ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

REGULATIONS – 2015

CHOICE BASED CREDIT SYSTEM

B.E. MANUFACTURING ENGINEERING

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) :

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

1. Be employed in jobs related to designing, modeling, analyzing, and managing modern complex systems, implementing and improving systems in manufacturing sectors at local, regional, national and global levels.
2. Have engaged in life-long learning, such as graduate studies and research, certification from professional organizations, Fundamentals of Engineering certification, or active participation in professional societies/activities.
3. Demonstrate professional success as evidenced by, among others, increased job responsibilities and leadership role at the place of employment and in greater society.

PROGRAMME OUTCOMES (POs):

a. Engineering/Foundational Knowledge in mathematics, engineering sciences, applied probability, computer science, humanities, and social science

b. Professional Skills to communicate in both oral and written forms and to be proficient in working in diverse teams of individuals

c. Manufacturing Engineering Knowledge/Skills in materials and manufacturing processes, process, assembly, and product engineering, manufacturing competitiveness, and manufacturing systems design,

d. Confidence in Engineering and professional skills.

e. Understanding of Professional and Ethical Behavior to be prepared for ethical decision making, service to the engineering profession, and have the means to continue in the acquisition of knowledge

PEO/ PO	a.	b.	c.	d.	e.
1.	✓		✓	✓	
2.		✓	✓	✓	✓
3.		✓	✓	✓	✓

Attested

DIRECTOR
Centre For Academic Courses
Anna University, Chennai-600 025.

B.E. Manufacturing Engineering
REGULATIONS - 2015
CHOICE BASED CREDIT SYSTEM
MAPPING OF COURSE OUTCOMES WITH PROGRAMME OUTCOMES:

			a	b	c	d	e
YEAR 1	SEM 1	**Theory**					
		Foundation English		✓			
		Mathematics - I	✓				
		Engineering Physics	✓			✓	
		Engineering Chemistry	✓				
		Engineering Graphics	✓	✓		✓	
		Practical					
		Basic Sciences Laboratory	✓				
		Engineering Practices Laboratory	✓			✓	
	SEM 2	**Theory**					
		Technical English		✓			
		Mathematics – II	✓				
		Materials Science	✓		✓	✓	
		Basic Electrical and Electronics Engineering	✓	✓	✓	✓	✓
		Computing Techniques	✓	✓		✓	
		Engineering Mechanics	✓		✓	✓	
		Practical					
		Electrical and Electronics Engineering Laboratory	✓	✓	✓	✓	✓
		Computer Practices Laboratory	✓	✓			
YEAR 2	SEM 3	**Theory**					
		Probability and Statistics	✓				
		Strength of Materials	✓		✓		
		Fluid Mechanics and Machinery	✓	✓		✓	
		Design Concepts in Engineering	✓				
		Environmental Science and Engineering	✓				

Attested

DIRECTOR
Centre For Academic Courses
Anna University, Chennai-600 025.

		Machine Tools and Processes	✓		✓	✓	
		Practical					
		Strength of Materials Laboratory	✓		✓		
		Fluid Mechanics and Machinery Laboratory	✓	✓		✓	
	SEM 4	**Theory**					
		Mechanics of Machines	✓		✓	✓	
		Thermodynamics	✓		✓	✓	
		Casting and Welding Technology	✓		✓	✓	
		Metal Forming and Powder Metallurgy	✓	✓	✓	✓	✓
		Engineering Materials and Metallurgy	✓		✓	✓	
		Machine Design	✓	✓	✓	✓	
		Practical					
		Manufacturing Technology Laboratory	✓		✓		
		Dynamics Laboratory	✓		✓		
YEAR 3	**SEM 5**	**Theory**					
		Hydraulics and Pneumatics	✓		✓	✓	
		Metrology and Computer Aided Inspection	✓		✓	✓	
		Computer Aided Design	✓	✓	✓	✓	
		Industrial Management	✓	✓	✓	✓	✓
		Professional Elective-I					
		Professional Elective-II					
		Practical					
		Metrology and Metallurgy Laboratory	✓		✓		
		Computer Aided Machine Drawing	✓	✓	✓	✓	
	SEM 6	**Theory**					
		Design of Jigs, Fixtures and Press Tools	✓	✓	✓	✓	
		Operations Research	✓	✓	✓	✓	
		CNC Technology	✓		✓	✓	
		Non Traditional Machining Processes	✓	✓	✓	✓	
		Professional Elective-III					
		Open Elective - I					

Attested

DIRECTOR
Centre For Academic Courses
Anna University, Chennai-600 025.

		Practical					
		CAM Laboratory	✓		✓		
		Creative and Innovative Project	✓	✓	✓	✓	✓
YEAR 4	**SEM 7**	**Theory**					
		Finite Element Analysis	✓	✓	✓	✓	
		Computer Integrated production Management System		✓	✓	✓	✓
		Mechatronics	✓		✓	✓	
		Professional Elective - IV					
		Professional Elective - V					
		Open Elective II					
		Practical					
		Mechatronics Laboratory	✓		✓		
		Industrial Training/Internship		✓	✓	✓	✓
	SEM 8	**Theory**					
		Professional Elective - VI					
		Open Elective III					
		Practical					
		Project Work	✓	✓	✓	✓	✓

ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

B.E. MANUFACTURING ENGINEERING

REGULATIONS – 2015

CHOICE BASED CREDIT SYSTEM

CURRICULA AND SYLLABI I - VIII SEMESTERS

SEMESTER I

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

SEMESTER II

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS7251	Technical English	HS	4	4	0	0	4
2.	MA7251	Mathematics – II	BS	4	4	0	0	4
3.	PH7251	Materials Science	BS	3	3	0	0	3
4.	EE7151	Basic Electrical and Electronics Engineering	ES	3	3	0	0	3
5.	GE7151	Computing Techniques	ES	3	3	0	0	3
6.	GE7153	Engineering Mechanics	ES	4	4	0	0	4
PRACTICAL								
7.	EE7261	Electrical and Electronics Engineering Laboratory	ES	4	0	0	4	2
8.	GE7161	Computer Practices Laboratory	ES	4	0	0	4	2
			TOTAL	**29**	**21**	**0**	**8**	**25**

Attested

DIRECTOR
Centre For Academic Courses
Anna University, Chennai-600 025.

SEMESTER III

S. 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.	GE7251	Environmental Science and Engineering	HS	3	3	0	0	3
4.	MA7357	Probability and Statistics	BS	4	4	0	0	4
5.	ME7351	Design Concepts in Engineering	PC	3	3	0	0	3
6.	MF7301	Machine Tools and Processes	PC	3	3	0	0	3
PRACTICAL								
7.	CE7261	Strength of Materials Laboratory	ES	4	0	0	4	2
8.	CE7361	Fluid Mechanics and Machinery Laboratory	ES	4	0	0	4	2
			TOTAL	**27**	**19**	**0**	**8**	**23**

SEMESTER IV

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	ME7353	Mechanics of Machines	PC	3	3	0	0	3
2.	ME7451	Machine Design	PC	5	3	2	0	4
3.	ME7452	Thermodynamics	PC	5	3	2	0	4
4.	MF7401	Casting and Welding Technology	PC	3	3	0	0	3
5.	MF7402	Metal Forming and Powder Metallurgy	PC	3	3	0	0	3
6.	ML7451	Engineering Materials and Metallurgy	PC	3	3	0	0	3
PRACTICAL								
7.	ME7412	Dynamics Laboratory	PC	4	0	0	4	2
8.	ME7413	Manufacturing Technology Laboratory	PC	4	0	0	4	2
			TOTAL	**30**	**18**	**4**	**8**	**24**

SEMESTER V

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	ME7551	Computer Aided Design	PC	3	3	0	0	3
2.	ME7553	Hydraulics and Pneumatics	PC	3	3	0	0	3
3.	ME7554	Industrial Management	PC	3	3	0	0	3
4.	MF7501	Metrology and Computer Aided Inspection	PC	3	3	0	0	3
5.		Professional Elective-I	PE	3	3	0	0	3
6.		Professional Elective-II	PE	3	3	0	0	3
PRACTICAL								
7.	ME7561	Computer Aided Machine Drawing	PC	4	0	0	4	2
8.	MF7511	Metrology and Metallurgy Laboratory	PC	4	0	0	4	2
			TOTAL	**26**	**18**	**0**	**8**	**22**

SEMESTER VI

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	ME7603	Design of Jigs, Fixtures and Press Tools	PC	3	3	0	0	3
2.	MF7601	CNC Technology	PC	3	3	0	0	3
3.	MF7602	Operations Research	PC	3	3	0	0	3
4.	MF7651	Non -Traditional Machining Processes	PC	3	3	0	0	3
5.		Professional Elective-III	PE	3	3	0	0	3
6.		Open Elective-I	OE	3	3	0	0	3
PRACTICAL								
7.	MF7611	CAM Laboratory	PC	4	0	0	4	2
8.	MF7612	Creative and Innovative Project[#]	EEC	4	0	0	4	2
			TOTAL	**26**	**18**	**0**	**8**	**22**

SEMESTER VII

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	ME7354	Mechatronics	PC	3	3	0	0	3
2.	ME7751	Finite Element Analysis	PC	3	3	0	0	3
3.	MF7701	Computer Integrated Production Management System	PC	3	3	0	0	3
4.		Professional Elective-IV	PE	3	3	0	0	3
5.		Professional Elective-V	PE	3	3	0	0	3
6.		Open elective-II	OE	3	3	0	0	3
PRACTICAL								
7.	ME7761	Mechatronics Laboratory	PC	4	0	0	4	2
8.	MF7711	Industrial Training/Internship*	EEC	*	0	0	0	2
			TOTAL	**22**	**18**	**0**	**4**	**22**

*4 weeks(Total duration can be flexibly covered in fifth and/or sixth semester holidays)

SEMESTER VIII

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Professional Elective-VI	PE	3	3	0	0	3
2.		Open Elective-III	OE	3	3	0	0	3
PRACTICAL								
3.	MF7811	Project Work	EEC	20	0	0	20	10
			TOTAL	**26**	**6**	**0**	**20**	**16**

TOTAL NO. OF CREDITS: 176

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

HUMANITIES AND SOCIAL SCIENCES (HS)

S. 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

BASIC SCIENCES (BS)

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA7151	Mathematics - I	BS	4	4	0	0	4
2.	PH7151	Engineering Physics	BS	3	3	0	0	3
3.	CY7151	Engineering Chemistry	BS	3	3	0	0	3
4.	BS7161	Basic Sciences Laboratory	BS	4	0	0	4	2
5.	MA7251	Mathematics – II	BS	4	4	0	0	4
6.	PH7251	Materials Science	BS	3	3	0	0	3
7.	MA7357	Probability and Statistics	BS	4	4	0	0	4

ENGINEERING SCIENCES (ES)

S. 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.	EE7151	Basic Electrical and Electronics Engineering	ES	3	3	0	0	3
4.	GE7151	Computing Techniques	ES	3	3	0	0	3
5.	GE7153	Engineering Mechanics	ES	4	4	0	0	4
6.	EE7261	Electrical and Electronics Engineering Laboratory	ES	4	0	0	4	2
7.	GE7161	Computer Practices Laboratory	ES	4	0	0	4	2
8.	CE7251	Strength of Materials	ES	3	3	0	0	3
9.	CE7352	Fluid Mechanics and Machinery	ES	3	3	0	0	3
10.	CE7261	Strength of Materials Laboratory	ES	4	0	0	4	2
11.	CE7361	Fluid Mechanics and Machinery Laboratory	ES	4	0	0	4	2

PROFESSIONAL CORE (PC)

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	ME7351	Design Concepts in Engineering	PC	3	3	0	0	3
2.	MF7301	Machine Tools and Processes	PC	3	3	0	0	3
3.	ME7353	Mechanics of Machines	PC	3	3	0	0	3
4.	ME7451	Machine Design	PC	5	3	2	0	4
5.	ME7452	Thermodynamics	PC	5	3	2	0	4
6.	MF7401	Casting and Welding Technology	PC	3	3	0	0	3
7.	MF7402	Metal Forming and Powder Metallurgy	PC	3	3	0	0	3
8.	ML7451	Engineering Materials and Metallurgy	PC	3	3	0	0	3
9.	ME7411	Dynamics Laboratory	PC	4	0	0	4	2
10.	ME7412	Manufacturing Technology Laboratory	PC	4	0	0	4	2
11.	ME7551	Computer Aided Design	PC	3	3	0	0	3
12.	ME7553	Hydraulics and Pneumatics	PC	3	3	0	0	3
13.	ME7554	Industrial Management	PC	3	3	0	0	3
14.	MF7501	Metrology and Computer Aided Inspection	PC	3	3	0	0	3
15.	ME7561	Computer Aided Machine Drawing	PC	4	0	0	4	2
16.	MF7511	Metrology and Metallurgy Laboratory	PC	4	0	0	4	2
17.	ME7603	Design of Jigs, Fixtures and Press Tools	PC	3	3	0	0	3
18.	MF7601	CNC Technology	PC	3	3	0	0	3
19.	MF7602	Operations Research	PC	3	3	0	0	3
20.	MF7651	Non -Traditional Machining Processes	PC	3	3	0	0	3
21.	MF7611	CAM Laboratory	PC	4	0	0	4	2
22.	ME7354	Mechatronics	PC	3	3	0	0	3
23.	ME7751	Finite Element Analysis	PC	3	3	0	0	3
24.	MF7701	Computer Integrated Production Management System	PC	3	3	0	0	3
25.	ME7761	Mechatronics Laboratory	PC	4	0	0	4	2

PROFESSIONAL ELECTIVES (PE)

S. 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.	GE7652	Total Quality Management	PE	3	3	0	0	3
4.	ME7072	Computational Techniques for Fluid Dynamics	PE	3	3	0	0	3
5.	ME7073	Design for Manufacturing	PE	3	3	0	0	3
6.	ME7077	Entrepreneurship Development	PE	3	3	0	0	3
7.	ME7081	Process planning and Cost estimation	PE	3	3	0	0	3
8.	ME7082	Product Design and Development	PE	3	3	0	0	3
9.	MF7001	MEMS and Micro System Fabrication	PE	3	3	0	0	3
10.	MF7002	Nano Coating	PE	3	3	0	0	3
11.	MF7003	Non Destructive Evaluation	PE	3	3	0	0	3
12.	MF7004	Plasticity theory and Metal forming	PE	3	3	0	0	3
13.	MF7005	Precision Engineering	PE	3	3	0	0	3
14.	MF7006	Processing of Plastics and Composite Materials	PE	3	3	0	0	3
15.	MF7007	Quality Control and Reliability Engineering	PE	3	3	0	0	3
16.	MF7008	Renewable Energy Sources	PE	3	3	0	0	3
17.	MF7009	Sustainable Manufacturing	PE	3	3	0	0	3
18.	MF7010	System Simulation	PE	3	3	0	0	3
19.	MF7011	Theory of Metal Cutting	PE	3	3	0	0	3
20.	MF7012	Value Engineering and Re Engineering	PE	3	3	0	0	3
21.	MF7071	Additive Manufacturing Technology	PE	3	3	0	0	3
22.	MF7072	Electronic Materials and Processing	PE	3	3	0	0	3
23.	MF7073	Electronics Manufacturing Technology	PE	3	3	0	0	3
24.	MF7074	Flexible Manufacturing Systems	PE	3	3	0	0	3

Attested

DIRECTOR
Centre For Academic Courses
Anna University, Chennai-600 025.

25.	MF7075	Industrial Robotics	PE	3	3	0	0	3
26.	MF7076	Nanotechnology	PE	3	3	0	0	3
27.	MF7077	Total Productive Maintenance	PE	3	3	0	0	3
28.	ML7751	Surface Engineering	PE	3	3	0	0	3
29.	PR7021	Engineering Economics and Financial Management	PE	3	3	0	0	3
30.	PR7651	Production of Automotive Components	PE	3	3	0	0	3
31.	GE7072	Foundation Skills in Integrated Product Development	PE	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
32.	MF7612	Creative and Innovative Project	EEC	4	0	0	4	2
33.	MF7711	Industrial Training	EEC	0	0	0	0	2
34.	MF7811	Project Work	EEC	20	0	0	20	10

SUMMARY

S.NO.	SUBJECT AREA	CREDITS AS PER SEMESTER								CREDITS TOTAL
		I	II	III	IV	V	VI	VII	VIII	
1.	HS	04	04	03	00	00	00	00	00	**11**
2.	BS	12	07	04	00	00	00	00	00	**23**
3.	ES	06	14	10	00	00	00	00	00	**30**
4.	PC	00	00	06	24	16	14	11	00	**71**
5.	PE	00	00	00	00	06	03	06	03	**18**
6.	OE	00	00	00	00	00	03	03	03	**9**
7.	EEC	00	00	00	00	00	02	02	10	**14**
	Total	**22**	**25**	**23**	**24**	**22**	**22**	**22**	**16**	**176**

HS7151 FOUNDATIONAL ENGLISH L T P C
4 0 0 4

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

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

CONTENTS

UNIT I GREETING AND INTRODUCING ONESELF 12
Listening- Types of listening – Listening to short talks, conversations; **Speaking** – Speaking about one's place, important festivals etc. – Introducing oneself, one's family/ friend; **Reading** – Skimming a passage– Scanning for specific information; **Writing**- Guided writing - Free writing on any given topic (My favourite place/ Hobbies/ School life, writing about one's leisure time activities, hometown, etc.); **Grammar** – Tenses (present and present continuous) -Question types - Regular and irregular verbs; **Vocabulary** – Synonyms and Antonyms.

UNIT II GIVING INSTRUCTIONS AND DIRECTIONS 12
Listening – Listening and responding to instructions; **Speaking** – Telephone etiquette - Giving oral instructions/ Describing a process – Asking and answering questions; **Reading** – Reading and finding key information in a given text - Critical reading - **Writing –**Process description(non-technical)- **Grammar** – Tense (simple past& past continuous) - Use of imperatives – Subject – verb agreement – Active and passive voice; - **Vocabulary** – Compound words – Word formation – Word expansion (root words).

UNIT III READING AND UNDERSTANDING VISUAL MATERIAL 12
Listening- Listening to lectures/ talks and completing a task; **Speaking** –Role play/ Simulation – Group interaction; **Reading** – Reading and interpreting visual material; **Writing**- Jumbled sentences – Discourse markers and Cohesive devices – Essay writing (cause & effect/ narrative);**Grammar** – Tenses (perfect), Conditional clauses –Modal verbs; **Vocabulary** –Cause and effect words; Phrasal verbs in context.

UNIT IV CRITICAL READING AND WRITING 12
Listening- Watching videos/ documentaries and responding to questions based on them; **Speaking** Informal and formal conversation; **Reading** –Critical reading (prediction & inference);**Writing**–Essay writing (compare & contrast/ analytical) – Interpretation of visual materials; **Grammar** – Tenses (future time reference);**Vocabulary** – One word substitutes (with meanings) – Use of abbreviations & acronyms – Idioms in sentences.

UNIT V LETTER WRITING AND SENDING E-MAILS 12
Listening- Listening to programmes/broadcast/ telecast/ podcast; **Speaking** – Giving impromptu talks, Making presentations on given topics- Discussion on the presentation; **Reading** –Extensive reading; **Writing**- Poster making – Letter writing (Formal and E-mail) ;**Grammar** – Direct and Indirect speech – Combining sentences using connectives; **Vocabulary** –Collocation;

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

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

TOTAL:60 PERIODS

OUTCOMES:

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

TEXTBOOK:

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

REFERENCES:

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

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

OBJECTIVES:

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

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 functions – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Errors and approximations – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT III INTEGRAL CALCULUS 12

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

UNIT IV MULTIPLE INTEGRALS 12

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

UNIT V DIFFERENTIAL EQUATIONS 12

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

TOTAL: 60 PERIODS

OUTCOMES:

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

TEXTBOOKS:

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

REFERENCES:

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

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

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

OBJECTIVE:

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

UNIT I PROPERTIES OF MATTER **9**

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

UNIT II ACOUSTICS AND ULTRASONICS **9**

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

UNIT III THERMAL AND MODERN PHYSICS **9**

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

UNIT IV APPLIED OPTICS **9**

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

UNIT V CRYSTAL PHYSICS **9**

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

TOTAL: 45 PERIODS

OUTCOME:

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

TEXTBOOKS:

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

REFERENCES:

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

CY7151 ENGINEERING CHEMISTRY

L	T	P	C
3	0	0	3

OBJECTIVE

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

.

UNIT I POLYMER CHEMISTRY 9

Introduction: Functionality-degree of polymerization. Classification of polymers- natural and synthetic, thermoplastic and thermosetting. Types and mechanism of polymerization: addition (free radical, cationic, anionic and living); condensation and copolymerization. Properties of polymers: Tg, tacticity, molecular weight-weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension.

UNIT II SURFACE CHEMISTRYAND CATALYSIS 9

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

UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY 9

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

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

OUTCOME

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

TEXTBOOKS

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

REFERENCES

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

GE7152 ENGINEERING GRAPHICS L T P C
3 2 0 4

OBJECTIVES

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

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION) 1

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

UNIT I PLANE CURVES AND FREE HANDSKETCHING 14

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

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES 14

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

UNIT III PROJECTION OF SOLIDS 14

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

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 14

Sectioning of solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section.
Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 15

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems.
Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method and vanishing point method.

COMPUTER AIDED DRAFTING (DEMONSTRATION ONLY) 3

Introduction to drafting packages and demonstration of their use.

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

OUTCOMES:

On Completion of the course the student will be able to

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

TEXT BOOK:

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

REFERENCES:

1. K.R.Gopalakrishna., “Engineering Drawing” (Vol I&II combined) Subhas Stores, Bangalore, 2007
2. Luzzader, Warren.J., and Duff,John M.,,’’ Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production”, Eastern

Economy Edition, Prentice Hall of India Pvt Ltd, New Delhi, 2005
3. M.B.Shah and B.C.Rana, "Engineering Drawing", Pearson, 2nd Edition, 2009
4. K.Venugopal and V.Prabhu Raja, "Engineering Graphics", New Age International (P)Limited ,2008.
5. K. V.Natarajan, "A text book of Engineering Graphics", 28th Edition, Dhanalakshmi Publishers, Chennai, 2015.
6. 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

TEXTBOOKS

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

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

OBJECTIVES

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

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

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

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

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

CONTENTS

UNIT I ANALYTICAL READING **12**
Listening- Listening to informal and formal conversations; **Speaking** – Conversation Skills(opening, turn taking, closing)-explaining how something works-describing technical functions and applications; **Reading** –Analytical reading, Deductive and inductive reasoning; **Writing**- vision statement–structuring paragraphs.

UNIT II SUMMARISING **12**

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

UNIT III DESCRIBING VISUAL MATERIAL **12**

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

UNIT IV WRITING/ E-MAILING THE JOB APPLICATION **12**

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

UNIT V REPORT WRITING **12**

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

TEACHING METHODS:

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

EVALUATION PATTERN:

Internals – 50%
End Semester – 50%

TOTAL:60 PERIODS

OUTCOMES

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

TEXTBOOK:

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

REFERENCES:

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

MA7251 **MATHEMATICS - II** **L T P C**

(Common to all branches of B.E. / B.Tech. Programmes in II Semester) **4 0 0 4**

OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To acquaint the student with the concepts of vector calculus, needed for problems in all engineering disciplines.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow of the electric current.
- To make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT I MATRICES **12**

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

UNIT II VECTOR CALCULUS **12**

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

UNIT III ANALYTIC FUNCTION **12**

Analytic functions – Necessary and sufficient conditions for analyticity - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions - Bilinear

Error! Objects cannot be created from editing field codes.

transformation.

UNIT IV COMPLEX INTEGRATION **12**

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour with no pole on real axis.

UNIT V LAPLACE TRANSFORMS **12**

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – – Transform of periodic functions – Application to solution of linear ordinary differential equations with constant coefficients.

TOTAL: 60 PERIODS

OUTCOMES:

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

TEXTBOOKS:

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

REFERENCES:

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

PH7251 **MATERIALS SCIENCE** **L T P C**

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

OBJECTIVE:

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

UNIT I PHASE DIAGRAMS **9**

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

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

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

UNIT III MECHANICAL PROPERTIES 9

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

UNIT IV MAGNETIC, DIELECTRIC AND SUPERCONDUCTING MATERIALS 9

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

UNIT V NEW MATERIALS 9

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

TOTAL: 45 PERIODS

OUTCOME:

Upon completion of this course, the students will

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

TEXTBOOKS:

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

REFERENCES:

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

EE7151 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING **L T P C 3 0 0 3**

OBJECTIVE:

- To impart the knowledge on basic concepts of electrical circuits and electrical machines.
- To impart the knowledge on basic concepts of electronic components, devices and circuits

UNIT I BASIC CONCEPTS AND DC CIRCUITS **9**

Ohm's law - Electrical resistance - Series /Parallel resistive circuits - Star/Delta transformations - Kirchoff's law - Node and Mesh analysis - Thevenin's and Norton's theorem.

UNIT II A.C.CIRCUITS **9**

RMS and average value of periodic waves - Form factor - Phase and Phase difference - Simple RC.RL and RLC circuits - series and parallel resonance - power and power factor - introduction to three phase systems – power measurement in 3 phase system.

UNIT III D.C. MACHINES **10**

Construction details of DC machines - principle of operation of DC generator - EMF equation - principle of DC motor - Back EMF - Voltage and torque equation - Principle of transformer - construction and type - EMF equation - Tests on transformer - Equivalent circuit - Induction motor - Construction and basic principle of operation - Starting and Running torques.

UNIT IV ELECTRONIC COMPONENTS AND DEVICES **9**

Operating principle and characteristics of Simple PN Junction Diodes, Zener diode, Bipolar Junction transistor - Field Effect Transistors – UJT – SCR.

UNIT V ANALOG CIRCUITS **8**

Rectifier and Power Supply Circuits, clipper, clamper using diodes, Operational Amplifiers (Ideal) - properties and typical circuits like differentiator, integrator, summer, comparator.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to use the various electrical machines like AC/ DC, electronic components and applications of analog circuits

REFERENCES:

1. Theraja, B.L., " A Text Books of Electrical Technology ", S.S. Chand and Co., New Delhi, 1998.
2. Edminister J.A., " Theory and Problems on Electric circuits ", McGraw Hill International Edition, 1994.
3. Kosow, I.L., " Electrical Machinery and Transformers ", 4th Edition, Prentice Hall of India, 1991.
4. Nagrath I.J. and Kothari D.P., "Theory and Problems of Basic Electrical Engineering", Prentice Hall of India, 1998.
5. Millman.J. and Grabel.S., Integrated Electronics, Tata McGraw Hill, 1995.
6. Horowits.P. and Hill.W., The Art of Electronics, McGraw Hill, 1995.

GE7151 COMPUTING TECHNIQUES **L T P C**

(Common to all branches of Engineering and Technology) **3 0 0 3**

OBJECTIVE

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

UNIT I INTRODUCTION **9**

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

UNIT II C PROGRAMMING BASICS 9

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

UNIT III ARRAYS AND STRINGS 9

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

UNIT IV POINTERS 9

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

UNIT V FUNCTIONS AND USER DEFINED DATA TYPES 9

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

TOTAL : 45 PERIODS

OUTCOME

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

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

TEXTBOOKS:

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

REFERENCES:

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

GE7153 ENGINEERING MECHANICS L T P C
4 0 0 4

OBJECTIVE :

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

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

OUTCOMES:

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

TEXT BOOK

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

REFERENCES

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

EE7261	ELECTRICAL AND ELECTRONIC 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

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 – Volumetric 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.

UNIT V THIN CYLINDERS, SPHERES AND THICk CYLINDERS **9**

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

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.

CE7352 FLUID MECHANICS AND MACHINERY L T P C
3 0 0 3

OBJECTIVES:

- The applications of the conservation laws to flow through pipes and hydraulic machines are studied.
- 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.

TEXTBOOKS:

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

REFERENCE:

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

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

OBJECTIVES:

To the study of nature and the facts about environment.

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

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14

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

Field study of common plants, insects, birds

Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 8

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c)Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards– soil waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides.

Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.

Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental

organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act– Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

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

TOTAL: 45 PERIODS

OUTCOMES:

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

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

TEXTBOOKS:

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.

MA7357 PROBABILITY AND STATISTICS L T P C
4 0 0 4

OBJECTIVES:

- To make the students acquire a sound knowledge in statistical techniques that model engineering problems.
- The Students will have a fundamental knowledge of the concepts of probability.

UNIT I RANDOM VARIABLES 12

Discrete and Continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma, Weibull and Normal distributions Functions of a random variable.

UNIT II TWO-DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and Conditional distributions – Covariance – Correlation and Linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III TESTS OF SIGNIFICANCE 12

Sampling distributions - Tests for single mean, proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – χ^2-test for goodness of fit – Independence of attributes – Non-parametric tests: Test for Randomness and Rank-sum test (Wilcoxon test).

UNIT IV DESIGN OF EXPERIMENTS 12

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

UNIT V STATISTICAL QUALITY CONTROL 12

Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

TOTAL: 60 PERIODS

OUTCOMES:

- Students will be able characterize probability models using probability mass (density) functions & cumulative distribution functions.
- 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.

TEXTBOOKS:

1. Milton, J. S. and Arnold, J.C., "Introduction to Probability and Statistics", TataMcGraw Hill, New Delhi, 4th Edition, 3rd Reprint, 2008.
2. Johnson, R.A. and Gupta, C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2011.

REFERENCES:

1. Devore, J.L., "Probability and Statistics for Engineering and the Sciences", Thomson Brooks/Cole, International Student Edition, New Delhi, 7th Edition, 2008.
2. Walpole, R.E., Myers, R.H., Myers, S.L. and Ye, K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2007.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", Elsevier, New Delhi, 3rd Edition, 2004.
4. Spiegel, M.R., Schiller, J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill, New Delhi, 2004.

ME 7351 DESIGN CONCEPTS IN ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart the importance of design in todays context of global competition, environmental awareness and customer oriented market.
- To impart the basic concepts and various aspects of design using simple examples and case studies.

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

OUTCOMES:

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

- Understand the various design requirements and processes involved in product development.
- Be exposed to various creativity and problem solving techniques.

TEXTBOOK:

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.

MF7301 MACHINE TOOLS AND PROCESSES L T P C
3 0 0 3

OBJECTIVE:

- To identify the necessity of "manufacturing" Define with examples the concept of manufacturing, Machine tools and machining. State with examples the main requirements for "machining" List the main classifications of the manufacturing processes with examples.

UNIT I FUNDAMENTALS OF METAL CUTTING 9

Mechanics of orthogonal and oblique cutting - Mechanics of chip formation - Types of chips produced in cutting - Cutting forces and power-Numerical Problems-Temperature in cutting - Machinability-Tool life - Numerical problems - Wear and failure-surface finish and integrity-Cutting Tool Materials-cutting fluids.

UNIT II MACHINE TOOLS AND PROCESSES FOR PRODUCING ROUND SHAPES 9

Turning parameters - Lathes and Lathe operations - Cutting screw threads - Drilling and drills - Drilling machines - Boring and boring machines - reaming and reamers - tapping and taps - Design considerations for drilling, reaming and tapping.

UNIT III MACHINE TOOLS AND PROCESSES FOR PRODUCING VARIOUS SHAPES 9

Milling operations - Milling machines - Planner and shaper: Machines and Operations - Broaching and broaching machines - Sawing - filing and finishing - gear manufactured by machining.

UNIT IV ABRASIVE MACHINING AND FINISHING OPERATIONS 9

Abrasives - bonded abrasives - Grinding process- wheel, gear grinding operations and machines - grinding fluids - Design Consideration for Grinding - Finishing operations: Lapping, Honing, Burnishing- economics of grinding and finishing operation.

UNIT V MACHINE TOOL STRUCTURE AND AUTOMATION 9

Machine tools structures -erecting and testing of machine tools- Vibration and chatters in machining- Automation: Capstan and Turret lathe - single spindle and multi spindle automats - Swiss type and automatic screw machines-Feeding Mechanisms-Transfer mechanism-Tracer controller Mechanism.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course this domain knowledge will increase their employability skills

- Use this knowledge to develop innovative ideas in the areas of machine building, work holding and tool holding methods.
- Encourages to involve in research in the area of machining

TEXTBOOKS:

1. Sharma P.C., “A Text book of production Technology: manufacturing processes” S.Chand & Company Limited, 7th Edition (2007).
2. Kalpakjian S. and SCHMID S., “Manufacturing Engineering and Technology”, Prentice-Hall of India”, 50th Edition (2006) , ISBN : 0131489658.

REFERENCES:

1. Krar S.F., “Technology of machine tools” McGraw-Hill, New York. (2011), 7th Edition
2. Brown J.A. “Modern manufacturing processes”, Industrial Press Inc., ISBN 0831130342,9780831130343(1991).
3. Paul E.D., Black J.T. and Kosher R.A, “Materials and Processes in Manufacturing”, Wiley, 9thEdition (2003), ISBN 0471033065.
4. Lindberg R.A., “Process and Materials of Manufactures” Prentice-Hall of India, Fourth Edition, ISBN 8131701034(1994).

CE7261 STRENGTH OF MATERIALS LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To study the mechanical properties of materials subjected to different types of loading.

LIST OF EXPERIMENTS

1. Tension test on mild steel rod
2. Compression test on wood
3. Double shear test on metal
4. Torsion test on mild steel rod
5. Impact test on metal specimen (Izod and Charpy)
6. Hardness test on metals (Rockwell and Brinell Hardness Tests)

7. Deflection test on metal beam
8. Compression test on helical spring
9. Deflection test on carriage spring

TOTAL: 60 PERIODS

OUTCOMES:

- The students will have the knowledge in the area of testing of materials

REFERENCES:

1. Strength of Materials Laboratory Manual, Anna University, Chennai-600 025.
2. IS 432(Part I) -1992 – Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement

CE7361 FLUID MECHANICS AND MACHINERY LABORATORY L T P C
0 0 4 2

OBJECTIVE:

- Students should be able to verify the principles studied in theory by performing the experiments in lab.

LIST OF EXPERIMENTS

1. **Flow Measurement** **32**
   1. a. Calibration of Rotometer
      b. Flow through Venturimeter
   2. Flow through a circular Orifice
   3. Determination of mean velocity by Pitot tube
   4. Verification of Bernoulli's Theorem
   5. a. Flow through a Triangular Notch
      b. Flow through a Rectangular Notch
2. **Losses in Pipes** **8**
   6. Determination of friction coefficient in pipes
   7. Determination of losses due to bends, fittings and elbows
3. **Pumps** **16**
   8. Characteristics of Centrifugal pumps
   9. Characteristics of Submersible pump
   10. Characteristics of Reciprocating pump
4. **Determination of Metacentric height** **4**
   Demonstration Only

TOTAL: 60 PERIODS

OUTCOMES:

- The students will be able to measure flow in pipes and determine frictional losses.
- The students will be able to develop characteristics of pumps and turbines

REFERENCES:

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

ME7353 **MECHANICS OF MACHINES** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the principles in the formation of mechanisms and their kinematics.
- To understand the effect of friction in different machine elements.
- To analyze the forces and torque acting on simple mechanical systems
- To understand the importance of balancing and vibration.

UNIT I KINEMATICS OF MECHANISMS 9

Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain – kinematics analysis in simple mechanisms – velocity and acceleration polygons– Analytical methods – computer approach – cams – classifications – displacement diagrams - layout of plate cam profiles – derivatives of followers motion – circular arc and tangent cams.

UNIT II GEARS AND GEAR TRAINS 9

Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gear trains – Epicyclic gear trains – automotive transmission gear trains.

UNIT III 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.

UNIT IV FORCE ANALYSIS 9

Applied and Constrained Forces – Free body diagrams – Static Equilibrium conditions – Two, Three and four members – Static Force analysis in simple machine members – Dynamic Force Analysis – Inertia Forces and Inertia Torque – D'Alembert's principle – superposition principle – dynamic Force Analysis in simple machine members

UNIT V BALANCING AND VIBRATION 9

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

TOTAL: 45 PERIODS

OUTCOME:

- The course will enable the student to understand the forces and torque acting on simple mechanical systems and also the importance of balancing and vibration and the effect of friction in different machine parts of practical significance.

TEXT BOOK:

1. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms" , 3rd Edition, Oxford University Press, 2009.

REFERENCES:

1. Rattan, S.S, "Theory of Machines", 3rd Edition, Tata McGraw-Hill, 2009.
2. Thomas Bevan, 'Theory of Machines', 3rd Edition, CBS Publishers and Distributors,2005.
3. Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2005
4. Benson H. Tongue, "Principles of Vibrations", Oxford University Press, 2nd Edition,2007
5. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw-Hill, 2009.
6. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines', Affiliated East-West Pvt. Ltd., New Delhi, 1988.

7. Rao.J.S. and Dukkipati.R.V. 'Mechanisms and Machine Theory', Wiley-Eastern Ltd., New Delhi, 1992.
8. John Hannah and Stephens R.C., 'Mechanics of Machines', Viva Low-Prices Student Edition, 1999.
9. Grover. G.T., "Mechanical Vibrations", Nem Chand and Bros., 1996
10. William T. Thomson, Marie Dillon Dahleh, Chandramouli Padmanabhan, "Theory of Vibration with Application**",** 5th edition Pearson Education, 2011
11. V.Ramamurthi, Mechanics of Machines, Narosa Publishing House, 2002.
12. Allen S. Hall Jr., "Kinematics and Linkage Design", Prentice Hall, 1961

ME7451 MACHINE DESIGN L T P C
(Use of P S G Design Data Book is permitted in the University examination) 3 2 0 4

OBJECTIVE

- To familiarize the various steps involved in the Design Process
- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
- To learn to use standard practices and standard data
- To learn to use catalogues and standard machine components

UNIT I STEADY STRESSES IN MACHINE MEMBERS 12

Introduction to the design process - factor influencing machine design, selection of materials based on mechanical properties - Preferred numbers, fits and tolerances – Direct, Bending and torsional stress equations – Impact and shock loading – calculation of principle stresses for various load combinations, eccentric loading -Factor of safety – Curved beams - theories of failure – Design for finite and infinite life under variable loading.

UNIT II SHAFTS, COUPLINGS, JOINTS AND BEARINGS 12

Design of solid and hollow shafts based on strength, rigidity and critical speed –Keys, key ways and splines –Rigid and flexible couplings. Welded joints and riveted joints for structures, Sliding contact and rolling contact bearings (Simple problems).

UNIT III ENERGY STORING ELEMENTS AND ENGINE COMPONENTS 12

Types of springs, Design of helical springs - Flywheels considering stresses in rims and arms for engines and punching machines- Connecting Rods and crank shafts.

UNIT IV DESIGN FOR FLEXIBLE ELEMENTS 12

Design of Flat belts and pulleys - Selection of V belts and pulleys – Design of Transmission chains and Sprockets.

UNIT V SPUR GEARS, HELICAL GEARS AND GEAR BOXES 12

Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects - Fatigue strength - Factor of safety - Gear materials – Design of straight tooth spur & helical gears based on strength and wear considerations. Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box -Constant mesh gear box. – Design of multi speed gear box for machine tool applications – Variable speed gear box .

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

OUTCOME

- Upon completion of this course, the students can able to successfully design machine components

TEXTBOOKS

1. Bhandari V, “Design of Machine Elements”, 3rd Edition, Tata McGraw-Hill Book Co, 2010.

REFERENCES

1. .Sundararajamoorthy T. V, Shanmugam .N, “Machine Design”, Anuradha Publications, Chennai, 2003.
2. Joseph Shigley,Charles Mischke,Richard Budynas and Keith Nisbett “Mechanical Engineering Design”, 8th Edition, Tata McGraw-Hill , 2008.
3. Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine Design”,4th Edition, Wiley, 2005
4. Alfred Hall, Halowenko, A and Laughlin, H., “Machine Design”, Tata McGraw-Hill Book Co.(Schaum’s Outline), 2010
5. Bernard Hamrock, Steven Schmid, Bo Jacobson, “Fundamentals of Machine Elements”,2nd Edition, Tata McGraw-Hill Book Co., 2006
6. Orthwein W, “Machine Component Design”, Jaico Publishing Co, 2003.
7. Ansel Ugural, “Mechanical Design – An Integral Approach, 1st Edition, Tata McGraw- Hill Book Co, 2003
8. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, “Design of Machine Elements” 8th Edition, Printice Hall, 2003.

ME7452 THERMODYNAMICS L T P C
3 2 0 4

OBJECTIVES:

- To understand the basic laws of Thermodynamics and Heat transfer.
- To understand the principle of operation of thermal equipments like IC engine, boilers, turbine and refrigerator etc.

UNIT I BASIC CONCEPTS OF THERMODYNAMICS 12

Thermodynamics and Energy - Systems - Types and properties - State and Equilibrium - Processes and Cycles - Forms of Energy - Temperature and Zeroth law of Thermodynamics - Pure substances - Phase change processes of pure substances - Property diagrams - Internal energy - Enthalpy - Energy transfer by Heat, Work and Mass - Applications.

UNIT II FIRST AND SECOND LAW OF THERMODYNAMICS 12

First law of thermodynamics - Energy balance for closed systems and steady flow systems - Applications of First law of Thermodynamics - Energy balance for Unsteady flow processes - Second law of Thermodynamics - Carnot Cycle - Change in Entropy - Entropy and irreversibility - Applications.

UNIT III HEAT ENGINES 12

Internal Combustion Engines - C.I and S.I Engines - Four Stroke and Two Stroke Engines- Gas Turbines - Boilers - Fire Tube Boiler & Water Tube Boilers, Boiler Accessories and Components. Steam turbines - Impulse Turbine and Reaction Turbine, Turbine Components - Refrigeration Cycle - Vapour Compression & Vapour Absorption System, Gas Refrigeration System - Environmental friendly Refrigerants - Air Conditioning.

UNIT IV GASES AND VAPOUR MIXTURES 12

Ideal and Real gases - Vander waals equations - Reduced property - Compressibility chart - Properties of mixture of gases - Dalton’s law and Gibbs - Internal energy, Enthalpy and specific heats of gas mixtures.

UNIT V HEAT TRANSFER 12

Laws of Governing - Modes of Heat Transfer-Concept of Heat resistance-Conduction-Plane wall, Cylinder system, Composite walss & Cylinders - Critical thickness - Fins - Simple Problems - Convection - Free and Forced - over flat plates and tubes - Heat exchangers Radiation - Black, grey body radiation - radiation Shield.

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

OUTCOMES:

- Upon completion of this course, the students can able to understand different gas power cycles and use of them in IC and R&AC applications.

TEXTBOOKS:

1. Cenegal Y.A. and Boles M.A., "Thermodynamics an Engineering Approach", Tata McGraw hill, Fourth edition, 2004.
2. Natarajan,E."Engineering thermodynamics: Fundamenats and Applications", 2nd Edition, 2014,Anuragam Publications, Chennai.

REFERENCES:

1. Dhar P.L., "Engineering Thermodynamics – A Generalized Approach", Elsevier, 2008.
2. Rathakrishnan E., "Fundamentals of Engineering Thermodynamics", Prentice Hall of India, Second Edition
3. Nag P.K., "Engineering Thermodynamics" ,Tata McGraw hill, Third edition, 2005
4. Moran M.J. and Shapiro H.N., "Fundamentals of Engineering Thermodynamics" John wiley &Sons, Fourth Editon, 2000.

MF7401 CASTING AND WELDING TECHNOLOGY L T P C
3 0 0 3

OBJECTIVE:

- To study various casting and welding methods including advanced techniques, with emphasis on basic principles, limitations and application areas.

UNIT I INTRODUCTION OF CASTING 9

Patterns : Making - materials, types, allowances pattern making - Moulding: materials, equipment, sand preparation, testing and control - Cores and core making - Design considerations in casting, gating system - Melting furnaces - directional solidification in castings, Metallurgical aspects of Casting- Steps involved in casting.

UNIT II CASTING PROCESSES 9

Casting processes: Steps, Advantages, limitations and applications of Sand castings, permanent mould casting - pressure die casting, centrifugal casting - precision casting: investment casting, shell Moulding - CO_2 Moulding, continuous casting, squeeze casting, Fettling and finishing, casting defects and Inspection.

UNIT III INTRODUCTION TO WELDING 9

Types of welding - Positions of welding-types of weld joints - Arc welding: power sources-Electrodes - flux - Gas welding - equipment - Welding symbols - Metallurgical aspects of welding - weld thermal cycles - Heat affected zone and its characteristics - pre and post weld heat treatments. Welding defects : causes and remedies - Welding inspection.

UNIT IV WELDING PROCESSES 9

Welding processes: Arc welding: SMAW, GTAW, GMAW, SAW, ESW - Resistance welding: spot, seam, projection, percussion, flash types - atomic hydrogen arc welding - thermit welding -

oxy acetylene gas welding- Flame cutting: Oxyacetylene, arc cutting- Soldering, brazing and braze welding - Electron beam welding, laser beam welding, plasma arc welding and ultrasonic welding - explosive welding - Friction stir welding - Under water welding.

UNIT V AUTOMATION OF WELDING AND CASTING 9

Layout of mechanized foundry - sand reclamation - Material handling in foundry - pollution control in Foundry - Recent trends in casting - Computer Aided design of Castings - Process. Automation in welding - Welding robots - Seam tracking vision and arc sensing - Overview of automation in various industries.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course the students are expected

- To produce useful research output in welding and casting.
- Use this knowledge in advancing the welding and casting process.
- Application of design knowledge to understand and to overcome defects in welding and casting.

TEXTBOOKS:

1. Gowri S., Hariharan P. and Suresh Babu A., "Manufacturing Technology-I", Pearson Education, 2008.
2. Little R.L., "Welding and Welding Technology", Tata McGraw Hill, 2008.
3. Heine R., Loper C. and Rosenthal P., "Principles of Metal Casting", Tata Mc Graw Hill Publishing Co. Ltd., New Delhi, 33rd Reprint, 2008.
4. Parmer R.S., "Welding Processes & Technology", Khanna Publishers, 2013.

REFERENCES:

1. Campbell J., "Casting Practice", Elsevier Science Publishing Co., 2004.
2. Campbell J., "Castings", Butterworth Heinemann, 2003.
3. Jeffus L., "Welding: Principles and Applications",Delmar, Cengage Learning, Delmar Publishers, 2012.
4. Cary H.B., "Modern Welding Technology", 6th Edition, Prentice Hall, 2004.
5. Weman K., "Welding Processes Handbook", CRC Press, 2003.
6. Jeffus L., "Welding for Collision Repair", Cengage Learning ,Delmar Publishers, 1999.
7. ASM Hand Book Vol:15, "Casting", ASM International, 2008.

MF7402 METAL FORMING AND POWDER METALLURGY L T P C
3 0 0 3

OBJECTIVE:

- At the end of this course the student should be able to understand the principles, equipments to be used, applications, advantages, limitations and economics of various metal forming processes such as bulk forming, sheet metal, special forming and powder metallurgy forming.

UNIT I INTRODUCTION TO METAL FORMING 9

Mechanical behavior of materials - Elastic and plastic deformation - Classification of Forming Processes - Temperature in metal working: hot and cold working - Introduction to the theory of plastic deformation.

UNIT II THEORY AND PRACTICE OF BULK FORMING PROCESSES 9

Analysis of plastic deformation in forging, rolling, extrusion, rod/wire and tube drawing processes - Effect of friction, calculation of forces, work done, process parameters, equipments, defects and applications - Recent advances in forging, rolling, extrusion and drawing processes - Experimental techniques of evaluation of friction in metal forming - Economics of bulk forming processes.

UNIT III SHEET METAL FORMING PROCESSES 9

Conventional sheet metal forming processes like shearing, bending and miscellaneous forming processes - High energy rate forming processes - Super plastic forming processes - Deep drawing process; Principles, process parameters, advantages, limitations and applications - Formability of sheet metals - Design considerations.

UNIT IV SPECIAL FORMING PROCESSES 9

Orbital forging - Isothermal forging - Hot and cold Isostatic pressing - High speed extrusion - High speed forming machines - Rubber pad forming - Water hammer forming - Fine blanking.

UNIT V POWDER METALLURGY 9

Overview of powder metallurgy techniques, advantages and their applications - Powder forging, rolling, extrusion and drawing - Secondary and finishing operations - Design considerations for powder metallurgy - Economics of powder metallurgy processes.

TOTAL: 45 PERIODS

OUTCOME:

- At the end of the course the student will be able to apply and compare different metal forming concepts in bulk forming and sheet metal forming process.

TEXTBOOKS:

1. Kalpakjian S. and Schmid S.R., “Manufacturing Processes for Engineering Materials”, Pearson, Chennai, 2009.
2. Mikell P. Groover, “Principles of Modern Manufacturing”, Wiley India Private Limited, 2014.

REFERENCES:

1. Schuler, “Metal Forming Hand Book”, Springer Verlag, Berlin, 1998.
2. Hosford W.F. and Caddell R.M. “Metal Forming: Mechanics and Metallurgy”, Cambridge University press, Cambridge, 2011.
3. Narayanasamy R., “Theory of Metal Forming Plasticity”, Narosa Publishers, New Delhi, 1999.
4. Nagpal G.R.,“Metal Forming Processes”, Khanna Publishers, Delhi, 2000.
5. Altan T.S. and Gagel H.L. “Metal Forming: Fundamentals and Applications”, American Society of Metals, Metals Park, Ohio, 1983.
6. Juneja B.L., “Fundamentals of Metal forming Processes”, New Age International (P) Ltd., Chennai, 2007.
7. ASM Handbook Committee, ASM Metals Hand book: Forming and Forging (Volume - 14), ASM International, Metals’ Park, Ohio, 1996.
8. Dieter G.E. “Mechanical Metallurgy”, McGraw Hill, New Delhi, 1988.

ML7451 ENGINEERING MATERIALS AND METALLURGY L T P C

3 0 0 3

OBJECTIVES:

- To impart knowledge on construction of phase diagrams and also the importance of iron-iron carbide phase diagram.
- To impart knowledge on different heat treatment processes used in industries and the basics behind the microstructure formation.
- To impart knowledge on the properties and applications of various engineering materials.
- To expose testing methods and procedures to find the mechanical properties of engineering materials.

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 - lzod and Charpy, Fatigue and Creep failure mechanisms.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to understand the phase diagrams and relate to the heat treatment processes.
- Ability to tailor structure-property correlations to engineering materials.
- Ability to select proper engineering materials for various engineering applications.
- Ability to perform various testing's to find the properties of engineering materials.

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.

ME7412 DYNAMICS LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- To give an understanding of some of the basic measurements carried out in manufacturing industries and the importance of calibrating measuring instruments.
- To understand the principles of kinematics and Dynamics involved in various mechanisms

DYNAMICS MEASUREMENTS

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

OUTCOME:

- Students will be able to use and calibrate various measuring instruments.
- Students will be able to understand the measurement of various kinematic and vibration parameters.

ME7413	MANUFACTURING TECHNOLOGY LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVE:

- To study and acquire knowledge on various basic machining operations and special purpose machines and their applications.

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. Preparation of Green sand moulds
15. Manufacturing of simple sheet metal components using shearing and bending operations
16. Friction Stir Welding of Aluminium plates

TOTAL: 60 PERIODS

OUTCOME:

- Upon completion of this course the students will be conversant with various machine tools and development of CNC part programs.

ME 7551 COMPUTER AIDED DESIGN

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand fundamental concepts of computer graphics and its tools in a generic framework.
- To provide clear understanding of CAD systems for 3D modeling and viewing.

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

OUTCOME:

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

- Understand the various stages in the design process and the role of computer graphic communication process.
- Understand the mathematics behind the use of computer for modeling of mechanical components

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.

ME 7553 HYDRAULICS AND PNEUMATICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide student with knowledge on the application of fluid power in process, construction and manufacturing Industries.
- To provide students with an understanding of the fluids and components utilized in modern industrial fluid power system.
- To develop a measurable degree of competence in the design, construction and operation of fluid power circuits.

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

OUTCOMES:

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

- Identify hydraulic and pneumatic components and its symbol and usage.
- Ability to design hydraulic and pneumatic circuits.

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.

ME7554 INDUSTRIAL MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVE

- To develop modern concepts of Industrial Management

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 inventory management systems-Tools of Techniques– Prevention control, industrial safety

UNIT III ORGANIZATIONAL BEHAVIOUR 9

Definition – Organization – Managerial Role and functions – organizational approaches, individual behavior – causes – Environmental Effect – Behavior and performance, perception – organizational Implications. Personality – Contributing factors – Dimension – Need Theories – process Theories – Job satisfaction, Learning and Behavior- Learning Curves, work design and approaches

UNIT IV GROUP DYNAMICS 9

Group Behavior – Groups – Contributing factors – Group Norms, Communication – Process – Barriers to communication – Effective Communication, leadership- Formal and informal characteristics- Managerial Grid – Leadership Styles – Group Decision making – Leadership Role in Group Decision, Group Conflicts – Types – Causes – Conflict Resolution – Inter group relations and conflict, Organizational 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) – Strategic Management – SWOT analysis –Evolving development strategies, information technology in management – Decision support system – Management Games – Business Process Re-engineering (BPR) – supply chain management (SCM) –Global Perspective – Principles and Steps – Advantages and Disadvantages

TOTAL: 45 PERIODS

OUTCOME

- The course will enable student preparedness to technology management and the forms of organisation in an industry. This course also enables the student to understand the functions of Management and also the organisational behaviour. It also gives some knowledge on the modern concepts such as Strategic management, SWOT analysis, Business Process Re-engineering (BPR) and supply chain management (SCM).

TEXTBOOKS

1. Herald Koontz and Heinz Weihrich, ‘Essentials of Management’, McGraw Hill Publishing Company, Singapore International Edition, 1980.
2. M.Govindarajan and S.Natarajan, Principles of Management, Prentice Hall of India Pvt.Ltd. New Delhi 2007

REFERENCES

1. S.Chandran, Organizational Behaviors, 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. Ltd. 1985

MF7501 METROLOGY AND COMPUTER AIDED INSPECTION L T P C
3 0 0 3

OBJECTIVE:

- To teach the students basic concepts in various methods of engineering measurement techniques and applications, understand the importance of measurement and inspection in manufacturing industries. Expose the students to various modern metrological instruments, the procedure used to operate these instruments and applications of computers in metrology.

UNIT I BASIC CONCEPTS OF MEASUREMENTS 9

Important terminologies - Elements of Measurement, Need for measurement - Factors influencing measurement - Precision and Accuracy - Methods of measurement - Errors in Measurements - Causes - Types-Handling of measuring instruments - Dos and Don'ts - Maintenance of Instruments - Clean room - Clean room procedures.

UNIT II LINEAR AND ANGULAR MEASUREMENTS 9

Measurement of Engineering Components - Comparators, Slip gauges, Rollers, Limit gauges - Design - Types - Principle, Applications : Auto collimator - Angle dekkor - Alignment telescope - Sine bar - Bevel protractors.

UNIT III FORM MEASUREMENTS 9

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

UNIT IV LASER METROLOGY 9

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

UNIT V COMPUTER AIDED INSPECTION AND ADVANCES IN METROLOGY 9

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

TOTAL: 45 PERIODS

OUTCOME:

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

- Understand various technical terms and perform measurement tasks accurately.
- Choose the right instrument and method of measurement for a particular application.
- Follow the right procedure for measurement of various components depending upon the applications.

TEXT BOOK:

1. Jain R.K., "Engineering Metrology", Khanna Publishers, 19th Edition, 2005.

REFERENCES:

1. Galyer J.F.W. and Shotbolt C.R., "Metrology for Engineers", O.R.Cassel, London,1993.
2. Thomas, "Engineering Metrology", Butthinson & Co., 1984.
3. Bewoor A.K. and Kulkarni V.A., "Metrology and Measurements", Tata McGraw-Hill, 2009.
4. Whitehouse D.J., The Handbook of Surface and Nanometrology, CRC Press, 2011.

ME 7561 COMPUTER AIDED MACHINE DRAWING

L	T	P	C
0	0	4	2

OBJECTIVES:

- To make the students understand and interpret drawings of machine components
- To prepare assembly drawings both manually and using standard CAD packages
- To familiarize the students with Indian Standards on drawing practices and standard components
- To gain 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:

- Appreciate the functions of various machine assemblies,
- Draw part drawings, sectional views and assembly drawings as per standards

TEXT BOOK:

1. Gopalakrishna K.R., "Machine Drawing", 22 nd 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

MF7511 METROLOGY AND METALLURGY LABORATORY L T P C
0 0 4 2

OBJECTIVES :

- To make the students understand the fundamental principles of measuring techniques by practicing exercises on various measuring instruments.
- Students should be able to perform metallographic study of the given samples and heat treatment study of steel.

LIST OF EXPERIMENTS - METROLOGY LAB :

1. Linear and Angular measurements using Autocollimator.
2. Measurement of tooth thickness using gear tooth Vernier caliper.
3. Calibration of optical comparator and measurement of dimensions.
4. Calibration of electrical comparator and checking of dimensions.
5. Exercises in Microhite.
6. Measurement of Taper Angle using sine bar.
7. Measurement of components using profile projectors.
8. Study Exercises in Video measuring system, Rolling gear tester, Surface Roughness Tester and CMMs.

LIST OF EXPERIMENTS - METALLURGY LAB :

1. Micro structural examination of steel.
2. Micro structural examination of grey cast iron.
3. Micro structural examination of nodular cast iron.
4. Micro structural examination of non ferrous material (Aluminum, Copper).
5. Heat treatment of steel (hardening, tempering, normalizing).

TOTAL : 60 PERIODS

OUTCOMES:

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

- Understand various technical terms and perform measurement tasks accurately.
- Choose the right instrument and method of measurement for a particular application.
- Follow the right procedure for measurement of various components depending upon the applications.
- Understand the microstructure features of specimens and correlate with their macroscopic behavior.

ME 7603	DESIGN OF JIGS, FIXTURES AND PRESS TOOLS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the importance, functions and design principles of Jigs, fixtures and press tools
- To gain proficiency in the development of standard views of the final design.

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)

OUTCOMES:

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

- Design jigs, fixtures and press tools and give the assembly drawing with dimensions and Parts list.
- Use the above knowledge to design various types of dies and give 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.

MF7601 CNC TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To understand the evolution and principle of CNC machine tools
- To describe constructional features of CNC machine tools, drives and positional transducers used in CNC machine tools
- To generate CNC programs for popular CNC controllers
- To describe tooling and work holding devices for CNC machine tools

UNIT I INTRODUCTION TO CNC MACHINE TOOLS 9

Evolution of CNC Technology - principles - features - advantages - applications - CNC and DNC concept - CNC controllers - characteristics - interpolators - types of CNC Machines - turning centre - machining centre - grinding machine - vertical turret lathe - turn-mill centre - EDM

UNIT II STRUCTURE OF CNC MACHINE TOOL 9

CNC Machine building - structural details - configuration and design - guide ways - Friction - Anti friction and other types of guide ways - elements used to convert the rotary motion to a linear

motion - Screw and nut - recirculating ball screw - spindle assembly - torque transmission elements - gears - timing belts - flexible couplings - Bearings.

UNIT III DRIVES AND CONTROLS 9

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

UNIT IV CNC PROGRAMMING 9

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

UNIT V TOOLING AND WORK HOLDING DEVICES 9

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

TOTAL: 45 PERIODS

OUTCOME:

At the end of this course

- This domain knowledge will increase their employability skills.
- Use this knowledge to program CNC machines.
- Use this knowledge to organize production using CNC machines.

TEXT BOOKS:

1. "Mechatronics" HMT, Tata McGraw,Hill Publishing Company Limited, New Delhi, 2005.
2. Mike Mattson., "CNC Programming Principles and Applications", Delmar Cengage learning, 2010.

REFERENCES:

1. Evans K., Polywka J. and Stanley Gabrel., "Programming of CNC Machines", Third Edition, Industrial Press Inc, New York, 2007.
2. Madison J., "CNC Machining Hand Book", Industrial Press Inc., 1996.
3. Smid P., "CNC Programming Hand book", Industrial Press Inc., 2007 Third Edition.
4. Jones B.L., "Introduction to Computer Numerical Control", Pitman, London, 1987.
5. Radhakrishnan P., "Computer Numerical Control Machines and Computer Aided Manufacturing", New Central Book Agency, 2014.
6. Rao P.N., "CAD/CAM Principles and Applications", Tata McGraw, Hill Publishing Company Limited, New Delhi, 2010.

MF7602 OPERATIONS RESEARCH L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I LINEAR MODELS **9**

The phase of an operation research study - Linear programming - Graphical method - Simplex algorithm - Duality formulation - Sensitivity analysis: - changes in - Objective function, RHS of Constraints and variables.

UNIT II TRANSPORTATION MODELS AND NETWORK MODELS **9**

Transportation Assignment Models - Traveling Salesman problem - Networks models - Shortest route - Minimal spanning tree - Maximum flow models - Project network - CPM and PERT networks - Critical path scheduling.

UNIT III INVENTORY AND REPLACEMENT MODELS **9**

Inventory models - Economic order quantity models - Quantity discount models - Stochastic inventory models - Multi product models - Inventory control models - replacement models - service life - Economics.

UNIT IV QUEUEING MODELS **9**

Queueing models - Queueing systems and structures - Notation parameter - Single server and multi server models - Poisson input - Exponential service - Constant rate service - Infinite population - Simulation - Monte Carlo Technique.

UNIT V DECISION MODELS **9**

Decision models - Game theory - Two person zero sum games - Graphical solution - Algebraic solution - Linear Programming solution - Single / Multi variable search technique - Dynamic Programming - Simple Problems.

TOTAL:45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to use the optimization techniques for use engineering and Business problems.

TEXT BOOK:

1. Taha H.A., “Operations Research”, Prentice Hall of India, 2003, Sixth Edition.

REFERENCES:

1. Shennoy G.V. and Srivastava U.K., “Operation Research for Management”, Wiley Eastern, 1994.
2. Bazara M.J., Jarvis and Sherali H., “Linear Programming and Network Flows”, John Wiley, 1990.
3. Philip D.T. and Ravindran A., “Operations Research”, John Wiley, 1992.
4. Hillier and Libeberman, “Operations Research”, Holden Day, 1986.
5. Budnick F.S., “Principles of Operations Research for Management”, Richard D Irwin, 1990.
6. Tulsian and Pasdey V., “Quantitative Techniques”, Pearson – Asia 2002.

MF7651 NON-TRADITIONAL MACHINING PROCESSES **L T P C**
3 0 0 3

OBJECTIVE:

At the end of this course the students are expected to

- Understand the working principles of various non-traditional machining processes, their applications, advantages and limitations.
- The students can also able to learn advanced nano finishing processes, recent developments in the non-traditional machining processes and to compare them.

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

OUTCOMES:

At the end of this course the students are expected to understand

- The working principles of various non-traditional machining processes, their applications, advantages and limitations.
- Advanced nano finishing processes.
- Recent developments in the non-traditional machining processes.
- Comparison of 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.

MF7611 **CAM LABORATORY** **L T P C**
0 0 4 2

OBJECTIVES:

- To understand the concepts of CNC machine tools types,cutting tools and metal cutting process.
- Generate part programs using CNC programming and simulation s/w for CNC Lathe, CNC Milling Machine and CNC Wire EDM.
- To get hands on experience by machining the parts on actual machines.
- To understand the configuration of 4 & 5 axis Robot, comprehend Robot programming methods using robot language.
- Create work cell configuration and verify by simulation.

LIST OF EXPERIMENTS

1. Study of different CNC control systems and CNC codes.
2. Programming and simulation for turning, taper turning, circular interpolation, thread cutting, facing and parting operations.
3. Programming and simulation using Canned cycles for CNC Lathe.
4. Programming and simulation for machining of internal surfaces in CNC Lathe.
5. Programming and simulation for 3D profile milling, drilling, rigid tapping, boring operation.
6. Programming and simulation for circular and rectangular pocket milling.
7. Programming using canned cycles for CNC Milling machine.
8. CNC code generation using machine simulation / CAM software packages - CNC Lathe.
9. CNC code generation using simulation / CAM software packages - CNC Milling machine / Machining centre.
10. Programming for CNC Wire cut EDM.
11. Dimensional and geometric measurement of machined features using VMS, Surface Roughness and CMM.
12. Robot programming for Material handling applications.
13. Understanding assembly, polishing, palletizing for different types of robots using software.
14. Design workcell for machine tending, welding, inspection using single & multiple robots using software.

TOTAL: 60 PERIODS

OUTCOMES:

At the end of this course

- Students will be able to use CNC machines for production.
- Use this knowledge to program CNC machines and Robots.
- Knowledge and skill development of the students in the area of advance manufacturing Technology-different metal machining process of complicated parts used in general engg.
- Robot workcell creation and handling.

LIST OF EQUIPMENTS REQUIRED:

1. Computers - 30.
2. CNC programming and machine simulation software for turning and milling.
3. CAM software for turning and for milling - for automatic code generation of Lathe, Mill and Wire cut EDM.
4. CNC Production type turning centre.
5. CNC Machining centre-3 axes.
6. CNC Wire Cut EDM.
7. Non contact type 2 axes Measuring System.
8. 3 D Coordinate Measuring Machine.
9. 3 D scanner with s/w.
10. Surface Roughness tester.
11. Ariticulate Robot.

12. Robot workcell design, programming and simulation software for different manufacturers of robots.

MF7612 CREATIVE AND INNOVATIVE PROJECT

L	T	P	C
0	0	4	2

The goal of this course is to help students to identify innovative projects that promotes and inhibit creativity to explore the variables that affect creativity and innovation. By the end of the period, students should be familiar with current thinking in their field, and able to apply the concepts to relevant research problems or practical applications.

The goal of this course is to drive them to learn concepts, models, frameworks, and tools that engineering graduates need in a world where creativity and innovation is fast becoming a pre-condition for competitive advantage. Each student will choose a nagging workplace problem or socially relevant problems that have been difficult for them to solve. At the end of the semester, each or group of students have to submit a report for evaluation.

TOTAL: 60 PERIODS

ME7354 MECHATRONICS

L	T	P	C
3	0	0	3

OBJECTIVE:

- To impart knowledge about the elements and techniques involved in Mechatronics systems in understanding the concept of automation.

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

OUTCOME:

- Upon completion of this course, the students will be able to design Mechatronics systems with the help of Microprocessor, PLC and other Electrical and Electronics Circuits.

Attested

DIRECTOR
Centre For Academic Courses
Anna University, Chennai-600 025.

TEXT BOOKS:

1. Bolton W., “Mechatronics”, Pearson Education, 2011.
2. Ramesh S Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085”, Prentice Hall, 2008.

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.

ME 7751 FINITE ELEMENT ANALYSIS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the concepts of Mathematical Modeling and numerical solution of engineering problems.
- To appreciate the use of Finite Element Method to a range of engineering problems.

UNIT I INTRODUCTION 9

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

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

OUTCOMES:

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

- Understand the use of the FEM to solve problems in Mechanical Engineering.
- Use the Finite Element Method to solve Structural, thermal and Eigen value 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.

MF7701 COMPUTER INTEGRATED PRODUCTION MANAGEMENT SYSTEM **L T P C 3 0 0 3**

OBJECTIVE:

- The course provides basic concepts of production planning and control, its bottlenecks, material requirement planning, shop floor control and different approaches to computer aided process planning in manufacturing sector.

UNIT I MANUFACTURING PLANNING AND CONTROL **9**

Basic concepts - Types of production System - Functions of production planning and control – problems with Production Planning and Control – Computer Integrated Production Management System - Evolution of the MPC system-Demand management in MPC system and the MPC Environment: Make-to-stock, Assembly - to - order, Make - to –order, Engineer- to-order.

UNIT II FORECASTING **9**

Forecasting system-Forecasting methods – Single and Double moving average methods – Single and Double exponential smoothing methods – Simple regression method of forecasting - Forecasting Errors.

UNIT III MATERIAL REQUIREMENT PLANNING **9**

Basic MRP Concepts – Inputs to the MRP System – Master production Schedule – Bill of Materials, Inventory Record File – MRP Logic – Gross requirements, net requirements, lot sizing – Capacity Requirement Planning (CRP)-Distribution Resource Planning (DRP) -Manufacturing Resource Planning (MRP II).

UNIT IV COMPUTER AIDED PROCESS PLANNING 9

Need for process planning – Functions of process planning – Approaches to CAPP-Variant process planning – part family search – Generative method of CAPP – Forward and Backward planning – input format – part description methods – CAD Models – Decision Logic – Artificial Intelligence – Knowledge Representation – Databases and Algorithms – Expert Process Planning - Automatic Process Planning-Future trends-Case Studies.

UNIT V SHOP FLOOR CONTROL 9

Functions of shop floor control – Order Release - Operations scheduling – Job sequencing and Priority rules - order progress – Automatic Identification System - Factory Data Collection system.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course the students are expected

- To familiarize the students with computer application in various activities of manufacturing, production and control system.
- To apply appropriate principles and strategies of planning and control, forecasting, material requirement planning, process planning concepts and shop floor control into computer integrated manufacturing system.

TEXT BOOKS:

1. Groover M.P., “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall of India, 2008.
2. Kant Vajpayee S., “Principles of Computer Integrated Manufacturing”, Prentice Hall of India, 2006.
3. Radhakrishnan P, Subramaniyan S, Raju V,"CAD/CAM/CIM",New Age INternational Publishers, Reprint 2013.

REFERENCES:

1. Groover M.P. and Zimmers E.W., “CAD/CAM, Computer Aided Design and Manufacturing”, Prentice Hall of India, 2006.
2. G. Halevi,R. Weill, "A Logical Approach to process planning”, First Edition, Chapman and Hall, 1995.
3. Chand T.C., “Expert process planning for manufacturing”, Addison Wesley publishing company, 1990.
4. Nanua Singh, "System Approach to Computer Integrated Design and Manufacturing", Wiley India Edition,reprint:2011.
5. Architecture Technology Corp., "Computer Aided Process Planning (CAPP)"Second Edition,Elsevier, 1991.

ONLINE COURSE MATERIALS:

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

ME 7761 **MECHATRONICS LABORATORY** **L T P C**
0 0 4 2

OBJECTIVES:

- To develop codes for the microprocessor, microcontroller and PLC.
- To gain knowledge about the various types of sensors and signal conditioning units.
- To interface the I/O devices with microprocessor, microcontroller and PLC.
- To understand the method of actuating and controlling the speed of electrical and mechanical drives.
- To understand image processing techniques and DAQ system.

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

OUTCOME:

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

- Have hands-on experience with sensors, actuators and controllers which are commonly used in Mechatronics systems.

MF7711 **INDUSTRIAL TRAINING/INTERNSHIP** **L T P C**
0 0 0 2

OBJECTIVE:

- The main objective of the Industrial Training is to experience and understand real life situations in industrial organizations and their related environments and accelerating the learning process of how student's knowledge could be used in a realistic way.

DURATION:

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

I. At the end of the training they have to submit a report with following information:
   1. Profile of the Industry,
   2. Product range,
   3. Organization structure,
   4. Plant layout,

5. Processes/Machines/Equipment/devices,
6. Personnel welfare schemes,
7. Details of the training undergone,
8. Projects undertaken during the training, if any
9. Learning points.

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

OUTCOME:
At the end of the course the student will be able to understand the different forms of organization, functions of management, organizational behavior, group dynamics and modern concepts in industrial management.

MF7811	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

OUTCOME:
On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

GE7071	DISASTER MANAGEMENT	L	T	P	C
		3	0	0	3

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

UNIT I INTRODUCTION TO DISASTERS 9

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

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

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

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

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

UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9

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

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

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

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

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

TEXTBOOK:

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

OBJECTIVES :

- 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.

GE7652 **TOTAL QUALITY MANAGEMENT** **L T P C**
3 0 0 3

AIM

- To provide comprehensive knowledge about the principles, practices, tools and techniques of Total quality management.

OBJECTIVES

- To understand the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
- To understand the TQM Principles.
- To learn and apply the various tools and techniques of TQM.
- To understand and apply QMS and EMS in any organization.

UNIT I INTRODUCTION **9**

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

UNIT II TQM PRINCIPLES 9

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

UNIT III TQM TOOLS & TECHNIQUES I 9

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

UNIT IV TQM TOOLS & TECHNIQUES II 9

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

UNIT V QUALITY MANAGEMENT SYSTEM 9

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

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to apply TQM concepts in a selected enterprise.
- Ability to apply TQM principles in a selected enterprise.
- Ability to apply the various tools and techniques of TQM.
- Ability to apply QMS and EMS in any organization.

TEXT BOOK:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.

REFERENCE:

1. James R. Evans and William M. Lindsay, “The Management and Control of Quality”, (6th Edition), South-Western (Thomson Learning), 2005.
2. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, Third Edition, 2003.
3. Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd., 2006 .
4. Janakiraman,B and Gopal, R.K, “Total Quality Management – Text and Cases”,Prentice Hall (India) Pvt. Ltd., 2006.

ME7072 COMPUTATIONAL TECHNIQUES FOR FLUID DYNAMICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To enable the students to understand the various discretization methods, solution procedures and turbulence modeling.
- To create confidence in solving complex problems in the field of fluid flow and heat transfer by using high speed computers.

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

OUTCOMES:

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

- Create numerical models and their role in the field of fluid flow and heat transfer
- Use the various discretization methods, solution procedures and turbulence models to solve flow and heat transfer problems.

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.

Attested

DIRECTOR
Centre For Academic Courses
Anna University, Chennai-600 025.

ME 7073 DESIGN FOR MANUFACTURING

L	T	P	C
3	0	0	3

OBJECTIVE:

- To understand the design constraints in manufacturing and assembly operations.

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

OUTCOME:

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

- Gain technical competency in design modification of components / products with respect to manufacturability.

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.

ME7077 ENTREPRENEURSHIP DEVELOPMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- The students will be provided with an understanding of the scope of an entrepreneur, key areas of development, financial assistance by the institutions, methods of taxation and tax benefits, etc.

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 – Financial Institutions – 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

OUTCOME:

- Upon completion of the course, the students will be able to gain knowledge and skills needed to run a business successfully.

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.

ME 7081	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To give an understanding of the fundamentals of Process Planning and estimation of appropriate costs of processes and products and applying these to manage competitive manufacturing systems and organisations.

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

OUTCOME:

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

- Make logical, rational and economical process plans and realistic cost estimates of Components and Products.

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.

ME 7082 PRODUCT DESIGN AND DEVELOPMENT L T P C
3 0 0 3

OBJECTIVES:

- To understand the basic concepts of Product Design and Process Development.
- To appreciate the importance, various stages, concepts, management and prototyping of products.

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

OUTCOME:

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

- Launch own ideas and the ideas of others, which would enable them to manage to work with innovation and development in large companies
- Apply new theories on innovation and change, including emerging paradigms such as user-driven innovation, open innovation and market forecasting in practice.

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.

MF7001 MEMS AND MICRO SYSTEM FABRICATION L T P C
3 0 0 3

OBJECTIVES:

- To understand the mechanics, scaling and design of micro system.
- To learn various micro fabrication processes.
- To impart knowledge on microsystems packaging and metrology of micro machined components.

UNIT I INTRODUCTION 9

Overview of MEMS and Microsystems: MEMS and Microsystems, Evolution of Micro fabrication, Microsystems and Microelectronics, Microsystems and miniaturization-Materials for MEMS and Microsystems:substrates and wafers, active substrate materials,Silicon,Galium Arsenide, Piezoelectric Crystals, Polymers, Packaging materials-Working principles of Microsystems: micro sensors, micro actuation, MEMS with micro actuators, Micro accelerometers, micro fluidics-Applications of Microsystems in various industries.

UNIT II MECHANICS, SCALING AND DESIGN 9

Engineering Mechanics for Microsystems design: Introduction, Static bending of Thin Plates, Mechanical Vibration, Thermomechanics, Thermofluid Engineering and micro system design, Laminar fluid flow, Incompressible fluid Flow, Heat conduction in solids-Scaling Laws in Miniaturization, Introduction to scaling, Scaling in (Electrostatic forces electromagnetic forces, Electricity, fluid mechanics, heat transfer)-Microsystems Design: Design Consideration, Process design, Mechanical Design, Design of Micro fluidic Network systems.

UNIT III MICRO SYSTEM FABRICATION PROCESSES 9

Introduction- Photolithography- Ion implantation- Chemical Vapor deposition-Physical Vapor deposition - clean room- Bulk micromachining :etching, isotropic and anisotropic etching, wet and dry etching- Surface micro machining :process, mechanical problems associated with surface micro machining- LIGA process :general description, materials for substrates and photo resists-SLIGA process-Abrasive jet micro machining-Laser beam micro machining-Micro Electrical Discharge Micro Machining –Ultrasonic Micro Machining- Electro chemical spark micro machining-Electron beam micro machining-Focused Ion Beam machining.

UNIT IV TOOL BASED MICROMACHINING 9

Theory of tool based micromachining-Chip formation-size effect in micromachining-micro turning, micro milling, and micro drilling- Micromachining tool design-Precision Grinding-Partial ductile mode grinding-Ultra precision grinding- Binderless wheel Free form optics.

UNIT V MICROSYSTEMS PACKAGING AND METROLOGY OF MICRO MACHINED COMPONENTS 9

Introduction - Microsystems Packaging-Interfaces in Microsystems Packaging-Essential Packaging Technologies-Three dimensional Packaging- Assembly of Microsystems-Signal Mapping and Transduction-Metrology of Micromachined components: SEM, optical microscopy, Scanning white light interferometry, Confocal Laser scanning microscopy, SPM, Molecular measuring machine, Micro coordinate measuring machine.

TOTAL : 45 PERIODS

OUTCOMES:

At the end of this course

- The student will be able to understand various MEMS techniques.
- Use this knowledge to design MEMS.
- Use this knowledge to measure MEMS components.

TEXT BOOKS:

1. Hsu T.R., “MEMS & Microsystems Design and Manufacture”, Tata McGraw Hill, 2002, ISBN: 9780070487093.
2. Jain V.K., “Introduction to Micromachining” Narosa Publishing House, 2010.

REFERENCES:

1. Jackson M.J., “Microfabrication and Nanomanufacturing” Taylor and Francis 2006.
2. McGeough J.A., “Micromachining of Engineering Materials”, CRC Press, 2001, ISBN: 0824706447.
3. Hak M.G., “MEMS Handbook”, CRC Press, 2006.
4. Madou M.F. “Fundamentals of Micro fabrication”, CRC Press, 2002, 2nd Edition.

MF7002 **NANO COATING** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the basics of Nanostructured coatings.
- To understand about different coating methods and characterization of nanocoatings.
- To understand the properties change due to coatings and also the applications.

UNIT I INTRODUCTION TO NANOSTRUCTURED COATING 9

Introduction of Nanotechnology - Production of Nanoparticles - Applications of Nanoparticles - Thin Films - Significance of Thin Films - Production of Thin Films - Applications of Thin films - Coating and Surface Engineering - Coating Issues and Applications.

UNIT II NANOSTRUCTURED COATINGS 9

Sol - gel Method - Chemical Reactions - Effect of Catalyst Hydrolysis - Electric Precipitation - Rotate Coating - Scattering Coating - Plasma Polymerization - Annealing - Heating Oxidation Thermal Spraying Nano - Composites - Transitional Metal Nitride Coatings - Super Rough and Super Hard - Nanocrystalline Coatings - Nanocomposite Coatings.

UNIT III CHARACTERISATION OF NANOCOATINGS 9

Thermodynamics of Nanostructured Materials - Interfaces Thermodynamics - Interface Traction - Interface Stresses - Chemical Equilibrium in Curved Interface - Influential Interface - Phase Interface - Measurement of Thermal and Electrochemical Properties - Condensed and Compressed Metals - Nano -Technological Compatibility in Coating - Improvement of Coating Quality - Abrasion, Scratch and Corrosion Resistant Coatings - Alumina as a Scratch and Abrasion Resistant - Corrosion resistant.

UNIT IV PROPERTIES OF NANOSTRUCTURED COATINGS 9

Mechanical Properties - Effects of Participation of Nanoparticles in Nanocoating - Size Effect - Effective Factors on Simultaneous Deposition - Effect of Density - Effect of Current Density - Effect of pH - Pulse Current Effect - Tensile and Fatigue Strength Physical Properties - Size Effect in Sensing Characterization - Thermal Stability - Optical properties.

UNIT V APPLICATIONS OF NANOCOATINGS 9

Surface Improvement for Making Fog and Vapor Resistant Layers - Self-Cleaning Glasses - Medical and Hygienic Applications - Food Packaging - Electrical and Electronic Applications - Lubricating Applications - Automobile industries - Defence applications.

TOTAL: 45 PERIODS

OUTCOMES:

- Will familiarize about the science of nanocoatings Will demonstrate the preparation of nanocoatings.
- Will develop knowledge in characteristic nanocoatings.

TEXT BOOKS:

1. Aliofkhazraei M., “Nanocoatings – Size Effect in Nanostructured Films” Springer, First Edition, 2011.
2. Akhlouf S.H. and Tiginyanu I., “Nanocoatings and Ultra Thin Films: Technologies and Applications”, Woodhead Publishing Ltd., 2011.

REFERENCE:

1. Cotler V.F., “Nanopowders and Nanocoatings: Production, Properties and Applications”, Nova Science Pub. Inc., 2010.

MF7003 NON DESTRUCTIVE EVALUATION L T P C
3 0 0 3

OBJECTIVE:

- To make students to understand various Non Destructive testing methods including advanced techniques, with emphasis on basic principles, limitations and application areas.

UNIT I INTRODUCTION 9

Visual methods: Optical aids - In-situ metallography - Optical holographic methods - Dynamic inspection.

UNIT II LIQUID PENETRANT & MAGNETIC INSPECTION 9

Penetrant systems: Principles - Process - Liquid penetrant materials - Emulsifiers-cleaners developers - sensitivity - Advantages - Limitations and Applications. Magnetic methods: Advantages - Limitations - Methods of generating fields: magnetic particles and suspending liquids Magnetography - field sensitive probes: applications. Measurement of metal properties.

UNIT III RADIOGRAPHIC METHODS 9

Principles of radiography - sources of radiation - Ionising radiation - sources-X-rays - Alpha - Beta and Gamma rays - Recording of radiation - Radiographic sensitivity - Fluoroscopic methods - special techniques - Radiation safety. Advantages - Limitations and applications.

UNIT IV ULTRASONIC TESTING OF MATERIALS 9

Ultrasonic testing: Principle - Advantages - disadvantages - Applications - Generation of Ultrasonic waves - general characteristics of ultrasonic waves: methods and instruments for ultrasonic materials testing: special techniques.

UNIT V ELECTRICAL AND OTHER METHODS 9

Electrical methods: Eddy current methods: potential - drop methods, applications-Other methods: Acoustic Emission methods - Acoustic methods: Leak detection: Thermal inspection.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Choose the right method of testing for detection of defects on various materials.
- Will understand to operate advanced NDT instruments and equipments easily.
- They will know the safety procedures of operating the NDT equipments and follow them.
- They will exploit the advantages of NDT in industrial applications for the benefit of the society.

TEXT BOOKS:

1. Halmshaw R., “Non Destructive Testing”, Edward Arnold Publication, London, 1987.
2. Hull B. and John V., “Non-destructive testing”, English Language Book Soc., 1989.
3. Ravi Prakash, “Non destructive Testing Techniques”, New Age Science, 2009.

REFERENCES:

1. Metals Handbook, “Nondestructive Inspection and Quality Control”, Vol. 17, 9th Edition, ASM International.
2. Hellier C., “Handbook of Non destructive Evaluation”, McGraw-Hill Professional, I edition, 2001.
3. “Non destructive Testing Handbook”, Vol. 1-10, 3rd Edition, American Society for Non Destructive Testing, 2010.

MF7004 PLASTICITY THEORY AND METAL FORMING L T P C
3 0 0 3

OBJECTIVES:

- At the end of the course the student should be able to understand the theory of plasticity and the advances in metal forming.

UNIT I FUNDAMENTALS OF ELASTICITY 9

Brief review of elasticity- Octahedral normal and shear stresses-Spherical and deviatric stress, Invariance in terms of the deviatoric stresses- Representative stress. Idealised stress-strain diagrams for different material models, Engineering and natural strains, Mathematical relationships between true stress and true strains, Cubical dilation, finite strains coefficients Octahedral strain, Strain rate and the strain rate tensor.

UNIT II YIELD CRITERIAS 9

Yield criteria for ductile metal, Von Mises, Tresca, Yield surface for Isotropic Plastic materials, Stress space, Experimental verification of Yield criteria, Yield criteria for an anisotropic material.

UNIT III STRESS STRAIN RELATIONS 9

Stress - Strain Relations, Plastic stress-strain relations, Prandtl Roeuss Saint Venant, Levy - Von Mises, Experimental verification of the Prandtl-Rouss equation, Yield locus, Symmetry convexity, Normality rule., Upper and lower bound theorems and corollaries.

UNIT IV APPLICATION TO PROBLEMS 9

Uniaxial tension and compression, bending of beams, Torsion of rods and tubes, Simple forms of indentation problems using upper bounds. Problems of metal forming - Extrusion, Drawing, Rolling and Forging.

UNIT V SLIP LINE THEORY 9

Introduction, Basic equations for incompressible two dimensional flows, continuity equations, Stresses in conditions of plain strain convention for slip-lines, Geometry of slip lines, Properties of slip lines.

TOTAL: 45 PERIODS

OUTCOME:

- At the end of the course the student will be able to apply and compare and analysis different metal forming concepts in bulk forming and sheet metal forming process by applying theory of plasticity.

TEXT BOOK:

1. Hosford W.F. and Caddell R.M. “Metal Forming: Mechanics and Metallurgy”, Cambridge University press, Cambridge, 2011.
2. Dr.Sadhu Singh, “Theory of Plasticity and Metal Forming Processes”, Khanna Publishers, Third Edition, 2003.

REFERENCES:

1. Hosford, W. F., Mechanical Behavior of Materials, Cambridge Univ. Press, 2005.
2. Marciniak, Z., Duncan, J.L. & J. Hu, Mechanics of Sheet Metal Forming, Oxford, 2002.
3. Dieter, G. E., Mechanical Metallurgy, McGraw-Hill, 3rd Ed., 1988.
4. Schey, J. A., Introduction to Manufacturing Processes, McGraw-Hill, 1987.
5. Johnson, W. and Mellor, P. B., "Engineering Plasticity, John Wiley, 1984.
6. Avitzur, B., Metal Forming: Processes and Analysis, McGraw-Hill, 1968.
7. Lange, K., Handbook of Metalforming, McGraw-Hill, 1985.
8. Avitzur, B., Handbook of Metal Forming, John Wiley, 1983.
9. Bakofen, W. A., Deformation Processing, Addison Wesley, 1972.
10. Hill, R., Mathematical Theory of Plasticity, Oxford, London, 1998.
11. Thomsen, E. G., Yang, C. T., and Kobayashi, S., Mechanics of Plastic Deformation in Metal Processing, Macmillan, NY, 1965.
12. Wagoner, R. and Chenot, J.L., Fundamentals of Metal Forming, John Wiley, 1996.

MF7005 PRECISION ENGINEERING L T P C
3 0 0 3

OBJECTIVE:

- To provide and enhance the technical knowledge in precision engineering, its components and applications.

UNIT I ELEMENTS OF PRECISION ENGINEERING 9

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

UNIT II PRECISION MACHINE COMPONENTS 9

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

UNIT III ERROR CONTROL 9

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

UNIT IV PRECISION MANUFACTURING 9

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

UNIT V MEMS 9

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

TOTAL : 45 PERIODS

OUTCOMES:

On Completion of the course, Students will:

- Operate high precision machineries with ease.
- Research and explore new areas of cutting tools.

TEXT BOOKS:

1. Venkatesh V.C. and Izman S., “Precision Engineering”, Tata McGraw Hill, 2007.
2. Murthy R.L., “Precision Engineering”, New Age International, 2009.

REFERENCE:

1. Nakazawa H., “Principles of Precision Engineering”, Oxford University Press, 1994. Institute of Physics Publishing, Bristol and Philadelphia, Bristol, BSI 6BE U.K.

MF7006 PROCESSING OF PLASTICS AND COMPOSITE MATERIALS L T P C
3 0 0 3

OBJECTIVE:

- The purpose of this subject is to equip the students with the knowledge of processes utilized in developing materials or making components using plastics and composite materials. This subject develops the competence of the students in major industrially practiced processing techniques.

UNIT I INTRODUCTION TO PLASTICS AND COMPOSITE 9

Chemistry and Classification of Polymers - Properties of Thermo Plastics - Properties of Thermosetting Plastics – Elastomers- Applications - Merits and Disadvantages - Fibres - Glass, Boron, Carbon, Organic, Ceramic and Metallic Fibers - Matrix Materials - Polymers, Metals and Ceramics.

UNIT II PROCESSING OF PLASTICS 9

Thermoplastics: Extrusion moulding- Injection Moulding - Blow Moulding - Rotational moulding - calendaring - Film blowing - thermoforming - Thermoset plastics: Compression, Transfer Moulding, Jet moulding, Laminated plastics - Casting - Machining of Plastics: Machining Parameters and their effect - Joining of Plastics - Mechanical Fasteners - Chemical bonding-Thermal bonding - Thermal welding.

UNIT III PROCESSING OF POLYMER MATRIX COMPOSITES 9

Open Mould Processes, Bag Moulding, Compression Moulding with BMC and SMC - Filament winding - Pultrusion - Centrifugal Casting - Injection Moulding - Application of PMC's.

UNIT IV PROCESSING OF METAL MATRIX COMPOSITES 9

Solid State Fabrication Techniques - Diffusion Bonding - Powder Metallurgy Techniques - Plasma Spray, Chemical and Physical Vapour Deposition of Matrix on Fibres - Liquid State Fabrication Methods: Infiltration - Squeeze Casting - Rheo Casting - Compo casting - Application of MMC's.

UNIT V PROCESSING OF CERAMIC MATRIX COMPOSITES 9

Coldpressing and sintering - hot pressing-rection bonding processes - Liquid infiltration - Lanxide process - In situ chemical reaction techniques: chemical vapour infiltration - chemical vapour deposition-Reactive consolidation - sol - gel techniques - pyrolysis - self propogating high temperature synthesis - Electropherotic deposition - Application of CMC's.

TOTAL: 45 PERIODS

OUTCOMES:

- The students will be able to identify various processing methods used for different types of plastics used in our daily life.
- This subject induces the students to do project work in the area of composite materials.

TEXT BOOKS:

1. Muccio E.A. "Plastics processing technology" , ASM International, 1994.
2. Chawla K.K Composite Materials - Science and Engineering (Materials Research and Engineering), Spinger, New York, 2012.
3. BrentStrong A., "Fundamentals of Composites Manufacturing: Materials, Methods and Applications", Society of Manufacturing Engineers, Michigan, 2008.
4. Chawla K.K., "Ceramic matrix composites Springer", 2nd Edition, 2003.
5. Gowri S., Hariharan P. and Suresh Babu A, "Manufacturing Technology-I" Pearson Education, 2008.

REFERENCES

1. Belofsky K., Plastics: :Product Design and Process Engineering Hanser Publishers, 1995.
2. Kobyashi A., "Machining of Plastics", Mc-Graw Hill, 1967.
3. Chawla K.K., "Composite Materials science and Engineering", 2nd Edition Springer, 1988.
4. Agarwal D. and Broutman L.J., "Analysis and Performance of Fiber Composites", Wiley, 1990.
5. Mallick P.K. and Newman S., "Composite Materials Technology", Hanser Publishers, 1991.

MF7007 QUALITY CONTROL AND RELIABILITY ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- Teach the essentiality of SQC, sampling and reliability engineering. Study on various types of control charts, six sigma and process capability to help the students understand various quality control techniques.
- Reliability engineering focuses on the dependability, failure mode analysis, reliability prediction and management of a system.

UNIT I STATISTICAL QUALITY CONTROL 9

Quality as a competitive priority - Methods and Philosophy of Statistical Process Control - Control Charts for Variables and Attributes - Cumulative sum and Exponentially weighted moving average control charts - Other SPC Techniques - Process - Capability Analysis - Six sigma concept.

UNIT II ACCEPTANCE SAMPLING 9

Reasons for acceptance sampling - Acceptance Sampling Problem - Single sampling plans for attributes - double sampling - multiple sampling - sequential sampling - Military standards - The Dodge Roming sampling plans - Random sampling

UNIT III RELIABILITY ENGINEERING 9

Definition of reliability - Performance and reliability - Reliability requirements - System life cycle - Mean time between failures - Mean time to failure - Mortality Curve - Availability - Maintainability.

UNIT IV FAILURE DATA ANALYSIS 9

Statistical failures of components - failure distributions – Bath tub curve - Negative exponential distribution - Normal distribution - log normal distribution – Gamma distribution - Weibull distribution Life distribution measurements - Accelerated life tests - Data requirements for reliability.

UNIT V RELIABILITY PREDICTION AND MANAGEMENT 9

Failure rate estimates - Effect of environment and stress - Series and Parallel systems - RDB analysis - Standby Systems - Complex Systems - Reliability demonstration testing - Reliability growth testing - Duane curve - Risk assessment - FMEA and Fault tree analysis.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Know and apply various quality tools to tackle dynamic industrial situations.
- Give a quality index to an industrial situation following an engineering approach.
- Estimate process capability and take remedial actions at the right time to have the
- processes under control.
- Understand reliability, various modes of failures, maintenance, replacement of machineries and equipments at the right time and be instrumental in enriching the industrial culture with quality policy leading to higher productivity.

TEXT BOOKS:

1. Khanna O.P., “Statistical Quality Control”, Dhanpat Rai Publications (P) Ltd., 2001.
2. Lewis E.E., “Introduction to Reliability Engineering”, John Wiley and Sons, 1996, 2nd Edition.

REFERENCES:

1. Montgomery D.C., “Statistical Quality Control: A Modern Introduction”, 2nd Edition, John Wiley and Sons, 2010.
2. Schilling E.G. and Neubauer D.V., Acceptance Sampling in Quality Control, CRC Press, 2009.

3. Klaasssen H.B. and Peppen J.C.L, “System reliability concepts and applications”, VSSD, 2008.
4. Zairi M., “Total Quality Management for Engineers”, Woodhead Publishing Limited 1991.
5. Noori H. and Russell, “Production and Operations Management - Total Quality and Responsiveness”, McGraw-Hill Inc, 1995.

MF7008 RENEWABLE ENERGY SOURCES L T P C
3 0 0 3

AIM:

- To instruct the importance of renewable energy and its utilization for the thermal and electrical energy needs and also the environmental aspects of these resources.

OBJECTIVE:

- At the end of the course, the student expected to understand and analyze the pattern of renewable energy resources Suggest methodologies / technologies for its utilization. Economics of the utilization and environmental merits

UNIT I SOLAR ENERGY 9

Solar Radiation - Measurements of solar Radiation and sunshine - Solar Thermal Collectors - Flat Plate and Concentrating Collectors - Solar Applications - fundamentals of photo Voltaic Conversion - solar Cells - PV Systems - PV Applications.

UNIT II WIND ENERGY 9

Wind Data and Energy Estimation - wind Energy Conversion Systems - Wind Energy generators and its performance - Wind Energy Storage - Applications - Hybrid systems.

UNIT III BIO - ENERGY 9

Biomass, Biogas, Source, Composition, Technology for utilization - Biomass direct combustion - Biomass gasifier - Biogas plant - Digesters - Ethanol production - Bio diesel production and economics.

UNIT IV OTEC, TIDAL, GEOTHERMAL AND HYDEL ENERGY 9

Tidal energy - Wave energy - Data, Technology options - Open and closed OTEC Cycles - Small hydro, turbines - Geothermal energy sources, power plant and environmental issues.

UNIT V NEW ENERGY SOURCES 9

Hydrogen, generation, storage, transport and utilisation, Applications: power generation, transport - Fuel cells - technologies, types - economics and the power generation.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. G.D. Rai, Non Conventional Energy Sources, Khanna Publishers, New Delhi, 1999.
2. S.P. Sukhatme, Solar Energy, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.

REFERENCES:

1. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K., 1996.
2. Twidell, J.W. & Weir, A., Renewable Energy Sources, EFN Spon Ltd., UK, 1986.
3. G.N. Tiwari, solar Energy – Fundamentals Design, Modelling and applications, Narosa Publishing House, New Delhi, 2002.
4. L.L. Freris, Wind Energy Conversion systems, Prentice Hall, UK, 1990.

MF7009 SUSTAINABLE MANUFACTURING L T P C
3 0 0 3

OBJECTIVE:

- To impart knowledge on sustainable manufacturing, polices, best practices for sustainable manufacturing, lean manufacturing, green energy, sustainable machinery, energy consumption, hazardous management and recyclability.

UNIT I SUSTAINABLE MANUFACTURING AND POLICIES 9

Introduction to sustainable manufacturing - Origins of sustainable manufacturing - Sustainable manufacturing concepts - Indian/European/US environmental policies - Legislative, cultural, societal and political issues - Sustainable quality systems - Emission less manufacturing - Comparison between green, eco-manufacturing, eco- machining, clean manufacturing and sustainable manufacturing.

UNIT II SUSTAINABILITY MANUFACTURING BEST PRACTICES 9

Introduction to best practices of sustainability manufacturing – Manufacturability issues in sustainable product design - Environmentally conscious design/manufacturing processes - Societal impact - Product functionality, serviceability, maintainability, upgradability - Innovative product/process designs for sustainability - Preservation of sustainable development.

UNIT III LEAN MANUFACTURING AND GREEN ENERGY 9

Introduction to lean Manufacturing - Lean manufacturing tools - Comparison of conventional manufacturing and lean Manufacturing - Advantages and Limitations of lean Manufacturing. Introduction to green energy concepts - Green house effect - Global warming - Climate change - Environmental degradation– Environmental pollution – Pollution due to manufacturing industries - Remedies.

UNIT IV SUSTAINABLE MACHINERY AND ENERGY CONSUMPTION 9

Selection of appropriate machine, materials, energy, resource utilisation for sustainability manufacturing – Performance evaluation of different machinery and its components in terms of energy consumption - Causes for inefficient operations of machinery – Scope for energy conservation - World energy consumption - Determination of power demand and consumption - Comparison of power generation cost using renewable and non- renewable sources.

UNIT V HAZARDOUS MANAGEMENT AND RECYCLABILITY 9

Introduction to hazardous management in industries – Need for hazardous waste management - Appropriate method of collection, storage, transport and disposal of hazardous waste - Hazardous waste prevention and Life cycle assessment - Advantages and limitations of hazardous management - Recyclability: Recycling, recharging, disassembly, recovery, remanufacturing - End-of-life and product take-back issues - Training of next generation workforces for sustainable manufacturing.

TOTAL : 45 PERIODS

OUTCOMES:

At the end of this course the student will be able

- To impart best practices for sustainable manufacturing in industries, understand polices for sustainable manufacturing.
- Understand concepts in lean manufacturing, green energy, sustainable machinery, energy consumption, hazardous management and recyclability.

TEXT BOOKS:

1. Günther Seliger, Marwan M.K. Khraisheh and I.S. Jawahir, Advances in Sustainable Manufacturing, Springer Berlin Heidelberg, London, 2011.
2. Davim, J.P., “Sustainable Manufacturing”, John Wiley & Sons, 2010.

REFERENCES:

1. Günther Seliger, Sustainability in Manufacturing: Recovery of Resources in Product and Material Cycles, Springer Berlin Heidelberg, 2010.
2. Clive George and Colin Kirkpatrick, Impact Assessment and Sustainable Development, Edward Elgar Publishing Ltd., USA, 2007.
3. Stephen Dovers, Environment and Sustainability Policy: Creation, Implementation, Evaluation, The Federation Press, Australia, 2005.
4. YP Abbi and Shashank Jain, Handbook on Energy Audit and Environment Management, TERI Press, New Delhi, 2006.
5. Craig B. Smith, Energy Management Principles: Applications, Benefits, Savings, Pergamon Press, USA, 1981.
6. Ronald G. Askin and Jeffrey B. Goldberg, Design and Analysis of Lean Production System, Wiley India Private Limited, India, 2007.
7. Salah El Hagga, Sustainable Industrial Design and Waste Management, Elsevier Academic Press, 2007.
8. Dornfield David, "Green Manufacturing", Springer, 2012.
9. Davim.J.Pauls, "Green Manufacturing Processes and Systems", Springer, 2013.

MF7010 SYSTEM SIMULATION L T P C
3 0 0 3

OBJECTIVES:

- To understand the importance and advantages of applying simulation techniques for solving various problems on discrete event systems.
- To teach various random number generation techniques, its use in simulation, tests and validity of random numbers etc. Development of simulation models, verification, validation and analysis. Introduction to various simulation languages and comparison.

UNIT I INTRODUCTION 9

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

UNIT II RANDOM NUMBERS/VARIATES 9

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

UNIT III DESIGN OF SIMULATION EXPERIMENTS 9

Problem formulation – data collection and reduction – logic developments – initial conditions – run length, tabular method of simulation – development of models using higher level languages for systems like queuing, production, inventory and maintenance – output analysis and interpretation, validation.

UNIT IV DISCRETE SYSTEM SIMULATION LANGUAGES 9

Need for simulation language - Comparison of simulation languages: SIMCRIPT, GASP, SIMULA, GPSS, PROMODEL, EXTEND, ARENA and FLEXSIM.

UNIT V QUEUING POLICIES, ALGORITHMS AND CASE STUDIES 9

Introduction to basic Single - pass heuristics, meta-heuristics and applications - Application of Genetic algorithms and Ant colony based algorithms in Discrete event simulation models with simple examples. Development of simulation models using the simulation language studies for

systems for systems like, queuing systems, production systems, inventory systems, maintenance and replacement systems, investment analysis and network. Manual simulation problems.

TOTAL : 45 PERIODS

OUTCOMES:

- The student will be able to understand industrial scenarios, involve in intelligent questioning sessions with experts to get clear insight about the problem and build an appropriate simulation model.
- The students can understand the type of model to be built suiting to the industrial situation and choose right measures of performances for evaluation and analysis.
- They can justify their findings with statistical analysis and successfully compromise the management in implementing their proposed ideas and produce results.
- Students can easily understand simulation models developed in other simulation software and involve in expert suggestions to improvise the same.
- They can teach simulation situations through their own models and show the effects of altering them.

TEXT BOOK:

1. Banks J and Carson J.S., Nelson B.L, "Discrete event system simulation", 4th Edition, Pearson, 2005.

REFERENCES:

1 Schriber T.J., "Simulation using GPSS", John Wiley, 2002.
2. Law A.M. and Kelton W.D., "Simulation Modeling and Analysis", McGraw Hill, 2003.

WEB REFERENCE BOOKS:

- http:www.bcnn.net.

MF7011 THEORY OF METAL CUTTING L T P C
3 0 0 3

OBJECTIVES:

- To learn tool nomenclature, mechanical of metal cutting and forces in metal cutting.
- To know the thermal aspects in machining, tool materials, tool life and wear mechanisms

UNIT I TOOL NOMENCLATURE 9

Single point tool-significance of the various angles provided and nose radius-American, German CIRP and orthogonal system of tool nomenclature, nomenclature of drills, milling cutters and broaches-grinding wheels, Need for chip breakers.

UNIT II MECHANICS OF METAL CUTTING 9

Mechanisms of formation of chips-types of chips and the conditions conducive for the formation of each type built- up edge, its effects orthogonal Vs oblique cutting-Merchant's circle diagram-Force and Velocity relationship, shear plane angle, Energy considerations in matching-Ernst Mechant's theory of shear angle relationship-original assumption and modifications made.

UNIT III FORCES IN MACHINING 9

Forces in turning, drilling, milling and grinding, conventional Vs climb milling-mean and maximum cross sectional areas of chip in milling-specific cutting pressure-specific horse power-requirements of tool dynamometers-construction and principle of operation of tool dynamometers for turning, drilling and milling.

UNIT IV THERMAL ASPECTS IN MACHINING 9

Sources of heat generation in machining-temperature measurement techniques in machining, Functions of cutting fluid-characteristics of cutting fluid-types, modes of applications, additives-application of cutting fluids- dry machining, Minimum Quantity Lubrication (MQL) machining.

UNIT V TOOL MATERIALS, TOOL WEAR AND TOOL LIFE 9

Requirements of tool materials-advances in tool materials-HSS, coated HSS, carbides and coated carbides, ceramic, cold pressed, hot pressed, ceramic composites, CBN, PCD, properties, advantages and limitations-ISO-specifications for inserts and tool holders, tool wear, type mechanisms, tool life, machinability, economics of machining, chatter in machining.

TOTAL : 45 PERIODS

OUTCOMES:

At the end of this course

- The student will be able to understand various tool nomenclatures.
- Use this knowledge to calculate forces in machining.
- Use this knowledge for the selection of tools for various machining operations.

TEXTBOOKS:

1. Juneja B.L and Sekhon G.S., "Fundamentals of Metal cutting and Machine Tools",New Age International (P) Ltd., 2008.

REFERENCES:

1. Shaw M.C., "Metal cutting principles", Oxford, Clarendon Press, 2004. ISBN13: 9780195142068.
2. Bhattacharya A. "Metal Cutting Theory and Practice", New Central Book Agency (p) Ltd., Calcutta, 1984.
3. Venkataesh V.C and Chandrasekaran. H, "Experimental Techniques in Metal Cutting", Prentice Hall of India, 1982.
4. Xing Sheng Li & Low.I.M., Editors, "Advanced ceramic tools for machining Applications",I TRANSTECH PUBLICATIONS, 1994.
5. Kuppuswamy. G., "Principles of Metal Cutting", Universities Press, 1996.

MF7012 VALUE ENGINEERING AND RE ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To understand and analyze the theory and methodology of Value Engineering with the Guidelines, Performa and Checklist for a systematic, step by step application of the technique to the current industrial problems.
- To provide the knowledge about Reengineering Principles, the various models and implementation method, which are adopted in the industry.

UNIT I FUNDMENTALS OF VALUE ENGINEERING 9

Value Types - How to add value job plan - Technique employed - Selection of project and team members - Value Engineering Job Plan - Benefits - Audit.

UNIT II VALUE ENGINEERING AND JOB PLAN 9

General and information phase - Function Classification, Fast diagram - Meaningful costs -Cost analysis - idea listing and comparison - Feasibility ranking - Investigator phase, study summary - guidelines for writing value engineering proposal - Financial aspects - List cycle cost analysis - Oral presentation - Audit - Case studies and Discussion.

UNIT III REENGINEERING PRINCIPLES 9

The 6R's of organizational transformation and reengineering - process reengineering - preparing the workforce - Principles of Transformation and Reengineering - Methodology - Organizational Transformation Guidelines.

UNIT IV REENGINEERING PROCESS IMPROVEMENT MODELS 9

Transformation Models - Performance Improvement Model - PMI leadership expectation - Production and service improvement model - Moen and Nolan Strategy Model - Quality Models - Personal and Process improvement.

UNIT V IMPLEMENTATION OF REENGINEERING 9

Process analysis techniques - Work flow analysis - Value analysis approach - Nominal group technique - Fish bone diagram - Pareto analysis - team building - Force field analysis - Implementation.

TOTAL: 45 PERIODS

OUTCOMES:

- The student will be able to practice the principles of value manufacturing
- This domain knowledge will help them to systematically doing value analysis
- The students will understand Systematic starting over and reinventing the way a firm, or a business process

TEXT BOOKS:

1. Iyer S.S., "Value Engineering", New Age Information, 1996.
2. Dr. Edosomwan J.A., "Organization Transformation and Process reengineering", British Library Cataloguing in Publication data, 1996.

REFERENCE:

1. Younker D.L., "Value Engineering", Marcel Dekker, Inc., 2003.

MF7071 ADDITIVE MANUFACTURING TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To know the principle, methods, possibilities and limitations as well as environmental effects of Additive Manufacturing technologies.
- To be familiar with the characteristics of the different materials those are used in Additive Manufacturing technologies.

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

OUTCOME:

- On completion of this course, students will learn about a working principle and construction of Additive Manufacturing technologies, their potential to support design and manufacturing, modern development in additive manufacturing process and case studies relevant to mass customized manufacturing.

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.

MF7072 ELECTRONIC MATERIALS AND PROCESSING L T P C

3 0 0 3

OBJECTIVES

- To describe the basic processes of materials that are used to fabricate semiconductor and MEMS devices.
- To learn the thermal considerations of electronic materials.

UNIT I INTRODUCTION 9

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

UNIT II ORGANIC MATERIALS AND PROCESSES 9

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

UNIT III MEMS MATERIALS AND PROCESS 9

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

UNIT IV MATERIALS SYSTEMS 9

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

UNIT V THERMAL MANAGEMENT OF MATERIALS AND SYSTEMS 9

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

TOTAL: 45 PERIODS

OUTCOME:

- Students will be familiar about the electronics material characteristics, and preparation and production process.

TEXT BOOKS:

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

REFERENCES:

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

MF7073 ELECTRONICS MANUFACTURING TECHNOLOGY L T P C

3 0 0 3

OBJECTIVES:

- To understand wafer preparation and PCB fabrication, the types of Mounting Technologies and components for electronics assembly & SMT process in detail.
- To know various Defects, Inspection Equipments SMT assembly process and repair, rework and quality aspects of Electronics assemblies.

UNIT I INTRODUCTION TO ELECTRONICS MANUFACTURING 9

History, definition, wafer preparation by growing, machining, and polishing, diffusion, microlithography, etching and cleaning, Printed circuit boards, types- single sided, double sided, multi layer and flexible printed circuit board, design, materials, manufacturing, inspection.

UNIT II COMPONENTS AND PACKAGING 9

Introduction to packaging, types-Through hole technology(THT) and Surface mount technology(SMT), Through hole components – axial, radial, multi leaded, odd form. Surface-mount components- active, passive. Interconnections - chip to lead interconnection, die bonding, wire bonding, TAB, flip chip, chip on board, multi chip module, direct chip array module, leaded, leadless, area array and embedded packaging, miniaturization and trends.

UNIT III SURFACE MOUNT TECHNOLOGY PROCESS 9

Introduction to the SMT Process, SMT equipment and material handling systems, handling of components and assemblies - moisture sensitivity and ESD, safety and precautions needed, IPC and other standards, stencil printing process - solder paste material, storage and handling, stencils and squeegees, process parameters, quality control. Component placement- equipment

type, flexibility, accuracy of placement, throughput, packaging of components for automated assembly, Cp and Cpk and process control. soldering- reflow process, process parameters, profile generation and control, solder joint metallurgy, adhesive, underfill and encapsulation process - applications, materials, storage and handling, process and parameters.

UNIT IV INSPECTION AND TESTING 9

Inspection techniques, equipment and principle - AOI, X-ray. Defects and Corrective action - stencil printing process, component placement process, reflow soldering process, underfill and encapsulation process, electrical testing of PCB assemblies- In circuit test, functional testing, fixtures and jigs.

UNIT V REPAIR, REWORK, QUALITY AND RELIABILITY OF ELECTRONICS ASSEMBLIES 9

Repair tools, methods, rework criteria and process, thermo-mechanical effects and thermal management, Reliability fundamentals, reliability testing, failure analysis, design for manufacturability, assembly, rework ability, testing, reliability, and environment.

TOTAL: 45 PERIODS

OUTCOMES:

- Perform fabrication of PCBs and use of mounting technology for electronic assemblies. Perform quality inspection on the PCBs

TEXTBOOKS:

1. Prasad R., “Surface Mount Technology – Principles and practice”, second Edition, Chapman and Hall, 1997, New York, ISBN 0-41-12921-3.
2. Tummala R.R., “Fundamentals of microsystem packaging”, Mc -Graw Hill, 2001, ISBN 00-71-37169-9.

REFERENCES:

1. Puligandla Viswanadham and Pratap Singh, “Failure Modes and Mechanisms in Electronic Packages”, Chapman and Hall, New York, 1997, N.Y. ISBN 0-412-105591-8.
2. Totta P., Puttlitz K. and Stalter K., “Area Array Interconnection Handbook”, Kluwer Academic Publishers, Norwell, MA, USA, 2001. ISBN 0-7923-7919-5.
3. Lee N.C., “Reflow Soldering Process and Trouble Shooting SMT,BGA,CSP and Flip Chip Technologies”, 2001, Elsevier Science.
4. Zarrow P. and Kopp D. “Surface Mount Technology Terms and Concepts”, 1997, Elsevier Science and Technology,.ISBN 0750698756.
5. Harper C.A., “Electronic Packaging and Interconnection Handbook” Second Edition, McGraw Hill Inc., New York, N.Y., 1997, ISBN 0-07-026694-8.
6. Martin B. and Jawitz W., “Printed Circuit board materials handbook”, McGraw-Hill Professional, 1997.
7. Lau J.H., “Ball Grid Array Technology, McGraw-Hill Professional, 1997.
8. www.ipc.org.

MF7074 FLEXIBLE MANUFACTURING SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

- To understand the Modern manufacturing systems
- To understand the concepts and applications of flexible manufacturing systems

UNIT I PLANNING, SCHEDULING AND CONTROL OF FLEXIBLE MANUFACTURINGSYSTEMS 9

Introduction to FMS - development of manufacturing systems - benefits - major elements of FMS - types of flexibility - FMS application and flexibility –single product, single batch, n - batch scheduling problem - knowledge based scheduling system.

UNIT II COMPUTER CONTROL AND SOFTWARE FOR FLEXIBLE MANUFACTURING SYSTEMS 9

Introduction - composition of FMS - hierarchy of computer control - computer control of work center and assembly lines - FMS supervisory computer control - types of software specification and selection - trends.

UNIT III FMS SIMULATION AND DATA BASE 9

Application of simulation - model of FMS - simulation software - limitation - manufacturing data systems - data flow - FMS database systems - planning for FMS database.

UNIT IV GROUP TECHNOLOGY AND JUSTIFICATION OF FMS 9

Introduction - matrix formulation - mathematical programming formulation - graph formulation - knowledge based system for group technology - economic justification of FMS - application of possibility distributions in FMS systems justification.

UNIT V APPLICATIONS OF FMS AND FACTORY OF THE FUTURE 9

FMS application in machining, sheet metal fabrication, prismatic component production - aerospace application - FMS development towards factories of the future - artificial intelligence and expert systems in FMS - design philosophy and characteristics for future.

TOTAL: 45 PERIODS

OUTCOME:

- Ability to perform Planning, Scheduling and control of Flexible Manufacturing systems Perform simulation on software's use of group technology to product classification.

TEXT BOOK:

1. Jha.N.K., “Handbook of flexible manufacturing systems”, Academic Press Inc., 1991.

REFERENCES:

1. Groover M.P., “Automation, production systems and computer integrated manufacturing”, Prentice Hall of India Pvt., New Delhi, 2007.
2. Kalpakjian S., “Manufacturing Engineering and Technology”, Addison-Wesley Publishsing Co., 2013.
3. Radhakrishnan P. and Subramanyan S., “CAD/CAM/CIM”, Wiley Eastern Ltd., New Age International Ltd., 1994.
4. Raouf A. and Daya B.M., “Flexible manufacturing systems: recent development”, Elsevier Science, 1995.
5. Ohno T., “Toyota production system: beyond large-scale production”, Productivity Press (India) Pvt. Ltd., 1992.

MF7075 INDUSTRIAL ROBOTICS L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I FUNDAMENTALS OF ROBOT 9

Robot - Definition - Laws of Robot- Robot Anatomy - Co ordinate Systems, Work Envelope, Types and Classification-Specifications - Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load - Robot Parts and their Functions - Need for Robots-Different Applications - Material Handling, Processing and Assembly.

UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS 9

Pneumatic Drives - Hydraulic Drives - Mechanical Drives - Electrical Drives - Stepper Motors, Servo Motors - Salient Features, Applications and Comparison of all these drives. End Effectors - Grippers - Mechanical Grippers, Pneumatic and Hydraulic - Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

UNIT III SENSORS AND MACHINE VISION 9

Requirements of a sensor, Principles and Applications of various types of sensors - contact sensors - touch sensors, position & displacement sensors - potentiometers, encoders, LVDT, pneumatic sensors, force & torque sensors, wrist sensors, joint sensors, tactile array sensors, slip sensors for robot grippers, Proximity & Range sensors, optical sensors, Electro-optical imaging sensors. Machine vision - Camera, Frame Grabber, Sensing and Digitizing Image Data-Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition.

UNIT IV ROBOT KINEMATICS 9

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

UNIT V ROBOT PROGRAMMING AND ROBOT ECONOMICS 9

Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effectors commands and simple Programs. RGV, AGV: Implementation of Robots in Industries - Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to apply the basic engineering knowledge for the design of robotics.

TEXT BOOKS:

1. Klafter R.D., Chmielewski T.A and Negin M., “Robotic Engineering - An Integrated Approach”, Prentice Hall, 2010.
2. Groover M.P., “Industrial Robotics(SIE): Technology, Programming and Applications”, McGraw Hill, 2012.

REFERENCES:

1. Craig J.J., “Introduction to Robotics Mechanics and Control”, Pearson Education, 2008.
2. Deb S.R., “Robotics Technology and Flexible Automation” Tata Mc Graw Hill Book Co., 2010.
3. Koren Y., “Robotics for Engineers’, Mc Graw Hill Book Co., 1992.
4. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., “Robotics Control, Sensing, Vision and Intelligence”, McGraw Hill Book Co., 1987.

MF7076 **NANO TECHNOLOGY** **L T P C**
3 0 0 3

OBJECTIVES:

At the end of this course the students are expected to understand the general issues relating to nanotechnology and nanofabrication.

- Methods for production of Nanomaterials.
- Characteristic techniques of Nanomaterials.

UNIT I INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOGY 9

History, background scope and interdisciplinary nature of nanoscience and nanotechnology, scientific revolutions. Definition of Nanometer, Nanomaterials, and Nanotechnology. Concepts of nanotechnology - size dependent phenomena, surface to volume ratio, atomic structure, molecules and phases, energy at the nanoscale molecular and atomic size.

UNIT II SYNTHESIS NANOMATERIALS AND PROCESSING OF NANOMATERIALS BY PHYSICAL METHODS 9

Introduction: Importance of Synthesis and Processing techniques, nanofabrication, Bottom-Up versus Top Down; Top-down approach with examples. Stability and dispersion of Nanoparticles, Surface modification of inorganic nanoparticles by organic functional groups Physical Methods: Ball milling synthesis, Arc discharge, RF-plasma, Plasma arch technique, Inert gas condensation, electric explosion of wires, Ion sputtering method, Laser pyrolysis, Molecular beam epitaxy and electrodeposition. Electro spinning, Physical vapor Deposition (PVD) - Chemcial vapour Deposition (CVD) - Atomic layer Deposition (ALD) - Self Assembly - LB (Langmuir-Blodgett) technique.

UNIT III PROCESSING OF NANOMATERIALS BY CHEMICAL METHODS 9

Chemical precipitation methods - co-precipitation, arrested precipitation, sol - gel method, chemical reduction, photochemical synthesis, electrochemical synthesis, Microemulsions or reverse micelles, Sonochemical synthesis, Hydrothermal, solvothermal, supercritical fluid process, solution combustion process,4 spray pyrolysis method, flame spray pyrolysis, gas phase synthesis, gas condensation process, chemical vapor condensation. Fundamental aspects of VLS (Vapor-Liquid-Solid) and SLS (SolutionLiquid-Solid) processes - VLS growth of Nanowires - Control of the size of the nanowires - Precursors and catalysts - SLS growth - Stress induced recrystallization.

UNIT IV LITHOGRAPHY 9

Nanomanipulation and Nano lithography - Soft Lithography - Electron beam lithography, SEM based nanolithography, AFM based nanolithography, Ion beam lithography - Oxidation and metallization - Mask and its application - Deep UV lithography, X-ray based Lithography, Dip pen lithography. Self-assembly of Nanoparticles and Nanowires.

UNIT V CHARACTERISATION OF NANOMATERIALS 9

Scanning Probe Microscopy (SPM) – Scanning tunneling microscope, Transmission electron microscope, Scanning transmission electron microscope, Atomic force microscope, Scanning force microscopy, Electrostatic force microscopy , Dynamic force microscopy, Magnetic force microscopy, Scanning thermal microscopy, Peizo force microscopy, scanning capacitance microscopy, Nano indentation - Issues in characterization of nanomaterials.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course

- The student will be able to produce nanomaterials using various techniques.
- Use this knowledge to characterize nanomaterials.
- Use this knowledge to fabricate nano-scaled products.

TEXT BOOKS:

1. Guozhong Cao, “Nanostructures and Nanomaterials, synthesis, properties and applications”, Imperial College Press, 2004.
2. M.S. Ramachandra Rao, Shubra Singh, Nanoscience and Nanotechnology: fundamentals to Frontiers, Wiley 2013.
3. Charles P. Poole Jr. and Franks. J. Qwens, "Introduction to Nanotechnology" Wiley publications.

REFERENCES:

1. Nanomaterials – A. K. Bandyopadhyay, New Age International Publishers, 2nd Edition,2010.
2. T. Pradeep , “NANO The Essential , understanding Nanoscience and Nanotechnology”. Tata McGrawHill Publishing Company Limited, 2007.
3. C.A. Mirkin and C.M. Niemeyer, Nanobiotechnology- II, More Concepts and Applications, WILEY-VCH, Verlag Gmb H&Co, 2007.
4. David G. Bucknall. Nanolithography and patterning techniques in microelectronics, CRC Press.
5. Hari Singh Nalwa - Encyclopedia of Nanotechnology.
6. Processing & properties of structural Naonmaterials by Leon L. Shaw (editor).
7. Chemistry of Nanomaterials : Synthesis, properties and applications by CNR Rao et.al.
8. Nanochemistry: A chemical approach to Nanomaterials Roayal Society of Chemistry, Ozin and Arsenault, Cambridge UK 2005.
9. Nanoparticles: From Theory to Applications, G.Schmidt, Wiley Weinheim 2004.

MF7077 TOTAL PRODUCTIVE MAINTENANCE L T P C
3 0 0 3

OBJECTIVE:

- To teach the students basic concepts of Total Productive Maintenance. Expose the students to the objectives, maintenance models, group activities, logistics, condition monitoring and implementation of Total Productive Maintenance.

UNIT I MAINTENANCE CONCEPTS 9

Introduction - Objectives and functions – Productivity, Quality, Reliability and Maintainability (PQRM) - Terotechnology - Reliability Centered Maintenance - Predictive Maintenance - Condition Based Maintenance - maintainability prediction - availability and system effectiveness- maintenance costs - maintenance organization.

UNIT II MAINTENANCE MODELS 9

Minimal repair - As Good As New policy - maintenance types - balancing PM and breakdown maintenance - PM schedules: deviations on both sides of target values - PM schedules: functional characteristics - replacement models.

UNIT III TOTAL PRODUCTIVE MAINTENANCE 9

Zero breakdowns - Zero Defects and TPM - maximizing equipment effectiveness – Autonomous maintenance program - five pillars of TPM - TPM small group activities - TPM organization - Management Decision - Educational campaign - Creation of Organizations - Establishment of basic policies and goals - Formation of master plan - TPM implementation.

UNIT IV MAINTENANCE LOGISTICS 9

Human factors in maintenance - maintenance manuals - maintenance staffing methods - queuing applications - simulation - spare parts management - maintenance planning and scheduling.

UNIT V ONLINE MONITORING 9

Condition monitoring - Infrared Thermography, Oil Analysis, acoustic emissions testing, Motor Current Analysis, Vibration Measurement and Analysis, Wear Debris Monitoring, Visual checks - corrosion control - Maintenance Management Information System - Expert system applications.

TOTAL: 45 PERIODS

OUTCOMES:

- Implementation the concept of total productive maintenance to the industries.
- Effectively use the total productive maintenance for online monitoring of processes.

TEXT BOOKS :

1. Nakajima S., “Introduction to TPM”, Productivity Press, Chennai, 1992.
2. Srivastava S.K., “Maintenance Engineering (Pri.Practices & Management)”, S. Chand Group, 2011.

REFERENCES :

1. Wireman T., “Total Productive Maintenance”, Industrial Press Inc., New york, 2004.
2. Goto F., “Equipment planning for TPM Maintenance Prevention Design”, Productivity Press, 1992.
3. Shirose K., “Total Productive Maintenance for Workshop Leaders”, Productivity Press, 1992.
4. Shirose K., “TPM for Operators”, Productivity Press, 1996.
5. Suzuki T., “New Directions for TPM”, Productivity Press, 1993.
6. Kelly A., “Maintenance planning and control”, Butterworths, London, 1991.

ML7751 SURFACE ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVE

- The subject provides knowledge on various types of corrosion, their kinetics, testing and methods of protection as well as introduction to tribology.

UNIT I INTRODUCTION 12

Introduction to tribology, surface degradation, wear and corrosion, types of wear, adhesive, abrasive, oxidative, corrosive, erosive and fretting wear, roles of friction and lubrication-, expressions for corrosion rate. emf and galvanic series - merits and demerits -Pourbaix diagram for iron, magnesium and aluminium. Forms of corrosion - Uniform, pitting, intergranular, stress corrosion. corrosion fatigue. dezincification. erosion corrosion, crevice corrosion - Cause and remedial measures - Pilling Bedworth ratio - High temperature oxidation-Hydrogen embrittlement-Remedial Measures.

UNIT II KINETICS OF CORROSION 8

Exchange current density, polarization - concentration, activation and resistance, Tafel quation; passivity, electrochemical behaviour of active/passive metals, Flade potential, theories of passivity, Effect of oxidising agents

UNIT III CORROSION OF INDUSTRIAL COMPONENTS 8

Corrosion in fossil fuel power plants, Automotive industry, Chemical processing industries, corrosion in petroleum production operations and refining, Corrosion of pipelines.

UNIT IV TESTING **8**

Purpose of corrosion testing - Classification - Susceptibility tests for intergranular corrosion- Stress corrosion test. Salt spray test humidity and porosity tests, accelerated weathering tests. ASTM standards for corrosion testing and tests for assessment of wear

UNIT V PROTECTION METHODS **9**

Organic, Inorganic and Metallic coatings, Electroless plating and Anodising - Cathodic protection, corrosion inhibitors - principles and practice - inhibitors for acidic neutral and other media. Special surfacing processes - CVD and PVD processes, sputter coating. Laser and ion implantation, Arc spray, plasma spray, Flame spray, HVOF.

TOTAL: 45 PERIODS

OUTCOME

- Ability to control the factors that affect the metal corrosion.
- Ability to measure the corrosion rate.
- Ability to prevent corrosion by coatings and inhibitors, etc.

TEXT BOOKS

1. Fontana and Greene. “Corrosion Engineering”. McGraw Hill Book Co. New York. USA,1986.
2. Raj Narayan. “An Introduction to Metallic Corrosion and its prevention”, Oxford & 1BH, New Delhi,1983.

REFERENCES

1. Kenneth G Budinski. “Surface Engineering for Wear Resistance”. Prentice Hall Inc..Engelwood Cliff., New Jersey. USA 1988
2. Denny A. Jones,”Principles and Prevention of Corrosion” 2nd Edition, Prentice Hall of India,1996.
3. Uhlig. H.H. “Corrosion and Corrosion Control”. John Wiley & Sons. New York. USA. 1985.
4. ASM Metals Handbook. Vol.5. “Surface Engineering”. ASM Metals Park. Ohio. USA. 1994.
5. ASM Metals Handbook. Vol.l3,”Corrosion”. ASM Metals Park. Ohio. USA. 1994

PR7021 ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT **L T P C**
3 0 0 3

OBJECTIVE:

- To introduce the concepts of economics as applied to Engineering and Management of Finance in business.

UNIT I FINANCIAL ACCOUNTING **9**

Accounting principles – preparation and interpretation of profit and loss statement – balance sheet – Fixed assets – current assets – depreciation – depreciation methods.

UNIT II PROFIT VOLUME ANALYSIS **9**

Cost volume profit relationship – relevant costs in decision making – profit management analysis – break even analysis – margin of safety – angle of incidence and multi product break even analysis Effect of changes in volume, selling price, fixed cost and variable cost.

UNIT III WORKING CAPITAL MANAGEMENT **9**

Current assets and liability decisions – Estimation of working capital requirements – Management of accounts receivable – Inventory – Cash – Inventory valuation methods.

UNIT IV CAPITAL BUDGETING **9**

Significance of capital budgeting – payback period – present value method – Accounting rate of return method.

UNIT V ENGINEERING ECONOMICS 9

Economics – Engineering economics – Demand analysis – Laws of demand – Production and cost – Pricing methods – Cost volume profit analysis.

TOTAL: 45 PERIODS

OUTCOME:

The student will be understand economics, financial issues and management of industry.

TEXT BOOKS:

1. R.Kesavan, C. Elanchezian and T.Sundar Selwyn – Engineering Economics and Financial Accounting, Laxmi Publications, 2016.

REFERENCES:

1. C.James, Vanhorn, Fundamentals of Financial Management PHI 5th edition 2012
2. Charles T.Homgren, Cost Accounting, PHI 9th edition 2009.
3. S.N.Maheswaran, Management Accounting and Financial Control, Sultan Chand, 3rd edition 2013.

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

OBJECTIVES:

- To impart knowledge in various manufacturing methods in developing automotive components.
- To study the principle of automobile engineering.

UNIT I ENGINE 9

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

UNIT II ENGINE PARTS 9

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

UNIT III FUEL AND TRANSMISSION SYSTEM 9

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

UNIT IV CHASSIS AND SUSPENSION SYSTEM 9

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

UNIT V RECENT ADVANCES 9

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

TOTAL: 45 PERIODS

OUTCOME:

- The students shall have knowledge of production of various automotive components.

TEXT BOOKS:

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

REFERENCES:

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

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

Attested

DIRECTOR
Centre For Academic Courses
Anna University, Chennai-600 025.