	T	P	C
3	0	0	3

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

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

UNIT I FUNDAMENTALS OF COMPUTER GRAPHICS 9

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

UNIT II GEOMETRIC MODELING 9

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

UNIT III VISUAL REALISM 9

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

UNIT IV PART ASSEMBLY 9

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

UNIT V CAD STANDARDS 9

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

TOTAL : 45 PERIODS

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

1. Employ the fundamental concepts of computer graphics and its tools in a generic framework.
2. Create and manipulate the geometric models using curves, surfaces and solids
3. Develop3D model and visualrealism in CAD systems.
4. Apply geometrical dimensioning and tolerancing in assembly modeling.
5. Adapt the standard CAD practices in engineering design.

TEXT BOOK:

1. Ibrahim Zeid "Mastering CAD CAM" Tata McGraw-Hill Publishing Co.2007

REFERENCES:

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

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ME 7601 DESIGN OF TRANSMISSION SYSTEMS L T P C
4 0 0 4

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

1. Designing flexible elements like belt, ropes and chain drives for engineering applications.
2. Designing spur and helical gear drives for power transmission.
3. Designing bevel and worm drives for power transmission.
4. Designing multi speed gear box for machine tool and automotive applications.
5. Designing clutch and brake systems for engineering applications

UNIT I DESIGN OF FLEXIBLE ELEMENTS 12

Motor power capacity for various applications - Design of Flat belts and pulleys - Selection of V belts and sheaves – Selection of wire ropes and pulleys – Design of Transmission chains and Sprockets.

UNIT II SPUR AND HELICAL GEARS 12

Gear materials - Design of straight tooth spur & helical gears based on speed ratios, number of teeth, Fatigue strength, Factor of safety, strength and wear considerations. Force analysis -Tooth stresses - Dynamic effects - Helical gears – Module - normal and transverse, Equivalent number of teeth - forces.

UNIT III BEVEL AND WORM GEARS 12

Straight bevel gear: Gear materials - Tooth terminology, tooth forces and stresses, equivalent number of teeth, estimation of dimensions of straight bevel gears.

Worm Gear: Gear materials - Tooth terminology, Thermal capacity, forces and stresses, efficiency, estimation of dimensions of worm gear pair.

UNIT IV GEAR BOXES 12

Need - Design of sliding and constant mesh gear boxes: Speed selection - Geometric progression - Standard step ratio - Ray diagram, kinematic layout – Determination of number of teeth. Design of multi speed gear box for machine tool applications, Variable speed gear box, Fluid Couplings, Torque Converters for automotive applications.

UNIT V CLUTCHES, BRAKES AND CAMS 12

Design of single and multi plate clutches, cone clutches, internal expanding rim clutches and Electromagnetic clutches. Design of brakes: External shoe brakes - Single and Double Shoe, Internal expanding shoe brakes and Band brakes.

Design of Cams: Types- Pressure angle and under cutting, determination of base circle -forces and surface stresses.

TOTAL:60 PERIODS

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

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

- Select flexible elements like belt, ropes and chain drives for power transmission.
- Design spur and helical gear drives for power transmission.
- Design bevel and worm drives for power transmission.
- Design multi speed gear box for machine tool and automotive applications.
- Choose clutch and brake systems for power transmission.

TEXT BOOKS:

1. Joseph Shigley,Charles Mischke, Richard Budynas and Keith Nisbett “Mechanical Engineering Design”, 10th Edition, Tata McGraw-Hill, 2014.
2. Sundararajamoorthy T. V and Shanmugam .N, “Machine Design”, 9th edition, Anuradha Publications, Chennai, 2003.

REFERENCES:

1. Bhandari V, “Design of Machine Elements”, 15th Reprint, Tata McGraw-Hill Book Co, 2014.
2. Prabhu. T.J., “Design of Transmission Elements”, Mani Offset, Chennai, 2003.
3. Md. Jalaludeen , Machine Design, Volume II, Design of Transmission Systems, 4th edition, Anuradha Publications, 2014.
4. GitinMaitra,L. Prasad “Handbook of Mechanical Design”, 2nd Edition, Tata McGraw-Hill,2001.
5. C.S.Sharma, Kamlesh Purohit, “Design of Machine Elements”, Prentice Hall of India,Pvt. Ltd., 2003.
6. Bernard Hamrock, Steven Schmid, Bo Jacobson, “Fundamentals of Machine Elements”,2nd Edition, Tata McGraw Hill, 2006.
7. Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine component Design”,5th Edition, Wiley, 2011
8. Design Data Hand Book, PSG College of Technology, 2013- Coimbatore

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ME 7602 HEAT AND MASS TRANSFER L T P C
4 0 0 4

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

1. Applying the principle mechanism of heat transfer under steady state and transient conditions.
2. Applying the fundamental concept and principles in convective heat transfer.
3. Applying the theory of phase change heat transfer and design of heat exchangers.
4. Applying the fundamental concept and principles in radiation heat transfer.
5. Analyzing the relation between heat and mass transfer and to solve simple mass transfer problems.

UNIT I CONDUCTION 12

General Differential equation – Cartesian, Cylindrical and Spherical Coordinates – One Dimensional Steady State Heat Conduction –– plane and Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infinite and Infinite Solids –Use of Heisler's charts. One dimensional Numerical analysis in conduction.

UNIT II CONVECTION 12

Boundary Layer Concept – Forced Convection: External Flow – Flow over Plates, Cylinders Spheres and Bank of tubes. Internal Flow – Entrance effects. Free Convection – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres.

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 12

Nusselt's theory of condensation- Regimes of Pool boiling and Flow boiling, correlations in boiling and condensation. Heat Exchanger Types - Overall Heat Transfer Coefficient – Fouling Factors. LMTD and NTU methods. Introduction to TEMA Standards.

UNIT IV RADIATION 12

Radiation laws, Black Body and Gray body Radiation. Shape Factor. Electrical Analogy. Radiation Shields. Gas Radiation.

UNIT V MASS TRANSFER 12

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion. Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations.

TOTAL:60 PERIODS

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

1. Interpret the boundary conditions and analyse problems on conduction heat transfer.
2. Apply the concept of free and forced convection heat transfer principles in engineering systems.

3. Design the heat exchangers and understand the phase change characteristics of fluids.
4. Implement the concept of radiation heat transfer in various systems.
5. Analyze the mass transfer in engineering systems.

TEXT BOOKS:

1. Yunus A. Cengel, "Heat Transfer A Practical Approach" – Tata McGraw Hill, Vth Edition – 2013.
2. Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2010

REFERENCES:

1. R.C. Sachdeva, "Fundamentals of Engineering Heat & Mass transfer", New Age International Publishers, 2009
2. Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 7th Edition, 2014.
3. S.P. Venkateshan, "Heat Transfer", Ane Books, New Delhi, 2014.
4. Nag, P.K., "Heat Transfer", Tata McGraw Hill, New Delhi, 2002
5. Ozisik, M.N., "Heat Transfer", McGraw Hill Book Co., 1994.
6. Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 2012
7. Yadav, R., "Heat and Mass Transfer", Central Publishing House, 2012.

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HS7561 COMMUNICATION SKILLS AND SOFT SKILLS L T P C
1 0 2 2

COURSE DESCRIPTION

This course aims to help engineering students acquire the employability skills necessary for the workplace. It also attempts to meet the expectations of the employers by giving special attention to presentation skills, group discussion skills and soft skills. This aim will be achieved through expert guidance and teaching activities focusing on the above listed skills and language skills in the Language Laboratory.

OBJECTIVES

- To enhance the employability skills of students with a special focus on presentation skills, group discussion skills and interview skills and soft skills.
- To help them improve their writing skills necessary for the workplace situation.

CONTENTS

UNIT I WRITING SKILLS

Preparing job applications – writing the cover letter and resume – applying for jobs online – e-mail etiquette – writing reports – collecting, analyzing and interpreting data.

UNIT II SOFT SKILLS

Hard skills & soft skills – soft skills: self-management skills & people skills – training in soft skills – persuasive skills – sociability skills – interpersonal skills – team building skills – leadership skills – problem solving skills – adaptability – stress management – motivation techniques – life skills.

UNIT III PRESENTATION SKILLS

Preparing slides using the computer– structuring the content (parts of a presentation)- body language – answering questions – individual presentation practice –– mini presentation (practice sessions)

UNIT IV GROUP DISCUSSION SKILLS

Participating in group discussions – understanding group dynamics – brainstorming – questioning and clarifying – GD strategies (expressing opinions, accepting or refusing others opinions, turn taking) – activities to improve GD skills – viewing recorded GD – mock GD.

UNIT V INTERVIEW SKILLS

Interview etiquette–technical Interview/HR Interview/body language – mock interview – attending job interviews – Types of interviews- telephone/skype interview – stress interview, one to one/panel interview – FAQs related to job interview.

TOTAL: 45 PERIODS

OUTCOMES:

- Students will be able to make presentations and participate in group discussions with confidence.
- Students will be able to perform well in interviews.
- They will have adequate writing skills.

REFERENCES:

1. Downes, Colm. Cambridge English for Job Hunting. CUP, 2008
2 Corneilssen, Joep. How to Prepare for Group Discussion and Interview. New Delhi: Tata-McGraw-Hill, 2009.
3. Dabreo, Desmond A. Group Discussion and Team Building. Mumbai: Better Yourself Books, 2004.
4. Ramesh, Gopalswamy, and Mahadevan Ramesh. The ACE of soft skills. New Delhi: Pearson, 2010.
5. Gulati, Sarvesh. Corporate Soft skills. New Delhi: Rupa and Co. 2006.
6. Van Emden, Joan, and Lucinda Becker. Presentation Skills for Students. New York: Palgrave Macmillan, 2004.
7. Sarawati, V. and Revathi Vishwanathan, Soft Skills for Career Communication Preesat Publications, Chennai: 2011

EXTENSIVE READERS

1. Covey, Stephen R. The 7 Habits of Highly Effective People.New York: Free Press, 1989
2. Bagchi, Cubroto. The Professional. New Delhi: Penguin Books India, 2009.

WEB RESOURCES

1. www.humanresources.about.com
2. www.careerride.com
3. https://bemycareercoach.com/softskills

ME 7611 THERMAL ENGINEERING LABORATORY – II

L	T	P	C
0	0	4	2

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

1. Predicting the thermal conductivity of solids and liquids.
2. Estimating the heat transfer coefficient values of various fluids.
3. Analyzing the working of cooling tower.
4. Testing the performance of tubes in tube heat exchangers.
5. Testing the performance of the refrigeration and air-conditioning systems

LIST OF EXPERIMENTS:

1. Thermal conductivity measurement using guarded plate apparatus.
2. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
3. Determination of heat transfer coefficient under natural convection from a vertical cylinder.
4. Determination of heat transfer coefficient under forced convection from a tube.
5. Determination of Thermal conductivity of composite wall.
6. Determination of Thermal conductivity of insulating powder.
7. Heat transfer from pin-fin apparatus (natural & forced convection modes)
8. Determination of Stefan – Boltzmann constant.
9. Determination of emissivity of a grey surface.
10. Determination of Effectiveness of Parallel / counter flow heat exchanger.
11. Determination of COP of a refrigeration system
12. Performance test in a simple Air-Conditioning system
13. Performance test on a cooling tower

TOTAL:60 PERIODS

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

1. Predict the thermal conductivity of solids and liquids.
2. Estimate the heat transfer coefficient values of various fluids.
3. Analyze the working of cooling tower.
4. Test the performance of tubes in tube heat exchangers.
5. Test the performance of the refrigeration and air-conditioning systems

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ME 7355 POWER PLANT ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the working of power plants and analyse their performance.
- To learn the economics of power generation.

UNIT I HYDRO POWER PLANTS 9

Energy scenario – Global and National. Essential elements and classification of hydro power plants. Typical Layout and associated components. Selection of turbines. Pumped storage plants.

UNIT II COAL, OIL AND GAS TURBINE POWER PLANTS 9

Cycle analysis - Layout of modern coal based power plant. Super Critical Boilers - FBC Boilers. Subsystems – Water and Steam, Fuel and ash handling, Air and Gas, Draught system. Diesel and Gas Turbine power plants- Layout and Functioning. Environmental impact and Control.

UNIT III NUCLEAR POWER PLANTS 9

Layout and subsystems. Fuels and Nuclear reactions. Boiling Water Reactor, Pressurized Water Reactor, Fast Breeder Reactor, Gas Cooled and Liquid Metal Cooled Reactors – working and Comparison. Safety measures. Environmental aspects.

UNIT IV RENEWABLE ENERGY POWER PLANTS 9

Solar power plants – Photovoltaic and Thermal. Wind power plants – Vertical and Horizontal axes Wind Turbines. Biomass power plants – Gasification and combustion. Tidal and Ocean Thermal Energy plants. Geothermal plants. Fuel cell – Types. Hybrid power plants.

UNIT V ECONOMICS OF POWER GENERATION 9

Load and load duration curves. Electricity billing – costing of electrical energy – Tariff structures. Economics of power plant – Fixed and variable cost. Payback period. Net Present Value, Internal Rate of Return. Emission calculation and carbon credit.

TOTAL:45 PERIODS

OUTCOMES:

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

1. Describe the working of a hydro-electric power plant and select appropriate turbine
2. Compare the pro's and con's of coal, diesel and gas turbine power plants
3. Enumerate components associated with the nuclear power plants
4. Apply suitable technologies for harnessing renewable energy
5. Perform economic analysis of power plants and carbon credit calculation

TEXT BOOKS:

1. P.K.Nag, "Power Plant Engineering", Tata McGraw Hill, 2014.
2. Paul Breeze, "Power Generation Technologies", Elsevier Ltd., 2014.

REFERENCES:

1. Black and Veatch, "Power Plant Engineering", Indian edition, CBS Publishers and Distributors, New Delhi, 1998.
2. M.M.El.Wakil, "Power Plant Technology", Tata McGraw Hill, 2010.
3. K.Rajput, "Power Plant Engineering", Laxmi Publications, 2005.
4. Janet Wood, "Nuclear Power", The Institution of Engineering and Technology, 2007.
5. James Momoh, Smart Grids - Fundamentals of Design and analysis, Wiley Press, 2012.

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ME 7701 COMPUTER INTEGRATED MANUFACTURING L T P C
3 0 0 3

COURSE OBJECTIVES:

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

1. Applying the concept of CIM & Automation and analyzing the Manufacturing process.
2. Applying the Manufacturing knowledge in Process Planning and will gain Confidence in controlling production.
3. Analyzing Cellular Manufacturing.
4. Converting conventional system to FMS.
5. Selecting and applying Industrial Robots for Industries

UNIT I INTRODUCTION 9

Various phases in Product Design and CAD, CAM, Concepts of CAD/CAM – CIM concepts and elements – Types of production – Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In-Time Production.

UNIT II PRODUCTION PLANNING & CONTROL AND COMPUTERISED PROCESS PLANNING 9

Process planning – Computer Aided Process Planning (CAPP) – Aggregate Production Planning and Master Production Schedule – Material Requirement Planning (MRP I) – Simple Problems – Capacity Planning – Shop Floor Control – Inventory Control – EOQ, WIP costs & Inventory Holding Costs - Simple Problems – Introduction to Manufacturing Resource Planning (MRP II) & Enterprise Resource Planning (ERP).

UNIT III CELLULAR MANUFACTURING 9

Group Technology(GT), Part Families – Parts Classification and coding – Simple Problems in OPITZ Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing –Rank Order Clustering Method - Arranging Machines in a GT cell – Hollier Method – Simple Problems.

UNIT IV FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS) 9

Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Implementation Issues – Quantitative analysis of Bottleneck Model on simple problems in FMS. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety.

UNIT V INDUSTRIAL ROBOTICS 9

Robot Anatomy and Related Attributes – Classification - Control systems – End Effectors – Sensors – Applications – Basics of Robot Part Programming – Robot Accuracy and Repeatability – Simple Problems.

TOTAL: 45 PERIODS

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

1. Apply the concept of CIM & Automation and analyze the Manufacturing process.
2. Make use of the Manufacturing knowledge to create Computer Aided Process Planning, and implement production control strategies effectively.
3. Implement the concepts of Group Technology for the formation of Machine cells in cellular manufacturing.
4. Formulate and Design Flexible Manufacturing Systems.
5. Select suitable Robot configuration for Industrial applications.

TEXT BOOK:

1. Mikell .P. Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall of India, 2009.

REFERENCES:

1. Kant Vajpayee S, “Principles of Computer Integrated Manufacturing”, Prentice Hall India,2003.
2. Radhakrishnan P, Subramanyan S.and Raju V., “CAD/CAM/CIM”, 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.
3. Gideon Halevi and Roland Weill, “Principles of Process Planning – A Logical Approach” Chapman & Hall, London, 1995.
4. P Rao, N Tewari and T.K. Kundra, “Computer Aided Manufacturing”, Tata McGraw Hill Publishing Company, 2000.

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

ME 7751 FINITE ELEMENT ANALYSIS L T P C
3 0 0 3

COURSE OBJECTIVES:

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

1. Developing mathematical models for Boundary Value Problems and their numerical solution.
2. Applying concepts of Finite Element Analysis to solve one dimensional problem.
3. Determining field variables for two dimensional scalar variable problems.
4. Determining field variables for two-dimensional vector variable problems.
5. Applying the need for Isoperimetric transformation and the use of numerical integration

UNIT I INTRODUCTION 9

Historical Background – Mathematical Modeling of field problems in Engineering –Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.

UNIT II ONE-DIMENSIONAL PROBLEMS 9

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices - Solution of problems from solid mechanics including thermal stresses-heat transfer. Natural frequencies of longitudinal vibration and mode shapes. Fourth Order Beam Equation –Transverse deflections and Transverse Natural frequencies of beams.

UNIT III TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS 9

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements and Quadrilateral elements- Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems – Torsion of Non circular shafts.

UNIT IV TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS 9

Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Constitutive matrices and Strain displacement matrices – Stiffness matrix – Stress calculations - Plate and shell elements.

UNIT V ISOPARAMETRIC FORMULATION AND ADVANCED TOPICS 9

Natural co-ordinate systems – Isoparametric elements – Shape functions for isoparametric elements – One and two dimensions – Serendipity elements – Numerical integration - Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software- Introduction to Non Linearity.

TOTAL:45 PERIODS

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

1. Develop mathematical models for Boundary Value Problems and their numerical solution
2. Formulate the Finite Element methodology to solve the one dimensional problem(s).
3. Estimate field variables for two dimensional scalar variable problems
4. Determine field variables for two-dimensional vector variable problems
5. Apply the Isoparametric transformationand the use of numerical integration to engineering problems.

TEXT BOOKS:

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

REFERENCES:

1. Logan, D.L., “A first course in Finite Element Method”, Thomson Asia Pvt. Ltd., 2002.
2. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, “Concepts and Applications of Finite Element Analysis”, 4th Edition, Wiley Student Edition, 2002.
3. Rao, S.S., “The Finite Element Method in Engineering”, 3rd Edition, Butter worth Heinemann, 2004.
4. Chandrupatla and Belagundu, “Introduction to Finite Elements in Engineering”, 3rd Edition, Prentice Hall, 1990.
5. David Hutton, “Fundamentals of Finite Element Analysis” McGrawHill, 2005
6. Dhanaraj. R and Prabhakaran Nair. K, “Finite Element Analysis”, Oxford Publications, 2015.

CO	PO												PSO		
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1	3	3	2	2	2			1			2	2	3		1
2	3	3	2	2	2			1			2	2	3		1
3	3	3	2	2	2			1			2	2	3		1
4	3	3	2	2	2			1			2	2	3		1
5	3	3	2	2	2			1			2	2	3		1

ME 7711 CREATIVE AND INNOVATIVE PROJECT

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

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

1. Creative and innovative thinking towards potential research areas in the field of Mechanical Engineering.
2. Comparing and contrast the several existing solutions for the problem identified.
3. Formulating and propose a plan for creating a solution for the research plan identified.
4. Conducting the experiments as a team and interpret the results.
5. Reporting and presenting the findings of the work conducted.

TOTAL:60 PERIODS

OUTCOMES:

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

1. Think creatively and innovatively towards potential research areas in the field of Mechanical Engineering.
2. Compare and contrast the several existing solutions for the problems identified.
3. Formulate and propose a plan for creating a solution for the research plan identified.
4. Conduct the experiments as a team and interpret the results.
5. Report and present the findings of the work conducted.

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

ME 7712	SIMULATION AND ANALYSIS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

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

1. Applying the fundamental working principle of CNC machine tool.
2. Programming G & M Code programming and simulate the CNC program.
3. Generating part programming data through CAM software and Integrating CNC for unconventional machine tools.
4. Applying the principles of EDM Processes and Additive Manufacturing process.
5. Analyzing the force, stress, deflection, thermal stress, heat transfer, vibrations in mechanical components.

UNIT I SIMULATION **30**

LIST OF EXPERIMENTS

1. MANUAL PART PROGRAMMING:
   (i) Part Programming - CNC Machining Centre
      a) Linear Cutting.
      b) Circular cutting.
      c) Cutter Radius Compensation.
      d) Canned Cycle Operations.
   (ii) Part Programming - CNC Turning Centre
      a) Straight, Taper and Radius Turning.
      b) Thread Cutting.
      c) Rough and Finish Turning Cycle.
      d) Drilling and Tapping Cycle.
2. COMPUTER AIDED PART PROGRAMMING
      e) CL Data and Post process generation using CAM packages.
      f) Application of CAPP in Machining and Turning Centre.

3. STUDY OF CNC EDM, CNC EDM WIRE-CUT AND RAPID PROTOTYPING.

UNIT II ANALYSES **30**

LIST OF EXPERIMENTS

Use of any finite element analysis software for following problems:

1. Force and Stress analysis using link elements in Trusses, cables and bars.
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of flat plates and simple shells.
4. Stress analysis of axi – symmetric components.
5. Thermal stress and heat transfer analysis of fins, plates and cylinders.
6. Vibration analysis of spring-mass systems.
7. Modal analysis of Beams.
8. Harmonic, transient and spectrum analysis of simple systems

TOTAL:60 PERIODS

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

1. Apply the fundamental working principle of CNC machine tool.
2. Program G & M Code programming and simulate the CNC program.
3. Generate part programming data through CAM software and Integrating the CNC and unconventional machine tools.
4. Apply the principles of EDM Processes and Additive Manufacturing process
5. Evaluate and determine the force, stress, deflection and vibrational characteristics in structural components.
6. Simulate and evaluate the thermal stress and heat transfer characteristics in mechanical components.

CO	PO												PSO		
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1	3	3	3		3							1	3	2	3
2	3	3	3	3	3								2	3	2
3	3	3	2	2	3									2	2
4	3	3	3	3	3			1	2	2	1	2	3		3
5	3	3	3	3	3			1	2	2	1	2	3		3

ME 7761 MECHATRONICS LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

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

LIST OF EXPERIMENTS:

1. Experimental study of basic Signal Conditioning Circuits.
2. Measurement of Displacement, Force and Temperature using Transducers.
3. Experiments on application of LDR, Optocoupler, Ultrasonic and Infrared sensors.
4. Modelling and Analysis of basic Hydraulic, Pneumatic and Electro-Pneumatic Circuits using Simulation Software.
5. Actuation of Hydraulic, Pneumatic and Electro-Pneumatic circuits.
6. Application of PLC with Timers and Counters.
7. Solving basic Arithmetic Problems using 8085 Microprocessor and 8051 Microcontroller.
8. Automatic Temperature Control System.
9. Speed and Direction Control of DC drives by Microcontroller.
10. Speed Control of AC drives by Microcontroller.
11. Stepper Motor Actuation and Control.
12. Servo Motor Actuation and Control.
13. Actuation of Double-Acting Cylinder by Microcontroller and PLC.
14. Application of Image Processing System.
15. Data Acquisition System - Measurement and Analysis of Displacement, Force and Temperature.
16. Modelling and Analysis of Robot using Simulation Software.
17. Control of Robotic Actuation by Microcontroller.

TOTAL:60 PERIODS

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

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

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

ME 7811 **PROJECT WORK** **L T P C**
0 0 20 10

OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination.
- A project topic must be selected by the students in consultation with their guides.
- The aim of the project work is to deepen comprehension of principles by applying them to a new problem which may be the design and fabrication of a device for a specific application, a research project with a focus on an application needed by the industry/society, a computer project, a management project or a design project.
- The progress of the project is evaluated based on a minimum of three reviews.
- The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated jointly by external and internal examiners constituted by the Head of the Department based on oral presentation and the project report.

TOTAL: 300 PERIODS

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

1. Discover potential research areas in the field of Mechanical Engineering.
2. Compare and contrast the several existing solutions for the problems identified.
3. Formulate and propose a plan for creating a solution for the research plan identified.
4. Conduct the experiments as a team and interpret the results.
5. Report and present the findings of the work conducted.

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

GE 7071 **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.

IE7451 PRODUCTION AND OPERATIONS MANAGEMENT L T P C
3 0 0 3

AIM:

- To impart knowledge in the areas of production and Operations management applicable to various types of manufacturing and service systems.

OBJECTIVES

- To understand and appreciate the concept of Production and Operations Management in creating and enhancing a firm's competitive advantages.
- To understand the concept and contribution of various constituents of Production and Operations Management (both manufacturing and service)
- To understand the interdependence of the operations function with the other key functional areas of a firm
- To apply analytical skills and problem-solving tools to the analysis of the operations problems

UNIT I INTRODUCTION 9

Overview of Production System, Objectives of Operation Management, Scope of Operations Management, Operations Management Frame work, Relationship of operations with other Functional areas, Manufacturing Vs Service sector, Operations Decision making, Production Design Process and Process choices

UNIT II FORECASTING 9

Need, Determinants of Demand, Demand Patterns, Measures of forecast error, Qualitative Forecasting Methods-Delphi techniques. Market Research, Nominal Group Technique Quantitative Forecasting methods – Moving Average Methods, Exponential Smoothing Methods, Regression methods, Monitoring and Control of Forecasts, Requirements and Selection of Good forecasting methods.

UNIT III AGGREGATE PLANNING AND MATERIAL REQUIREMENT PLANNING 9

Role of aggregate Product planning, Managerial inputs to Aggregate planning, Pure and Mixed strategies, Mathematical Models for Aggregate planning – Transportation Method, Linear programming Formulation, Linear Decision Rues, Master Production Schedule(MPS), Procedure for developing MPS, MRP, Lot sizing methods of MRP, MRP Implementation issues.

UNIT IV CAPACITY MANAGEMENT 9

Measures of capacity, Factors affecting capacity, Capacity planning, Systematic approach to capacity planning, Long-term and short-term capacity decisions, Tools for capacity planning, Capacity Requirement planning- Business process outsourcing-, MRP – II, Introduction to ERP, Introduction TOC.

UNIT V PRODUCTION ACTIVITY CONTROL AND LEAN MANUFACTURING 9

Objectives and Activities of Production Activity Control - Introduction to Scheduling in different types of Production Systems.

Lean Manufacturing-Principles – Activities - Tools and techniques - Case studies.

TOTAL: 45 PERIODS

OUTCOMES

- To understand the various parts of the operations and production management processes and their interaction with other business functions
- To develop the ability to identify operational methodologies to assess and improve an organizations performance
- To develop essential skills of modelling, managing and optimizing operations decisions in manufacturing and service organizations.

- Utilize a variety of quantitative and qualitative methods and tools used in managing and improving operations decisions.

REFERENCES:

1. Panneerselvam. R, Production and operations Management,PHI,2012
2. Seetharama L.Narasimhan, Dennis W.McLeavey, Peter J.Billington, "Production Planning And Inventory Control" , PHI, 2009.
3. Norman Gaither, Greg Frazier, Operations Management, Thomson Learning, 2002.
4. Lee J.Krajewski, Larry P.Ritzman, "Operations Management Strategy and Analysis", PHI, 2003.

MA 7352 APPLIED STATISTICS

L	T	P	C
4	0	0	4

OBJECTIVE:

- The students will have a fundamental knowledge of the concepts of statistical method analyse and apply the tools in solving management problems.

UNIT I TESTS OF SIGNIFICANCE **12**

Sampling distributions – Central limit theorem-Tests for single mean, proportion and difference of means, proportions (large and small samples) - Tests for single variance and equality of variances- χ^2 - test for goodness of fit - Independence of attributes.

UNIT II NON - PARAMETRIC TESTS **12**

Advantages and drawbacks over parametric methods – Sign test - Median test – Mann-Whitney Wilcoxon U-test – Wald-Wolfowitz run test.

UNIT III DESIGN OF EXPERIMENTS **12**

Completely randomized design - Randomized block design - Latin square design - 2^2 factorial design - Taguchi's robust parameter design.

UNIT IV STATISTICAL QUALITY CONTROL **12**

Control charts for variables - Control charts for attributes - Tolerance limits - Acceptance sampling by attributes.

UNIT V TIME SERIES **12**

Components of time series - Analysis of time series - Measurement of trend - Measurement of seasonal fluctuations.

TOTAL:60 PERIODS

OUTCOME:

- The students can independently participate in the processes of analysis, planning, formulating strategies of development, decision-making, governing and management, and independent making of tactical and strategic decisions related to the statistics.

TEXT BOOKS:

1. Walpole R.E., Myers R.H., Myers S.L. and Keying Ye, "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition 2007.
2. Gupta S.C. and Kapoor V.K., "Fundamentals of Applied Statistics", Sultan Chand and Sons, New Delhi, 2nd Edition, Reprint, 2002.

REFERENCES:

1. Johnson R.A., "Miller and Freund's Probability and Statistics for Engineers", PHI Learning Pvt. Ltd., New Delhi, 8th Edition, 2011.
2. Devore, J.L., "Probability and Statistics for Engineering and the Sciences", Thomson Brooks/Cole, International Student Edition, New Delhi, 7th Edition, 2008.

3. Milton, J. S. and Arnold, J.C., “Introduction to Probability and Statistics”, Tata McGraw Hill, New Delhi, 4th Edition, 3rd Reprint, 2008.

ME 7001 ADVANCED INTERNAL COMBUSTION ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES: The main learning objective of this course is to prepare the students for:
1. Explaining the working of Gasoline fuel injection systems and SI combustion.
2. Explaining the working of Diesel fuel injection systems and CI com bustion.
3. Identifying the source and measure it; explain the mechanism of emission formation and control methods.
4. Selecting alternative fuel resources and its utilization techniques in IC engines.
5. Explaining advanced combustion modes and future power train systems.

UNIT I SPARK IGNITION ENGINES **9**

Mixture requirements – Fuel injection systems – Monopoint, Multipoint & Direct injection -Stages of combustion – Normal and Abnormal combustion, Spark Knock, Factors affecting knock, Combustion chambers.

UNIT II COMPRESSION IGNITION ENGINES **9**

Diesel Fuel Injection Systems - Stages of combustion – Knocking – Factors affecting knock – Direct and Indirect injection systems – Combustion chambers – Fuel Spray behaviour – Spray structure and spray penetration – Air motion - Introduction to Turbo charging.

UNIT III POLLUTANT FORMATION AND CONTROL **9**

Pollutant – Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling Emissions – Catalytic converters, Selective Catalytic Reduction and Particulate Traps – Methods of measurement –Emission norms and Driving cycles.

UNIT IV ALTERNATIVE FUELS **9**

Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel - Properties, Suitability, Merits and Demerits - Engine Modifications.

UNIT V RECENT TRENDS **9**

Air assisted Combustion, Homogeneous charge compression ignition engines – Variable Geometry turbochargers – Common Rail Direct Injection Systems - Hybrid Electric Vehicles –NO_x Adsorbers - Onboard Diagnostics.

TOTAL:45 PERIODS

COURSE OUTCOMES: Upon completion of this course, the students will be able to:
1. Describe the operation of SI engine and its combustion characteristics
2. Explain the operation of CI engine and its combustion characteristics.
3. Identify the source of engine pollutants, measure pollutant concentration and use appropriate control strategies
4. Categorize and utilize the various liquids and gaseous alternate fuels in IC engines.
5. Identify and understand modern combustion concepts and engine advancements

TEXT BOOKS:

1. V. Ganesan, “Internal Combustion Engines”, V Edition, Tata McGraw Hill, 2012.
2. K.K. Ramalingam, “Internal Combustion Engine Fundamentals”, Scitech Publications, II Ed., 2011.

REFERENCES:

1. R.B. Mathur and R.P. Sharma, “Internal Combustion Engines”, Dhanpat Rai & Sons 2007.
2. B.P. Pundir, “IC Engines Combustion & Emission”, Narosa Publishing House, 2014.
3. Duffy Smith, “Auto Fuel Systems”, The Good Heart Wilcox Company, Inc., 2003.

CO	PO												PSO		
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1	2	1	1	1	2	2	2	1		2	1	2	2	1	2
2	2	1	1	1	2	2	2	1		2	1	2	2	1	2
3	2	1	2	1	2	3	3	2		2	1	2	2	1	1
4	2	1	2	1	2	2	2	1		2	1	2	2	1	1
5	2	1	1	1	2	2	2	1		2	1	2	2	1	1

ME 7002 ADVANCED METROLOGY L T P C
3 0 0 3

COURSE OBJECTIVES:

1. To introduce the fundamentals of measurements and the procedure for estimating measurement uncertainty when conducting experiments.
2. To give an overview of the various optical measuring instruments used in industries.
3. To give an understanding of the importance of surface metrology and the different methods of measuring surface finish.
4. To give an understanding of the concepts of nanometrology.
5. To provide an overview of the various measurements and their applications in manufacturing industries for research and in quality control.

UNIT I FUNDAMENTALS OF METROLOGY 9

Basic metrological concepts, Quality of measurements – errors, Uncertainty, Basic to advanced metrology evolution, Regression analysis, Design of experiments.

UNIT II OPTICAL DIMENSIONAL METROLOGY 9

Optical Metrology Overview, Machine Vision for Metrology, Multi-sensor coordinate metrology, Laser Tracking Systems, Laser scanners, Displacement Measuring Interferometry, Phase-Shifting Systems and Phase-Shifting Analysis, Moiré Metrology, Computed Tomography.

UNIT III ADVANCES IN SURFACE METROLOGY - 2D, 3D 9

Surface Geometry and Its Importance in Function, Surfaces and Manufacture, Filtering – Gaussian, 2RC, Advanced Filters, Surface finish parameters – Amplitude, Spacing, Hybrid, Shape, Autocorrelation, Power Spectral Density, Bearing Area.

3D areal and parametric measurement, Need for 3D surface topography measurement, Stylus instruments, Optical Instruments – Chromatic confocal Microscopy, Interferometry, Non-optical Scanning Microscopy – Scanning electron Microscopes, Scanning probe microscopes, Parameters for characterizing 3D surface topography.

UNIT IV NANOMETROLOGY 9

Precision to Nanometrology, Optical Micro-Metrology of Small Objects - White-Light Interference 3D Microscopes, Focus-Based Optical Metrology- Fringe projection method, Measurement of Typical Nanofeatures, Measuring Length to Nanoscale with Interferometers and Other Devices, Nano Geometry in Macro Situations.

UNIT V METROLOGY IN MANUFACTURING 9

Case studies relating to various manufacturing sectors - Automobile, space, nuclear, Tool wear; Metrology in manufacturing research, Role of Metrology in Industry 4.0.

TOTAL:45 PERIODS

OUTCOMES:

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

1. Plan the experiments and analyse the measured data, and estimate measurement uncertainty
2. Describe the working principle and applications of optical measuring instruments.
3. Apply surface finish measurement in manufacturing process analysis.
4. Outline the principles and methods of nanometrology.
5. Enumerate the role of metrology in I4.0 and apply measurements for quality control in manufacturing.

TEXT BOOKS:

1. Kevin Harding, "Handbook of Optical Dimensional Metrology, Series: Series in Optics and Optoelectronics", Taylor & Francis, 2013.
2. David J. Whitehouse, "Handbook of Surface and Nanometrology", Second Edition, CRC Press, 2010.

REFERENCES:

1. Toru Yoshizawa, "Handbook of Optical Metrology: Principles and Applications", CRC Press, 2009.
2. James G. Bralla, "Handbook of Product Design for Manufacture", McGraw Hill Book Co., 2004.
3. S. P. Venkateshan, "Mechanical Measurements", Second edition, John Wiley & Sons, 2015.
4. Balasubramanian Muralikrishnan, Jayaraman Raja, "Computational Surface and Roundness Metrology", Springer-Verlag London Ltd., 2009.
5. Ken J Stout, Liam Blunt, "Three Dimensional Surface Topography", Second edition, Penton press, 2000..

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ME 7003 CASTING AND WELDING PROCESSES

L	T	P	C
3	0	0	3

OBJECTIVE:

- To impart knowledge on Design of Gating system for Castings, Foundry Practice of Ferrous, Non Ferrous alloys, Foundry Mechanisation, Welding Processes and Welding Metallurgy.

UNIT I DESIGN OF GATING SYSTEM **9**

Gating system design - pouring time – Choke Area – Sprue – Other gating elements – Riser design - Caine's – Modulus – Naval Research Laboratory method – feeding distances – Chills feeding Aids – Design of Castings.

UNIT II FERROUS AND NON FERROUS CASTINGS **9**

Steel Casting – The family of cast iron – melting of steels and cast irons – Grey iron foundry practice – Ductile iron – Malleable Iron casting design – Aluminium, Magnesium, Copper, Zinc. , Duplex Stainless Steel and Titanium alloys foundry practice.

UNIT III FOUNDRY MECHANISATION 9

Mechanical equipments in foundry – plant site location, layout – Plant Engineering –Maintenance – Services – Practical aspects.

UNIT IV WELDING PROCESS AND TECHNOLOGY 9

Friction Welding Process – effect of speed and pressure – explosive welding – plasma arc welding – Electron beam welding – High frequency induction welding - Laser beam welding.

UNIT V WELDING METALLURGY 9

Weld thermal cycles – Heat Affected Zone (HAZ) – Weldability of steels – Cast Iron – Stainless steel, aluminium – Copper and Titanium alloys – Hydrogen embrittlement – Pro and post weld heat Treatments – weld defects – Testing of Welds.

TOTAL:45 PERIODS

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

1. Explain the design of gating system in casting process
2. Explain the ferrous casting metallurgy and its applications.
3. Explain the nonferrous casting metallurgy and its applications.
4. Explain the ferrous welding metallurgy, the defects associated and its applications.
5. Explain the welding metallurgy of alloy steels and non-ferrous metals, the defects associated and its applications.

TEXT BOOK:

1. P.N.Rao, “Manufacturing Technology”, Tata McGraw Hill, 2008.

REFERENCES:

1. Heine, Loper and Rosenthal, “Principles of Metal Casting”, Tata McGraw Hill, 2001.
2. A.K.Chakrabarti, “Casting Technology and Cast Alloys”, Prentice –Hall Of India Ltd, 2005.
3. T.V.Rama Rao, “Metal casting Principles and Practice”, New Age International, 2010.
4. R.S Parmar, “Welding Engineering and Technology”, Khanna Publishers, 2002.

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ME 7004 COMPOSITE MATERIALS AND MECHANICS L T P C
3 0 0 3

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

1. Analyzing mechanical strength of the composite material
2. Developing the FRP and other composites by different manufacturing methods
3. Analyzing fiber reinforced Laminates for different combinations of plies with different orientations of the fiber.
4. Evaluating the stresses in the lamina of the laminate using different failure theories
5. Analyzing thermo-mechanical behavior and evaluate residual stresses in different types of laminates using the Classical Laminate Theory.

UNIT I INTRODUCTION TO COMPOSITE MATERIALS 9

Definition-Matrix materials-polymers-metals-ceramics - Reinforcements: Particles, whiskers, inorganic fibers, metal filaments- ceramic fibers- fiber fabrication- natural composite wood, Jute - Advantages and drawbacks of composites over monolithic materials. Mechanical properties and applications of composites, Particulate-Reinforced composite Materials, Dispersion-Strengthened

composite, Fiber-reinforced composites Rule of mixtures-Characteristics of fiber-Reinforced composites, Manufacturing fiber and composites,

UNIT II MANUFACTURING OF COMPOSITES 9

Manufacturing of Polymer Matrix Composites (PMCs)-handlay-up, spray technique, filament winding, Pultrusion, Resin Transfer Moulding (RTM)-, bag moulding, injection moulding, Sandwich Mould Composites (SMC) - Manufacturing of Metal Matrix Composites (MMCs) - Solid state, liquid state, vapour state processing, Manufacturing of Ceramic Matrix Composites (CMCs) –hot pressing-reaction bonding process-infiltration technique, direct oxidation- interfaces.

UNIT III INTRODUCTION, LAMINA CONSTITUTIVE EQUATIONS 9

Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Q_{ij}), Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.

UNIT IV LAMINA STRENGTH ANALYSIS AND ANALYSIS OF LAMINATED FLAT PLATES 9

Introduction - Maximum Stress and Strain Criteria. von-Mises Yield criterion forIsotropic Materials. Generalized Hill's Criterion for Anisotropic materials. Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies.

UNIT V THERMAL ANALYSIS 9

Assumption of Constant Co-efficient of Thermal Expansion (C.T.E.) - Modification of Hooke's Law. Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T.E's. C.T.E's for special Laminate Configurations – Unidirectional, Off-axis, Symmetric Balanced Laminates, Zero C.T.E laminates, Thermally Quasi-Isotropic Laminates.

TOTAL:45 PERIODS

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

1. Analyze mechanical strength of the composite material
2. Develop the FRP and other composites by different manufacturing methods
3. Analyze fiber reinforced Laminates for different combinations of plies with different orientations of the fiber.
4. Evaluate the stresses in the lamina of the laminate using different failure theories
5. Analyze thermo-mechanical behavior and evaluate residual stresses in different types of laminates using the Classical Laminate Theory.

TEXT BOOKS:

1. Gibson, R.F., "Principles of Composite Material Mechanics", McGraw-Hill, 1994, Second Edition - CRC press in progress.
2. Hyer, M.W., "Stress Analysis of Fiber – Reinforced Composite Materials", McGraw-Hill, 1998.

REFERENCES:

1. Issac M. Daniel and Ori Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press-2006, First Indian Edition – 2007.
2. Mallick, P.K., Fiber –"Reinforced Composites: Materials, Manufacturing and Design", Maneel Dekker Inc, 1993.
3. Halpin, J.C., "Primer on Composite Materials, Analysis", Techomic Publishing Co., 1984.
4. Agarwal, B.D., and Broutman L.J., "Analysis and Performance of Fiber Composites", John Wiley and Sons, New York, 1990.
5. Mallick, P.K. and Newman, S., (edition), "Composite Materials Technology: Processes and Properties", Hansen Publisher, Munish, 1990.

6. Madhujit Mukhopadhyay, “Mechanics of Composite Materials and Structures”, University Press (India) Pvt. Ltd., Hyderabad, 2004 (Reprinted 2008).
7. Chung, Deborah D.L., “Composite Materials: Science and Applications”, Ane Books Pvt. Ltd./Springer, New Delhi, 1st Indian Reprint, 2009.

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ME 7006 ENGINEERING MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

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

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

UNIT I INTRODUCTION 9

Technology Management - Definition – Functions – Evolution of Modern Management – Scientific Management Development of Management Thought. Approaches to the study of Management, Forms of Organization – Individual Ownership – Partnership – Joint Stock Companies – Co-operative Enterprises – Public Sector Undertakings, Corporate Frame Work – Share Holders – Board of Directors – Committees – Chief Executive – Line and Functional Managers, Constraints – Environmental – Financial – Legal – Trade Union.

UNIT II FUNCTIONS OF MANAGEMENT 9

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

UNIT III ORGANIZATIONAL BEHAVIOUR 9

Definition – Organization – Managerial Role and functions – Organizational approaches, Individual behaviour – causes – Environmental Effect – Behaviour and Performance, Perception – Organizational Implications. Personality – Contributing factors – Dimension – Need Theories – Process Theories – Job Satisfaction, Learning and Behaviour – Learning Curves, Work Design and approaches.

UNIT IV GROUP DYNAMICS 9

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

UNIT V MODERN CONCEPTS 9

Management by Objectives (MBO) – Management by Exception (MBE) – SWOT Analysis – Decisions Support System (DSS) – Management Games – Business Process Re-engineering (BPR) – Enterprises Resource Planning (ERP) – Supply Chain Management (SCM) – Activity Based Management (ABM) – Principles and Steps – Advantages and disadvantages

TOTAL : 45 PERIODS

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

1. Explain basic concepts of management; forms of business organization and trade unions function in professional organizations.
2. Identify the various functions of management.
3. Analyze the concepts of organizational behavior.
4. Adapt group dynamics in an organization.
5. Apply modern concepts and marketing in management.

TEXT BOOK:

1. Herald Koontz and Heinz Weihrich, 'Essentials of Management', McGraw Hill Publishing Company, Singapore International Edition, 1980.

REFERENCES:

1. S.Chandran, Organizational Behaviours, Vikas Publishing House Pvt. Ltd., 1994
2. Ties, AF, Stoner and R.Edward Freeman, 'Management' Prentice Hall of India Pvt. Ltd., New Delhi, 110011, 1992.
3. Joseph J, Massie, 'Essentials of Management' Prentice Hall of India Pvt. Ltd., 1985.
4. M. Govindarajan and S. Natarajan, Principles of Management, Prentice Hall of India Pvt. Ltd., New Delhi, 2007.

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ME 7007 GAS DYNAMICS AND SPACE PROPULSION L T P C
3 0 0 3

COURSE OBJECTIVES:

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

1. Applying the fundamentals of compressible flow concepts and the use of gastables.
2. Analyzing the compressible flow behaviour in constant area ducts.
3. Analyzing the development of shock waves and its effects.
4. Explaining the types of jet engines and their performance parameters.
5. Explaining the types of rocket engines and their performance parameters.

UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS 9

Energy and momentum equations of compressible fluid flows, Concepts of compressible flow – Mach waves and Mach cone. Flow regimes, effect of Mach number on compressibility. Stagnation, static, critical properties and their interrelationship. Isentropic flow and its relations. Isentropic flow through variable area ducts – nozzles and diffusers. Use of Gas tables.

UNIT II FLOW THROUGH DUCTS 9

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties. Choking concept, Isothermal flow with friction. Use of Gas tables.

UNIT III NORMAL AND OBLIQUE SHOCKS 9

Governing equations - Rankine-Hugoniot Relation. Variation of flow parameters across the normal and oblique shocks. Prandtl – Meyer expansion and relation. Use of Gas tables.

UNIT IV JET PROPULSION 9

Theory of jet propulsion – thrust equation – Performance parameters - thrust, power and efficiency. Operation, cycle analysis and performance of ram jet, turbojet, turbofan, turbo prop and pulse jet engines.

UNIT V SPACE PROPULSION 9

Types of rocket engines and propellants. Characteristic velocity – thrust equation. Theory of single and multistage rocket propulsion. Liquid fuel feeding systems. Solid propellant geometries. Orbital and escape velocity. Rocket engine performance parameters and problems.

TOTAL:45 PERIODS

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

1. Outline the concepts of compressible flow and compute fluid properties using gas tables.
2. Analyze the fluid flow behaviour in constant area ducts under different thermodynamic conditions
3. Describe the formation of shock waves and its effects.
4. Compare the performance characteristics of various jet engines
5. Examine the various propellants and compute the performance parameters of rocket engine

TEXT BOOKS:

1. Anderson, J.D.," Modern Compressible flow", 3rd Edition, McGraw Hill, 2003.
2. Yahya, S.M., "Fundamentals of Compressible Flow with Aircraft and Rocket propulsion", New Age International (P) Limited, 4th Edition, 2012.

REFERENCES:

1. Zucker, R.D., and Biblarz, O., "Fundamentals of Gas Dynamics", 2nd edition, Wiley, 2011.
2. Sutton, G.P. "Rocket Propulsion Elements", John Wiley, 8th edition 2010, New York.
3. Rathakrishnan, E., "Gas Dynamics", Prentice Hall of India, 2006.
4. Shapiro, A.H.," The Dynamics and Thermodynamics of Compressible Fluid Flow, Vol. 1", John Wiley, 1953.
5. Balachandran, P., "Fundamentals of Compressible Fluid Dynamics", Prentice Hall of India, 2007
6. Hill and Peterson, "Mechanics and Thermodynamics of Propulsion", Addison – Wesley, 1965.
7. Zucrow, N.J., "Aircraft and Missile Propulsion, Vol.1 & II", John Wiley, 1975.

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5	2	2	2	1	1		1					1	2	1	1

ME 7008 **MACHINE VISION** **L T P C**
3 0 0 3

OBJECTIVES:

1. Explaining the concepts of Physics behind Digital Image Processing.
2. Illustrating the Methods of Image Acquisition.
3. Applying the different knowledge in different types image Processing.
4. Developing knowledge of different types analyzing the Captured Image.
5. Implementing at the idea about Machine Vision Applications.

UNIT I INTRODUCTION **9**

Human Vision – Machine vision and Computer Vision – Benefits of Machine Vision – Block Diagram and Function of Machine Vision System Implementation of Industrial Machine Vision System – Physics of Light – Interactions of Light – Refraction at a Spherical Surface – Thin Lens Equation.

UNIT II IMAGE ACQUISITION **9**

Scene Constraints – Lighting Parameters – Lighting Sources, Selection – Lighting Techniques – Types and Selection – Machine Vision Lenses and Optical Filters, Specifications and Selection – Imaging Sensors – CCD and CMOS, Specifications – Interface Architectures – Analog and Digital Cameras –Digital Camera Interfaces – Camera Computer Interfaces, Specifications and Selection – Geometrical Image Formation Models – Camera Calibration.

UNIT III IMAGE PROCESSING **9**

Machine Vision Software – Fundamentals of Digital Image – Image Acquisition Modes – Image Processing in Spatial and Frequency Domain – Point Operation, Thresholding, Grayscale Stretching – Neighborhood Operations, Image Smoothing and Sharpening – Edge Detection – Binary Morphology – Color image processing.

UNIT IV IMAGE ANALYSIS **9**

Feature Extraction – Region Features, Shape and Size Features – Texture Analysis – Template Matching and Classification – 3D Machine Vision Techniques – Decision Making.

UNIT V MACHINE VISION APPLICATIONS **9**

Machine Vision Applications in Manufacturing, Electronics, Printing, Pharmaceutical, Textile, Applications in Non-Visible Spectrum, Metrology, Vision Guided Robotics – Field and Service Applications – Agricultural, and Bio Medical Field, Augmented Reality, Surveillance, Bio-Metrics.

TOTAL:45 PERIODS

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

1. Explain the concepts of Physics behind Digital Image Processing.
2. Illustrate the Methods of Image Acquisition.
3. Apply the different knowledge in different types image Processing.
4. Develop knowledge of different types analyzing the Captured Image.
5. Implement at the idea about Machine Vision Applications.

TEXT BOOKS:

1. Alexandaer Hornberg, “Hand Book of Machine Vision”, Wiley-VCH, 2006.
2. Davies E.R., “Machine Vision Theory, Algorithms and Practicalities”, Elsevier, 2005.

REFERENCES:

1. Nello Zuech, “Understanding and Applying Machine Vision”, Marcel Decker, 2000.
2. Bruce Batchelor and Frederick Waltz, “Intelligent Machine Vision Techniques, Implementations and Applications”, Springer-Verlag, 2001.
3. Rafael C. Gonzales, Richard. E. Woods and Steven L. Eddins, “Digital Image Processing Using MATLAB”, McGraw Hill Education, 2014.
4. Milan Sonka, Vaclav Hlavac and Roger Boyle, “Image Processing, Analysis, and Machine Vision”, Cengage Learning, 2014.
5. Malay K. Pakhira, “Digital Image Processing and Pattern Recognition”, PHI Learning,

2011.
6. Chanda B. and Dutta Majumder D., “Digital Image Processing and Analysis”, PHI Learning, 2011.

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ME 7009 MEASUREMENT AND CONTROLS L T P C
3 0 0 3

COURSE OBJECTIVES: The main learning objective of this course is to prepare the students for:
1. Identify measurement parameters and analyze errors of measurements.
2. Select and apply suitable transducer for a particular measurement.
3. Identify measurement parameters and select the appropriate sensor for it.
4. Explain the working of various types of control systems of apply for specific applications.
5. Apply the principle of automatic control systems to control various parameter(s).

UNIT I MEASUREMENTS 9

General concepts – Units and standards – Measuring instruments –sensitivity, readability, range accuracy, precision – static and dynamic response – repeatability hysteresis – systematic and random errors – correction – calibration and Uncertainty.

UNIT II INSTRUMENTS 9

Transducer, Modifying (intermediate) and Terminal stages – Mechanical and electrical transducers – preamplifiers – charge amplifiers – filters – attenuators – D’ Arsonval – CRO – Oscillographs – records – microprocessor based data logging, processing and output.

UNIT III PARAMETERS FOR MEASUREMENT 9

Dimension, displacement velocity, acceleration, impact – Force, torque, power – strain-pressure – humidity- temperature – flow-Time, frequency and phase angle – noise and sound level. Radio tracer techniques –flow visualization.

UNIT IV AUTOMATIC CONTROL SYSTEMS 9

Basic elements – feedback principle implication of measurements – Error detectors – final actuating elements – Two position, multi-position, floating, proportional controls – relays – servo amplifiers – servo motors – mechanical, Electrical, magnetic, electronic, hydraulic, pneumatic systems.

UNIT V APPLICATION OF CONTROL SYSTEMS 9

Governing of speed, kinetic and process control – pressure, temperature, fluid level, flow-thrust and flight control – photo electric controls.

TOTAL:45 PERIODS

COURSE OUTCOMES: Upon completion of this course, the students will be able to:
1. Identify measurement parameters and analyze errors of measurements.
2. Select and apply suitable transducer for a particular measurement.
3. Identify measurement parameters and select the appropriate sensor for it.
4. Explain the working of various types of control systems of apply for specific applications.
5. Apply the principle of automatic control systems to control various parameter(s).

TEXT BOOKS:

1. S.P.Venkateshan ,"Mechanical Measurements ", Ane Books,India ,2014
2. I.J.Nagrath and M.Gopal, "Control Systems Engineering", John wiley& Sons, 2nd Ed., Ch.1-4, 1982.

REFERENCES:

1. J.P.Holman and N.J.Gajda Jr., "Experimental Methods for Engineers", Mc Graw Hill Int. Edition, 5th Ed., 1989.
2. E.O.Doeblin, "Measurement Systems, Application and Design", Mc Graw Hill Int. Edition, 4th Ed., 1990.
3. T.G.Beckwith and N.L.Buck, "Mechanical Measurements", Addision Wesley Pub, Co., 1969.

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ME 7010 MECHANICAL VIBRATION AND NOISE CONTROL

L	T	P	C
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COURSE OBJECTIVES:

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

1. Apply the fundamental concepts of vibration.
2. Apply the fundamentals of noise.
3. Describe the various sources of noise for automotive applications.
4. Determine the natural frequencies and mode shapes of the two-degree freedom systems.
5. To apply the various control techniques to reduce the vibration and noise and improve the life of the components.

UNIT I BASICS OF VIBRATION 9

Introduction, classification of vibration: free and forced vibration, undamped and damped vibration, linear and non linear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies.

UNIT II BASICS OF NOISE 9

Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis.

UNIT III AUTOMOTIVE NOISE SOURCES 9

Noise - Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine necessary contributed noise, transmission noise, aerodynamic noise, tyre noise, brake noise.

UNIT IV TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS 9

Vibration isolation, tuned absorbers, un-tuned viscous dampers, damping treatments, dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.

UNIT V SOURCES OF NOISE AND ITS CONTROL 9

Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers

TOTAL:45 PERIODS

COURSE OUTCOMES:

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

1. Apply the fundamental concepts of vibration.
2. Apply the fundamentals of noise.
3. Describe the various sources of noise for automotive applications.
4. Determine the natural frequencies and mode shapes of the two-degree freedom systems.
5. Expose themselves to various control measures of both vibration and noise in different industrial applications.

TEXT BOOKS:

1. Singiresu S.Rao - "Mechanical Vibrations", 5th Edition, Pearson Education, 2010
2. Grover. G.T., "Mechanical Vibrations", Nem Chand and Bros., 2009.

REFERENCES:

1. Benson H. Tongue, "Principles of Vibrations", 2nd Edition, Oxford University, 2007.
2. David Bies and Colin Hansen, "Engineering Noise Control – Theory and Practice", 4th Edition CRC Press; 4 edition (24 June 2009).
3. William T. Thomson, Marie Dillon Dahleh, Chandramouli Padmanabhan, "Theory of Vibration with Application", 5th edition Pearson Education, 2011.
4. Bernard Challen and Rodica Baranescu - "Diesel Engine Reference Book" – Second Edition - Butterworth-Heinemann Ltd; 2 edition May 1999.
5. Julian Happian-Smith - "An Introduction to Modern Vehicle Design"- Butterworth- Heinemann, ISBN 0750-5044-3 – 2004.
6. Rao, J.S and Gupta, K., "Introductory course on Theory and Practice of Mechanical Vibration", Reprint, New Age International Publications, 2014.
7. A.A. Shabana, "Theory of vibrations – An introduction", 3rd Edition, Springer, 2010.
8. BalakumarBalachandran and Edward B. Magrab, "Fundamentals of Vibrations", 1st Editon, Cengage Learning, 2009.
9. John Fenton, "Handbook of Automotive body Construction and Design Analysis "– Professional Engineering Publishing, ISBN 1-86058-073- 1998**.**

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ME 7011 MEMS AND MICROSYSTEMS L T P C

3 0 0 3

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

1. Selecting suitable material for MEMS and Microsystems, and explain the scaling laws involved in miniaturization.
2. Explaining the various micro-manufacturing processes.
3. Applying the working principle of electrostatic and thermal based MEMS sensors and actuators in the design of MEMS devices.
4. Applying the working principle of piezo-resistive, piezo-electric and magnetic effect in the

design of MEMS devices.

5. Designing the elements of Micro-fluidic systems, and select suitable MEMS devices for Industrial applications.

UNIT I BASIC ENGINEERING FOR MEMS 9

History of MEMS Development, Multidisciplinary Nature of Microsystems, Energy Domains, Scalling Laws in Miniaturaization, Essential Electrical and Mechanical Concepts in MEMS, Materials for MEMS and Microsystems.

UNIT II MICROMANUFACTURING TECHNIQUES 9

Photolithography, Ion Implantation, Diffusion, Oxidation, Chemical Vapour Deposition, Physical Vapour Deposition-Sputtering, Deposition by Epitaxy, Etching, Bulk Micromanufacturing, Micromachining Processes, LIGA Process, Microsystem Assembly and Testing.

UNIT III ELECTROSTATIC AND THERMAL BASED MEMS 9

Introduction to Electrostatic Sensors and Actuators, Parallel-Plate Capacitor, Application of Parallel-Plate Capacitors, Interdigitated Finger Capacitors, Applications of Comb-Drive Devices, Introduction to Thermal Sensors and Actuators, Sensors and Actuators Based on Thermal Expansion, Thermocouples, Thermal Resistors, Shape Memory Alloy, Applications of Thermal Sensors and Actuators.

UNIT IV PIEZO / RESISTIVE / ELECTRIC AND MAGNETIC BASED MEMS 9

Introduction to Piezoresistive & Piezoelectric effects, Piezoresistive & Piezoelectric materials, Stress Analysis of Mechanical Elements, Applications of Piezoresistive & Piezoelectric Sensors and Actuators, Essential Concepts and Principles of Magnetic Sensors and Actuators, Fabrication of Micro Magnetic Components, Applications of Magnetic Sensors and Actuators.

UNIT V MICROFLUIDICS AND APPLICATIONS OF MEMS 9

Microfluidics - Fluid Mechanics Concepts, Design and Fabrication of Channels, Valves, Pumps, Case Studies - Accelerometer, Gyros, RF MEMS and MOEMS.

TOTAL:45 PERIODS

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

1. Select suitable material for MEMS and Microsystems, and explain the scaling laws involved in miniaturization.
2. Explain the various micro-manufacturing processes.
3. Apply the working principle of electrostatic and thermal based MEMS sensors and actuators in the design of MEMS devices.
4. Apply the working principle of piezo-resistive, piezo-electric and magnetic effect in the design of MEMS devices.
5. Design the elements of Micro-fluidic systems, and select suitable MEMS devices for Industrial applications.

TEXT BOOKS:

1. Chang Liu, “Foundations of MEMS”, Pearson Education, 2012.
2. Tai-Ran Hsu, “MEMS and Micro systems Design and Manufacture”, McGraw Hill Education, 2015.

REFERENCES:

1. Stephen D Senturia, “Microsystem Design”, Kluwer Academic Publishers, 2002.
2. Marc Madou, “Fundamentals of Microfabrication”, CRC Press, 2002.
3. Nitaigour Premchand Mahalik, “MEMS”, McGraw Hill Education, 2014.

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ME 7012 MICROCONTROLLER AND EMBEDDED SYSTEMS

L	T	P	C
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OBJECTIVE:

1. To impart knowledge about 8051 microcontroller and PIC
2. To get acquainted with programming of 8051 microcontroller
3. To become familiarized with PIC18FXXX
4. To provide insight into the methods of interfacing the i/o devices with microcontroller

To perceive the real-time applications of microcontrollers

UNIT I INTRODUCTION TO MICROCONTROLLER 9

Microprocessors and Microcontrollers - CISC and RISC - Fundamentals of Assembly Language Programming - Instruction to Assembler - C Programming for Microcontrollers - Compiler and IDE - Introduction to Embedded Systems - Architecture of 8051 family - PIC 18FXXX - Family - Memory Organization.

UNIT II PROGRAMMING OF 8051 MICROCONTROLLER 9

Instruction Set - Addressing Modes - I/O Programming - Timer/Counter - Interrupts - Serial Communication of 8051.

UNIT III PROGRAMMING OF PIC18FXXX MICROCONTROLLER 9

Instruction Set - Addressing Modes - I/O Programming - Timer/Counter - Interrupts – Serial Communication, CCP, ECCP, PWM Programming of PIC18FXXX.

UNIT IV PERIPHERAL INTERFACING 9

Interfacing of Relays, Memory, Key Board, Displays - Alphanumeric and Graphic, RTC, ADC and DAC, I^2C, Stepper Motors and DC Motors, SPI with 8051 and PIC Family.

UNIT V SPECIAL PURPOSE MICROCONTROLLER & APPLICATIONS 9

Application of Microcontroller in Washing Machine, Electronic Voltage Stabilizer, ECU in Automobiles, Simple Robotics. Dedicated Controller for Motor Drives, Inverters, Mobile Applications.

TOTAL:45 PERIODS

OUTCOMES:

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

1. To explain the basic concepts of 8051 microcontroller and PIC
2. To program the 8051 microcontroller by using timers and counters
3. To program the PIC18FXXX microcontroller and will also able to apply ECCP module suitable for a variety of power and motor control applications
4. To execute the interfacing of sensors and actuators with 8051 microcontroller and PIC.
5. To design and create automated systems with the aid of microcontroller and PIC

TEXT BOOKS:

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D,Mckinlay, “The 8051 Microcontroller and Embedded Systems”, Pearson Education, 2011.
2. Manish K. Patel, “The 8051Microcontroller based embedded systems”, McGraw Hill Education, 2014.

REFERENCES:

1. Muhammad Ali Mazidi, Rolin D,Mckinlay and Danny Causey “ PIC Microcontroller and Embedded Systems” Pearson Education, 2014.
2. M.Rafiquzzaman, “Microcontroller theory and applications with the PIC18F”, Wiley, 2014.
3. Kenneth J. Aylala, “The 8051 Microcontroller”, Thomson Learning, 2005
4. John B. Peatman, “PIC programing”, McGraw Hill International, 2005.
5. Julio Sanchez and Maria P.Canton “Microcontroller Programming”, CRC Press, 2013.

6. James W. Stewart, “The 8051 Micro controller hardware, software and Interfacing”, Prentice Hall, 2003.

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ME 7013 NEW AND RENEWABLE SOURCES OF ENERGY L T P C
3 0 0 3

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

1. Describing the current energy scenario in terms of conventional renewable energy and future plan.
2. Applying the principle of various solar energy generating devices.
3. Applying the principle of various wind energy devices.
4. Applying the principle of various bio energy devices.
5. Applying the principle of various ocean and geothermal energy devices

UNIT I SOLAR ENERGY 9

Present renewable energy status in India - Solar radiation – Measurements of solar radiation and sunshine – Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems – Solar PV applications.

UNIT II WIND ENERGY 9

Wind data and energy estimation – Betz limit - Site selection for windfarms – Horizontal axis wind turbine – Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues - Applications.

UNIT III BIO - ENERGY 9

Bio resources – Biomass direct combustion – Biomass gasifier - Types of biomass gasifiers - 4Cogeneration –- Carbonisation – Pyrolysis - Biogas plants – Digesters –Biodiesel production – Ethanol production - Applications.

UNIT IV OCEAN AND GEOTHERMAL ENERGY 9

Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications - Environmental impact.

UNIT V NEW ENERGY SOURCES 9

Fuel cell – Principle - Types of fuel cells – Hydrogen energy – Properties – Hydrogen production – Storage – Transport and utilisation - Safety issues.

TOTAL:45 PERIODS

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

1. Assess and apply different technologies for harnessing solar energy
2. Analyse and evaluate the performance of wind mills
3. Examine and recommend appropriate technologies for conversion of biomass to energy
4. Summarise the different option for receiving energy from ocean and compare their relative pros and cons.

5. Analyse and interpret the relevance of new energy sources namely fuel cells, hydrogen energy for the current scenario.

OUTCOME:

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

- Know the importance of renewable energy sources utilization and various renewable energy technologies.

TEXT BOOKS:

1. G.D. Rai, “Non Conventional Energy Sources”, Khanna Publishers, New Delhi, 2014.
2. Twidell, J.W. & Weir, A., “Renewable Energy Resources”, EFN Spon Ltd., UK, 2005.

REFERENCES:

1. Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford University Press, U.K., 2012.
2. S.P. Sukhatme, “Solar Energy: Principles of Thermal Collection and Storage”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.
3. G.N. Tiwari, “Solar Energy – Fundamentals Design, Modelling and applications”, Alpha Science Intl Ltd, 2015.
4. B.H. Khan, “Non-Conventional Energy Resources”, The McGraw Hill companies, 2009

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ME 7014 NON-DESTRUCTIVE MATERIALS EVALUATION L T P C
3 0 0 3

OBJECTIVES:

1. To make the students to understand the importance of NDT in quality assurance.
2. To imbibe the students the basic principles of various NDT techniques, its applications, limitations, codes and standards.
3. To equip the students with proper competencies to locate a flaw in various materials, products.
4. To make the students to be ready to use NDT techniques for in-situ applications too.
5. To inculcate the knowledge of selection of the right NDT technique for a given application.

UNIT I INTRODUCTION AND VISUAL INSPECTION METHODS 9

NDT versus Mechanical testing, Need for NDT, Relative merits and limitations, various physical characteristics of materials and their applications in NDT.

Visual Inspection -Unaided, Aided- Borescopes -Videoscopes, Special features in Borescopes, Selection of borescopes, Optical sensors, Microscopes & replication Microscopy Technique and applications.

UNIT II LIQUID PENETRANT TESTING AND MAGNETIC PARTICLE TESTING 9

LPT - Principle, types, Procedures, Penetrants and their characteristics, Emulsifiers, Solvent Cleaners / Removers, Developers- properties and their forms, Equipments, Advantages and limitations, Inspection and Interpretation, Applications.

MPT-Principle, Theory of Magnetism, Magnetising current, Magnetisation methods, Magnetic particles, Procedure, Interpretation, Relevant and Non-relevant indications, Residual magnetism, Demagnetisation – need, methods,Advantages and Limitations, Applications, Magnetic Rubber Inspection, Magnetic Printing, Magnetic Painting.

UNIT III THERMOGRAPHY AND EDDY CURRENT TESTING 9

Thermography – Introduction, Principle, Contact & Non-Contact inspection methods, Active & Passive methods, Liquid Crystal – Concept, example, advantages &limitations. Electromagnetic spectrum, infrared thermography- approaches, IR detectors, Instrumentation and methods and applications.

Eddy current Testing – Principle, properties of eddy currents, Eddy current sensing elements, probes, Instrumentation, Types of arrangement, Advantages & Limitations, Interpretation of Results & applications.

UNIT IV ULTRASONIC TESTING AND ACOUSTIC EMISSION TESTING 9

Ultrasonic Testing-Principle, Basic Equipment, Transducers, couplants, Ultrasonic wave, Variables in UT, Transmission and Pulse-echo method, Straight beam and angle beam, A-Scan, B-Scan & C-Scan, Phased Array Ultrasound & Time of Flight Diffraction, Advantages & Limitations, Interpretation of Results & Applications.

Acoustic Emission Technique – Introduction, Types of AE signal, AE wave propagation, Source location, Kaiser effect, AE transducers, Principle, AE parameters, AE instrumentation, Advantages & Limitations, Interpretation of Results, Applications.

UNIT V RADIOGRAPHY 9

Introduction, Principle, X-ray Production, Gamma ray sources, tubing materials, Xray tubing characteristics, Interaction of X-ray with matter, Imaging, Film techniques, Filmless techniques, Types and uses of filters and screens, Real time radiography, geometric factors, inverse square law, characteristics of film, graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Digital Radiography – Film Digitisation, Direct Radiography & Computed Radiography, Computed Tomography, Gamma ray Radiography, Safety in X- ray and Gamma Rray radiography.

TOTAL:45 PERIODS

COURSE OUTCOMES:

The students will be able to:

1. Compare the various visual inspection techniques and select a suitable inspection technique for the given component.
2. Make use of the Penetrant and magnetic particle testing methods for flaw detection.
3. Interpret the data obtained from Thermographic and Eddy current inspections.
4. Evaluate the results obtained through Ultrasonic inspection and Acoustic Emission techniques.
5. Explain the techniques involved in the Radiographic testing and the various advancements in Radiography.

TEXT BOOKS:

1. ASM Metals Handbook, “Non-Destructive Evaluation and Quality Control”, American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
2. Paul E Mix, “Introduction to nondestructive testing: a training guide”, Wiley, 2nd edition New Jersey, 2005

REFERENCES:

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu “Practical Non-Destructive Testing”, Narosa Publishing House, 2009.
2. Ravi Prakash, “Non-Destructive Testing Techniques”, New Age International Publishers, 1st revised edition, 2010
3. Charles, J. Hellier,“ Handbook of nondestructive evaluation”, McGraw Hill, New York 2001.
4. G. Gaussorgues, “Infrared Thermography”, Chapman & Hall, University Press, Cambridge, 1994.
5. ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook,Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, AcousticEmission Testing, Vol.

7, Ultrasonic Testing.

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ME 7015 PRINCIPLES OF ROBOTICS

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

1. Explaining the concepts of industrial robots with respect to its classification, specifications and coordinate systems. Reviewing the need and application of robots in different engineering fields.
2. Exemplifying the different types of robot drive systems as well as robot end effectors.
3. Applying the different sensors and image processing techniques in robotics to improve the ability of robots.
4. Developing robotic programs for different tasks and analyzing the kinematics motions of robot.
5. To gain knowledge about Robot Control, Robot Programming and Applications of Robots.

UNIT I FUNDAMENTALS OF ROBOTICS AND THEIR ACTUATORS 9

Introduction to Robotics, Robot Joints, Robot Configurations - Joint Notations - Work Envelope – Applications and Limitations, Speed of Motion and Load Carrying Capacity, Robot Control Systems, Precision of Movement.

Overview of Electric, hydraulic and Pneumatic Drives, Stepper & Servo Drives – Linear & Rotary types, Smart Actuators of Micro Robots.

UNIT II ROBOT LOCOMOTION AND END EFFECTORS 9

Walkers - Leg Actuators – Leg Geometry – Walking Techniques, Pipe Crawlers, Tracked Vehicles and Suspension Systems, Robot End Effector – Grippers and Gripper force analysis – Robot Tools – Considerations in Gripper Selection and Design.

UNIT III ROBOT SENSORS AND VISION 9

Tactile Sensors, Proximity and Range Sensors, Sensing and digitizing function in Robot Vision, Image processing and Analysis, Training the Vision System, Applications of Robot Sensors and Vision.

UNIT IV ROBOT MOTION ANALYSIS AND CONTROL 9

Introduction to manipulator Kinematics, Homogeneous Transformations and Robot Kinematics, Manipulator Path Control, Robot Arm Statics and Dynamics, Trajectory Planning, Robot Control System.

UNIT V ROBOT PROGRAMMING AND APPLICATIONS 9

Classification of Robot Languages and Programming, Graphical Simulation of Robotic Work cells, Robot Cell Design and Control, Humanoid Robots, Micro Robots, Tele-operated Robots, Application of Robots in Surgery, Manufacturing, Space and Underwater.

TOTAL:45 PERIODS

COURSE OUTCOMES:

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

1. Explain the different types of joints and drives to design robotic configuration.
2. Design the appropriate locomotive mechanisms for robots and grippers.
3. Identify the different sensors and apply the image processing techniques to enhance robots maneuverability.
4. Apply kinematic and dynamic principles in robot motion control.
5. Develop programs forrobotic applications.

TEXT BOOKS:

1. C Robert J Schilling, "Fundamentals of Robotics Analysis and Control", Pearson Education, 2009.
2. 2.Groover M.P., Weiss M., Nagel R.N. and Odrey N.G., "Industrial Robotics -Technology, Programming and Applications", McGraw Hill Education, 2011.

REFERENCES:

1. Craig J.J., "Introduction to Robotics Mechanics and Control", Pearson Education, 2008.
2. Fu K.S., Gonzalz R.C. and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill Education, 2008.
3. Deb S.R. and Deb S., "Robotics Technology and Flexible Automation", McGraw Hill Education, 2010.
4. Maja J Mataric, "The Robotics Primer", Universities Press, 2009.

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ME 7016 REFRIGERATION AND AIR CONDITIONING

L	T	P	C
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COURSE OBJECTIVES:

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

1. Explaining the different types of refrigerant, their properties, and selecting appropriate refrigerant for a HVAC system.
2. Explaining different types and components of RAC systems.
3. Designing the heat load and system size.
4. Explaining types of air-conditioning system and air distribution configurations.
5. Applying the safety and types of control in HVAC systems.

UNIT I VAPOUR COMPRESSION REFRIGERATION SYSTEM 9

Introduction to Refrigeration - Unit of Refrigeration and C.O.P.– Ideal cycles- Vapor compression cycle: p-h and T-s diagrams - deviations from theoretical cycle - sub-cooling and super heating- effects of condenser and evaporator pressure on COP- multi-pressure system - low temperature refrigeration - Cascade systems – problems.

UNIT II REFRIGERANTS AND COMPONENTS OF REFRIGERATION SYSTEMS 9

Refrigerants desirable properties – Classification - Nomenclature - ODP & GWP; Equipments: Type of Compressors, Condensers, Expansion devices, Evaporators.

UNIT III OTHER REFRIGERATION SYSTEMS 9

Working principles of Vapour absorption systems and adsorption cooling systems - Steam jet refrigeration- Thermoelectric refrigeration- Air refrigeration - Magnetic - Vortex and Pulse tube refrigeration systems.

UNIT IV PSYCHROMETRIC PROPERTIES AND PROCESSES 9

Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temp., Thermodynamics wet bulb temp., Psychrometric chart; Psychrometry of air-conditioning processes, mixing of air stream.

UNIT V AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION 9

Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection; fresh air load, human comfort & IAQ principles, effective temperature & chart, calculation of summer & winter air conditioning load; Classifications, Layout of plants; Air distribution system. Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors, Actuators & Safety controls, Filters.

TOTAL:45 PERIODS

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

1. Identify the different types of refrigeration cycles, refrigerant and their properties, and select appropriate refrigerant for specific application.
2. Categorize different types of components in RAC systems.
3. Apply non compression based refrigeration systems depending upon energy input.
4. Compute the thermodynamic properties of moist air and analyze the Psychrometric processes.
5. Estimate the heat load and design the appropriate air-conditioning systems with proper safety controls.

TEXT BOOKS:

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

REFERENCES:

1. Roy J. Dossat, “Principles of Refrigeration”, Pearson Education Asia, 4th ed, 2009.
2. “ASHRAE Hand book”, Fundamentals 2010
3. Jones W.P., “Air conditioning engineering”, Elsevier Butterworth-Heinemann, 5th ed, 2001.

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ME 7017	STATISTICAL PROCESS CONTROL AND RELIABILITY ENGINEERING	L	T	P	C
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COURSE OBJECTIVES:

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

1. Applying the 7 QC tools in problem solving for continuous improvement.
2. Designing online sampling plan for quality control using control charts and perform process capability studies.
3. Applying the strategies of acceptance sampling plan to perform quality audit in the customer site.
4. Evaluating the different reliability measurements applying the reliability concepts
5. Selecting the suitable method of improving the reliability and integrate reliability concepts in new product design and development.

UNIT I INTRODUCTION AND STATISTICAL PROCESS CONTROL 9

Introduction:-definitions of quality, Evolution of Quality: Inspection, Quality Control, Quality assurance Customer-Orientation: Internal & External Customer Concept, Life cycle approach to quality costs- Prevention; Appraisal and Failure costs. Seven SPC tools -Histogram, Check sheets, Ishikawa diagrams, Pareto, Scatter diagrams, Control charts and flow chart.

UNIT II ONLINE QUALITY CONTROL 9

Control chart for attributes –control chart for non conformings– p chart and np chart – control chart for nonconformities– C and U charts, Control chart for variables – X chart, R chart and σchart - State of control and process out of control identification in charts, pattern study and process capability studies.

UNIT III OFFLINE QUALITY CONTROL 9

Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producers Risk and consumers Risk. AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD- uses of standard sampling plans.

UNIT IV RELIABILITY CONCEPTS 9

Reliability engineering - fundamentals – failure data analysis, Mean failure rate, Mortality curve-concept of burn –in period, useful life and wear out phase of a system, mean time to failure, mean time between failure, hazard rate – failure density and conditional reliability-Maintainability and availability – simple problems.

UNIT V RELIABLITY ESTIMATION 9

System reliability: Series, Parallel and Mixed configurations, Reliability improvements techniques-use of Pareto analysis – design for reliability – redundancy unit and standby redundancy- fault tree analysis – Optimization in reliability – Product design – Product analysis – Product development – Product life cycles.

TOTAL: 45 PERIODS

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

1. Apply the 7 QC tools in problem solving for continuous improvement.
2. Design online sampling plan for quality control using control charts and perform process capability studies.
3. Apply the strategies of acceptance sampling plan to perform quality audit in the customer site.
4. Evaluate the different reliability measurements applying the reliability concepts
5. Select the suitable method of improving the reliability and integrate reliability concepts in new product design and development.

TEXT BOOKS:

1. Douglas.C. Montgomery, " Introduction to Statistical quality control", 7th edition, John Wiley 2012.
2. Srinath. L.S., "Reliability Engineering", 4th edition Affiliated East west press, 2005.

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REFERENCES:

1. John.S. Oakland. "Statistical process control", 5th edition, Elsevier, 2005
2. Connor, P.D.T.O., "Practical Reliability Engineering", Wiley India, 2008
3. Grant, Eugene .L "Statistical Quality Control", TMH, 2005
4. Monohar Mahajan, "Statistical Quality Control", Dhanpat Rai & Sons, reprint 2013.
5. Besterfield D.H., "Quality Control", 8th edition, Prentice Hall, 2009..

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ME 7018 THEORY OF METAL FORMING

L	T	P	C
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OBJECTIVES:

- To impart knowledge on plasticity, surface treatment for forming of various types of metal forming process.
- To study the basic concepts of metal forming techniques and force calculation in metal forming process.
- To study the various sheet metal forming concepts.
- To study the powder metallurgy and special forming process concepts.
- To study the surface treatment and metal forming concepts.

UNIT I THEORY OF PLASTICITY 9

Theory of plastic deformation–Yield criteria–Tresca and von-Mises–Distortion energy–Stress-strain relation–Mohr's circle representation of a state of stress–cylindrical and spherical co-ordinate systems–upper and lower bound solution methods–Overview of FEM applications in Metal Forming.

UNIT II THEORY AND PRACTICE OF BULK FORMING PROCESSES 9

Analysis of plastic deformation in Forging, Rolling, Extrusion, rod/wire drawing and tube drawing – Effect of friction–calculation of forces, work done–Process parameters, equipment used –Defects–applications–Recent advances in Forging, Rolling, Extrusion and Drawing processes–Design consideration in forming.

UNIT III SHEET METAL FORMING 9

Formability studies–Conventional processes–HERF techniques–Superplastic forming techniques –Hydro forming–Stretch forming–Water hammer forming–Principles and process parameters–Advantage, Limitations and application.

UNIT IV POWDER METALLURGY AND SPECIAL FORMING PROCESSES 9

Overview of P/M technique – Advantages – applications – Powder preform forging – powder rolling – Tooling, process parameters and applications - Orbital forging – Isothermal forging – Hot and cold isostatic pressing – High speed extrusion – Rubber pad forming – Fine blanking –LASER beam forming.

UNIT V SURFACE TREATMENT AND METAL FORMING APPLICATIONS 9

Experiment techniques of evaluation of friction in metal forming selection – influence of temperature and gliding velocity – Friction heat generation – Friction between metallic layers – Lubrication carrier layer – Surface treatment for drawing, sheet metal forming, Extrusion, hot and cold forging. Processing of thin Al tapes – Cladding of Al alloys – Duplex and triplex steel rolling Thermo mechanical regimes of Ti and Al alloys during deformation – Formability of welded blank sheet – Laser structured steel sheet - Formability of laminated sheet.

TOTAL:45 PERIODS

OUTCOMES:

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

1. Ability to learn stress-strain concepts and apply suitably to find out the solution to plastic deformation
2. Apply the theory of plasticity and its application for analysing various bulk forming processes
3. Understand the principle of Sheet metal forming and apply in different applications
4. Ability to use powder metallurgy and special forming processes for different applications
5. Understand the different treatment applied on forming components

TEXT BOOKS:

1. Surender Kumar, “Technology of Metal Forming Processes”, Prentice Hall India Publishers, 2008.
2. Nagpal G.R., “Metal Forming Processes”-Khanna publishers, 2005.

REFERENCES:

1. Helmi A Youssef, Hassan A. El-Hofy, “Manufacturing Technology: Materials, Processes and Equipment”, CRC publication press, 2012.
2. SAE Transactions, “Journal of Materials and Manufacturing Section 5”, 1993 – 2007.
3. Dieter,G.E,”Mechanical Metallurgy” TMH, Third edition March 2013.
4. Marciniak,Z., Duncan J.L., Hu S.J., “Mechanics of Sheet Metal Forming”, Butterworth-Heinemann An Imprint of Elesevier, 2006.
5. Altan T., “Metal forming – Fundamentals and applications” – American Society of Materials Park, 2003.
6. “ASM Hand book, Forming and Forging”, Ninth edition, Vol – 14, 2003.
7. Shiro Kobayashi,Soo-Ik Oh,Taylan Altan-“,Metal forming and Finite Element Method”, Oxford University Press, 2001.
8. Proc. Of National Seminar on - Advances in Metal Forming MIT, March 2000.

CO	PO												PSO		
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ME 7019 **TURBO MACHINERY** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

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

1. Explaining the energy transfer in rotor and stator parts of the turbo machines.
2. Explaining the function of various elements of centrifugal fans and blowers.
3. Evaluating the working and performance of centrifugal compressor.
4. Analyzing flow behavior and flow losses in axial flow compressor.
5. Explaining the types and working of axial and radial flow turbines

UNIT I WORKING PRINCIPLES 9

Classification of Turbomachines. Energy transfer between fluid and rotor - Euler equation and its interpretation. Velocity triangles. Thermal, Mechanical and overall efficiencies. Polytropic efficiency. Degree of reaction. Dimensionless parameters for Turbomachines.

UNIT II CENTRIFUGAL FANS AND BLOWERS 9

Types – components – working. Flow analysis in impeller blades-volute and diffusers. Velocity triangles - h-s diagram. Performance characteristic curves – various losses.

UNIT III CENTRIFUGAL COMPRESSOR 9

Components - Impeller types. Velocity triangles - h-s diagram. slip factor and power input factor. Performance characteristics and various losses. Geometry and performance calculation.

UNIT IV AXIAL FLOW COMPRESSOR 9

Construction details. Work done factor. Stage velocity diagrams - h-sdiagram. Performance characteristics, efficiency and stage losses. Vortex theory.

UNIT V AXIAL AND RADIAL FLOW TURBINES 9

Components - Types - Stage velocity diagrams - impulse and reaction stages. Performance coefficients and losses. Multistaging. Optimum conditions. Performance characteristics.

TOTAL:45 PERIODS

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

1. Analyze and compute the energy transfer in turbo machines.
2. Evaluate the performance of centrifugal fans and blowers through velocity triangles
3. Design the centrifugal compressor for various engineering applications.
4. Interpret the effect of blade geometries on performance of axial flow compressors
5. Categorize the different types of turbines and their applications

TEXT BOOKS:

1. Yahya, S.M., “Turbines, Compressor and Fans”, 4th Edition, Tata McGraw Hill, 2011.
2. Ganesan, V., “Gas Turbines”, 3rd Edition, Tata McGraw Hill, 2011.

REFERENCES:

1. Saravanamutto, Rogers, Cohen, Straznicky., “Gas Turbine Theory”, 6 th Edition, Pearson Education Ltd, 2009.
2. Bruno Eck.,” Fans; design and operation of centrifugal, axial-flow, and cross-flow fans”, Pergamom Press, 1973.
3. Dixon, S.L., “Fluid Mechanics and Thermodynamics of Turbomachinery”, 7th Edition, Butterworth-Heinemann, 2014.
4. Shepherd, D.G., “Principles of Turbomachinery”, Collier Macmillan Ltd, 1961.
5. Stepanoff, A.J., “Blowers and Pumps”, John Wiley and Sons Inc. 1965.
6. Gopalakrishnan .G and Prithvi Raj .D,” A Treatise on Turbomachines”, Scitech Publications (India) Pvt. Ltd., 2nd Edition, 2008.

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ME7071 AUTOMOBILE ENGINEERING L T P C
3 0 0 3

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

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

UNIT I INTRODUCTON TO AUTOMOTIVES 9

An overview of different types of automobiles and their power sources. Specifications, Performance Parameters, Quality standards, Trends in automobile design.

UNIT II POWER SOURCE FEATURES 9

Reciprocating Engine systems, Rotary Engine systems, Gas Turbine systems, Hybrid systems. Pollutant emissions and their control; Catalytic converter systems, Electronic Engine Management systems.

UNIT III TRANSMISSION, SUSPENSION AND BRAKING SYSTEMS 9

Clutch system, Gear box system, propeller shafting, differential, axles, wheels and tyres and preliminaries of suspension systems.

UNIT IV AUXILIARY SYSTEMS 9

Electrical and electronic systems, safety systems, Heating, Ventilation, and Air Conditioning (HVAC) systems, Vehicle Thermal Management System and vehicle body design features.

UNIT V TESTS, SERVICE AND MAINTENANCE 9

Engine Tuning, vehicle maintenance, engine and Chassis Dynamometry Pollutants and emissions check, Wind Tunnel Tests, preliminaries of engine and vehicle testing.

TOTAL:45 PERIODS

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

1. Identify different types of automobiles and emerging trends in automotive design.
2. Compare the constructional and operational features of reciprocating and rotary engines.
3. Outline the construction and working features of transmission, differential and axle systems of a vehicle.
4. Enumerate the functioning and troubleshooting HVAC and vehicle thermal management systems.
5. Understand the vehicle testing and maintenance procedures

TEXT BOOK:

1. William H. Crouse and Donald L. Anglin, “Automotive Mechanics”, Tata McGraw Hill, 2004, Tenth Edition.

REFERENCES:

1. Bosch “Automotive Handbook”, Robert Bosch GmbH, Germany, 2004, Sixth Edition.

2. Jack Erjavek, “Automotive Technology – A Systems Approach”, Thomson Learning, 3rd Edition, 1999.

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ME7072 COMPUTATIONAL TECHNIQUES FOR FLUID DYNAMICS L T P C
3 0 0 3

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

1. Applying the fundamentals of CFD, and developing case specific governing equations.
2. Performing finite difference and finite volume-based analysis for steady and transient diffusion problems.
3. Implementing various mathematical schemes under finite volume method for convention diffusion.
4. Solving complex problems in the field of fluid flow and heat transfer with the support of high speed computers.
5. Applying the various discretization methods, solution procedure and the concept of turbulence modeling.

UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 9

Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Chemical species transport –Physical boundary conditions – Time-averaged equations for Turbulent Flow – Turbulent–Kinetic Energy Equations – Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.

UNIT II FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION 9

Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – Finite volume formulation for steady state One, Two and Three -dimensional diffusion problems –Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations – Use of Finite Difference and Finite Volume methods.

UNIT III FINITE VOLUME METHOD FOR CONVECTION DIFFUSION 9

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes properties of discretization schemes – Conservativeness, Boundedness, Transportiveness, Hybrid, Power-law, QUICK Schemes.

UNIT IV FLOW FIELD ANALYSIS 9

Finite volume methods -Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms.

UNIT V TURBULENCE MODELS AND MESH GENERATION 9

Turbulence models, mixing length model, Two equation (k-Є) models – High and low Reynolds number models – Structured Grid generation – Unstructured Grid generation – Mesh refinement – Adaptive mesh – Software tools.

TOTAL:45 PERIODS

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

1. Use the concepts of CFD and formulate governing equations for different systems.
2. Compute the solutions for steady and transient diffusion problems using finite difference and finite volume methods.
3. Implement various discretization schemes under finite volume method for convection diffusion systems.
4. Evolve the solutions for complex fluid flow and heat transfer problems using various algorithms
5. Apply the various turbulence models for the engineering systems

TEXT BOOKS:

1. Versteeg, H.K., and Malalasekera, W.,"An Introduction to Computational Fluid Dynamics": The finite volume Method, Pearson Education Ltd. Third Edition – 2014.
2. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw Hill Publishing Company Ltd., 1998.

REFERENCES:

1. John D. Anderson "Computational Fluid Dynamics - The basics with Applications", McGraw-Hill International Editions, 1995.
2. Anil W. Date, "Introduction to Computational Fluid Dynamics", Cambridge University Press, Reprinted 2010.
3. Yogesh Jaluria & Kenneth E. Torrance, "Computational Heat Transfer", CRC press, 2nd Edition, 2002.
4. John. F. Wendt, "Computational Fluid Dynamics – An Introduction", Springer, Third Edition, 2013.
5. Suhas V, Patankar, "Numerical Heat transfer and Fluid flow", Taylor & Francis, 2009.

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4	2	2	2	2	3	2	2	2	2	2	2	2	2	2	2
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ME 7073 **DESIGN FOR MANUFACTURING** **L T P C**
3 0 0 3

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

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

UNIT I INTRODUCTION AND CASTING 9

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

UNIT II FORMING 9

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

UNIT III WELDING 9

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

UNIT IV MACHINING 9

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

UNIT V ASSEMBLY 9

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

TOTAL:45 PERIODS

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

1. Interpret the economics and design of cast components.
2. Design best manufacturing practices for forming of components.
3. Formulate design consideration in the design of welded products.
4. Develop design principles for machining.
5. Apply principles of assembly in the design of assembly of parts.

TEXT BOOK:

1. James G. Bralla, “Handbook of Product Design for Manufacture”, McGraw Hill Book Co., 2004.

REFERENCES:

1. Boothroyd, G., Dewhurst, P., & Knight, A. W., “Product Design for Manufacture and Assembly”, 3rd Edition, CRC Press – Taylor Francis Group, 2011.
2. Harry Peck, “Designing for Manufacture”, Sir Isaac Pitman & Sons Ltd., 1973.

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

ME 7074 DESIGN OF HEAT EXCHANGERS L T P C
3 0 0 3

COURSE OBJECTIVES:

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

1. Explaining the fundamentals of heat exchangers and its types, performing the thermal analysis on heat exchangers.
2. Designing the components of heat exchangers for various applications.
3. Performing the flow and stress analysis of heat exchangers.
4. Explaining the fundamentals and applications of compact heat exchangers.
5. Explaining the fundamentals and applications of condenser and cooling towers.

UNIT I INTRODUCTION 9

Types of heat exchangers, shell and tube heat exchangers – regenerators and recuperators - Temperature distribution and its implications - Parts description, Classification as per Tubular Exchanger Manufacturers Association (TEMA).

UNIT II PROCESS DESIGN OF HEAT EXCHANGERS 9

Heat transfer correlations, Overall heat transfer coefficient, analysis of heat exchangers – LMTD and effectiveness method. Sizing of finned tube heat exchangers, U tube heat exchangers, Design of shell and tube heat exchangers, fouling factors, pressure drop calculations.

UNIT III STRESS ANALYSIS 9

Stress in tubes – header sheets and pressure vessels – thermal stresses, shear stresses - types of failures, buckling of tubes, flow induced vibration.

UNIT IV COMPACT AND PLATE HEAT EXCHANGER 9

Types- Merits and Demerits- Design of compact heat exchangers, plate heat exchangers, performance influencing parameters, limitations.

UNIT V CONDENSERS AND COOLING TOWERS 9

Design of surface and evaporative condensers – cooling tower – performance characteristics.

TOTAL:45 PERIODS

OUTCOMES:

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

1. Summarize and select the different types of heat exchangers for specific applications.
2. Design the heat exchangers for various applications.
3. Predict the different thermal stresses in heat exchangers.
4. Categorizeand formulate the design aspects of compact and plate heat exchangers.
5. Analyze and evaluate parametric influences on performance of condenser and cooling towers.

TEXT BOOKS:

1. Sadik Kakac, Hongtan Liu, Anchasa Pramuanjaroenkij, “Heat Exchangers Selection, Rating and Thermal Design”, CRC Press, Third Edition, 2012.
2. Shah, R. K., Dušan P. Sekulić,” Fundamentals of heat exchanger design”, John Wiley & Sons, 2003.

REFERENCES:

1. Robert W. Serth, “Process heat transfer principles and applications”, Academic press, Elesevier, 2010.
2. Sarit Kumar Das,” Process heat transfer”, Alpha Science International, 2005.
3. John E. Hesselgreaves, “Compact heat exchangers: selection, design, and operation”, Elsevier science Ltd, 2001.
4. T. Kuppan, “Heat exchanger design hand book”, New York: Marcel Dekker, 2009.
5. Eric M. Smith, “Advances in thermal design of heat exchangers: a numerical approach: direct-sizing, step-wise rating, and transients”, John Wiley & Sons, 1999.
6. Arthur. P Frass, “Heat Exchanger Design”, John Wiley & Sons, 1989.
7. G.F. Hewitt, G. L. Shires, T. R. Bott, “Process Heat transfer”, CRC Press, 1993.

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ME 7075 DESIGN OF PRESSURE VESSELS AND PIPING

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OBJECTIVES:

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

1. understanding the design philosophy and different failure modes of pressure vessels.
2. exploring the knowledge of stresses and deflection in various form of vessels.
3. obtaining the knowledge of design of pressure vessels, stress concentration in pressure vessel and theory of reinforcement.
4. acquiring the knowledge of buckling and fracture mechanisms in pressure vessels.
5. studying the principle of pipe drafting and material selection for piping.

UNIT I INTRODUCTION 9

Methods for determining stresses – Terminology and Ligament Efficiency – Applications.

UNIT II STRESSES IN PRESSURE VESSELS 9

Introduction – Stresses in a circular ring, cylinder –Dilation of pressure vessels, Membrane stress Analysis of Vessel – Cylindrical, spherical and, conical heads – Thermal Stresses – Discontinuity stresses in pressure vessels.

UNIT III DESIGN OF VESSELS 9

Design of Tall cylindrical self supporting process columns – Supports for short vertical vessels – Stress concentration at a variable Thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of Reinforcement – Pressure Vessel Design.

UNIT IV BUCKLING AND FRACTURE ANALYSIS IN VESSELS 9

Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading.

UNIT V PIPING 9

Introduction – Flow diagram – piping layout and piping stress Analysis.

TOTAL:45 PERIODS

OUTCOMES:

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

1. Understand the design philosophy and different failure modes of pressure vessels.
2. Explore the knowledge of stresses and deflection in various form of vessels.
3. Obtain the knowledge of design of pressure vessels, stress concentration in pressure vessel and theory of reinforcement.
4. Acquire the knowledge of buckling and fracture mechanisms in pressure vessels.
5. Study the principle of pipe drafting and material selection for piping.

TEXT BOOK:

1. John F. Harvey, “Theory and Design of Pressure Vessels”, CBS Publishers and Distributors, 1987.

REFERENCES:

1. Henry H. Bedner, “Pressure Vessels, Design Hand Book”, CBS publishers and Distributors, 1987.
2. Stanley, M. Wales, “Chemical process equipment, selection and Design. Buterworths series in Chemical Engineering”, 1988.
3. William. J., Bees, “Approximate Methods in the Design and Analysis of Pressure Vessels and Piping”, Pre ASME Pressure Vessels and Piping Conference, 1997.
4. Sam Kannapan, “Introduction to Pipe Stress Analysis”. John Wiley and Sons, 1985.

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ME 7076 ENERGY CONSERVATION IN INDUSTRIES L T P C
3 0 0 3

OBJECTIVES:

- To understand and analyse the energy data of industries.
- To carryout energy accounting and balancing.
- To conduct energy audit and suggest methodologies for energy savings.
- To utilise the available resources in optimal ways.

UNIT I INTRODUCTION 9

Energy - Power – Present scenario of World / Nation: Environmental aspects of Energy Generation – Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Basic instruments for Energy Auditing.

UNIT II ECONOMICS 9

Energy / Cost index diagram – Energy Economics – Cost of production – Economic evaluation techniques – Return on investment, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing – ESCO concept

UNIT III ELECTRICAL SYSTEMS 9

TANGEDCO Billing – HT and LT supply - Transformers - Efficiency - Power Factor - Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.

UNIT IV THERMAL SYSTEMS 9

Stoichiometry, Combustion principles, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency Computation and Encon Measures - Steam Traps - Cogeneration - Waste heat recovery devices.

UNIT V ENERGY CONSERVATION IN MAJOR UTILITIES 9

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems - Cooling Towers – D.G. sets

TOTAL:45 PERIODS

COURSE OUTCOMES:

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

1. Analyse the energy data of industries.
2. Apply ESCO and other financial evaluation techniques to estimate the accruable energy savings/monetary benefits for any energy efficiency project
3. Diagnose the causes for under performance of various electrical utilities and suggest remedies for improving their efficiency
4. Compute the stoichiometric air requirement for any given fuel and quantify the energy losses associated with thermal utilities of industries
5. Improve the efficiency by adopting energy conservation in major utilities

TEXT BOOK:

1. Guide book for National Certification Examination for “Energy Managers and Energy Auditors” (4 Volumes). Available at www.beeindia.in

REFERENCES:

1. L.C. Witte, P.S. Schmidt, D.R. Brown, “Industrial Energy Management and Utilisation” HemispherePubl, Washington, 1988.
2. Guide book for National Certification Examination for” Energy Managers and Energy Auditors” (4 Volumes). Available at www.beeindia.in
3. Callaghn, P.W. “Design and Management for Energy Conservation”, Pergamon Press, Oxford, 1981.
4. I.G.C. Dryden, “The Efficient Use of Energy” Butterworths, London, 1982
5. W.C. Turner, “Energy Management Hand book” Wiley, New York, 1982.
6. W.R. Murphy and G. Mc KAY “Energy Management” Butterworths, London 1987.

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ME7077 ENTREPRENEURSHIP DEVELOPMENT L T P C
3 0 0 3

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

1. Explaining the types, characteristics of entrepreneurship and its role in economic development.
2. Applying the theories of achievement motivation and the principles of entrepreneurship development program to enterprise.
3. Selecting the appropriate form of business ownership in setting up an enterprise.
4. Applying the fundamental concepts of finance and accounting to enterprise.
5. Identifying sickness in industry, selecting the appropriate corrective measures, and identifying the growth strategies in enterprise.

UNIT I ENTREPRENEURSHIP 9

Entrepreneur – Characteristics – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur – Role of Entrepreneurship in Economic Development – Factors Affecting Entrepreneurial Growth – Economic, Non Economic, Government Actions.

UNIT II MOTIVATION 9

Entrepreneurial Motivation: Theories and Factors, Achievement Motivation –Entrepreneurial Competencies – Entrepreneurship Development Programs – Need, Objectives – Business Game, Thematic Apperception Test, Self Rating, Stress management.

UNIT III BUSINESS 9

Small Enterprises – Definition, Characteristics, Project Identification and selection – Project Formulation: Significance, content, formulation of project report – Project Appraisal: Concept and method – Ownership Structures: Selection & Pattern.

UNIT IV FINANCING AND ACCOUNTING 9

Finance: Need, Sources, Capital Structure, Term Loans – Accounting: Need, Objectives, Process,

Journal, Ledger, Trial Balance, Final Accounts – Working Capital Management: Significance, Assessment, Factors, Sources, Management.

UNIT V SUPPORT TO ENTREPRENEURS 9

Sickness in small Business: Concept, Signals, Symptoms, Magnitude, Causes and Consequences, Corrective Measures – Government Policy for Small Scale Enterprises: Growth Policy, Support. Institutional Support to Entrepreneurs: Need and Support – Taxation Benefits to Small Scale Industry: Need, Depreciation, Rehabilitation, Investment.

TOTAL:45 PERIODS

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

1. Explain the types, characteristics of entrepreneurship and its role in economic development.
2. Apply the theories of achievement motivation and the principles of entrepreneurship development program.
3. Select the appropriate form of business ownership in setting up an enterprise.
4. Apply the fundamental concepts of finance and accounting to enterprise.
5. Identify sickness in industry, select the appropriate corrective measures, and identify the growth strategies in enterprise.

TEXT BOOKS:

1. S.S.Khanka, “Entrepreneurial Development” S.Chand & Co. Ltd. Ram Nagar New Delhi,1999.
2. Kurahko & Hodgetts, “ Entrepreneurship – Theory, process and practices”, Thomson learning 6th edition.

REFERENCES:

1. Hisrich R D and Peters M P, “Entrepreneurship” 5th Edition Tata McGraw-Hill, 2002.
2. Mathew J Manimala,” Entrepreneurship theory at cross roads: paradigms and praxis” Dream tech, 2nd edition 2006.
3. Rabindra N. Kanungo, “Entrepreneurship and innovation”, Sage Publications, New Delhi, 1998.

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ME 7078 INTRODUCTION TO 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:

1. Selecting the constraints on the availability of resources and developing a model and render an optimal solution during the given circumstances.
2. Appraising the challenges in the transportation and production problems and furnishing a rational solution to maximize the benefits.
3. Planning the purchase/ manufacturing policies, managing the spares/ stocks and meeting the customer demands.
4. Analyzing the queue discipline and exploring the avenues for better customer service.
5. Investigating the nature of the project/ failure and offering methodical assistance towards decision making

UNIT I LINEAR PROGRAMMING PROBLEMS 9

OR-Definition - Phases - models, LP problems formulation – Graphical solution, GLPP, Standard and Canonical forms of LPP- simplex methods- Big M, Two phase methods, Alternate optimal solutions, Duality in LP.

UNIT II TRANSPORTATION 9

Transportation problems- Basic feasible solution, Optimal solution By MODI method, Balanced and Unbalanced TP, Degeneracy, Production problems. Assignment problems – Hungarian method Traveling salesman problems - Sequencing models- Johnson algorithm, n job 2 machines, n job 3 machines and n job m machines.

UNIT III INVENTORY CONTROL 9

Types of inventory- Inventory cost - EOQ - Deterministic inventory problems – Purchase and Production models with and without shortages-EOQ with price breaks - Stochastic inventory problems - Multi product problems - Systems of inventory control (P and Q Systems)- Determination of buffer stock and re-order levels -Selective inventory control techniques (ABC, VED, SDE, etc.)

UNIT IV QUEUING THEORY 9

Queuing system - Characteristics - symbols - Poisson process and exponential distribution -Single server queuing models - Multiserver queuing models, Simulation Monte Carlo technique- Inventory & Queuing problems.

UNIT V PROJECT MANAGEMENT AND REPLACEMENT MODELS 9

Project management: Network logic – Ford-Fulkerson's rule - AON diagram - CPM and PERT techniques, Critical path and float calculations Replacement models -types of failures – Gradual failures-replacement of items: Efficiency deteriorates with time, sudden failures- individual and group replacement policies.

TOTAL:45 PERIODS

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

1. Select the constraints on the availability of resources, develop a model and render an optimal solution for the given circumstances.
2. Appraise the challenges in the transportation and production problems and furnish a rational solution to maximize the benefits.
3. Plan the purchase/ manufacturing policies, manage the spares/ stocks and meet the customer demands.
4. Analyze the queue discipline and explore the avenues for better customer service.
5. Investigate the nature of the project/ failure and offer methodical assistance towards decision making.

TEXT BOOKS:

1. Wayne.L.Winston, “Operations research applications and algorithms”, 4th edition, 2007,Thomson learning.
2. Hamdy ATaha, “Operations research an introduction”, 9th edition 2011, PHI/Pearson education.

REFERENCES:

1. G.Srinivasan, “Operations research principles and applications”, 2nd edition EEE 2010, PHI.
2. R.Pannerselvam, “Operations research”, 2nd edition 2009, PHI
3. Frederick. S. Hiller and Gerald.J.Lieberman, “Operations research concepts and cases”, 8th edition (SIE) 2008,TMH.
4. Ravindran, Phillips and Solberg, “Operations research principles and practice”, 2nd edition 2007, Wiley India.
5. J.K.Sharma, “Operations research theory and applications”,5Th edition 2013, Macmillan India.
6. Prem kumar Gupta and D.S.Hira, “Problems in Operations research”,2009 S.Chand.

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ME 7079 **LEAN SIX SIGMA** **L T P C**
3 0 0 3

OBJECTIVE:

1. To explain the lean principles and the need to follow these principles in industries.
2. To give an overview of the various tools and techniques involved in lean manufacturing used in industries.
3. To provide the necessary skills needed to analyse a given situation to draw the current state map and to identify potential improvement areas and then draw the future state map.
4. To give an understanding of the various tools used in a six sigma project for quality improvement.
5. To provide an overview of the DMAIC methodology in a six sigma project.

UNIT I EVOLUTION AND OVERVIEW OF LEAN MANUFACTURING 9

Evolution of Mass production, Traditional versus Mass production, Evolution of Toyota (Lean) Production System, Business Dynamics of Lean production, Principles of Lean production – Value, Value stream, Flow, Pull, Perfection.

UNIT II LEAN MANUFACTURING – TOOLS AND TECHNIQUES 9

3Ms – Muda, Mura, Muri, 7 Wastes in Manufacturing, Lean Tools to eliminate Muda - 5S, Standardised work, TPM, SMED, Jidoka – Poka Yoke, JIT, Heijunka, Kanban, One piece production.

UNIT III VALUE STREAM MAPPING 9

Need for Value Stream mapping; Steps involved in Value stream mapping – Choose value stream – PQ and PR analysis, Current State map, Lean Metrics, Future State Map, Kaizen plans; Lean implementation - Cultural change, Lean in the Supply chain.

UNIT IV SIX SIGMA – TOOLS AND TECHNIQUES 9

Cost of Quality – Conformance and Non-Conformance cost, 7 Basic Quality Control Tools, Seven Management tools, FMEA.

UNIT V SIX SIGMA METHODOLOGY 9

Need for Six Sigma, Six Sigma Team, DMAIC Methodology - Define, Measure, Analyse, Improve and Control; Lean Six Sigma.

TOTAL:45 PERIODS

OUTCOME:

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

- Apply the various tools, techniques and methodology of lean manufacturing and six sigma concepts to the potential quality gaps in manufacturing / production industries.

TEXT BOOKS:

1. Pascal Dennis, “Lean production Simplified: A plain language guide to the world’s most powerful Production system”, Productivity Press 2007

2. Issa Bass and Barbara Lawton, “Lean Six Sigma using Sigma XL and Minitab”, Tata McGraw Hill 2010.

REFERENCES:

1. Yasuhiro Monden, Toyota Production System: “An Integrated approach to Just-in-Time”, CRC Press 2012
2. Taiichi Ohno, Toyota “Production System: Beyond Large-Scale Production”, Productivity Press 1988
3. Mike Rother and Rother Shook, “Learning to See: Value-Stream Mapping to Create Value and Eliminate” Muda, The Lean Enterprise Institute 2003
4. James Womack, Daniel T. Jones, and Daniel Roos, “The Machine that changed the world”, Free Press 1990
5. James Womack and Daniel T. Jones, “Lean Thinking: Banish waste and create wealth in your organization”, Free Press 2003.
6. Donna C. S. Summers, “Six sigma: Basic tools and techniques”, Pearson / Prentice Hall 2007.

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ME 7080 MARKETING MANAGEMENT

L	T	P	C
3	0	0	3

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

1. Explaining the basic concepts in marketing.
2. Explaining the various buying behaviour methods.
3. Analyzing the various product pricing concepts.
4. Analyzing the various marketing planning principles and its strategies.
5. Describing the trends of advertising, sales promotion methods.

UNIT I CONCEPTS IN MARKETING 9

Definition, Marketing Process, Dynamics, Needs, Wants and Demands, Marketing Concepts, Environment, Mix, Types, Philosophies, Selling vs Marketing, Consumer Goods, Industrial Goods.

UNIT II BUYING BEHAVIOUR AND MARKET SEGMENTATION 9

Cultural, Demographic factors, Motives, Types, Buying Decisions, Segmentation factors, Demographic, Psycho graphic and Geographic Segmentation, Process, Patterns. Services marketing and Industrial marketing.

UNIT III PRODUCT, PRICE AND MARKETING RESEARCH 9

Product, Classifications of product, Product Hierarchy, Product Life Cycle, New product development, Branding.

Price: Objectives, Pricing Decisions and Pricing Methods, Pricing Management, Introduction, Uses, Process of Marketing Research.

UNIT IV MARKETING PLANNING AND STRATEGY FORMULATION 9

Components of a Marketing Plan, Strategy Formulation and the Marketing Process, Implementation, Portfolio Analysis, BCG, GEC Grids.

UNIT V ADVERTISING, SALES PROMOTION AND DISTRIBUTION 9

Advertising-Characteristics, Impact, Goals, Types, Sales Promotion – Point of purchase, Unique Selling Propositions, Characteristics, Wholesaling, Retailing, Channel Design, Logistics, Modern Trends in Retailing, Modern Trends, e-Marketing.

TOTAL:45 PERIODS

COURSE OUTCOMES:

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

- Explain the basic concepts in marketing.
- Distinguish the various buying behavior methods.
- Analyze the different pricing concepts.
- Outline the marketing planning principles and its strategies.
- Illustrate the trends of advertising, sales, promotion and distribution.

TEXT BOOKS:

1. Govindarajan. M, “Marketing management – concepts, cases, challenges and trends”, Prentice hall of India, second edition, 2007.
2. Philip Kolter & Keller, “Marketing Management”, Prentice Hall of India, XII edition, 2006.

REFERENCES:

1. Donald S. Tull and Hawkins, “Marketing Research”, Prentice Hall of Inida-1997.
2. Philip Kotler and Gary Armstrong “Principles of Marketing” Prentice Hall of India, XII Edn, 2000.
3. Ramasamy and Nama kumari, “Marketing Management**:** Planning, Implementation and Control, Macmillan and Company,”, 2002
4. Czinkota&Kotabe, “Marketing management”, Thomson learning, Indian edition 2007
5. Adrain palmer, “Introduction to marketing theory and practice”, Oxford university press IE 2004.

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ME 7081 PROCESS PLANNING AND COST ESTIMATION L T P C

3 0 0 3

COURSE OBJECTIVES:

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

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

UNIT I INTRODUCTION TO PROCESS PLANNING 9

Aims and Objectives, Place of process planning in Manufacturing cycle, Drawing interpretation, Dimensional tolerance vs Production processes.

UNIT II PROCESS PLANNING STEPS 9

Design of a process plan – Selection of production processes, tools and process parameters-Positioning and work holding devices, Selection of inspection devices and tools, Documenting the process plan, Simple Case studies.

Computer-Aided Process Planning (CAPP) – Benefits, Architecture and approaches.

UNIT III INTRODUCTION TO COST ESTIMATION 9

Importance, Types, Purpose, Components, Procedure, Classification of costs, Cost elements, Overhead expenses, Break-even analysis.

UNIT IV PRODUCTION COST ESTIMATION 9

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

UNIT V ESTIMATION OF MACHINING TIME AND COST 9

Estimation of Machining time – Lathe operations, Drilling, Milling, Shaping and Planing, and Grinding, Cost estimation for machining processes.

TOTAL:45 PERIODS

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

1. Explain the Process flow for a given Product.
2. Create a process planfor manufacturing a component.
3. Estimate the overhead cost associated with manufacturing plant.
4. Evaluate the total cost for the Cast, welded and Forged products.
5. Analyze the machining time and estimate the cost of machined product.

TEXT BOOKS:

1. Gideon Halevi, “Process and operation planning”, Kluwer academic publishers (Printed ebook), 2003.
2. M. Adithan,” Process Planning and Cost Estimation”, New Age International Publishers, 2007.

REFERENCES:

1. Peter Scallan, “Process planning, The Design/Manufacture interface”, Butterworth-Heinemann, 2003.
2. Robert Creese, M. Adithan, B.S Pabla, “Estimating and Costing for the Metal Manufacturing Industries”, Marcel Dekker, 1992.
3. Phillip F. Ostwald, Jairo Munoz, “Manufacturing Processes And Systems”, 9th Edition, Wiley student edition, 2002.
4. Chitale, A, K., and Gupta, R. C,, “Product Design and manufacturing”, Prentice Hall of India, New Delhi , 1997.
5. G.B.S. Narang, V. Kumar, “Production and Costing”, Khanna Publishers, 2000.

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ME 7082 PRODUCT DESIGN AND DEVELOPMENT

L	T	P	C
3	0	0	3

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

1. Applying the principles of generic development process; conducting customer need analysis; and setting product specification for new product design and development.
2. Generating, selecting, screening, and testing concepts for new product design and development.
3. Applying the principles of product architecture and industrial design to concept generation, selection, design and develop new products.
4. Applying the principles of DFMand Prototyping to design and develop new product.
5. Applying the concepts of economics principles; project management practices in the development of new product by prototyping

UNIT I INTRODUCTION **9**

Introduction – Characteristics of Successful Product Development – Duration and cost of Product Development – Challenges – Generic Development Process – Concept Development: the Front End Process – Adaptation of the Generic Product Development Process – Product Development Process Flow – Product Development Organization.

UNIT II PRODUCT PLANNING, IDENTIFYING CUSTOMER NEEDS, PRODUCT SPECIFICATION **9**

Product Planning Process: Identification of opportunities; evaluation and prioritization of projects; allocation of resources & plan timing; completion of pre-project planning. Identification of Customer Needs: Collection of raw data from customers; interpretation of raw data of customer needs; organization of the needs into a hierarchy; establishment of relative importance of needs. Product Specifications: Establishment of Target Specifications, Setting-up of Final Specifications.

UNIT III CONCEPT GENERATION, SELECTION, TESTING **9**

Concept Generation: clarification of the problem; searching externally; searching internally, systematic exploration. Concept Selection: concept screening steps; concept scoring steps. Concept Testing: Defining the purpose of concept test; choosing a survey population; format; communicating the concept; measuring the customer response; interpretation of results.

UNIT IV PRODUCT ARCHITECTURE, INDUSTRIAL DESIGN, DESIGN FOR MANUFACTURE **9**

Product Architecture: Types of modularity – Implications – Establishing the Architecture – Platform Planning. Industrial Design: Assessing the need – Impact – Design Process. Design for Manufacturing: estimation of manufacturing costs; reduction of costs of components, assembly, supporting production; other factors.

UNIT V PROTOTYPING AND MANAGING PRODUCTS **9**

Prototype Basics – Principles of Prototyping – Prototyping Technologies – Planning for Prototypes. Management of Projects: Understanding and representing Tasks – Baseline Project Planning – Accelerating Projects – Project Execution – Postmortem Project Evaluation.

TOTAL:45 PERIODS

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

1. Apply the principles of generic development process; conduct customer need analysis; and set product specification for new product design and development.
2. Create and Generate concepts for new product design and development.
3. Implement the principles of product architecture and industrial design to design and develop new products.
4. Select the principles of DFMA and Prototyping for new product development.
5. Adapt the concepts of economics principles; project management practices in the development of new product

TEXT BOOK:

1. Ulrich K.T. and Eppinger S.D., "Product Design and Development" McGraw-Hill Education; 5 edition, 2011.

REFERENCES:

1. Belz A., 36-Hour Course: "Product Development" McGraw-Hill, 2010.
2. Rosenthal S., "Effective Product Design and Development", Business One Orwin, Homewood, 1992, ISBN 1-55623-603-4.
3. Pugh S., "Total Design – Integrated Methods for Successful Product Engineering", Addison Wesley Publishing, 1991, ISBN 0-202-41639-5.

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ME7083 SUSTAINABLE AND GREEN MANUFACTURING L T P C
3 0 0 3

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

1. Applying the knowledge of sustainability in manufacturing.
2. Evaluating the environment management system by applying environmental strategic assessment and life cycle assessment
3. Applying various strategies for sustainable manufacturing.
4. Applying the concepts of green manufacturing, waste management, energy consumption in any manufacturing industry
5. Analysing and applying the concept of recycling of waste; designing consciously for systematic framework.

UNIT I INTRODUCTION TO SUSTAINABLE MANUFACTURING 9

Sustainable Manufacturing - Concept of Triple bottom line, Environmental, Economic and Social Dimensions of Sustainability, Sustainable Product Development – Various Phases.

UNIT II EVALUATING SUSTAINABILITY 9

Sustainability performance evaluators- Frameworks and techniques - environmental management systems - life cycle assessment - strategic and environmental impact assessments - carbon and water foot-printing.

UNIT III MANUFACTURING STRATEGY FOR SUSTAINABILITY 9

Concepts of Competitive Strategy and Manufacturing Strategies and development of a strategic improvement programme - Manufacturing strategy in business success Strategy formation and formulation - Structured strategy formulation - Sustainable manufacturing system design options - Approaches to strategy formulation - Realization of new strategies/system designs.

UNIT IV GREEN MANUFACTURING 9

Green manufacturing- Definition, motivation and barriers to green manufacturing- Environmental impact of manufacturing- Waste generation- Energy consumption- Strategies for green manufacturing – Green manufacturing by design – Life cycle assessment.

UNIT V RECYCLING 9

Reclamation and recycling of waste- Recycling as Universal resource policy- Innovation towards environmental sustainability – systematic framework for conscious design- International green manufacturing standards and compliance.

TOTAL: 45 PERIODS

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

1. Apply the knowledge of sustainability in manufacturing.
2. Evaluate the environment management system by applying environmental strategic assessment and life cycle assessment
3. Apply various strategies for sustainable manufacturing.
4. Apply the concepts of green manufacturing, waste management, energy consumption in any manufacturing industry
5. Analyze and apply the concept of recycling of waste; design consciously for systematic framework.

TEXT BOOKS:

1. Davim, J.P., “Sustainable Manufacturing”, John Wiley & Sons, 2010.
2. Dornfield David, “Green Manufacturing”, Springer, 2012.

REFERENCES:

1. Seliger, G ,”Sustainable Manufacturing: Shaping Global Value Creation”, Springer, 2012.
2. Jovane, F., Ęmper, W.E. and Williams, D. J., “The ManuFuture Road: Towards Competitive and Sustainable High-Adding-Value Manufacturing”, Springer, 2009.
3. Kutz, M.,” Environmentally Conscious Mechanical Design”, John Wiley & Sons, 2007.
4. G. Atkinson, S. Dietz, E. Neumayer, —Handbook of Sustainable Manufacturingǁ. Edward Elgar Publishing Limited, 2007
5. Christian N. Madu “Handbook of environmentally conscious manufacturing” London : Kluwer Academic Publishers, 2001.
6. Joseph Sarkis “Greener manufacturing and operations: from design to delivery and back” Greenleaf Pub., 2001
7. Davim.J.Pauls, “Green Manufacturing Processes and Systems”, Springer, 2013

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ME 7351 DESIGN CONCEPTS IN ENGINEERING L T P C

3 0 0 3

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

1. Analyzing the various design requirements and get acquainted with the processes involved in product development.
2. Applying the design processes to develop a successful product.
3. Applying scientific approaches to provide design solutions.
4. Designing solution through relate the human needs and provide a solution.
5. Applying the principles of material selection, costing and manufacturing in design

UNIT I DESIGN TERMINOLOGY 9

Definition-various methods and forms of design-importance of product design-static and dynamic products-various design projects-morphology of design-requirements of a good design-concurrent engineering-computer aided engineering-codes and standards-product and process cycles-bench marking.

UNIT II DESIGN PROCESS 9

Basic modules in design process-scientific method and design method-Need identification, importance of problem definition-structured problem, real life problem- information gathering - customer requirements- Quality Function Deployment (QFD)- product design specifications-generation of alternative solutions- Analysis and selection-Detail design and drawings-Prototype, modeling, simulation, testing and evaluation.

UNIT III CREATIVITY IN DESIGN 9

Creativity and problem solving-vertical and lateral thinking-invention-psychological view, mental blocks-Creativity methods-brainstorming, synectics, force fitting methods, mind map, concept map-Theory of innovative problem solving (TRIZ) - conceptual decomposition creating design concepts.

UNIT IV HUMAN AND SOCIETAL ASPECTS 9

Human factors in design, ergonomics, user friendly design-Aesthetics and visual aspects environmental aspects-marketing aspects-team aspects-legal aspects-presentation aspects.

UNIT V MATERIAL AND PROCESSES IN DESIGN 9

Material selection for performance characteristics of materials-selection for new design substitution for existing design-economics of materials-selection methods-recycling and material selection-types of manufacturing process, process systems- Design for Manufacturability (DFM) - Design for Assembly (DFA).

TOTAL:45 PERIODS

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

1. Articulate the various design requirements and get acquainted with the processes involved in product development.
2. Design the processes to develop a successful product.
3. Implement the scientific approaches to provide design solutions.
4. Integrate human and societal aspects in design.
5. Select materials and manufacturing processes in design.

TEXT BOOK:

1. George E.Dieter, “Engineering Design: A Materials and Processing Approach” 4th Edition, Tata McGraw Hill, 2008.

REFERENCES:

1. Joseph E.Shigley, Charles R.Mische ,”Mechanical Engineering Design”, McGraw Hill International edition, 6th Edition 2009.
2. Edward B.Magrab,Satyandra K. Gupta, F. Patrick McCluskey and Peter Sandborn, “Integrated Product and Process Design and Development”, 2nd edition, CRC Press, 2009.
3. James Garratt,” Design and Technology”, 2nd Revised Edition, Cambridge University Press, 1996.

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ME 7603 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS

L	T	P	C
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COURSE OBJECTIVES:

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

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

UNIT I PRINCIPLES OF JIGS, FIXTURES AND PRESS WORKING 9

Objectives and importance of tool design—work holding devices- Basic elements of jigs and fixtures- location – clamping-indexing-operational chart-Fits and Tolerances

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

UNIT II JIGS 9

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

UNIT III FIXTURES 9

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

UNIT IV DESIGN OF CUTTING DIES 9

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

UNIT V DESIGN OF BENDING, FORMING, DRAWING AND MISCELLANEOUS DIES 9

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

TOTAL:45 PERIODS

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

COURSE OUTCOMES:

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

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

5. Design various parts of forming dies and draw the standard dimensioned views.

TEXT BOOKS:

1. Joshi, P.H. “Jigs and Fixtures”, Second Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2010.
2. Joshi P.H “Press tools - Design and Construction”, S. Chand & Co Ltd2001.

REFERENCES:

1. K. Venkataraman, “Design of Jigs Fixtures & Press Tools”, Anne Publications, 2015.
2. Donaldson, Lecain and Goold “Tool Design”, III rd Edition Tata McGraw Hill, 2000.
3. Kempster, “Jigs and Fixture Design”, Hoddes and Stoughton – Third Edition 1974.
4. Hoffman “Jigs and Fixture Design” – Thomson Delmar Learning, Singapore, 2004.
5. “ASTME – Fundamentals of tool design”- Prentice Hall of India pvt. Ltd New Delhi 1984.
6. “Design Data Hand Book”, PSG College of Technology, 2013, Coimbatore.
7. V.Balachandran, “Design of Jigs Fixtures & Press Tools”, Notion Press, 2015.

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MF7071 ADDITIVE MANUFACTURING TECHNOLOGY L T P C
3 0 0 3

COURSE OBJECTIVES:

1. To introduce the development of Additive Manufacturing (AM), various business opportunities and application.
2. To familiarize various software tools, processes and techniques to create physical objects that satisfy product development / prototyping requirements, using AM.
3. To be acquainted with vat polymerization and material extrusion processes.
4. To be familiar with extrusion based and sheet lamination processes
5. To gain knowledge on various printing processes and beam deposition processes

UNIT I INTRODUCTION 9

Overview – Need - Development of Additive Manufacturing Technology -Principle –AM Process Chain- Classification –Rapid Prototyping- Rapid Tooling – Rapid Manufacturing – Applications- Benefits –Case studies.

UNIT II DESIGN FOR ADDITIVE MANUFACTURING 9

Design tools: Data processing - CAD model preparation – Part orientation and support structure generation – Model slicing –Tool path generation- Design for Additive Manufacturing: Concepts and objectives- AM unique capabilities – DFAM for part quality improvement- Customised design and fabrication for medical applications.

UNIT III PHOTOPOLYMERIZATION AND POWDER BED FUSION PROCESSES 9

Photo polymerization: SLA-Photo curable materials – Process - Advantages and Applications. Powder Bed Fusion: SLS-Process description – powder fusion mechanism – Process Parameters – Typical Materials and Application. Electron Beam Melting.

UNIT IV EXTRUSION BASED AND SHEET LAMINATION PROCESSES 9

Extrusion Based System: FDM-Introduction – Basic Principle – Materials – Applications and Limitations – Bioextrusion. Sheet Lamination Process:LOM- Gluing or Adhesive bonding – Thermal bonding.

UNIT V PRINTING PROCESSES AND BEAM DEPOSITION PROCESSES 9

Droplet formation technologies – Continuous mode – Drop on Demand mode – Three Dimensional Printing – Advantages – Bioplotter - Beam Deposition Process:LENS- Process description – Material delivery – Process parameters – Materials – Benefits – Applications.

TOTAL: 45 PERIODS

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

1 Outline the evolution of AM technology and compare the various techniques.
2 Explain the process of transforming a concept into the final product by AM technology.
3 Elaborate the SLA and powder based processes, and their applications.
4 Describe theworking principles and applications of extrusion based and sheet lamination processes.
5 Enumerate the advantages, limitations and applications of various printing processes and beam deposition processes for various applications.

TEXT BOOKS:

1. Ian Gibson, David W.Rosen, Brent Stucker “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing” Springer , 2010.
2. Chua C.K., Leong K.F., and Lim C.S., “Rapid prototyping: Principles and applications”, Third edition, World Scientific Publishers, 2010.

REFERENCES:

1. Liou L.W. and Liou F.W., “Rapid Prototyping and Engineering applications :A tool box for prototype development”, CRC Press, 2007.
2. Kamrani A.K. and Nasr E.A., “Rapid Prototyping: Theory and practice”, Springer, 2006.
3. Tom Page “Design for Additive Manufacturing” LAP Lambert Academic Publishing, 2012.
4. Andreas Gebhardt “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing” Hanser Gardner Publication 2011.

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

MF7651 NON-TRADITIONAL MACHINING PROCESSES L T P C

3 0 0 3

COURSE OBJECTIVES:

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

UNIT I INTRODUCTION AND MECHANICAL ENERGY BASED PROCESSES 9

Introduction to non-traditional machining processes, need for non-traditional machining, classification of non-traditional machining processes, their applications, advantages, limitations. Abrasive jet machining, abrasive water jet machining, ultrasonic machining their working principles, equipments, effect of process parameters, applications, advantages and limitations.

UNIT II CHEMICAL AND ELECTRO CHEMICAL ENERGY BASED PROCESSES 9

Chemical machining, electro-chemical machining, electro-chemical honing, electro-chemical grinding, electro-chemical deburring their working principles, equipments, effect of process parameters, applications, advantages and limitations.

UNIT III THERMO-ELECTRIC ENERGY BASED PROCESSES 9

Electric discharge machining, wire electric discharge machining, laser beam machining, plasma arc machining, electron beam machining, Ion beam machining their working principles, equipments, effect of process parameters, applications, advantages and limitations.

UNIT IV ADVANCED NANO FINISHING PROCESSES 9

Abrasive flow machining, chemo-mechanical polishing, magnetic abrasive finishing, magneto rheological finishing, magneto rheological abrasive flow finishing their working principles, equipments, effect of process parameters, applications, advantages and limitations.

UNIT V RECENT TRENDS IN NON-TRADITIONAL MACHINING PROCESSES 9

Recent developments in non-traditional machining processes, their working principles, equipments, effect of process parameters, applications, advantages and limitations. Comparison of non-traditional machining processes.

TOTAL: 45 PERIODS

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

1 Formulate different types of non-traditional machining processes and evaluate mechanical energy based non-traditional machining processes.
2 Illustrate chemical and electro chemical energy based processes.
3 Evaluate thermo-electric energy based processes.
4 Interpret nano finishing processes.
5 Analyse hybrid non-traditional machining processes and differentiate non-traditional machining processes.

TEXT BOOKS:

1. M. Adithan, “Unconventional Machining Processes”, Atlantic, New Delhi, 2009.
2. V. K. Jain, “Introduction to Micromachining”, Narosa publishing House, New Delhi, 2014.

REFERENCES:

1. V. K. Jain, “Advanced Machining Processes”, Allied Publishers Pvt. Ltd., New Delhi, 2002.
2. Serope Kalpakjian and Steven R. Schmid, “Manufacturing Engineering and Technology”, Prentice Hall, 2013.
3. Serope Kalpakjian and Stevan R. Schemid, “Manufacturing Processes for Engineering Materials”, Pearson Education, 2008.
4. Brahem T. Smith, “Advanced machining”, I.F.S., U.K, 1989.
5. Benedict, G.F., “Non-traditional Manufacturing Processes”, Marcel Dekker Inc., New York 1987.
6. Pandey P.C. and Shan H.S., “Modern Machining Processes”, Tata McGraw Hill, New Delhi,1980.
7. Metals Handbook, Vol. 3, Machining, American Society for Metals, Metals Park, USA.

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

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

TEXTBOOKS:

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