ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
R - 2017
B.E. PRODUCTION ENGINEERING
CHOICE BASED CREDIT SYSTEM

PROGRAMME EDUCATIONAL OBJECTIVES:
1. Graduates formulate, analyze and solve Manufacturing and Industrial engineering problems.
2. Graduates acquire employment in Manufacturing Sectors / become product and process design professionals for sustainable manufacturing.
3. Graduates become entrepreneurs in Manufacturing Engineering sector.

PROGRAM OUTCOMES (POS):
After the successful completion of Engineering Program, the graduates will be able to,

S.NO	GRADUATE ATTRIBUTES	PROGRAM OUTCOMES (PO)
a.	Engineering Knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization in to the solution of complex engineering problems.
b.	Problem Analysis	Identify, formulate, study literature, and analyze complex problems in Engineering reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c.	Design and Development of solution	Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d.	Conduct Investigation of Complex problem	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions for complex Engineering Problems.
e.	Modern tools usage	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.
f.	Engineer and Society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g.	Environment and Sustainability	Understand the impact of the Engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h.	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i.	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j.	Communication	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k.	Project management and finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l.	Life long learning	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PEO / PO Mapping

PEO / PO	a	b	c	d	e	f	g	h	i	j	k	l
1	√	√										
2	√		√	√	√		√	√	√	√		√
3	√					√	√	√	√	√	√	

Semester Course wise PEO mapping

		Course Title	a	b	c	d	e	f	g	h	i	j	k	l
YEAR I	**SEMESTER I**	Communicative English							√					
		Engineering Mathematics I	√				√							
		Engineering Physics	√	√			√							
		Engineering Chemistry	√	√			√							
		Problem Solving and Python Programming		√			√							
		Engineering Graphics		√							√		√	
		Problem Solving and Python Programming Laboratory		√	√		√							
		Physics and Chemistry Laboratory	√	√										
	SEMESTER II	Technical English							√					
		Engineering Mathematics II	√				√							
		Materials Science	√	√			√							
		Basic Electrical, Electronics and Instrumentation Engineering	√	√	√		√				√	√	√	√	
		Environmental Science and Engineering	√		√			√		√				
		Engineering Mechanics	√		√	√	√			√		√		
		Engineering Practices Laboratory	√	√							√		√	
		Basic Electrical, Electronics and Instrumentation Engineering Laboratory	√	√	√	√	√	√				√	√	
YEAR II	**SEMESTER III**	Transforms and Partial Differential Equations	√				√							
		Basic Machining Process	√		√	√							√	
		Thermodynamics and Thermal Engineering	√	√	√	√	√			√	√			
		Strength of Materials for Mechanical Engineers	√	√	√		√				√	√	√	
		Fluid Mechanics and Machinery	√	√	√		√			√	√	√	√	
		Basic Machining Process Laboratory	√	√	√	√							√	
		Strength of Materials and Fluid Mechanics &	√	√	√		√			√	√	√	√	

Year	Semester	Course	1	2	3	4	5	6	7	8	9	10	11	12
		Machinery Laboratory												
		Computer Aided Machine Drawing		√	√								√	
		Interpersonal Skills/Listening & Speaking						√						
	SEMESTER IV	Statistics and Numerical Methods	√	√	√		√			√		√	√	√
		Engineering Metallurgy	√	√	√					√		√	√	
		Computer Integrated Manufacturing	√	√	√							√	√	
		Mechanics of Machines	√		√	√	√					√	√	
		Fluid Power Drives and Control	√		√	√	√					√	√	
		Metallurgy Laboratory	√		√					√		√	√	
		Fluid Power Laboratory	√		√	√	√					√	√	
		Dynamics Laboratory	√	√	√								√	
YEAR III	SEMESTER V	Engineering Metrology and Measurements	√	√		√	√					√	√	
		Metal Forming Technology	√	√		√						√	√	
		Design of Machine Elements and Transmission Systems	√	√	√	√	√				√	√		
		Foundry Technology	√	√	√		√				√	√	√	√
		Welding Technology	√	√	√		√				√	√	√	√
		Open Elective - I												
		Welding and Foundry Laboratory	√	√	√	√	√	√			√	√	√	√
		Metrology Laboratory	√	√	√		√	√				√	√	√
		Professional Communication							√					
	SEMESTER VI	Production Planning and Control	√	√			√					√	√	√
		Computer Aided Product Design	√	√	√	√	√				√		√	
		Metal Cutting and CNC Machines	√	√	√	√	√				√	√		
		Design of Jigs, Fixtures and Press Tools	√	√	√	√						√		
		Finite Element Analysis	√	√	√		√				√	√	√	√
		Professional Elective I												

			1	2	3	4	5	6	7	8	9	10	11	12
		Metal Forming Lab and Special Machines Laboratory	√	√									√	
		CNC Machine Laboratory	√	√	√	√	√			√		√	√	
		Design and Fabrication Project	√	√	√	√	√	√	√	√	√	√	√	√
YEAR IV	**SEMESTER VII**	Mechatronics	√	√		√	√	√		√	√		√	
		Total Quality Management	√	√			√				√		√	
		Quality Control and Reliability Engineering	√	√			√	√		√	√			
		Open Elective - II												
		Professional Elective II												
		Professional Elective III												
		Computer Aided Simulation and Analysis Laboratory	√	√	√		√	√			√		√	
		Microprocessor and Mechatronics Laboratory	√	√	√	√	√			√	√		√	
	SEMESTER VIII	Process Planning and Cost Estimation	√	√			√				√		√	√
		Professional Elective IV												
		Professional Elective V												
		Project Work	√	√	√	√	√	√	√	√	√	√	√	√

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ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
B.E. PRODUCTION ENGINEERING
REGULATIONS - 2017
CHOICE BASED CREDIT SYSTEM
I TO VIII SEMESTERS CURRICULA AND SYLLABI

SEMESTER I

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS8151	Communicative English	HS	4	4	0	0	4
2.	MA8151	Engineering Mathematics - I	BS	4	4	0	0	4
3.	PH8151	Engineering Physics	BS	3	3	0	0	3
4.	CY8151	Engineering Chemistry	BS	3	3	0	0	3
5.	GE8151	Problem Solving and Python Programming	ES	3	3	0	0	3
6.	GE8152	Engineering Graphics	ES	6	2	0	4	4
PRACTICALS								
7.	GE8161	Problem Solving and Python Programming Laboratory	ES	4	0	0	4	2
8.	BS8161	Physics and Chemistry Laboratory	BS	4	0	0	4	2
			TOTAL	**31**	**19**	**0**	**12**	**25**

SEMESTER II

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS8251	Technical English	HS	4	4	0	0	4
2.	MA8251	Engineering Mathematics - II	BS	4	4	0	0	4
3.	PH8251	Materials Science	BS	3	3	0	0	3
4.	BE8253	Basic Electrical, Electronics and Instrumentation Engineering	ES	3	3	0	0	3
5.	GE8291	Environmental Science and Engineering	HS	3	3	0	0	3
6.	GE8292	Engineering Mechanics	ES	5	3	2	0	4
PRACTICALS								
7.	GE8261	Engineering Practices Laboratory	ES	4	0	0	4	2
8.	BE8261	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ES	4	0	0	4	2
			TOTAL	**30**	**20**	**2**	**8**	**25**

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA8353	Transforms and Partial Differential Equations	BS	4	4	0	0	4
2.	PR8301	Basic Machining Process	PC	3	3	0	0	3
3.	PR8302	Thermodynamics and Thermal Engineering	PC	5	3	2	0	4
4.	CE8395	Strength of Materials for Mechanical Engineers	ES	3	3	0	0	3
5.	CE8394	Fluid Mechanics and Machinery	ES	4	4	0	0	4
PRACTICAL								
6.	PR8311	Basic Machining Process Laboratory	PC	4	0	0	4	2
7.	CE8381	Strength of Materials and Fluid Mechanics & Machinery Laboratory	ES	4	0	0	4	2
8.	ME8381	Computer Aided Machine Drawing	PC	4	0	0	4	2
9.	HS8381	Interpersonal Skills/Listening & Speaking	EEC	2	0	0	2	1
			TOTAL	**33**	**17**	**2**	**14**	**25**

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA8452	Statistics and Numerical Methods	BS	4	4	0	0	4
2.	ME8491	Engineering Metallurgy	PC	3	3	0	0	3
3.	PR8491	Computer Integrated Manufacturing	PC	3	3	0	0	3
4.	PR8451	Mechanics of Machines	PC	3	3	0	0	3
5.	PR8401	Fluid Power Drives and Control	PC	3	3	0	0	3
PRACTICAL								
6.	PR8481	Metallurgy Laboratory	PC	4	0	0	4	2
7.	PR8411	Fluid Power Laboratory	PC	4	0	0	4	2
8.	ME8481	Dynamics Laboratory	PC	4	0	0	4	2
			TOTAL	**30**	**16**	**0**	**14**	**22**

SEMESTER V

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	PR8501	Engineering Metrology and Measurements	PC	3	3	0	0	3
2.	MF8791	Metal Forming Technology	PC	3	3	0	0	3
3.	PR8551	Design of Machine Elements and Transmission Systems	PC	5	3	2	0	4
4.	PR8502	Foundry Technology	PC	3	3	0	0	3
5.	PR8592	Welding Technology	PC	3	3	0	0	3
6.		Open Elective - I	OE	3	3	0	0	3
PRACTICAL								
7.	PR8511	Welding and Foundry Laboratory	PC	4	0	0	4	2
8.	PR8561	Metrology Laboratory	PC	4	0	0	4	2
9.	HS8581	Professional Communication	EEC	2	0	0	2	1
			TOTAL	**30**	**18**	**2**	**10**	**24**

SEMESTER VI

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	IE8693	Production Planning and Control	PC	3	3	0	0	3
2.	PR8601	Computer Aided Product Design	PC	3	3	0	0	3
3.	PR8602	Metal Cutting and CNC Machines	PC	3	3	0	0	3
4.	ME8095	Design of Jigs, Fixtures and Press Tools	PC	3	3	0	0	3
5.	ME8692	Finite Element Analysis	PC	3	3	0	0	3
6.		Professional Elective I	PE	3	3	0	0	3
PRACTICAL								
7.	PR8611	Metal Forming Lab and Special Machines Laboratory	PC	4	0	0	4	2
8.	PR8612	CNC Machine Laboratory	PC	2	0	0	2	1
9.	ME8682	Design and Fabrication Project	EEC	2	0	0	4	2
			TOTAL	**26**	**18**	**0**	**10**	**23**

SEMESTER VII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	ME8791	Mechatronics	PC	3	3	0	0	3
2.	GE8077	Total Quality Management	HS	3	3	0	0	3
3.	ME8098	Quality Control and Reliability Engineering	PC	3	3	0	0	3
4.		Open Elective - II	OE	3	3	0	0	3
5.		Professional Elective II	PE	3	3	0	0	3
6.		Professional Elective III	PE	3	3	0	0	3
PRACTICAL								
7.	MF8761	Computer Aided Simulation and Analysis Laboratory	PC	4	0	0	4	2
8.	PR8711	Microprocessor and Mechatronics Laboratory	PC	4	0	0	4	2
			TOTAL	**26**	**18**	**0**	**8**	**22**

SEMESTER VIII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	ME8793	Process Planning and Cost Estimation	PC	3	3	0	0	3
2.		Professional Elective IV	PE	3	3	0	0	3
3.		Professional Elective V	PE	3	3	0	0	3
PRACTICAL								
4.	PR8811	Project Work	EEC	20	0	0	20	10
			TOTAL	**29**	**9**	**0**	**20**	**19**

TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE = 185

HUMANITIES AND SOCIAL SCIENCES (HS)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS8151	Communicative English	HS	4	4	0	0	4
2.	HS8251	Technical English	HS	4	4	0	0	4
3.	GE8291	Environmental Science and Engineering	HS	3	3	0	0	3
4.	GE8077	Total Quality Management	HS	3	3	0	0	3

BASIC SCIENCE (BS)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA8151	Engineering Mathematics I	BS	4	4	0	0	4
2.	PH8151	Engineering Physics	BS	3	3	0	0	3
3.	CY8151	Engineering Chemistry	BS	3	3	0	0	3
4.	BS8161	Physics and Chemistry Laboratory	BS	4	0	0	4	2
5.	MA8251	Engineering Mathematics II	BS	4	4	0	0	4
6.	PH8251	Materials Science	BS	3	3	0	0	3
7.	MA8353	Transforms and Partial Differential Equations	BS	4	4	0	0	4
8.	MA8452	Statistics and Numerical Methods	BS	4	4	0	0	4

ENGINEERING SCIENCES (ES)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	GE8151	Problem Solving and Python Programming	ES	3	3	0	0	3
2.	GE8152	Engineering Graphics	ES	6	2	0	4	4
3.	GE8161	Problem Solving and Python Programming Laboratory	ES	4	0	0	4	2
4.	BE8253	Basic Electrical, Electronics and Instrumentation Engineering	ES	3	3	0	0	3
5.	GE8292	Engineering Mechanics	ES	5	3	2	0	4
6.	GE8261	Engineering Practices Laboratory	ES	4	0	0	4	2
7.	BE8261	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ES	4	0	0	4	2
8.	CE8395	Strength of Materials for Mechanical Engineers	ES	3	3	0	0	3
9.	CE8394	Fluid Mechanics and Machinery	ES	4	4	0	0	4
10.	CE8381	Strength of Materials and Fluid Mechanics & Machinery Laboratory	ES	4	0	0	4	2

PROFESSIONAL CORE (PC)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	PR8301	Basic Machining Process	PC	3	3	0	0	3
2.	PR8302	Thermodynamics and Thermal Engineering	PC	5	3	2	0	4
3.	PR8311	Basic Machining Process Laboratory	PC	4	0	0	4	2
4.	ME8381	Computer Aided Machine Drawing	PC	4	0	0	4	2
5.	ME8491	Engineering Metallurgy	PC	3	3	0	0	3
6.	PR8491	Computer Integrated Manufacturing	PC	3	3	0	0	3
7.	PR8451	Mechanics of Machines	PC	3	3	0	0	3
8.	PR8401	Fluid Power Drives and Control	PC	3	3	0	0	3
9.	PR8481	Metallurgy Laboratory	PC	4	0	0	4	2
10.	PR8411	Fluid Power Laboratory	PC	4	0	0	4	2
11.	ME8481	Dynamics Laboratory	PC	4	0	0	4	2
12.	PR8501	Engineering Metrology and Measurements	PC	3	3	0	0	3
13.	MF8791	Metal Forming Technology	PC	3	3	0	0	3
14.	PR8551	Design of Machine Elements and Transmission Systems	PC	5	3	2	0	4
15.	PR8502	Foundry Technology	PC	3	3	0	0	3
16.	PR8592	Welding Technology	PC	3	3	0	0	3
17.	PR8511	Welding and Foundry Laboratory	PC	4	0	0	4	2
18.	PR8561	Metrology Laboratory	PC	4	0	0	4	2
19.	IE8693	Production Planning and Control	PC	3	3	0	0	3
20.	PR8601	Computer Aided Product Design	PC	3	3	0	0	3
21.	PR8602	Metal Cutting and CNC Machines	PC	3	3	0	0	3
22.	ME8095	Design of Jigs, Fixtures and Press Tools	PC	3	3	0	0	3
23.	PR8611	Metal Forming Lab and Special Machines Laboratory	PC	4	0	0	4	2
24.	PR8612	CNC Machine Laboratory	PC	2	0	0	2	1
25.	ME8791	Mechatronics	PC	3	3	0	0	3
26.	ME8692	Finite Element Analysis	PC	3	3	0	0	3
27.	ME8098	Quality Control and Reliability	PC	3	3	0	0	3
28.	MF8761	Computer Aided Simulation and Analysis Laboratory	PC	4	0	0	4	2
29.	PR8711	Microprocessor and Mechatronics Laboratory	PC	4	0	0	4	2
30.	ME8793	Process Planning and Cost Estimation	PC	3	3	0	0	3

PROFESSIONAL ELECTIVES FOR PRODUCTION ENGINEERING

SEMESTER VI, ELECTIVE I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	PR8001	Surface Engineering	PE	3	3	0	0	3
2.	PR8072	New Product Development	PE	3	3	0	0	3
3.	IE8651	Reliability Engineering	PE	3	3	0	0	3
4.	GE8075	Intellectual Property Rights	PE	3	3	0	0	3
5.	GE8073	Fundamentals of Nano Science	PE	3	3	0	0	3

SEMESTER VII, ELECTIVE II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	PR8002	Fuzzy Logic and ANN	PE	3	3	0	0	3
2.	PR8003	Instrumentation and Control	PE	3	3	0	0	3
3.	PR8004	Machine Vision	PE	3	3	0	0	3
4.	MG8491	Operations Research	PE	3	3	0	0	3
5.	GE8071	Disaster Management	PE	3	3	0	0	3
6.	GE8074	Human Rights	PE	3	3	0	0	3

SEMESTER VII, ELECTIVE III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	ME8099	Robotics	PE	3	3	0	0	3
2.	PR8071	Lean Six Sigma	PE	3	3	0	0	3
3.	ME8092	Composite Materials and Mechanics	PE	3	3	0	0	3
4.	ME8097	Non Destructive Testing and Evaluation	PE	3	3	0	0	3
5.	ME8073	Unconventional Machining Processes	PE	3	3	0	0	3
6.	MF8072	Total Productive Maintenance	PE	3	3	0	0	3

SEMESTER VIII, ELECTIVE IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	PR8005	Production Management	PE	3	3	0	0	3
2.	PR8006	Engineering Economics and Financial Management	PE	3	3	0	0	3
3.	EE8091	Micro Electro Mechanical Systems	PE	3	3	0	0	3
4.	PR8007	Design of Machine Tool Structure	PE	3	3	0	0	3
5.	MG8091	Entrepreneurship Development	PE	3	3	0	0	3

SEMESTER VIII, ELECTIVE V

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MG8892	Marketing Management	PE	3	3	0	0	3
2.	ME8074	Vibration and Noise Control	PE	3	3	0	0	3
3.	MG8791	Supply Chain Management	PE	3	3	0	0	3
4.	GE8076	Professional Ethics in Engineering	PE	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS8381	Interpersonal Skills/Listening & Speaking	EEC	2	0	0	2	1
2.	HS8581	Professional Communication	EEC	2	0	0	2	1
3.	ME8682	Design and Fabrication Project	EEC	2	0	0	4	2
4.	PR8811	Project Work	EEC	20	0	0	20	10

SUMMARY

	Subject Area	Credits per Semester								Credits Total	Percentage %
	NAME OF THE PROGRAMME										
		I	II	III	IV	V	VI	VII	VIII		
1	HS	4	7				3			14	7.56
2	BS	12	7	4	4					27	14.59
3	ES	9	11	9						29	15.13
4	PC			11	18	20	15	13	3	80	43.24
5	PE						3	6	6	15	8.10
6	OE					3		3		6	3.24
7	EEC			1	-	1	2		10	14	8.10
	TOTAL	25	25	25	23	24	23	22	19	185	
	Non-Credit /(Mandatory)										

| | | **L** | **T** | **P** | **C** |

HS8151   **COMMUNICATIVE ENGLISH**   **4**   **0**   **0**   **4**

OBJECTIVES:
- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will, enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills

UNIT I   **SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS**   **12**

Reading- short comprehension passages, practice in skimming-scanning and predicting- Writing- completing sentences- - developing hints. Listening- short texts- short formal and informal conversations. Speaking- introducing oneself - exchanging personal information- Language development- Wh- Questions- asking and answering-yes or no questions- parts of speech. Vocabulary development-- prefixes- suffixes- articles.- count/ uncount nouns.

UNIT II   **GENERAL READING AND FREE WRITING**   **12**

Reading - comprehension-pre-reading-post reading- comprehension questions (multiple choice questions and /or short questions/ open-ended questions)-inductive reading- short narratives and descriptions from newspapers including dialogues and conversations (also used as short Listening texts)- register- Writing – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures –Listening- telephonic conversations. Speaking – sharing information of a personal kind—greeting – taking leave- Language development – prepositions, conjunctions Vocabulary development- guessing meanings of words in context.

UNIT III   **GRAMMAR AND LANGUAGE DEVELOPMENT**   **12**

Reading- short texts and longer passages (close reading) Writing- understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences Listening – listening to longer texts and filling up the table- product description- narratives from different sources. Speaking- asking about routine actions and expressing opinions. Language development- degrees of comparison- pronouns- direct vs indirect questions- Vocabulary development – single word substitutes- adverbs.

UNIT IV   **READING AND LANGUAGE DEVELOPMENT**   **12**

Reading- comprehension-reading longer texts- reading different types of texts- magazines Writing- letter writing, informal or personal letters-e-mails-conventions of personal email- Listening- listening to dialogues or conversations and completing exercises based on them. Speaking- speaking about oneself- speaking about one's friend- Language development- Tenses- simple present-simple past- present continuous and past continuous- Vocabulary development- synonyms-antonyms- phrasal verbs

UNIT V   EXTENDED WRITING   12

Reading- longer texts- close reading –Writing- brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing-Listening – listening to talks-conversations- Speaking – participating in conversations- short group conversations-Language development-modal verbs- present/ past perfect tense - Vocabulary development-collocations-fixed and semi-fixed expressions

TOTAL: 60   PERIODS

OUTCOMES: At the end of the course, learners will be able to:
•   Read articles of a general kind in magazines and newspapers.
•   Participate effectively in informal conversations; introduce themselves and their friends and express opinions in English.
•   Comprehend conversations and short talks delivered in English
•   Write short essays of a general kind and personal letters and emails in English.

TEXT BOOKS:
1.   Board of Editors. Using English A Course book for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2015
2.   Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES
1   Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge,2011.
2   Means,L. Thomas and Elaine Langlois. English & Communication For Colleges. CengageLearning ,USA: 2007
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 Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
5   Dutt P. Kiranmai and RajeevanGeeta. Basic Communication Skills, Foundation Books: 2013

MA8151   **ENGINEERING MATHEMATICS – I**   **L   T   P   C**
                                                                           4   0   0   4

OBJECTIVES :
The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus. The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modeling the engineering problems mathematically and obtaining solutions. This is a foundation course which mainly deals with topics such as single variable and multivariable calculus and plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

UNIT I   DIFFERENTIAL CALCULUS   **12**

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules - Maxima and Minima of functions of one variable.

UNIT II   FUNCTIONS OF SEVERAL VARIABLES   **12**

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

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

TOTAL : 60 PERIODS

OUTCOMES :
After completing this course, students should demonstrate competency in the following skills:
- Use both the limit definition and rules of differentiation to differentiate functions.
- Apply differentiation to solve maxima and minima problems.
- Evaluate integrals both by using Riemann sums and by using the Fundamental Theorem of Calculus.
- Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables.
- Evaluate integrals using techniques of integration, such as substitution, partial fractions and integration by parts.
- Determine convergence/divergence of improper integrals and evaluate convergent improper integrals.
- Apply various techniques in solving differential equations.

TEXT BOOKS :
1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015. [For Units I & III - Sections 1.1, 2.2, 2.3, 2.5, 2.7(Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1(Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].

REFERENCES :
1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
5. Weir, M.D and Joel Hass, "Thomas Calculus", 12th Edition, Pearson India, 2016.

	L	**T**	**P**	**C**
PH8151	**3**	**0**	**0**	**3**

PH8151   **ENGINEERING PHYSICS**

OBJECTIVES:
- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

UNIT I   PROPERTIES OF MATTER   9
Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment - I-shaped girders - stress due to bending in beams.

UNIT II   WAVES AND FIBER OPTICS   9
Oscillatory motion – forced and damped oscillations: differential equation and its solution – plane progressive waves – wave equation. Lasers : population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Semiconductor lasers: homojunction and heterojunction – Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) – losses associated with optical fibers - fibre optic sensors: pressure and displacement.

UNIT III   THERMAL PHYSICS   9
Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation – heat conductions in solids – thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters.

UNIT IV   QUANTUM PHYSICS   9
Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – tunnelling (qualitative) - scanning tunnelling microscope.

UNIT V   CRYSTAL PHYSICS   9
Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - crystal imperfections: point defects, line defects – Burger vectors, stacking faults – role of imperfections in plastic deformation - growth of single crystals: solution and melt growth techniques.

TOTAL :   45   PERIODS

OUTCOMES:
Upon completion of this course,
- the students will gain knowledge on the basics of properties of matter and its applications,
- the students will acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics,
- the students will have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers,
- the students will get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes, and
- the students will understand the basics of crystals, their structures and different crystal growth techniques.

TEXT BOOKS:
1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.

REFERENCES:
1. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2010.
3. Tipler, P.A. & Mosca, G. "Physics for Scientists and Engineers with Modern Physics'. W.H.Freeman, 2007.

CY8151   **ENGINEERING CHEMISTRY**   **L T P C**
                                                                                                                            3 0 0 3

OBJECTIVES:
- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- To develop an understanding of the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.
- Preparation, properties and applications of engineering materials.
- Types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels.
- Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.

UNIT I   WATER AND ITS TREATMENT   9
Hardness of water – types – expression of hardness – units – estimation of hardness of water by EDTA – numerical problems – boiler troubles (scale and sludge) – treatment of boiler feed water – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) external treatment – Ion exchange process, zeolite process – desalination of brackish water - Reverse Osmosis.

UNIT II   SURFACE CHEMISTRY AND CATALYSIS   9
Adsorption: Types of adsorption – adsorption of gases on solids – adsorption of solute from solutions – adsorption isotherms – Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – contact theory – kinetics of surface reactions, unimolecular reactions, Langmuir - applications of adsorption on pollution abatement.
Catalysis: Catalyst – types of catalysis – criteria – autocatalysis – catalytic poisoning and catalytic promoters - acid base catalysis – applications (catalytic convertor) – enzyme catalysis– Michaelis – Menten equation.

UNIT III   ALLOYS AND PHASE RULE   9
Alloys: Introduction- Definition- properties of alloys- significance of alloying, functions and effect of alloying elements- Nichrome and stainless steel (18/8) – heat treatment of steel. Phase rule: Introduction, definition of terms with examples, one component system -water system - reduced phase rule - thermal analysis and cooling curves - two component systems - lead-silver system - Pattinson process.

UNIT IV   FUELS AND COMBUSTION   9

Fuels: Introduction - classification of fuels - coal - analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum - manufacture of synthetic petrol (Bergius process) - knocking - octane number - diesel oil - cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG) - power alcohol and biodiesel. Combustion of fuels: Introduction - calorific value - higher and lower calorific values- theoretical calculation of calorific value - ignition temperature - spontaneous ignition temperature - explosive range - flue gas analysis (ORSAT Method).

UNIT V   ENERGY SOURCES AND STORAGE DEVICES   9

Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant - breeder reactor - solar energy conversion - solar cells - wind energy. Batteries, fuel cells and supercapacitors: Types of batteries – primary battery (dry cell) secondary battery (lead acid battery, lithium-ion-battery) fuel cells – H_2-O_2 fuel cell.

TOTAL: 45 PERIODS

OUTCOMES:

- The knowledge gained on engineering materials, fuels, energy sources and water treatment techniques will facilitate better understanding of engineering processes and applications for further learning.

TEXT BOOKS:

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2015
2. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013.

REFERENCES:

1. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
2. Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.
3. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.

GE8151   PROBLEM SOLVING AND PYTHON PROGRAMMING   L T P C
**   3 0 0 3**

OBJECTIVES:

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

UNIT I   ALGORITHMIC PROBLEM SOLVING   9

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II   DATA, EXPRESSIONS, STATEMENTS   9

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III   CONTROL FLOW, FUNCTIONS   9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV   LISTS, TUPLES, DICTIONARIES   9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

UNIT V   FILES, MODULES, PACKAGES   9

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of the course, students will be able to
- Develop algorithmic solutions to simple computational problems
- Read, write, execute by hand simple Python programs.
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python Programs.

TEXT BOOKS:
1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
2. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

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

GE8152   **ENGINEERING GRAPHICS**   **L T P C**
                                                                              2 0 4 4
OBJECTIVES:
- To develop in students, graphic skills for communication of concepts, ideas and design of engineering products.
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination)   1
Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I   PLANE CURVES AND FREEHAND SKETCHING   7+12
Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves.
Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects

UNIT II   PROJECTION OF POINTS, LINES AND PLANE SURFACE   6+12
Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III   PROJECTION OF SOLIDS   5+12
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.

UNIT IV   PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF
**   SURFACES   5+12**
Sectioning of above 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.

UNIT V   ISOMETRIC AND PERSPECTIVE PROJECTIONS   6+12
Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method .

                                                              TOTAL: 90 PERIODS
OUTCOMES:
On successful completion of this course, the student will be able to
- familiarize with the fundamentals and standards of Engineering graphics
- perform freehand sketching of basic geometrical constructions and multiple views of objects.
- project orthographic projections of lines and plane surfaces.
- draw projections and solids and development of surfaces.
- visualize and to project isometric and perspective sections of simple solids.

TEXT BOOK:
1. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.

REFERENCES:
1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
2. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
4. 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.
5. N S Parthasarathy And Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.

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

Special points applicable to University Examinations on Engineering Graphics:
1.   There will be five questions, each of either or type covering all units of the syllabus.
2.   All questions will carry equal marks of 20 each making a total of 100.
3.   The answer paper shall consist of drawing sheets of A3 size only. 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

GE8161	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

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

LIST OF PROGRAMS
1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton's method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers

5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame

PLATFORM NEEDED
Python 3 interpreter for Windows/Linux

OUTCOMES:
Upon completion of the course, students will be able to
- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.
- Use Python lists, tuples, dictionaries for representing compound data.
- Read and write data from/to files in Python.

TOTAL : 60 PERIODS

BS8161	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
	(Common to all branches of B.E. / B.Tech Programmes)	0	0	4	2

OBJECTIVES:
- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter and liquids.

LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)
1. Determination of rigidity modulus – Torsion pendulum
2. Determination of Young's modulus by non-uniform bending method
3. (a) Determination of wavelength, and particle size using Laser
   (b) Determination of acceptance angle in an optical fiber.
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
6. Determination of wavelength of mercury spectrum – spectrometer grating
7. Determination of band gap of a semiconductor
8. Determination of thickness of a thin wire – Air wedge method

TOTAL: 30 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to
- apply principles of elasticity, optics and thermal properties for engineering applications.

CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

OBJECTIVES:

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
- To acquaint the students with the determination of molecular weight of a polymer by viscometery.

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 polyvinyl 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.
16. Conductometric titration of strong acid vs strong base.

OUTCOMES:
- The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

TOTAL: 30 PERIODS

TEXTBOOKS:
1. Vogel's Textbook of Quantitative Chemical Analysis (8TH edition, 2014)

	L	**T**	**P**	**C**
HS8251 **TECHNICAL ENGLISH**	4	0	0	4

OBJECTIVES:
The Course prepares second semester engineering and Technology students to:
- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations , participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialisation.

UNIT I   INTRODUCTION TECHNICAL ENGLISH   12
Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- Speaking –Asking for and giving directions- Reading – reading short technical texts from journals- newspapers-   Writing- purpose statements – extended definitions – issue- writing instructions – checklists-recommendations-Vocabulary Development- technical vocabulary Language Development –subject verb agreement - compound words.

UNIT II   READING AND STUDY SKILLS   12
Listening- Listening to longer technical talks and completing exercises based on them-Speaking – describing a process-Reading – reading longer technical texts- identifying the various transitions in a text- paragraphing- Writing- interpreting cgarts, graphs- Vocabulary Development-vocabularyused in formal letters/emails and reports   Language Development- impersonal passive voice, numerical adjectives.

UNIT III   TECHNICAL WRITING AND GRAMMAR   12
Listening- Listening to classroom lectures/ talkls on engineering/technology -Speaking – introduction to technical presentations-   Reading – longer texts both general and technical, practice in speed reading; Writing-Describing a process, use of sequence words- Vocabulary Development- sequence words- Misspelled words. Language Development- embedded sentences

UNIT IV   REPORT WRITING   12
Listening- Listening to documentaries and making notes. Speaking – mechanics of presentations-Reading – reading for detailed comprehension- Writing- email etiquette- job application – cover letter –Résumé preparation(via email and hard copy)- analytical essays and issue based essays--Vocabulary Development- finding suitable synonyms-paraphrasing-. Language Development- clauses- if conditionals.

UNIT V   GROUP DISCUSSION AND JOB APPLICATIONS   12
Listening- TED/Ink talks; Speaking –participating in a group discussion -Reading– reading and understanding technical articles Writing– Writing reports- minutes of a meeting- accident and survey-Vocabulary Development- verbal analogies Language Development- reported speech
                                                                              TOTAL :   60   PERIODS

OUTCOMES:
At the end of the course learners will be able to:
- Read technical texts and write area- specific texts effortlessly.
- Listen and comprehend lectures and talks in their area of specialisation successfully.
- Speak appropriately and effectively in varied formal and informal contexts.
- Write reports and winning job applications.

TEXT BOOKS:
1. Board of editors. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES
1. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice.Oxford University Press: New Delhi,2014.
2. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
3. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
4. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
5. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning, USA: 2007
   Students can be asked to read Tagore, Chetan Bhagat and for supplementary reading.

MA8251   **ENGINEERING MATHEMATICS – II**   **L   T   P   C**
                                                                                           4   0   0   4

OBJECTIVES :
This course is designed to cover topics such as Matrix Algebra, Vector Calculus, Complex Analysis and Laplace Transform. Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering. Vector calculus can be widely used for modeling the various laws of physics. The various methods of complex analysis and Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines.

UNIT I   MATRICES   12
Eigen values and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigen values 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 - Vector identities – 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 FUNCTIONS   12
Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function - Conformal

mapping – Mapping by functions $w = z + c,\ cz, \dfrac{1}{z}, z^2$ - Bilinear transformation.

UNIT IV   COMPLEX INTEGRATION   12
Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour.

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 second order ordinary differential equations with constant coefficients.

TOTAL: 60 PERIODS

OUTCOMES :
After successfully completing the course, the student will have a good understanding of the following topics and their applications:
   • Eigen values and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices.
   • Gradient, divergence and curl of a vector point function and related identities.
   • Evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification.
   • Analytic functions, conformal mapping and complex integration.
   • Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients.

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

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

PH8251	**MATERIALS SCIENCE** (Common to courses offered in Faculty of Mechanical Engineering Except B.E. Materials Science and Engineering)	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

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

UNIT I   PHASE DIAGRAMS   9
Solid solutions - Hume Rothery's rules – the phase rule - single component system - one-component system of iron - binary phase diagrams - isomorphous systems - the tie-line rule - the lever rule - application to isomorphous system - eutectic phase diagram - peritectic phase diagram - other invariant reactions – free energy composition curves for binary systems - microstructural change during cooling.

UNIT II   FERROUS ALLOYS   9
The iron-carbon equilibrium diagram - phases, invariant reactions - microstructure of slowly cooled steels - eutectoid steel, hypo and hypereutectoid steels - effect of alloying elements on the Fe-C system - diffusion in solids - Fick's laws - phase transformations - T-T-T-diagram for eutectoid steel – pearlitic, baintic and martensitic transformations - tempering of martensite – steels – stainless steels – cast irons.

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 and their properties.

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, melt spinning process, applications - shape memory alloys: phases, shape memory effect, pseudoelastic effect, NiTi alloy, applications – nanomaterials: preparation (bottom up and top down approaches), properties and applications – carbon nanotubes: types.

TOTAL : **45** **PERIODS**

OUTCOMES:

Upon completion of this course,
- the students will have knowledge on the various phase diagrams and their applications
- the students will acquire knowledge on Fe-Fe$_3$C phase diagram,various microstructures and alloys
- the students will get knowledge on mechanical properties of materials and their measurement
- the students will gain knowledge on magnetic, dielectric and superconducting properties of materials
- the students will understand the basics of ceramics, composites and nanomaterials.

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

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

BE8253 **BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING** **L T P C 3 0 0 3**

OBJECTIVES:

 To impart knowledge on
- Electric circuit laws, single and three phase circuits and wiring
- Working principles of Electrical Machines
- Working principle of various electronic devices and measuring instruments

UNIT I **ELECTRICAL CIRCUITS** **9**

Basic circuit components - Ohms Law - Kirchoff's Law – Instantaneous Power – Inductors - Capacitors – Independent and Dependent Sources - steady state solution of DC circuits - Nodal analysis, Mesh analysis- Thevinin's Theorem, Norton's Theorem, Maximum Power transfer theorem- Linearity and Superposition Theorem.

UNIT II   AC CIRCUITS   9
Introduction to AC circuits – waveforms and RMS value – power and power factor, single phase and three-phase balanced circuits – Three phase loads - housing wiring, industrial wiring, materials of wiring

UNIT III   ELECTRICAL MACHINES   9
Principles of operation and characteristics of ; DC machines, Transformers (single and three phase) ,Synchronous machines , three phase and single phase induction motors.

UNIT IV   ELECTRONIC DEVICES & CIRCUITS   9
Types of Materials – Silicon & Germanium- N type and P type materials – PN Junction –Forward and Reverse Bias –Semiconductor Diodes –Bipolar Junction Transistor – Characteristics —Field Effect Transistors – Transistor Biasing –Introduction to operational Amplifier –Inverting Amplifier –Non Inverting Amplifier –DAC – ADC .

UNIT V   MEASUREMENTS & INSTRUMENTATION   9
Introduction to transducers -   Classification of Transducers: Resistive, Inductive, Capacitive, Thermoelectric, piezoelectric, photoelectric, Hall effect and Mechanical - ,Classification of instruments - Types of indicating Instruments - multimeters –Oscilloscopes- – three-phase power measurements– instrument transformers (CT and PT)

TOTAL : 45 PERIODS

OUTCOMES:
Ability to
- Understand electric circuits and working principles of electrical machines
- Understand the concepts of various electronic devices
- Choose appropriate instruments for electrical measurement for a specific application

TEXT BOOKS
1. Leonard S Bobrow, " Foundations of Electrical Engineering", Oxford University Press, 2013
2. D P Kothari and I.J Nagarath, "Electrical Machines "Basic Electrical and Electronics Engineering", McGraw Hill Education(India) Private Limited, Third Reprint ,2016
3. Thereja .B.L., "Fundamentals of Electrical Engineering and Electronics", S. Chand & Co. Ltd., 2008

REFERENCES
1. Del Toro, "Electrical Engineering Fundamentals", Pearson Education, New Delhi, 2007
2. John Bird, "Electrical Circuit Theory and Technology", Elsevier, First Indian Edition, 2006
3. Allan S Moris, "Measurement and Instrumentation Principles", Elseveir, First Indian Edition, 2006
4. Rajendra Prasad, "Fundamentals of Electrical Engineering", Prentice Hall of India, 2006
5. A.E.Fitzgerald, David E Higginbotham and Arvin Grabel, "Basic Electrical Engineering", McGraw Hill Education(India) Private Limited, 2009
6. N K De, Dipu Sarkar, "Basic Electrical Engineering",Universities Press (India)Private Limited 2016

GE8291   **ENVIRONMENTAL SCIENCE AND ENGINEERING**   **L T P C**
                                                                          3 0 0 3

OBJECTIVES:
- To study the nature and facts about environment.
- To finding and implementing 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 – solid 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 environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

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

REFERENCES :
1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD,New Delhi, 2007.
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) PVT, LTD, Hydrabad, 2015.
3. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.
4. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014.

GE8292   ENGINEERING MECHANICS   L T P C
**   3 2 0 4**

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

UNIT I   STATICS OF PARTICLES   9+6

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces – Vectorial representation of forces – Vector operations of forces -additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility .

UNIT II   EQUILIBRIUM OF RIGID BODIES   9+6
Free body diagram – Types of supports –Action and reaction forces –stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions

UNIT III   PROPERTIES OF SURFACES AND SOLIDS   9+6
Centroids and centre of mass – Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula – Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.

UNIT IV   DYNAMICS OF PARTICLES   9+6
Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion - Newton's laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.

UNIT V   FRICTION AND RIGID BODY DYNAMICS   9+6
Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

TOTAL : 45+30=75 PERIODS

OUTCOMES:
On successful completion of this course, the student will be able to
- illustrate the vectorial and scalar representation of forces and moments
- analyse the rigid body in equilibrium
- evaluate the properties of surfaces and solids
- calculate dynamic forces exerted in rigid body
- determine the friction and the effects by the laws of friction

TEXT BOOKS:
1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
2. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

REFERENCES:
1. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 1998.
2. Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.
3. Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education 2006.
4. Meriam J.L. and Kraige L.G., " Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2", Third Edition, John Wiley & Sons,1993.
5. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.

GE8261   **ENGINEERING PRACTICES LABORATORY**   **L T P C**
                                                                    0 0 4 2

OBJECTIVES:

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

GROUP A (CIVIL & MECHANICAL)

I   CIVIL ENGINEERING PRACTICE   13

Buildings:

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

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
(b) Study of pipe connections requirements for pumps and turbines.
(c) Preparation of plumbing line sketches for water supply and sewage works.
(d) Hands-on-exercise:
  Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.
(b) Hands-on-exercise:
  Wood work, joints by sawing, planing and cutting.

II   MECHANICAL ENGINEERING PRACTICE   18
Welding:

(a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
(b) Gas welding practice
Basic Machining:

(a) Simple Turning and Taper turning
(b) Drilling Practice

Sheet Metal Work:

(a) Forming & Bending:
(b) Model making – Trays and funnels.
(c) Different type of joints.

Machine assembly practice:

(a) Study of centrifugal pump
(b) Study of air conditioner

Demonstration on:

(a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
(b) Foundry operations like mould preparation for gear and step cone pulley.
(c) Fitting – Exercises – Preparation of square fitting and V – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

III   ELECTRICAL ENGINEERING PRACTICE   13
1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

IV   ELECTRONICS ENGINEERING PRACTICE   16
1. Study of Electronic components and equipments – Resistor, colour coding   measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL: 60 PERIODS

OUTCOMES:
On successful completion of this course, the student will be able to
- fabricate carpentry components and pipe connections including plumbing works.
- use welding equipments to join the structures.
- Carry out the basic machining operations
- Make the models using sheet metal works
- Illustrate on centrifugal pump, Air conditioner, operations of smithy, foundary and fittings
- Carry out basic home electrical works and appliances
- Measure the electrical quantities
- Elaborate on the components, gates, soldering practices.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15 Sets.
2. Carpentry vice (fitted to work bench)	15 Nos.
3. Standard woodworking tools	15 Sets.
4. Models of industrial trusses, door joints, furniture joints	5 each
5. Power Tools: (a) Rotary Hammer	2 Nos
(b) Demolition Hammer	2 Nos
(c) Circular Saw	2 Nos
(d) Planer	2 Nos
(e) Hand Drilling Machine	2 Nos
(f) Jigsaw	2 Nos

MECHANICAL

1. Arc welding transformer with cables and holders	5 Nos.
2. Welding booth with exhaust facility	5 Nos.
3. Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Sets.
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos.

5. Centre lathe	2 Nos.
6. Hearth furnace, anvil and smithy tools	2 Sets.
7. Moulding table, foundry tools	2 Sets.
8. Power Tool: Angle Grinder	2 Nos
9. Study-purpose items: centrifugal pump, air-conditioner	One each.

ELECTRICAL

1. Assorted electrical components for house wiring	15 Sets
2. Electrical measuring instruments	10 Sets
3. Study purpose items: Iron box, fan and regulator, emergency lamp 1 each	
4. Megger (250V/500V)	1 No.
5. Power Tools: (a) Range Finder	2 Nos
(b) Digital Live-wire detector	2 Nos

ELECTRONICS

1. Soldering guns	10 Nos.
2. Assorted electronic components for making circuits	50 Nos.
3. Small PCBs	10 Nos.
4. Multimeters	10 Nos.
5. Study purpose items: Telephone, FM radio, low-voltage power supply	

BE8261   BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION   L T P C
ENGINEERING LABORATORY   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 generator
2. Load test on Single phase Transformer
3. Load test on Induction motor
4. Verification of Circuit Laws
5. Verification of Circuit Theorems
6. Measurement of three phase power
7. Load test on DC shunt motor.
8. Diode based application circuits
9. Transistor based application circuits
10. Study of CRO and measurement of AC signals
11. Characteristics of LVDT
12. Calibration of Rotometer
13. RTD and Thermistor

Minimum of 10 Experiments to be carried out :-

OUTCOMES:
- Ability to determine the speed characteristic of different electrical machines
- Ability to design simple circuits involving diodes and transistors
- Ability to use operational amplifiers

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	D. C. Motor Generator Set	2
2	D.C. Shunt Motor	2
3	Single Phase Transformer	2
4	Single Phase Induction Motor	2
5	Ammeter A.C and D.C	20
6	Voltmeters A.C and D.C	20
7.	Watt meters LPF and UPF	4
8.	Resistors & Breadboards	-
9.	Cathode Ray Oscilloscopes	4
10.	Dual Regulated power supplies	6
11.	A.C. Signal Generators	4
12.	Transistors (BJT, JFET)	-

MA8353	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L T P C
		4 0 0 4

OBJECTIVES:
- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I   PARTIAL DIFFERENTIAL EQUATIONS   12
Formation of partial differential equations – Singular integrals - Solutions of standard types of first order partial differential equations - Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II   FOURIER SERIES   12
Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.

UNIT III   APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS   12

Classification of PDE – Method of separation of variables - Fourier Series Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction.

UNIT IV   FOURIER TRANSFORMS   12

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT V   Z - TRANSFORMS AND DIFFERENCE EQUATIONS   12

Z-transforms - Elementary properties – Inverse Z-transform (using partial fraction and residues) – Initial and final value theorems - Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

TOTAL : 60 PERIODS

OUTCOMES :
Upon successful completion of the course, students should be able to:
- Understand how to solve the given standard partial differential equations.
- Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
- Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
- Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

TEXT BOOKS :
1. Grewal B.S., "Higher Engineering Mathematics"*,* 43rd Edition, Khanna Publishers, New Delhi, 2014.
2. Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

REFERENCES :
1. B.V Ramana.., "Higher Engineering Mathematics"*,* McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
2. Erwin Kreyszig, "Advanced Engineering Mathematics "*,* 10th Edition, John Wiley, India, 2016.
3. G. James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
4. L.C Andrews, L.C and Shivamoggi, B, "Integral Transforms for Engineers" SPIE Press, 1999.
5. N.P. Bali. and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2014.
6. R.C. Wylie, and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

PR8301   **BASIC MACHINING PROCESS**   **L T P C**
                                                                            3 0 0 3

OBJECTIVE:
- To impart the knowledge on basic concepts of various machining processes and machine tools.

UNIT I   LATHE   9
Introduction to production processes – types of production (job, batch and mass) –Lathe – Engine Lathe – block diagram – sketch – functions of each part – work holding devices in lathe – functions – Chuck, Centre, Dogs, Steady Rest and Follower Rest, mechanism of lathe – Apron, Feed, Tumbler Gear, various operations performed in Lathe – facing, turning, chamfering and knurling – relative positions of tool and job – Taper turning operations (three methods_ thread cutting – thread – RH and LH, single start and multi start with application – Method of thread cutting – selection and arrangement of tool and work. Problems in metric and inch thread conversion – Specifications of Lathe – Burnishing.

UNIT II   SHAPER, PLANER AND SLOTTER   9
Purpose of shaping – block diagram – functions of each part. Purpose of planer – block diagram – functions of each part. Purpose of slotting machine – block diagram – functions and working principle. Operations carried out – horizontal plane, vertical plane, v type with relative position – Comparison of planer with shaper – work holding devices in shaper and planer – Quick return mechanism in shaper – mechanical and hydraulic – cross feed mechanism –Types of planer with application – mechanism in planer – Comparison of shaping with slotting – tool holding devices in shaper, planer and slotter – specifications of shaper, planer and slotter simple problems to calculate the velocity – speed, feed and depth of cut.

UNIT III   DRILLING   9
Purpose of drilling – block diagrm and function – types of drilling machines – portable drilling – bench type – sensitive drilling – radial arm drilling – functions of parts – purpose and operation – gang milling, multiple drill head, upright drilling, relative operations – reaming, boring, tapping, counter boring, courses sinking, trepanning and spot facing (with simple sketch, purpose and application). Work holding devices – specification torque calculation – speed, feed and depth of cut.

UNIT IV   MILLING   9
Milling machine purpose – up and down milling – classification of milling machines – slot, keyway machining – methods of milling – single piece, string, rotary, index, gang, progressive, copy. Horizontal milling machine – block diagram – functions of each part applications – Vertical milling machine – block diagram – functions of each part applications – Gear cutting using milling machine – procedure with neat sketch – milling cutters – peripheral, face, end T slot, form etc. – attachments and special accessories for milling – rotary, slotting attachment – indexing mechanism – methods of indexing – direct, plain, compound and differential indexing – problems – specifications – cutting conditions and parameters.

UNIT V   GRINDING   9
Purpose – classification – surface finish – applications – grinding wheel – types – specifications – selection – surface grinding machine – block diagram – functions of each part – cylindrical grinding – Centreless grinding – Comparison – infeed, end feed and through feed. Balancing, dressing, loading and Truing of wheel – special grinding machines – specification of machine – cutting condition. For all machines, demonstration to be done in a Workshop or using CD to explain the actual operation.

TOTAL: 45 PERIODS

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

- Understand the constructional features and working principles of Lathe, work holding devices and also understands the concepts of mechanics of metal cutting.
- Understand the constructional features and working principles of shaper, planer and slotter, work holding devices and various machining operations performed.
- Understand the constructional features and working principles of drilling machine and its types.
- Understand the constructional features and working principles of milling machine and its types, work holding devices and various machining operations performed.
- Understand the constructional features and working principles of grinding machine and its types.

TEXT BOOKS

1. HMT Bangalore, "Production Technology", Tata McGraw Hill Publishing Company Limited, New Delhi, 28TH REPRINT,2008.
2. Sharma. P.C., "A Text Book of Production Technology", S. Chand and Company, 8th Edition, 2014.

REFERENCES

1. Jain. R.K., "Production Technology", Khanna Publishers, New Delhi, 2001.
2. Hajra Choudhary etal, "Elements of Production Technology –Vol.II", Asia Publishing House, 2010.
3. Kumar. B., "Manufacturing Technology", Khanna Publishers, New Delhi 2000.
4. Radhakrishnan. P., "Manufacturing Technology, Vol.I", Scitech Publications, 2002.

PR8302   **THERMODYNAMICS AND THERMAL ENGINEERING**   **L T P C**
                                                                       3 2 0 4

OBJECTIVE:

- To introduce fundamental concepts in thermodynamics, heat transfer, propulsion and refrigeration and air conditioning.

UNIT 1   BASIC THERMODYNAMICS   9+6
Systems, Zeroth low, first law. Steady flow energy equation. Heat and work transfer in flow and non-flow processes. Second law, Kelvin-Planck statement - Clausius statement - Concept ofs Entropy, Clausius inequality, Entropy change in non-flow processes. Properties of gases and vapours.

UNIT II   AIR CYCLE AND COMPRESSORS   9+6
Otto, Diesel, Dual combustion and Brayton cycles. Air standard efficiency . Mean effective pressure, Reciprocating compressors.

UNIT III   STEAM AND JET PROPULSION   9+6
Properties of steam – Rankine cycle – Steam Nozzles – Simple jet propulsion system – Thrust rocket motor – Specific impulse.

UNIT IV   REFRIGERATION AND AIR-CONDITIONING   9+6
Principles of Psychrometry and refrigeration - Vapour compression - Vapour absorption types - Co-efficient of performance, Properties of refrigerants – Basic Principle and types Air conditioning.

UNIT V   HEAT TRANSFER   9+6
Conduction in parallel, radial and composite wall – Basics of Convective heat transfer - Fundamentals of Radiative heat transfer – Flow through heat exchangers.

TOTAL: 75 PERIODS

(Use of standard thermodynamic tables, Mollier diagram and Refrigerant property tables are permitted)

OUTCOMES:
Student will be able to
- To solve the basic problem in thermodynamics and its concepts
- To understand the concepts in Internal Combustion engines and Compressor
- To understand the basics in Production of Electricity and solve problems based on same
- To know the basics in Refrigeration and Air conditioning
- To analyze the heat transfer techniques and heat transfer in condensers.

TEXT BOOKS
1. Nag.P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, 2013.
2. Rathakrishnan E., "Fundamentals of Engineering Thermodynamics", Prentice-Hall India, 2006.

REFERENCES
1. Ramalingam K.K. "Thermodynamics", Sci-Tech Publications, 2006
2. Holman.J.P., "Thermodynamics", 3rd Ed. McGraw-Hill, 2007.
3. Venwylen and Sontag, "Classical Thermodynamics", Wiley Eastern, 1987
4. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2007.
5. Merala C, Pother, Craig W, Somerton, "Thermodynamics for Engineers", Schaum Outline Series, Tata McGraw-Hill, New Delhi, 2013.

CE8395	STRENGTH OF MATERIALS FOR MECHANICAL ENGINEERS	L	T	P	C
		3	0	0	3

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

UNIT I   STRESS, STRAIN AND DEFORMATION OF SOLIDS   9
Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic constants – Volumetric strains –Stresses on inclined planes – 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 method 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 and thick cylinders – spherical shells subjected to internal pressure –
Deformation in spherical shells – Lame's theorem.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to

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

TEXT BOOKS:

1. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2016
2. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2009

REFERENCES:

1. Egor. P.Popov "Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2002
2. Ferdinand P. Been, Russell Johnson, J.r. and John J. Dewole "Mechanics of Materials",
   Tata McGraw Hill Publishing 'co. Ltd., New Delhi, 2005.
3. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2013
4. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education
   Series, 2010.

CE8394   FLUID MECHANICS AND MACHINERY   L T P C
**   4 0 0 4**

OBJECTIVES:

- The properties of fluids and concept of control volume are studied
- The applications of the conservation laws to flow through pipes are studied.
- To understand the importance of dimensional analysis
- To understand the importance of various types of flow in pumps.
- To understand the importance of various types of flow in turbines.

UNIT I   FLUID PROPERTIES AND FLOW CHARACTERISTICS   12

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

UNIT II   FLOW THROUGH CIRCULAR CONDUITS   12

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   12

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

UNIT IV   PUMPS   12

Impact of jets - Euler's equation - Theory of roto-dynamic 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 – Rotary pumps –classification.

UNIT V   TURBINES   12

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

TOTAL: 60 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.
- Can analyse and calculate major and minor losses associated with pipe flow in piping networks.
- Can mathematically predict the nature of physical quantities
- Can critically analyse the performance of pumps
- Can critically analyse the performance of turbines.

TEXT BOOK:
1. Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi 2013.

REFERENCES:
1. Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011
2. Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi 2016
3. Robert W.Fox, Alan T. McDonald, Philip J.Pritchard, "Fluid Mechanics and Machinery", 2011.
4. Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co. 2010

PR8311   **BASIC MACHINING PROCESS LABORATORY**   **L T P C**
                                                                              0 0 4 2

OBJECTIVE:
- To introduce different machining process and machine tool to develop components.

LIST OF EXPERIMENTS:
1. Lathe: Facing, Plain turning, Step Turning
2. Lathe: Taper Turning, Threading, Knurling
3. Lathe: Multi start Threading, Burnishing
4. Shaper: Cube
5. Shaper: Cube, V-Block
6. Drilling: Counter sinking, Counter Boring, Tapping
7. Milling Vertical: Surfacing, Pocket Milling
8. Milling Horizontal: Polygonal shape milling
9. Grinding: Surface & Cylindrical grinding
10. Slotting: Machining an internal spline

                                                      TOTAL: 60 PERIODS
OUTCOMES:
Upon the completion of this course, student will have
- Ability to select appropriate turning process to obtain finished components.
- Ability to select appropriate milling process to obtain finished components.
- Ability to select appropriate shaper and slotting process to obtain finished components.
- Ability to select appropriate grinding process to obtain optimum surface finish.
- Ability to coordinate various machining process in sequence to get desired design in final components.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Lathe	15
2	Drilling Machine	2
3	Shaper	2
4	Vertical Milling Machine	1
5	Horizontal Milling Machine	1
6	Surface Grinding Machine	1
7	Cylindrical Grinding Machine	1
8	Slotting Machine	1

CE8381   **STRENGTH OF MATERIALS AND FLUID MECHANICS**   **L   T   P   C**
& MACHINERY LABORATORY   **0   0   4   2**

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

STRENGTH OF MATERIALS   **30**

LIST OF EXPERIMENTS
1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminium rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen
5. Hardness test on metals - Brinnell and Rockwell Hardness Number
6. Deflection test on beams
7. Compression test on helical springs
8. Strain Measurement using Rosette strain gauge
9. Effect of hardening- Improvement in hardness and impact resistance of steels.
10. Tempering- Improvement Mechanical properties Comparison
    (i) Unhardened specimen
    (ii) Quenched Specimen and
    (iii) Quenched and tempered specimen.
11. Microscopic Examination of
    (i) Hardened samples and
    (ii) Hardened and tempered samples.

OUTCOME:
- Ability to perform Tension, Torsion, Hardness, Compression, and Deformation test on Solid materials.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Universal Tensile Testing machine with double 1 shear attachment – 40 Ton Capacity	1
2	Torsion Testing Machine (60 NM Capacity)	1
3	Impact Testing Machine (300 J Capacity)	1
4	Brinell Hardness Testing Machine	1
5	Rockwell Hardness Testing Machine	1
6	Spring Testing Machine for tensile and compressive loads (2500 N)	1
7	Metallurgical Microscopes	3
8	Muffle Furnace (800 C)	1

FLUID MECHANICS AND MACHINES LABORATORY 30

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

TOTAL: 60 PERIODS

OUTCOMES:
Upon completion of this course, the students will be able to:
- Perform Tension, Torsion, Hardness, Compression, and Deformation test on Solid materials.
- Use the measurement equipments for flow measurement.
- Perform test on different fluid machinery.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. NO.	NAME OF THE EQUIPMENT	Qty.
1	Orifice meter setup	1
2	Venturi meter setup	1
3	Rotameter setup	1
4	Pipe Flow analysis setup	1
5	Centrifugal pump/submergible pump setup	1
6	Reciprocating pump setup	1
7	Gear pump setup	1
8	Pelton wheel setup	1
9	Francis turbine setup	1
10	Kaplan turbine setup	1

ME8381　　　　　　**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 pump

                                                      TOTAL:60 PERIODS

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 the completion of this course the students will be able to
CO1   Follow the drawing standards, Fits and Tolerances
CO2   Re-create part drawings, sectional views and assembly drawings as per standards

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

REFERENCES:
1. N. D. Bhatt and V.M. Panchal, "Machine Drawing", 48th Edition, Charotar Publishers,2013
2. Junnarkar, N.D., "Machine Drawing", 1st Edition, Pearson Education, 2004
3. N. Siddeshwar, P. Kanniah, V.V.S. Sastri, "Machine Drawing" , published by Tata Mc GrawHill,2006
4. S. Trymbaka Murthy, "A Text Book of Computer Aided Machine Drawing", CBS Publishers, New Delhi, 2007

HS8381	INTERPERSONAL SKILLS/LISTENING&SPEAKING	L	T	P	C
		0	0	2	1

OBJECTIVES: The Course will enable learners to:
- Equip students with the English language skills required for the successful undertaking of academic studies with primary emphasis on academic speaking and listening skills.
- Provide guidance and practice in basic general and classroom conversation and to engage in specific academic speaking activities.
- improve general and academic listening skills
- Make effective presentations.

UNIT I

Listening as a key skill- its importance- speaking - give personal information - ask for personal information - express ability - enquire about ability - ask for clarification Improving pronunciation - pronunciation basics taking lecture notes - preparing to listen to a lecture - articulate a complete idea as opposed to producing fragmented utterances.

UNIT II

Listen to a process information- give information, as part of a simple explanation - conversation starters: small talk - stressing syllables and speaking clearly - intonation patterns - compare and contrast information and ideas from multiple sources- converse with reasonable accuracy over a wide range of everyday topics.

UNIT III

Lexical chunking for accuracy and fluency- factors influence fluency, deliver a five-minute informal talk - greet - respond to greetings - describe health and symptoms - invite and offer - accept - decline - take leave - listen for and follow the gist- listen for detail

UNIT IV

Being an active listener: giving verbal and non-verbal feedback - participating in a group discussion - summarizing academic readings and lectures conversational speech listening to and participating in conversations - persuade.

UNIT V

Formal and informal talk - listen to follow and respond to explanations, directions and instructions in academic and business contexts - strategies for presentations and interactive communication - group/pair presentations - negotiate disagreement in group work.

TOTAL :   30   PERIODS

OUTCOMES: At the end of the course Learners will be able to:
- Listen and respond appropriately.
- Participate in group discussions
- Make effective presentations
- Participate confidently and appropriately in conversations both formal and informal

TEXT BOOKS:
1. Brooks,Margret. Skills for Success. Listening and Speaking. Level 4 Oxford University Press, Oxford: 2011.
2. Richards,C. Jack. & David Bholke. Speak Now Level 3. Oxford University Press, Oxford: 2010

REFERENCES:
1. Bhatnagar, Nitin and MamtaBhatnagar. Communicative English for Engineers and Professionals. Pearson: New Delhi, 2010.
2. Hughes, Glyn and Josephine Moate. Practical English Classroom. Oxford University Press: Oxford, 2014.
3. Vargo, Mari. Speak Now Level 4. Oxford University Press: Oxford, 2013.
4. Richards C. Jack. Person to Person (Starter). Oxford University Press: Oxford, 2006.
5. Ladousse, Gillian Porter. Role Play. Oxford University Press: Oxford, 2014

MA8452	**STATISTICS AND NUMERICAL METHODS**	**L**	**T**	**P**	**C**
		4	**0**	**0**	**4**

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

UNIT I   TESTING OF HYPOTHESIS   12
Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

UNIT II   DESIGN OF EXPERIMENTS   12
One way and two way classifications - Completely randomized design – Randomized block design – Latin square design - 2^2 factorial design.

UNIT III   SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS   12
Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method - Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

**UNIT IV   INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL
                    INTEGRATION   12**
Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

UNIT V   NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS   12

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

TOTAL: 60 PERIODS

OUTCOMES :
Upon successful completion of the course, students will be able to:
- Apply the concept of testing of hypothesis for small and large samples in real life problems.
- Apply the basic concepts of classifications of design of experiments in the field of agriculture.
- Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and   integration for engineering problems.
- Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
- Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

TEXT BOOKS :
1. Grewal. B.S. and Grewal. J.S., "Numerical Methods in Engineering and Science ", 10th Edition, Khanna Publishers, New Delhi, 2015.
2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

REFERENCES :
1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 2006.
4. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 2004.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", 8th Edition, Pearson Education, Asia, 2007.

ME8491	ENGINEERING METALLURGY	L	T	P	C
		3	0	0	3

OBJECTIVE:
- To impart knowledge on the structure, properties, treatment, testing and applications of metals and non-metallic materials so as to identify and select suitable materials for various engineering applications.

UNIT I   ALLOYS AND PHASE DIAGRAMS   9

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

UNIT II   HEAT TREATMENT   9

Definition – Full annealing, stress relief, recrystallisation and spheroidising – normalising, hardening and Tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram CCR – Hardenability, Jominy end quench test - Austempering, martempering – case hardening, carburizing, Nitriding, cyaniding, carbonitriding – Flame and Induction hardening – Vacuum and Plasma hardening. .

UNIT III   FERROUS AND NON-FERROUS METALS   9

Effect of alloying additions on steel- α and β stabilisers– stainless and tool steels – HSLA, Maraging steels – Cast Iron - Grey, white, malleable, spheroidal – alloy cast irons, Copper and copper alloys – Brass, Bronze and Cupronickel – Aluminium and Al-Cu – precipitation strengthening treatment – Bearing alloys, Mg-alloys, Ni-based super alloys and Titanium alloys.

UNIT IV   NON-METALLIC MATERIALS   9

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of various thermosetting and thermoplastic polymers (PP, PS, PVC, PMMA, PET,PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE, Polymers – Urea and Phenol formaldehydes)- Engineering Ceramics – Properties and applications of Al_2O_3, SiC, Si_3N_4, PSZ and SIALON –Composites-Classifications-Metal Matrix and FRP - Applications of 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), hardness tests, Impact test Izod and charpy, fatigue and creep failure mechanisms.

TOTAL: 45 PERIODS

OUTCOMES
Upon the completion of this course the students will be able to
CO1   Explain alloys and phase diagram, Iron-Iron carbide diagram and steel classification.
CO2   Explain isothermal transformation, continuous cooling diagrams and different heat treatment processes.
CO3   Summarize the mechanism of plastic deformation and testing mechanical properties.
CO4   Clarify the effect of alloying elements on ferrous and non-ferrous metals.
CO5   Differentiate different non-mettalic materials.

TEXT BOOKS:
1. Avner,, S.H., "Introduction to Physical Metallurgy", McGraw Hill Book Company,1997.
2. Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, Revised Indian Edition 2014

REFERENCES:
1. U.C.Jindal : Material Science and Metallurgy, "Engineering Materials and Metallurgy", First Edition, Dorling Kindersley, 2012
2. Kenneth G.Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 2010.
3. Raghavan.V, "Materials Science and Engineering", Prentice Hall of India Pvt. Ltd., 2015.
4. Upadhyay. G.S. and Anish Upadhyay, "Materials Science and Engineering", Viva Books Pvt. Ltd., New Delhi, 2006.

PR8491   **COMPUTER INTEGRATED MANUFACTURING**   **L T P C**
                                                                              3 0 0 3

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

UNIT I   INTRODUCTION   9
Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerised elements of CIM system –Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In-Time Production.

**UNIT II   PRODUCTION PLANNING AND CONTROL AND COMPUTER AIDED PROCESS
                  PLANNING   9**
Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control-Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) - Simple Problems.

UNIT III   CELLULAR MANUFACTURING   9
Group Technology(GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method - Arranging Machines in a GT cell – Hollier Method – Simple Problems.

**UNIT IV   FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED
                  GUIDED VEHICLE SYSTEM (AGVS)   9**
Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety.

UNIT V   INDUSTRIAL ROBOTICS   9
Robot Anatomy and Related Attributes – Classification of Robots- Robot Control systems – End Effectors – Sensors in Robotics – Robot Accuracy and Repeatability - Industrial Robot Applications – Robot Part Programming – Robot Accuracy and Repeatability – Simple Problems.

TOTAL : 45 PERIODS

OUTCOMES:
Student will be able to
- Describe about the classical production system, the components of CIM .
- Explain the concept of Computer Aided Process Planning (CAPP) and Material Requirements Planning (MRP)
- Illustrate the cellular manufacturing using Rank order, Clustering and Hollier method
- Explain Flexible Manufacturing system and applications of Automated Guided Vehicles in the implementation of CIM..
- Describe the configurations of Industrial Robots, and their part programming.
- Understand the use of computers in various Manufacturing support systems.

TEXT BOOKS:
1. Mikell.P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008.
2. Radhakrishnan P, Subramanyan S.and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi, 2004.

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

PR8451	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 understand the importance of balancing and vibration.

UNIT I   KINEMATICS OF MACHINES   9
Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain – kinematics analysis in simple mechanisms – velocity and acceleration polygons – Cam and followers – classifications – displacement diagrams - layout of plate cam profiles – derivatives of followers motion

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 gears trains – epicyclic gear trains.

UNIT III   FRICTION   9
Types of friction – Friction Drives -friction in screw threads – bearings – Friction clutches – Belt drives

UNIT IV   BALANCING AND MECHANISM FOR CONTROL   9
Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines -Balancing a single cylinder engine – Balancing of Multi-cylinder inline, V-engines – Partial balancing in engines- Governors and Gyroscopic effects..

UNIT V   VIBRATION   9
Free, forced and damped vibrations of single degree of freedom systems – force transmitted to supports – vibration Isolation – vibration absorption – torsional vibration of shafts – single and multirotor systems – geared shafts – critical speed of shafts.

TOTAL: 45 PERIODS

OUTCOMES:

Student will be able to

- Understand the principles in the formation of mechanisms and their kinematics.
- Understand the construction features of Gears and Gear Trains.
- Understand the effect of friction in different machine elements.
- Understand the importance of balancing.
- Understand the importance of Governors and Gyroscopic effects.
- Understand the importance of vibration.

TEXT BOOKS:

1. Ambekar A.G.,Mechanism and Machine Theoryǁ Prentice Hall of India, New Delhi, 2007
2. Shigley J.E., Pennock G.R and Uicker J.J., —Theory of Machines and Mechanismsǁ, Oxford University Press, 2003

REFERENCES:

1. Ghosh.A, and A.K.Mallick, —Theory and Machine ǁ, Affiliated East-West Pvt. Ltd., New Delhi, 1988.
2. Ramamurthi. V., "Mechanisms of Machine", Narosa Publishing House, 2005.
3. Rao.J.S. and Dukkipatti R.V. —Mechanisms and Machines ǁ, Wiley-Eastern Ltd., New Delhi, 1998.
4. Robert L.Norton, "Design of Machinery", McGraw-Hill, 2012.
5. Thomas Bevan, —Theory of Machinesǁ, CBS Publishers and Distributors, 2010.

PR8401   **FLUID POWER DRIVES AND CONTROL**   **L T P C**
                                                                                    3 0 0 3

OBJECTIVES:

- To understand the working principle of hydraulic and pneumatic components and its selection
- To design hydraulic and pneumatic circuits for different applications

UNIT I   INTRODUCTION TO FLUID POWER   9

Introduction to fluid power controls – Hydraulics and pneumatics – Selection criteria, Application of Fluid power, Application of Pascal's Law, equation, Transmission and multiplication of force – Pressure Losses – Fluids, selection & properties – ISO symbols.

UNIT II   FLUID POWER DRIVES   9

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

UNIT III   FLUID POWER ELEMENTS   9

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

UNIT IV   HYDRAULIC AND PNEUMATIC CIRCUITS DESIGN   9
Design of Hydraulic and pneumatic circuits for automation, selection and specification of circuit components, sequencing circuits, cascade, and karnaugh – Veitch map method – Regenerative, speed control and synchronizing circuits.

UNIT V   ELECTRO PNEUMATICS AND PLC CIRCUITS   9
Use of electrical timers, switches, solenoid, relays and proximity sensors electro pneumatic sequencing - PLC – elements, functions and selection – PLC programming – Ladder diagram and different programming methods - Sequencing circuits.

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able
- To understand the fundamentals of pneumatics and hydraulics and its principles
- To understand constructional and operational features about the hydraulic and pneumatic drives system
- To identify pneumatic and hydraulic components and their functions
- To design basic and advanced pneumatic and hydraulic circuits for industrial applications
- To understand the basic concepts, elements and functions of Programmable Logic Controller

TEXT BOOKS:
1. Anthony Esposito "Fluid power with applications",7th Edition, Pearson education 2014.
2. Majumdar, "Oil hydraulics: Principles and Maintenance",7th Edition, Tata McGraw Hill, 2005
3. Majumdar, "Pneumatic system: Principles and Maintenance", Tata McGraw Hill, 2006

REFERENCES:
1. Srinivasan. R., "Hydraulic and Pneumatic Controls", Vijay Nicole Imprints Private Limited, 2011.
2. William W.Reaves, "Technology of Fluid Power", Delmer Publishers, 1997.
3. Petor Rohner, "Fluid Power Logic circuit", Design Macmillon Press Ltd., 1990.
4. Andrew Parr "Hydraulics & Pneumatics, Jaico Publishing House, 2004

PR8481	METALLURGY LABORATORY	L T P C
		0 0 4 2

OBJECTIVES:
- To train the students in observation and interpretation of Microstructure of Engineering materials.
- To train students in Heat treatment, hardenability and surface treatment of Engineering Materials
- To train the students in testing of Foundry sand

LIST OF EXPERIMENTS:
1. Specimen preparation for macro – examination.
2. Specimen preparation for micro examination and study of Micro structure of –
   a) Carbon steel s(High, Medium, and Low)
   b) Cast Iron (Gray, White, Nodular, Malleable)
   c) Brass (70/30), Bronze (tin bronze), Al-Si alloy, cupro-nickel, Ti alloy.
3. Quantitative metallography – Estimation of volume fraction, particle size, size distribution, and shape.
4. Cooling curves
   a) Pure Metal (Pb or Sn)
   b) Alloy (Pb-Sn or Pb-Sb)

5. Heat treatments (carry out the following heat treatment and study the micro structure before and after heat treatments)
    a) Annealing
    b) Normalising
    c) Quench Hardening
    d) Tempering
6. Jominy End Quench Test
7. Foundry Sand testing
    a) Sieve analysis
    b) Strength of moulding sand
    c) Permeability of moulding sand
    d) Clay content of moulding sand
    e) Moisture content of moulding sand
8. Electro-chemical Test
    a) Electro deposition
    b) Electro-chemical etching test

TOTAL: 60 PERIODS

OUTCOMES:
- Ability to interpret the microstructure of different ferrous and non ferrous alloy.
- Ability to perform quantitative metallography.
- Ability to perform heat treatment, surface treatment on metals.
- Ability to analyze the properties of Foundry Sand.
- Ability to perform Electro Chemical Test.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Jominy End Quench Test	1
2	Specimen Mounting Test with Digital Measurements	1
3	Trinocular Microscopes with Objective Lens	2
4	Disc Polishing Machine	2
5	Muffle Furnace	1
6	Optical Microscope with Image Analyzing Software	1
7	Micro Vicker Hardness Tester	1
8	Printer to print the Microstructure	1
9	Hardness Tester (Brinnel or Rockwell)	1

PR8411   **FLUID POWER LABORATORY**   **L T P C**
                                                               0 0 4 2

OBJECTIVES:
- To study the functional aspects of different pneumatic and hydraulic components and its usage in circuits.
- To train the students in designing different pneumatic and hydraulic circuits for different application.

LIST OF EXPERIMENTS
1. Study and use of pneumatic and hydraulic elements.
2. Simulation of speed control circuits in a hydraulic trainer.
3. Simulation of hydraulic circuits in a hydraulic trainer.

4. Simulation of single and double acting cylinder circuits using different directional control values
5. One shot and regenerative pneumatic circuits
6. Sequencing of pneumatic circuits
7. Simulation of Electro-pneumatic latch circuits
8. Simulation of Logic pneumatic circuits
9. Simulation of electro pneumatic sequencing circuits
10. Simulation of PLC based electro pneumatic sequencing circuits
11. Simulation of pneumatic circuits using PLC

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course, the students will have the
- Ability to understand the operational features of pneumatic and hydraulic elements.
- Ability to select and apply different pneumatics components to design fluid power circuit.
- Ability to select and apply different hydraulic components to design fluid power circuit.
- Ability to simulate the Electro-pneumatic latch circuits.
- Ability to simulate PLC based electro pneumatic circuits.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Hydraulic Trainer	1
2	Electro Hydraulic Trainer	1
3	PLC Based Hydraulic Trainer	1
4	Hydraulic Accumulator Intensifier, Press.	1
5	Transparent Hydraulic & Pneumatic Trainer	1
6	Vane Pump Test Rig	1
7	Pneumatic Trainer	1
8	Electro Pneumatic Trainer	1
9	PLC Based Pneumatic Trainer	1
10	Gear Pump Test Rig	1

ME8481   **DYNAMICS LABORATORY**   **L T P C**
                                                                          0 0 4 2

OBJECTIVES:

- To supplement the principles learnt in kinematics and Dynamics of Machinery.
- To understand how certain measuring devices are used for dynamic testing.

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 Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker, 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, effort etc., 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

OUTCOMES:
  ☐ Ability to demonstrate the principles of kinematics and dynamics of machinery
  ☐ Ability to use the measuring devices for dynamic testing.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Cam follower setup.	1 No.
2	Motorised gyroscope.	1 No.
3	Governor apparatus - Watt, Porter, Proell and Hartnell governors.	1 No.
4	Whirling of shaft apparatus.	1 No.
5	Dynamic balancing machine.	1 No.
6	Two rotor vibration setup.	1 No.
7	Spring mass vibration system.	1 No.
8	Torsional Vibration of single rotor system setup.	1 No.
9	Gear Models	1 No.
10	Kinematic Models to study various mechanisms.	1 No.
11	Turn table apparatus.	1 No.
12	Transverse vibration setup of a) cantilever b) Free-Free beam c) Simply supported beam.	1 No.

PR8501   **ENGINEERING METROLOGY AND MEASUREMENTS**   **L T P C**
                                                                        3 0 0 3

OBJECTIVES:
- To understand the basic principles of measurements
- To learn about various methods of measuring Mechanical parameters

UNIT I   CONCEPT OF MEASUREMENT   9
General concept – Generalised measurement system-Units and standards-measuring instruments: sensitivity, stability, range, accuracy and precision-static and dynamic response-repeatability-systematic and random errors-correction, calibration - Introduction to Dimensional and Geometric Toleranceing – interchangeability.

UNIT II   LINEAR AND ANGULAR MEASUREMENT   9
Definition of metrology-Linear measuring instruments: Vernier, micrometer, Slip gauges and classification, - Tool Makers Microscope - interferometery, optical flats, - Comparators: limit gauges Mechanical, pneumatic and electrical comparators, applications. Angular measurements: -Sine bar, Sine center, bevel protractor and angle Decker..

UNIT III   FORM MEASUREMENT   9
Measurement of screw threads: Thread gauges, floating carriage micrometer measurement of gear tooth thickness: constant chord and base tangent method-Gleason gear testing machine – radius measurements-surface finish: equipment and parameters, straightness, flatness and roundness measurements.

UNIT IV   LASER AND ADVANCES IN METROLOGY   9
Precision instruments based on laser-Principles- laser interferometer-application in measurements and machine tool metrology- Coordinate measuring machine (CMM): need, construction, types, applications.- computer aided inspection.

UNIT V   MEASUREMENT OF MECHANICAL PARAMETERS   9
Force, torque, power:-mechanical, pneumatic, hydraulic and electrical type-Pressure measurement - Flow: Venturi, orifice, rotameter, pitot tube –Temperature: bimetallic strip, thermocouples, pyrometer, electrical resistance thermistor

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course the student will be able
- Define the basic concepts and terminology in measurements.
- Differentiate the principle, operation of linear and angular measuring instruments
- Mathematically define the method of form measurements of screw threads, surface roughness and basic feature form.
- Explain the applications of laser on dimensional measurements &computer aided inspection.
- Illustrate the working principles of different measuring instruments for measuring mechanical parameters

TEXT BOOKS
1. Alan S. Morris, "The Essence of Measurement", Prentice Hall of India, 1997
2. Jain R.K., "Engineering Metrology", Khanna Publishers, 2009

REFERENCES
1. Gupta S.C, "Engineering Metrology", Dhanpat rai Publications, 2005
2. Jayal A.K, "Instrumentation and Mechanical Measurements", Galgotia Publications 2000
3. Beckwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education, 2006.
4. Donald Deckman, "Industrial Instrumentation", Wiley Eastern, 1985.

MF8791   **METAL FORMING TECHNOLOGY**   **L T P C**

                                                                        3 0 0 3

OBJECTIVE:
- To understand the principle, procedure and applications of Bulk Metal Forming and Sheet Metal Forming.

UNIT I   FUNDAMENTALS OF METAL FORMING   9
State of stress – Components of stress, symmetry of stress tensor, principal stresses – Stress deviator – von-mises, Tresca yield criteria – Octahedral shear stress and shear strain theory – Flow stress determination – Temperature in metal forming – Hot, cold and warm working – strain rate effects –metallurgical structures – residual stresses – Spring back.

UNIT II   FORGING AND ROLLING   9
Principle – classification – equipment – tooling – processes parameters and calculation of forces during forging and rolling processes – Ring compression test - Post forming heat treatment – defects (causes and remedies) – applications – Roll forming.

UNIT III   EXTRUSION AND DRAWING PROCESSES   9
Classification of extrusion processes – tool, equipment and principle of these processes – influence of friction – extrusion force calculation – defects (causes and remedies) – Rod/Wire drawing – tool, equipment and principle of processes – defects – Tube drawing and sinking processes – mannessmann process of seamless pipe manufacturing – Tube bending.

UNIT IV   SHEET METAL FORMING PROCESSES   9
Classification – conventional and HERF processes – presses – types and selection of presses – formability studies – FLD, Limiting Draw ratio - processes: Deep drawing, spinning, stretch forming, plate bending, Rubber pad forming, bulging and press brake forming – Explosion forming, electro hydraulic forming, Magnetic pulse forming.

,
UNIT V   RECENT ADVANCES   9
Super plastic forming – Electro forming – fine blanking – Hydro forming – Peen forming – Laser Forming – Micro forming - P/M forging – Isothermal forging – high speed hot forging – near net shape forming high velocity extrusion – CAD and CAM in forming.

                                                   TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of this course, the students can able to
- To understand the fundamental mechanics of metal forming processes
- To learn the principle, classification, equipments used and applications of Rolling and Forging Processes
- To learn the principle, classification, equipment's used and applications of Extrusion and Drawing Processes
- To understand the principle, procedure of various sheet metal forming processes
- To study about the recent advances in technology for metal forming

TEXT BOOKS:
1. Dieter G.E., **"Mechanical Metallurgy"**, McGraw Hill, Co., S.I. Edition, 2001
2. Nagpal G.R. **"Metal forming processes"**, Khanna publishers, New Delhi, 2004

REFERENCES:
1. Serope Kalpakjian, Steven R Schmid, **"Manufacturing Process for Engineering Materials"**, 4th Edition, Pearson Education, 2003.
2. Rao, P.N. **"Manufacturing Technology"**, TMH Ltd., 2003
3. Edward M.Mielink, **"Metal working Science Engineering"**, McGraw Hill, Inc, 2000.
4. Metal Handbook Vol.14, **"Forming and Forging"**, Metal Park, Ohio, USA, 1990

PR8551   DESIGN OF MACHINE ELEMENTS AND TRANSMISSION SYSTEMS   L T P C
3 2 0 4

OBJECTIVE:
- To introduce students to the design and theory of common machine elements and to give students experience in solving design problems involving machine elements.

UNIT I   INTRODUCTION   9+6
Fundamentals of Machine Design-Engineering Design, Phases of Design, Design Consideration - Standards and Codes - Selection of Materials –Design against Static and Dynamic Load –Modes of Failure, Factor of Safety, Principal Stresses, Theories of Failure-Stress Concentration, Stress Concentration Factors, Variable Stress, Fatigue Failure, Endurance Limit, Design for Finite and Infinite Life, Soderberg and Goodman Criteria.

UNIT II   DETACHABLE AND PERMANENT JOINTS   9+6
Design of Bolts under Static Load, Design of Bolt with Tightening/Initial Stress, Design of Bolts subjected to Fatigue – Keys -Types, Selection of Square and Flat Keys-Design of Riveted Joints and Welded Joints

UNIT III   SHAFTS AND COUPLING   9+6
Design of Shaft –For Static and Varying Loads, For Strength and Rigidity-Design of Coupling-Types, Flange, Muff and Flexible Rubber Bushed Coupling

UNIT IV   GEARS AND BELT DRIVES   9+6
Design of Spur and Helical Gear drives-Design of Belt drives-Flat and V Belts

UNIT V   SPRINGS AND BEARINGS   9+6
Design of Helical Spring-Types, Materials, Static and Variable Loads-Design of Leaf Spring-Design of Journal Bearing -Antifriction Bearing-Types, Life of Bearing, Reliability Consideration, Selection of Ball and Roller Bearings

TOTAL: 75 PERIODS

OUTCOMES:
Upon completion of this course, the students can able
- To formulate and analyze stresses and strains in machine elements subjected to various loads
- To analyze and design structural joints such as Riveted joints, welded joints, Bolts
- To analyze and design the components for power transmission like shaft and couplings.
- To analyze and design different types of gears and belts for engineering applications.
- To analyze and design mechanical springs and bearings.

TEXT BOOKS:
1. Joseph Edward Shigley, Charles R. Mischke " Mechanical Engineering Design", McGraw Hill, International Edition, 1992
2. Sharma. C.S. and Kamlesh Purohit, " Design of Machine Elements", Prentice Hall of India Private Limited, 2003

REFERENCES:
1. Bhandari. V.B., "Design of Machine Elements", Tata McGraw-Hill Publishing Company Limited, 2003.
2. Robert L.Norton, "Machin Design – An Integrated Approach", Prentice Hall International Edition, 2000.

PR8502   **FOUNDRY TECHNOLOGY**   **L T P C**
                                                                       3 0 0 3

OBJECTIVE:
- To understand the principle, procedure and applications of various foundry processes.

UNIT I   CASTING PROCESS   9
Introduction to casting – pattern – materials allowances – coding – types – moulds – mould making, sand – properties, types and testing of sands – core making – type of cores – single box, two box and 3 box moulding processes.

UNIT II   CASTING METALLURGY   9
Solidification of pure metal and alloys – shrinkage in cast metals – progressive and directional solidification –– Degasification of the melt-casting defects – Castability of steel , Cast Iron, Al alloys , Babbit alloy and Cu alloy.

UNIT III   DESIGN OF GATING SYSTEMS   9
Gating systems and their characteristics; the effects of gates on aspiration; turbulence and dross trap; recent trends. Chvorinov's Rule - Riser design - NRL method of riser design; feeding distance;

UNIT IV   RECENT TRENDS IN CASTING AND FOUNDRY LAYOUT   9
Shell moulding, precision investment casting, CO_2 moulding, centrifugal casting, Die casting, Continuous casting, Counter gravity low pressure casting, Squeeze casting and semi-solid processes. Layout of mechanized foundry – sand reclamation – material handling in foundry pollution control in foundry –– Computer aided design of casting.

UNIT V   TESTING OF CASTINGS   9
Causes and remedies for casting defects –Destructive testing – NDT – Dye penetrant – magnetic particle – X-ray, ultrasonics- case studies in testing of joints & castings. Methods of elimination and control of dissolved gases in castings. use of statistical quality control in foundry.
                                                                TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course, the students can able
- To understand of various steps in Casting Process.
- To analyze Casting Solidification and Castability of metals.
- To design different casting system and use different Foundry practices.
- To study of various recent trends in Casting methods.
- To perform different testing to study the defect in the casting and apply engineering skills to minimise the defects.

TEXT BOOKS:
1. Jain P.L., Principles of Foundry Technology, Tata McGraw Hill Publishers, 2003
2. Principle of metal casting – Heine Loper and Rosenthal – Tata McGraw Hill – 2005

REFERENCES
1. ASM Handbook, Vol 15, Casting, 2004
2. Taylor H.F., Fleming.M.C.,, "Foundry Engineering" M.C. & Wiley Eastern Ltd., 2009

PR8592   **WELDING TECHNOLOGY**   **L T P C**
                                                                          3 0 0 3

OBJECTIVE:
- To understand the basics of welding and to know about the various types of welding processes

UNIT I   GAS AND ARC WELDING PROCESSES: 9
Fundamental principles – Air Acetylene welding, Oxyacetylene welding, Carbon arc welding, Shielded metal arc welding, Submerged arc welding, TIG & MIG welding, Plasma arc welding and Electroslag welding processes - advantages, limitations and applications.

UNIT II   RESISTANCE WELDING PROCESSES: 9
Spot welding, Seam welding, Projection welding, Resistance Butt welding, Flash Butt welding, Percussion welding and High frequency resistance welding processes - advantages, limitations and applications.

UNIT III   SOLID STATE WELDING PROCESSES: 9
Cold welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction welding, Forge welding, Roll welding and Hot pressure welding processes - advantages, limitations and applications.

UNIT IV   OTHER WELDING PROCESSES: 9
Thermit welding, Atomic hydrogen welding, Electron beam welding, Laser Beam welding, Friction stir welding, Under Water welding, Welding automation in aerospace, nuclear and surface transport vehicles.

UNIT V   DESIGN OF WELD JOINTS, WELDABILITY AND TESTING OF WELDMENTS   9
Various weld joint designs – Welding defects – causes and remedies - Weldability of Aluminium, Copper, and Stainless steels. Destructive and non destructive testing of weldments.
                                                                 TOTAL : 45 PERIODS
OUTCOMES:
Upon completion of this course, the students can able
- Understand the construction and working principles of gas and arc welding process.
- Understand the construction and working principles of resistance welding process.
- Understand the construction and working principles of various solid state welding process.
- Understand the construction and working principles of various special welding processes.
- Understand the concepts on weld joint design, weldability and testing of weldments.

TEXT BOOKS
1. Little R.L., "Welding and welding Technology", Tata McGraw Hill Publishing Co., Ltd., New Delhi, 34th reprint, 2008.
2. Parmer R.S., "Welding Engineering and Technology", 1st Edition, Khanna Publishers, New Delhi, 2008.
3. Parmer R.S., "Welding Processes and Technology", Khanna Publishers, New Delhi, 1992.

REFERENCES
1. AWS- Welding Hand Book. 8th Edition. Vol- 2. "Welding Process"
2. Christopher Davis. "Laser Welding- Practical Guide". Jaico Publishing House.
3. Davis A.C., "The Science and Practice of Welding", Cambridge University Press, Cambridge, 1993
4. Nadkarni S.V. "Modern Arc Welding Technology", Oxford IBH Publishers, 1st Edition, 2005.
5. Schwartz M.M. "Metals Joining Manual". McGraw Hill Books, 1979.
6. Tylecote R.F. "The Solid Phase Welding of Metals". Edward Arnold Publishers Ltd. London.

PR8511   **WELDING AND FOUNDRY LABORATORY**   **L T P C**
                                                                 0 0 4 2

OBJECTIVE:
- To familiarize the students with test procedures followed in foundry and to practice various types of welding processes.

LIST OF EXPERIMENTS
Welding
1. Study of different welding equipments and accessories: Gas, Electric Welding
2. Oxy-acetylene gas welding of Lap joint, Butt Joint and T Joint.
3. Electric arc welding of Lap Joint, Butt Joint, and T Joint.
4. Welding of pipes in different positions.
5. Brazing practice – furnace brazing.
6. Brazing welding of cast iron.
7. Thermit welding of thick material like rod plates etc.

Foundry
1. Preparation of green moulding sand using a 5 kg muller and testing for Compression, shear, tensile, transverse strengths, hardness
2. in green condition:
3. in dry condition after drying in oven at 150º C for one and half hour.
4. Permeability testing.
5. Determining the clay content.
6. Sieve analysis of dry silica sand.
7. Determining the moisture content by various methods.
8. Melting any non-ferrous metal and making simple castings - Demonstration.

TOTAL: 60 PERIODS

OUTCOMES:
Upon completion of this course, the students will have
- Ability to perform gas welding operations to form the metals
- Ability to perform arc welding operations to form the metals
- Ability to perform brazing operations.
- Ability to carry out the foundry practices and perform different test required to characteristic transfer materials.
- Ability to perform sand and die casting process.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	5 Kg Muller	1
2	Sand rammer	1
3	Weighing balance	1
4	Universal sand strength testing with all accessories	1 SET
5	Permeability tester	1
6	Quick moisture tester	1
7	Infra-red drier	1
8	Sieve shaker with Sieves	1 SET
9	Crucible furnace	1
10	Oxy acetylene gas welding equipment	1 SET

PR8561 **METROLOGY LABORATORY** **L T P C**
0 0 4 2

OBJECTIVE:
- To familiar with different measurement equipments and use of this industry for quality inspection

LIST OF EXPERIMENTS
1. Measurements of angle using Sine bar / bevel protractor
2. Measurement of External and internal Taper angle
3. Measurement of Bore Diameter
4. Calibration of Dial gauge
5. Measurement of Roundness
6. Measurements of Screw Thread Parameters using three-wire method
7. Measurements of Surface Roughness
8. Measurements using Toolmakers Microscope
9. Measurements using Profile Projector
10. Measurements using Vision System
11. Measurements using CMM

TOTAL:60 PERIODS

OUTCOMES:
Upon completion of this course, the students will have
- Ability to handle different basic measurement tools and perform precise measurements.
- Ability to measure the surface roughness both manually and using sophisticated device.
- Ability to measure the dimensions using CMM.
- Ability to measure the dimension using Vision System.
- Ability to calibrate the measuring device.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Vernier Calipers 0-150 mm	5
2	Vernier Calipers 0-300 mm	2
3	Micrometer 0-25 mm	5
4	Micrometer 25-50 mm	2
5	Micrometer 50-75 mm	2
6	Dial gauges LC 10micrometer	3
7	Dial gauge L.C. 2micrometer	12
8	Height gauge Analog	1
9	Height gauge Digital	1
10	Slip gauge set	2 SET
11	Sine Bar 100 mm	1
12	Sine Bar 200 mm	2
13	Toolmakers microscope	1
14	Profile Projector	1
15	Gear tooth verniers	2
16	Flangernic 0-25	1
17	Flangemic 25-50	1
18	Floating carriage micrometer	1
19	Thread plug gauges m24 x 3	1
20	Thread plug gauges m20 x 2.5	1
21	3 wire set box	1

22	Surface roughness measuring Instrument	1
23	Precision spheres different dia	1 SET
24	Dial Guage Caliberator	1
25	Precision level	1
26	Digital Micrometer	1
27	Digital Vernier 0-150 mm	1
28	Digital Ht. Guage	1
29	Bevel Protractor	1
30	CMM	1
31	Vision measuring system	1
32	Boredial gauge 16-35, 35-60	1 BOX
33	Depth Vernier 0-150mm	1
34	Depth micrometer with 6 rods	1
35	Internal micrometer with Extn sleeves	1
36	Precision Rollers 8	2
37	Surface plate	1
38	Bench centre	1

HS8581	**PROFESSIONAL COMMUNICATION**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

OBJECTIVES: The course aims to:
- Enhance the Employability and Career Skills of students
- Orient the students towards grooming as a professional
- Make them Employable Graduates
- Develop their confidence and help them attend interviews successfully.

UNIT I
Introduction to Soft Skills-- Hard skills & soft skills - employability and career Skills—Grooming as a professional with values—Time Management—General awareness of Current Affairs

UNIT II
Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice— presenting the visuals effectively – 5 minute presentations

UNIT III
Introduction to Group Discussion— Participating in group discussions – understanding group dynamics - brainstorming the topic -– questioning and clarifying –GD strategies- activities to improve GD skills

UNIT IV
Interview etiquette – dress code – body language – attending job interviews– telephone/skype interview -one to one interview &panel interview – FAQs related to job interviews

UNIT V
Recognizing differences between groups and teams- managing time-managing stress- networking professionally- respecting social protocols-understanding career management-developing a long-term career plan-making career changes

TOTAL :   30   PERIODS

OUTCOMES:
At the end of the course Learners will be able to:
- Make effective presentations
- Participate confidently in Group Discussions.
- Attend job interviews and be successful in them.
- Develop adequate Soft Skills required for the workplace

Recommended Software
1. Globearena
2. Win English

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

IE8693	PRODUCTION PLANNING AND CONTROL	L T P C
		3 0 0 3

OBJECTIVES:
- To understand the various components and functions of production planning and control such as work study, product planning, process planning, production scheduling, Inventory Control.
- To know the recent trends like manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

UNIT I   INTRODUCTION   9
Objectives and benefits of planning and control-Functions of production control-Types of production job- batch and continuous-Product development and design-Marketing aspect - Functional aspects Operational aspect-Durability and dependability aspect aesthetic aspect. Profit consideration Standardization, Simplification & specialization- Break even analysis-Economics of a new design.

UNIT II   WORK STUDY   9
Method study, basic procedure-Selection-Recording of process - Critical analysis, Development Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data Predetermined motion time standards.

UNIT III   PRODUCT PLANNING AND PROCESS PLANNING   9
Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning Steps in process planning-Quantity determination in batch production-Machine capacity, balancing Analysis of process capabilities in a multi product system.

UNIT IV   PRODUCTION SCHEDULING   9

Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual loading-Basic scheduling problems - Line of balance – Flow production scheduling Batch production scheduling-Product sequencing – Production Control systems-Periodic batch control-Material requirement planning kanban – Dispatching-Progress reporting and expediting Manufacturing lead time-Techniques for aligning completion times and due dates.

UNIT V   INVENTORY CONTROL AND RECENT TRENDS IN PPC   9

Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system - Ordering cycle system-Determination of Economic order quantity and economic lot size ABC analysis-Recorder procedure-Introduction to computer integrated production planning systems elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

TOTAL: 45 PERIODS

OUTCOMES:
- Upon completion of this course, the students can able to prepare production planning and control activities such as work study, product planning, production scheduling, Inventory Control
- They can plan manufacturing requirements manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

TEXT BOOKS:
1. James.B.Dilworth,"Operations Management – Design, Planning and Control for Manufacturing and Services" McGraw Hill International Edition, 1992.
2. Martand Telsang, "Industrial Engineering and Production Management", First Edition, S. Chand and Company, 2000.

REFERENCES:
1. Chary. S.N., "Theory and Problems in Production & Operations Management", Tata McGraw Hill, 1995.
2. Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / Operations Management", 8th Edition John Wiley and Sons, 2000.
3. Jain. K.C. & Aggarwal. L.N., "Production Planning Control and Industrial Management", Khanna Publishers, 1990.
4. Kanishka Bedi, "Production and Operations management", 2nd Edition, Oxford university press, 2007.
5. Melynk, Denzler, " Operations management – A value driven approach" Irwin Mcgrawhill.
6. Norman Gaither, G. Frazier, "Operations Management" 9th Edition, Thomson learning IE, 2007
7. Samson Eilon, "Elements of Production Planning and Control", Universal Book Corpn.1984
8. Upendra Kachru, " Production and operations management – Text and cases" 1st Edition, Excel books 2007

PR8601   **COMPUTER AIDED PRODUCT DESIGN**   **L T P C**
                                                                               3 0 0 3

OBJECTIVES:
- To introduce the concepts and applications of CAD
- To introduce the various concepts and techniques used for Product design and to develop product design skills.

UNIT I   INTRODUCTION TO COMPUTER AIDED DESIGN   9
Introduction to Engineering Design – Various phases of systematic design – sequential engineering and concurrent engineering – Computer hardware & Peripherals – software packages for design and drafting.

UNIT II   COMPUTER GRAPHICS FUNDAMENTALS   9
Computer graphics – applications – principals of interactive computer graphics – 2D, 3D transformations – projections – curves – Bezier, B-Spline and NURBS – Concepts.

UNIT III   GEOMETRIC MODELING   9
Geometric Modeling – types – Wire frame, surface and solid modeling – Boundary Representation, constructive solid geometry – Graphics standards – assembly modeling – use of software packages

UNIT IV   PRODUCT DESIGN CONCEPTS   9
Product modeling – types of product models; product development process tools – TRIZ – Altshuller's inventive principles – Modeling of product metrics – Design for reliability – design for manufacturability – machining, casting, and metal forming – design for assembly and disassembly - Design for environment; Bench marking – FMEA – QFD – DOE – Taguchi method of DOE – Quality loss functions – Design for product life cycle.

UNIT V   PRODUCT DATA MANAGEMENT   9
Product Data Management – concepts – Collaborative product design and commerce – Information Acquisition – Sourcing factor – manufacturing planning factor – Customization factor – Product life cycle management.

                                                                    TOTAL: 45 PERIODS
OUTCOMES:
Upon completion of this course, the students
- Will be able to design and develop a system or component systematically in various stages.
- Have the ability to select suitable hardware and software for particular applications.
- Have potential to create geometric modeling and assembly modeling based on requirement using computer graphics.
- Have acquired knowledge to design a component by considering different aspects like manufacturing, assembly, usage etc.
- Will be able to manage various product data.

TEXT BOOKS
1. Kevin Otto, Kristin Wood, "Product Design", Pearson Education, 2011
2. Ibrahim Zeid, "CAD/CAM theory and Practice", Tata McGraw Hill, 1991.

REFERENCES
1. Biren Prasad, "Concurrent Engineering Fundamentals Vol.11", Prentice Hall, 1997.
2. James G.Bralla, "Handbook of Product Design for Manufacturing", McGraw Hill, 1994
3. David F.Rogers.J, Alan Adams, "Mathematical Elements for Computer Graphics", McGraw Hill, 1990

PR8602   **METAL CUTTING AND CNC MACHINES**   **L T P C**
                                                                          3 0 0 3

OBJECTIVES:
- To understand the theory of metal cutting
- To understand the concepts of gear manufacture
- To understand CNC machines constructional features, working and programming

UNIT I   MECHANICS OF METAL CUTTING   10
Tool nomenclature – single point and multi point cutting tools – orthogonal & oblique cutting – cutting forces, Merchant circle diagram – force & velocity relationship.

UNIT II   TOOL MATERIAL, TOOL WEAR AND TOOL LIFE   9
Requisites of tool materials – types of tool materials – Tool wear – Types, mechanism – Tool life - Machinability - types of chips – cutting fluids.

UNIT III   GEAR MANUFACTURE   8
Different methods of gear manufacture – Gear hobbling and gear shapi ng machines specifications – gear generation – different methods – gear finishing and shaving – grinding and lapping of hobs and shaping cutters – gear honing – gear broaching.

UNIT IV   CNC MACHINES   9
NC, CNC & DNC – types of CNC – constructional features – drives and control systems – feed back devices – Interchangeable tooling system – preset & qualified tools – ISO specification – Machining center – Turning center – CNC wire cut EDM.

UNIT V   CNC PROGRAMMING   9
Manual part programming – steps involved – sample program in lathe & milling. - Computer aided part programming – APT - CAM package – canned cycles - Programming.

                                                                 TOTAL: 45 PERIODS
OUTCOMES:
Upon completion of this course, students will be able
- To apply the principles of metal cutting and mechanics in machining process.
- To select tool materials based on requirement.
- To understood the concepts of various gear manufacturing methods.
- To acquire knowledge on modern material removal process like EDM.
- To perform CNC and APT program for turning and machining centre.

TEXT BOOKS
1. Nagpal G.R., "Machine Tool Engineering", Khanna Publishers, 2002
2. Groover.M.P., "Automatiion, production systems and computer integrated manufacturing", Prentice Hall , 2008

REFERENCES
1. GE Thyer, "Computer Numerical Control of Machine Tools", BH. Newners, 1991
2. Hajra Choudhury C.J., "Elements of Workshop Technology", Vol.I and Vol.II, Asia Publishing House, 2010.
3. Jonathan Lin.S.C., "Computer Numerical Control from Programming to Networking", Delmar Publishers, 1994

ME8095   **DESIGN OF JIGS, FIXTURES AND PRESS TOOLS**   **L T P C**
                                                                       3 0 0 3

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

UNIT I   LOCATING AND CLAMPING PRINCIPLES: 9
Objectives of tool design- Function and advantages of Jigs and fixtures – Basic elements – principles of location – Locating methods and devices – Redundant Location – Principles of clamping – Mechanical actuation – pneumatic and hydraulic actuation Standard parts – Drill bushes and Jig buttons – Tolerances and materials used.

UNIT II   JIGS AND FIXTURES   9
Design and development of jigs and fixtures for given component- Types of Jigs – Post, Turnover, Channel, latch, box, pot, angular post jigs – Indexing jigs – General principles of milling, Lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures – Modular fixturing systems- Quick change fixtures.

UNIT III   PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES   9
Press Working Terminologies - operations – Types of presses – press accessories – Computation of press capacity – Strip layout – Material Utilization – Shearing action – Clearances – Press Work Materials – Center of pressure- Design of various elements of dies – Die Block – Punch holder, Die set, guide plates – Stops – Strippers – Pilots – Selection of Standard parts – Design and preparation of four standard views of simple blanking, piercing, compound and progressive dies.

UNIT IV   BENDING AND DRAWING DIES   9
Difference between bending and drawing – Blank development for above operations – Types of Bending dies – Press capacity – Spring back – knockouts – direct and indirect – pressure pads – Ejectors – 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.

UNIT V   FORMING TECHNIQUES AND EVALUATION   9
Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine Blanking dies – 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.
                                                    TOTAL: 45 PERIODS
Note: (Use of P S G Design Data Book is permitted in the University examination)

OUTCOMES:
  Upon the completion of this course the students will be able to
  CO1   Summarize the different methods of Locating Jigs and Fixtures and Clamping principles
  CO2   Design and develop jigs and fixtures for given component
  CO3   Discuss the press working terminologies and elements of cutting dies
  CO4   Distinguish between Bending and Drawing dies.
  CO5   Discuss the different types of forming techniques

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", wheels publishing, 1996

REFERENCES:
1. ASTME Fundamentals of Tool Design Prentice Hall of India.
2. Design Data Hand Book, PSG College of Technology, Coimbatore.
3. Donaldson, Lecain and Goold "Tool Design", 5th Edition, Tata McGraw Hill, 2017.
4. Hoffman "Jigs and Fixture Design", Thomson Delmar Learning, Singapore, 2004.
5. Kempster, "Jigs and Fixture Design", Third Edition, Hoddes and Stoughton, 1974.
6. Venkataraman. K., "Design of Jigs Fixtures & Press Tools", Tata McGraw Hill, New Delhi, 2005.

ME8692	FINITE ELEMENT ANALYSIS	L	T	P	C
		3	0	0	3

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

UNIT I   INTRODUCTION   9
Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.

UNIT II   ONE-DIMENSIONAL PROBLEMS   9
One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices - Solution of problems from solid mechanics and heat transfer. Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation –Transverse deflections and Natural frequencies of beams.

UNIT III   TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS   9
Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems – Torsion of Non circular shafts –Quadrilateral elements – Higher Order Elements.

UNIT IV   TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS   9
Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations - Plate and shell elements.

UNIT V   ISOPARAMETRIC FORMULATION   9
Natural co-ordinate systems – Isoparametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems - Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software.

TOTAL : 45 PERIODS

OUTCOMES:
 CO1 Summarize the basics of finite element formulation.
 CO2 Apply finite element formulations to solve one dimensional Problems.
 CO3 Apply finite element formulations to solve two dimensional Problems.
 CO4 Apply finite element method to solve heat transfer and fluid mechanics problems.
 CO5 Apply finite element method to solve problems on dynamic analysis.

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

REFERENCES:
1. Bhatti Asghar M, "Fundamental Finite Element Analysis and Applications", John Wiley & Sons, 2005 (Indian Reprint 2013)*
2. Chandrupatla & Belagundu, "Introduction to Finite Elements in Engineering", 3rd Edition, Prentice Hall College Div, 1990
3. Logan, D.L., "A first course in Finite Element Method", Thomson Asia Pvt. Ltd., 2002
4. Rao, S.S., "The Finite Element Method in Engineering", 3rd Edition, Butterworth Heinemann, 2004
5. 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.

PR8611   METAL FORMING LAB AND SPECIAL MACHINES LABORATORY L T P C
                                             0 0 4 2

OBJECTIVES:
- To establish hands-on experience in sheet metal forming, bulge forming and Super plastic forming.
- To get hands on experience in machining gear, V-block, dovetail, etc.
- To study tool wear, acceptance test for machine tool

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

SPECIAL MACHINES LAB:
1. Gear Hobbing
  a. Spur Gear
  b. Helical Gear

2. Planning Machine
    a. V-Block
    b. Dove Tail
3. Centreless Cylindrical Grinding
4. Milling Machine
    a. Spur Gear
5. Tool And Cutter Grinding
6. Tool Wear Studies
7. Acceptance Test Of Machine Tool As Per ISI Test Chart
8. EDM
9. Capstan And Turret Lathe
10. Measurement Of Cutting Force

TOTAL: 60 PERIODS

OUTCOMES:
Upon the completion of this course the students will have
- Ability to perform hydraulic metal forming.
- Ability to perform super plastic forming in metals.
- Ability to perform extrusion process in nonferrous metals.
- Ability to machine raw materials to prepare gear, V-block, etc.,
- Ability to conduct acceptance test for machine tool.
  .

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Universal Testing Machine 10T	1
2	Erichsen cupping Tester	1
3	Hydraulic Press 50T	1
4	Water hammer forming apparatus	1
5	Two high Rolling mill	1
6	Top open muffle furnace (Max 1200 oC)	1
7	Dies for deep drawing	1 SET
8	Dies for Micro forming	1 SET
9	Dies for super plastic forming	1 SET
10	FEM package	1
11	Dies for Constructing FLD of sheet metals	1 SET

PR8612   **CNC MACHINE LABORATORY**   **L T P C**
                                                                                0 0 2 1

OBJECTIVE:
To train the students to write CNC Programming to simulate tool path simulation for different components.

LIST OF EXPERIMENTS
1. Study of different control systems and NC codes.
2. Program for Turning, Facing operation.
3. Program for circular interpolation, Taper turning operation
4. Program for thread cutting operation
5. Program using Do-Loop and Sub-routine.
6. Program for profile milling operation, circular interpolation
7. Program for Circular, rectangular pocket milling

8. Program for drilling cycle
9. Program for tool compensation and Program offset
10. NC code generation using CAD software packages
11. Study of cam packages
12. Study of CNC Wire cut EDM

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course, the students can able to
- Perform programming on CNC machine using computer assisted and manual part programming.
- Simulate tool path movement.
- To machine components using basic turning process.
- To machine industrial components using milling and drilling process.
- To coordinate the turning and milling process to obtain desired industrial components

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	CNC Lathe / Turning Centre	1
2	CNC Milling Machine / Machining Centre	1

ME8682	**DESIGN AND FABRICATION PROJECT**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

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

GUIDELINE FOR REVIEW AND EVALUATION
The students may be grouped into 2 to 4 and work under a project supervisor. The device/ system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL : 60 PERIODS

OUTCOMES:
Upon the completion of this course the students will be able to
CO1   design and Fabricate the machine element or the mechanical product.
CO2   demonstrate the working model of the machine element or the mechanical product.

ME8791   **MECHATRONICS**   **L   T   P   C**
                                                                                3   0   0   3

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

UNIT I   INTRODUCTION   9
Introduction to Mechatronics – Systems – Concepts of Mechatronics approach – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers**:** Static and dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance sensors – Strain gauges – Eddy current sensor – Hall effect sensor – Temperature sensors – Light sensors

UNIT II   MICROPROCESSOR AND MICROCONTROLLER   9
Introduction – Architecture of 8085 – Pin Configuration – Addressing Modes –Instruction set, Timing diagram of 8085 – Concepts of 8051 microcontroller – Block diagram,.

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 – Basic structure – Input and output processing – Programming – Mnemonics – Timers, counters and internal relays – Data handling – Selection of PLC.

UNIT V   ACTUATORS AND MECHATRONIC SYSTEM DESIGN   9
Types of Stepper and Servo motors – Construction – Working Principle – Advantages and Disadvantages. Design process-stages of design process – Traditional and Mechatronics design concepts – Case studies of Mechatronics systems – Pick and place Robot – Engine Management system – Automatic car park barrier.

                                                                          TOTAL : 45 PERIODS

OUTCOMES:
Upon the completion of this course the students will be able to
CO1   Discuss the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical, Electronic Systems and sensor technology.
CO2   Discuss the architecture of Microprocessor and Microcontroller, Pin Diagram, Addressing Modes of Microprocessor and Microcontroller.
CO3   Discuss Programmable Peripheral Interface, Architecture of 8255 PPI, and various device interfacing
CO4   Explain the architecture, programming and application of programmable logic controllers to problems and challenges in the areas of Mechatronic engineering.
CO5   Discuss various Actuators and Mechatronics system using the knowledge and skills acquired through the course and also from the given case studies

TEXT BOOKS:
1. Bolton, "Mechatronics", Prentice Hall, 2008
2. Ramesh S Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", 5th Edition, Prentice Hall, 2008.

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

GE8077	TOTAL QUALITY MANAGEMENT	L T P C
		3 0 0 3

OBJECTIVE:
- To facilitate the understanding of Quality Management principles and process.

UNIT I   INTRODUCTION   9
Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

UNIT II   TQM PRINCIPLES   9
Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III   TQM TOOLS AND TECHNIQUES I   9
The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV   TQM TOOLS AND TECHNIQUES II   9
Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

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

OUTCOME:
- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

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

REFERENCES:
1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. ISO 9001-2015 standards

ME8098	QUALITY CONTROL AND RELIABILITY ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:
- To introduce the concept of SQC
- To understand process control and acceptance sampling procedure and their application.
- To learn the concept of reliability.

UNIT I   INTRODUCTION AND PROCESS CONTROL FOR VARIABLES   9
Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality control: Quality cost-Variation in process causes of variation – Theory of control chart- uses of control chart –X chart, R chart and ☐chart - process capability – process capability studies and simple problems. Six sigma concepts

UNIT II   PROCESS CONTROL FOR ATTRIBUTES   9
Control chart for attributes –control chart for non conformings– p chart and np chart – control chart for nonconformities– C and U charts, State of control and process out of control identification in charts, pattern study.

UNIT III   ACCEPTANCE SAMPLING   9
Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD- uses of standard sampling plans.

UNIT IV   LIFE TESTING – RELIABILITY   9
Life testing – Objective – failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate – Weibull model, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability – simple problems. Acceptance sampling based on reliability test – O.C Curves.

UNIT V   QUALITY AND RELIABLITY   9
Reliability improvements – techniques- use of Pareto analysis – design for reliability – redundancy unit and standby redundancy – Optimization in reliability – Product design – Product analysis – Product development–Product life cycles.
Note: Use of approved statistical table permitted in the examination.

TOTAL: 45 PERIODS

OUTCOMES:
Upon the completion of this course the students will be able to
CO1   Summarize the concept of Quality and Process control for variables
CO2   Apply the process control for attributes
CO3   Explain the concept of sampling and to solve problems
CO4   Explain the concept of Life testing
CO5   Explain the concept Reliability and techniques involved

TEXT BOOKS:

1. Douglas.C. Montgomery, "Introduction to Statistical quality control", 7th edition, John Wiley 2012.
2. Srinath. L.S., "Reliability Engineering", Affiliated East west press, 2008.

REFERENCES:

1. Besterfield D.H., "Quality Control", Prentice Hall, 2013.
2. Connor, P.D.T.O., "Practical Reliability Engineering", John Wiley, 2012
3. Danny Samson, "Manufacturing & Operations Strategy", Prentice Hall, 1991
4. Grant, Eugene .L "Statistical Quality Control", McGraw-Hill, 2017
5. Gupta. R.C, "Statistical Quality control", Khanna Publishers, 2010.

MF8761	COMPUTER AIDED SIMULATION AND ANALYSIS	L	T	P	C
	LABORATORY	0	0	4	2

OBJECTIVES:
- To give exposure to software tools needed to analyze engineering problems.
- To expose the students to different applications of simulation and analysis tools.

LIST OF EXPERIMENTS:

A. SIMULATION
1. MATLAB basics, Dealing with matrices, Graphing-Functions of one variable and two variables
2. Use of Matlab to solve simple problems in vibration
3. Mechanism Simulation using software

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

TOTAL: 60 PERIODS
OUTCOME:
- To train the students to make use of software for simulation and analysis for various applications in the field of manufacturing engineering.

TEXT BOOKS:
1. The Mathworks, Inc, **"The student Edition of Matlab"**, student Edition, The MATLAB curriculum series, 1997
2. Rudra Pratap, **"Getting started with MATLAB"**, 1st Edition, Oxford University Press, 2010

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS
Finite Element Analysis Software, MATLAB Software, Computers with necessary accessories.

PR8711   MICROPROCESSOR AND MECHATRONICS LABORATORY   L T P C
                                                              0 0 4 2
OBJECTIVES:
- To expose the students to use the microprocessor to perform simple operations / Programming
- To design and develop hydraulic pneumatic and electrical circuits using simulating systems
- To study the characteristic of different hydraulic, pneumatic and electrical components.

MICROPROCESSOR LABORATORY

LIST OF EXPERIMENTS
1. Addition and subtraction of two 16- bit numbers
2. Sorting a series of numbers in Ascending and Descending order
3. Conversion of Binary number to BCD
4. Conversion of BCD to Binary
5. Implementation of Block-Data transfer
6. Controlling stepper motor using Microprocessor
7. Verification of Logic gates
8. Design of adders and subtractors
9. Multiplexer and Demultiplexer
10. Applications of an OPAMP
11. Characteristics of common emitter transistor
12. Transfer and Drain Characteristics of FET amplifier

MECHATRONICS LABORATORY

LIST OF EXPERIMENTS
1. Design and testing of fluid power circuits to control
      (i) Velocity **(ii)** direction and **(iii)** force of single and double acting actuators
1. Design of circuits with logic sequence using Electro pneumatic trainer kits.
2. Simulation of basic Hydraulic, Pneumatic and Electric circuits using software
3. Circuits with multiple cylinder sequences in Electro pneumatic using PLC
4. Speed Control of AC & DC drives
5. Servo controller interfacing for DC motor
6. PID controller interfacing
7. Stepper motor interfacing with 8051 Micro controller
      (ii) full step resolution (ii) half step resolution
8. Modeling and analysis of basic electrical, hydraulic and pneumatic systems using appropriate softwares
9. Computerized data logging system with control for process variables like pressure flow and temperature.

TOTAL: 60 PERIODS

OUTCOMES:
Upon the completion of this course, students will have the
- Ability to use the microprocessor to perform simple programme
- Ability to use microprocessor, PID controller for interface
- Ability to perform testing on fluid power inverter
- Ability to simulate circuits using hydraulic, Pneumatic and electrical components.
- Ability to use the computerized data logging system.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Basic Pneumatic Trainer Kit with manual and electrical controls/ PLC Control	1 Each
2	Basic Hydraulic Trainer Kit	1
3	Hydraulics and Pneumatics Systems Simulation Softwares	10 SET
4	8051 - Microcontroller kit with stepper motor and drive circuit	2 SET
5	Simulation Softwares and Sensors to measure Pressure, Flow rate, direction, speed, velocity and force	2 SET

ME8793	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
		3	0	0	3

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

UNIT I   INTRODUCTION TO PROCESS PLANNING   9
Introduction- methods of process planning-Drawing interpretation-Material evaluation – steps in process selection-.Production equipment and tooling selection

UNIT II   PROCESS PLANNING ACTIVITIES   9
Process parameters calculation for various production processes-Selection jigs and fixtures election of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies

UNIT III   INTRODUCTION TO COST ESTIMATION   9
Importance of costing and estimation –methods of costing-elements of cost estimation –Types of estimates – Estimating procedure- Estimation labor cost, material cost- allocation of over head charges- Calculation of depreciation cost

UNIT IV   PRODUCTION COST ESTIMATION   9
Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop

UNIT V MACHINING TIME CALCULATION 9

Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations ,Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding.

TOTAL: 45 PERIODS

OUTCOMES:
Upon the completion of this course the students will be able to
CO1 select the process, equipment and tools for various industrial products.
CO2 prepare process planning activity chart.
CO3 explain the concept of cost estimation.
CO4 compute the job order cost for different type of shop floor.
CO5 calculate the machining time for various machining operations.

TEXT BOOKS:
1. Peter scalon, "Process planning, Design/Manufacture Interface", Elsevier science technology Books, Dec 2002.
2. Sinha B.P, "Mechanical Estimating and Costing", Tata-McGraw Hill publishing co, 1995.

REFERENCES:
1. Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 2nd Edition, PHI, 2002.
2. Ostwalal P.F. and Munez J., "Manufacturing Processes and systems", 9th Edition, John Wiley, 1998.
3. Russell R.S and Tailor B.W, "Operations Management", 4th Edition, PHI, 2003.
4. Mikell P. Groover, "Automation, Production, Systems and Computer Integrated Manufacturing", Pearson Education 2001.
5. K.C. Jain & L.N. Aggarwal, "Production Planning Control and Industrial Management",Khanna Publishers 1990.

PR8811	PROJECT WORK	L T P C
		0 0 20 10

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

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 300 PERIODS

OUTCOMES:
Students will be able to
- An ability to apply knowledge of mathematics, science and engineering
- An ability to design and conduct experiments as well as to analyze and interpret data
- An ability to design a system, component or process to meet the desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability

- An ability to function on multidisciplinary teams
- An ability to identify, formulate and solve engineering problems
- An understanding of professional and ethical responsibility
- An ability to communicate effectively
- The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context
- A recognition of need for, and an ability to engage in life-long learning
- A knowledge of contemporary issues
- An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
- An ability to demonstrate knowledge / understand the engineering and management principles and apply these projects as a member/Leader in a team to manage projects in multidisciplinary environments.

PR8001   **SURFACE ENGINEERING**   **L T P C**
                                                                         3 0 0 3

OBJECTIVES:
- To study the surface preparation techniques
- To import knowledge on thermal spraying process and electrodeposited coating
- To study the process of Hot dip and diffusion coating
- To induce the testing procedure for surface coating

UNIT I   METAL CLEANING AND PREVIEW ON SURFACE ENGINEERING   9
Need and relevance of surface engineering – pre-treatment of coating, General cleaning process for ferrous and non-ferrous metals and alloys – selection of cleaning process – alkaline cleaning – emulsion cleaning- ultrasonic cleaning – acid and pickling salt bath descaling – abrasive bath cleaning – polishing and short peening – classification of surface engineering processes.

UNIT II   THERMAL SPRAYING PROCESSES AND ELECTRODEPOSITED COATINGS   9
Thermal spraying – flame, arc, plasma and HVOF processes – PLV process – design for thermally sprayed coatings – coating production – spray consumables principles of electroplating – Technology and control electroplating systems – properties and Faraday's Law – factors affecting throwing power – Applications of electrodeposites – non-aqueous and electroless deposition.

UNIT III   HOT DIP COATING AND DIFFUSION COATINGS   9
Principles – surface preparation batch coating and continuous coating process – coating properties and applications, Principles of cementation – cladding – Diffusion coating of C.N. Al, Si, Cr and B – structure, properties and application of diffusion coatings – chemical vapour deposition – physical vapour deposition.

UNIT IV   NON-METALLIC COATING OXIDE AND COVENSION COATINGS   9
Plating coating – laequers – rubbers and elastomers – vitreous enamels – anodizing phosphating and chromating – application to aluminium, magnesium, tin, zinc, cadmium copper and silver – phosphating primers.

UNIT V   QUALITY ASSURANCE, TESTING AND SELECTION OF COATINGS   9

The quality plan – design – testing and inspection of thickness adhesion, corrosion, resistance and porosity measurement – selection of coatings – industrial applications of engineering coatings. Basic mechanisms of wear – abrasive, adhesive wear, contact fatigue – fretting corrosion – testing wear resistance practical diagnosis of wear.

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to
- Understand the important of surface engineering to industries.
- Understand the principles involved in thermal spray for coating.
- Analyze the process and mechanism of different diffusion coating process
- Understand the methods of non metallic coating
- Select appropriate coatings for industrial application with the knowledge in testing procedure and quality assurance.

TEXT BOOKS:
1. Stand Grainger and J. Blunt, Engineering coatings – design and application, Woodhead Publishing, 1998.
2. Peter Dearnley, Introduction to surface engineering: Cambridge University Press, 2017.
3. J.S. Burnell-Gray and P.K. Datta , Surface Engineering Casebook: Solutions to Corrosion and Wear-Related Failures, Woodhead Publishing, 1996.

REFERENCES:
1. J. Paulo Davim, Materials and Surface Engineering, Research and Development, Woodhead Publishing Reviews: Mechanical Engineering Series, 2012
2. Joseph R. Davis, Surface Engineering For Corrosion And Wear Resistance, ASM International, 2001.
3. Parthasarathy. N.V., Electroplating Handbooks, Prentice Hall, 1992
4. Metals Hand Book vol.2 ^{8th} Edition, American society of metals 1994.
5. Gabe. D.R., "Principles of Metal surface treatment and protection", Pergamon, 1990
6. Niku-Lavi, "Advances in surface treatments", Pergamon, 1990

PR8072   NEW PRODUCT DEVELOPMENT   L T P C
3 0 0 3

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

UNIT I   INTRODUCTION   9

Need for developing products – the importance of engineering design – types of design –the design process – relevance of product lifecycle issues in design –designing to codes and standards- societal considerations in engineering design –generic product development process – various phases of product development-planning for products –establishing markets- market segments- relevance of market research

UNIT II   CUSTOMER NEEDS   9
Identifying customer needs –voice of customer –customer populations- hierarchy of human needs-
need gathering methods – affinity diagrams – needs importance- establishing engineering
characteristics-competitive benchmarking- quality function deployment- house of quality- product
design specification-case studies

UNIT III   CREATIVE THINKING   9
Creative thinking –creativity and problem solving- creative thinking methods- generating design
concepts-systematic methods for designing –functional decomposition – physical decomposition –
functional representation –morphological methods-TRIZ- axiomatic design

UNIT IV   DECISION MAKING AND PRODUCT ARCHITECTURE   9
Decision making –decision theory –utility theory –decision trees –concept evaluation methods –Pugh
concept selection method- weighted decision matrix –analytic hierarchy process – introduction to
embodiment design –product architecture – types of modular architecture –steps in developing
product architecture

UNIT V   DESIGN AND COST ANALYSIS   9
Industrial design – human factors design –user friendly design – design for serviceability – design for
environment – prototyping and testing – cost evaluation –categories of cost – overhead costs –
activity based costing –methods of developing cost estimates – manufacturing cost –value analysis in
costing

TOTAL: 45 PERIODS

TEXT BOOKS
1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, "Product Design and Development ", 4th Edition,
   2009, Tata McGraw-Hill Education, ISBN-10-007-14679-9
2. Kevin Otto, Kristin Wood, "Product Design", Indian Reprint 2015, Pearson Education,ISBN
   9788177588217

REFERENCES
1. Clive L.Dym, Patrick Little, "Engineering Design: A Project-based Introduction", 3rd Edition, John
   Wiley & Sons, 2009, ISBN 978-0-470-22596-7.
2. George E.Dieter, Linda C.Schmidt, "Engineering Design", McGraw-Hill International Edition, 4th
   Edition, 2009, ISBN 978-007-127189-9.
3. Yousef Haik, T. M. M. Shahin, "Engineering Design Process", 2nd Edition Reprint, Cengage
   Learning, 2010, ISBN 0495668141

IE8651   **RELIABILITY ENGINEERING**   **L T P C**
                                                                                  3 0 0 3
OBJECTIVE:
To impart knowledge in reliability concepts, reliability estimation methods and reliability improvement
methods

UNIT I   RELIABILITY CONCEPT   9
Reliability definition –Reliability parameters- f(t), F(t) and R(t) functions- Measures of central
tendency – Bath tub curve – A priori and posteriori probabilities of failure – Component mortality -
Useful life.

UNIT II   LIFE DATA ANALYSIS   9
Data classification – Non parametric methods: Ungrouped, Grouped, Complete, Censored data – Time to failure distributions – Probability plotting: Exponential, Weibull - Goodness of fit tests – Survival graphs.

UNIT III   RELIABILITY ESTIMATION   9
Series parallel configurations – Parallel redundancy – m/n system – Complex systems: RBD approach – Baye's method – Minimal path and cut sets - Fault Tree analysis – Standby system.

UNIT IV   RELIABILITY MANAGEMENT   9
Reliability testing: Failure terminated test – Time terminated test – Upper and lower MTBFs – Sequential Testing – Reliability growth monitoring – Reliability allocation.

UNIT V   RELIABILITY IMPROVEMENT   9
Analysis of downtime – Repair time distribution – Maintainability prediction – Measures of maintainability – Availability definitions – System Availability – Replacement decisions – Economic life.

TOTAL: 45 PERIODS

OUTCOME:
The Student must apply and optimize reliability for time independent and time dependent failure models through various testing methods for various manufacturing amnesty process

TEXT BOOKS:
1. Charles E.Ebeling, "An Introduction to Reliability and Maintainability Engineering", TMH, 2007
2. Kailash C. Kapur, Michael Pecht, "Reliability Engineering", Wiley, 2014

REFERENCES:
1. Aggarwal, K.K., "Reliability Engineering", Springer, 1993
2. E. Balagurusamy, "Reliability Engineering", Tata McGraw-Hill Education, © 1984, Reprint 2010.
3. Jiang, Renyan, "Introduction to Quality and Reliability Engineering", Springer, 2015
4. Roy Billington and Ronald N. Allan, "Reliability Evaluation of Engineering Systems", Springer, 2007.

GE8075   **INTELLECTUAL PROPERTY RIGHTS**   **L T P C**
                                                                                           3 0 0 3

OBJECTIVE:
• To give an idea about IPR, registration and its enforcement.

UNIT I   INTRODUCTION   9
Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

UNIT II   REGISTRATION OF IPRs   10
Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad

UNIT III   AGREEMENTS AND LEGISLATIONS   10
International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

UNIT IV   DIGITAL PRODUCTS AND LAW   9
Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

UNIT V   ENFORCEMENT OF IPRs   7
Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

TOTAL: 45 PERIODS

OUTCOME:
- Ability to manage Intellectual Property portfolio to enhance the value of the firm.

TEXT BOOKS
1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
2. S.V. Satarkar, Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002

REFERENCES
1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2012.
2. Prabuddha Ganguli,"Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

GE8073   FUNDAMENTALS OF NANOSCIENCE   L T P C
                                                                                 3 0 0 3

OBJECTIVE:
To learn about basis of nanomaterial science, preparation method, types and application

UNIT I   INTRODUCTION   8
Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles - quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical,   Electronic, Optical,   Magnetic and Thermal   properties. Introduction to properties and motivation for study (qualitative only).

UNIT II   GENERAL METHODS OF PREPARATION   9
Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III   NANOMATERIALS   12
Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites,   Nanoclays-functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.

UNIT IV   CHARACTERIZATION TECHNIQUES   9

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation.

UNIT V   APPLICATIONS   7

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery.

TOTAL : 45 PERIODS

OUTCOMES:
- Will familiarize about the science of nanomaterials
- Will demonstrate the preparation of nanomaterials
- Will develop knowledge in characteristic nanomaterial

TEXT BOOKS :
1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "Nanoscale Charecterisation of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCES:
1. G Timp, "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia,"The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.

PR8002	FUZZY LOGIC AND ANN	L T P C
		3 0 0 3

OBJECTIVES:
- To impact knowledge on fuzzy logic principles
- To understand models of ANN
- To use the fuzzy logic and neural network for application related to design and manufacture

UNIT I   INTRODUCTION TO FUZZY LOGIC PRINCIPLES   9

Basic concepts of fuzzy set theory – operations of fuzzy sets – properties of fuzzy sets – Crisp relations – Fuzzy relational equations – operations on fuzzy relations – fuzzy systems – propositional logic – Inference – Predicate Logic – Inference in predicate logic – fuzzy logic principles – fuzzy quantifiers – fuzzy inference – fuzzy rule based systems – fuzzification and defuzzification – types.

UNIT II   ADVANCED FUZZY LOGIC APPLICATIONS   9

Fuzzy logic controllers – principles – review of control systems theory – various industrial applications of FLC adaptive fuzzy systems – fuzzy decision making – Multiobjective decision making – fuzzy classification – means clustering – fuzzy pattern recognition – image processing applications – systactic recognition – fuzzy optimization.

UNIT III   INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS   9

Fundamentals of neural networks – model of an artificial neuron – neural network architectures – Learning methods – Taxonomy of Neural network architectures – Standard back propagation algorithms – selection of various parameters – variations Applications of back propagation algorithms.

UNIT IV   OTHER ANN ARCHITECTURES   9

Associative memory – exponential BAM – Associative memory for real coded pattern pairs – Applications adaptive reasonance theory – introduction – ART 1 – ART2 – Applications – neural networks based on competition – kohenen self organizing maps – learning vector quantization – counter propagation networks – industrial applications.

UNIT V   RECENT ADVANCES   9

Fundamentals of genetic algorithms – genetic modeling – hybrid systems – integration of fuzzy logic, neural networks and genetic algorithms – non traditional optimization techniques like ant colony optimization – Particle swarm optimization and artificial immune systems – applications in design and manufacturing.

TOTAL: 45 PERIODS

OUTCOMES:
Upon the completion of this course, the students will be able to
- Develop the skill in basic understanding on fuzzy logic.
- Develop the skill in basic understanding on neural network
- Explore the functional components of neural classification conducer and the functional components of fuzzy logic classification on controller.
- Develop and implement a basic trainable neural network (or) a fuzzy logic system to design and manufacturing.
- Understand the recent advances in fundamentals of genetic algorithm.

TEXT BOOKS:
1. Rajasekaran. S.. Vijayalakshmi Pai. G.A. "Neural Networks, Fuzzy Logic and Genetic Algorithms", Prentice Hall of India Private Limited, 2003
2. Timothy J.Ross, "Fuzzy logic with Engineering Applications", McGraw Hill, 2017
3. Zurada J.M. "Introduction to Artificial Neural Systems", Jaico publishing house, 2016.

REFERENCES:
1. Klir.G, Yuan B.B. "Fuzzy sets and Fuzzy Logic Prentice Hall of India private limited, 1997.
2. Laurene Fausett, "Fundamentals of Neural Networks", Prentice hall, 1992
3. Gen, M. and Cheng R. "Genetic Algorithm and Engineering Design", john wiley 1997

PR8003   **INSTRUMENTATION AND CONTROL**   **L T P C**
                                                                           3 0 0 3
OBJECTIVES:
- To understand the principle of measuring displacement, velocity, acceleration, vibration, force, stress and strain
- To build mathematical model for control system.
- To familiar with bode plots.

UNIT I   INTRODUCTION   9
Static and dynamic characteristics of measurement systems, standards and calibration, error and uncertainty analysis, statistical analysis of data, and curve fitting.

**UNIT II   MECHANICAL MEASUREMENTS AND INDUSTRIAL
                INSTRUMENTATION   9**
Measurement of displacement, velocity (linear and rotational), acceleration, shock, vibration, force torque power, strain, stress, pressure temperature.

UNIT III   DATA DISPLAY AND RECORDING DEVICES   9
Data display-CRO,LED, LCD, magnetic tape recorders, x-y recorders, UV recorders, Oscilloscope recorders, digital printers and data loggers.

UNIT IV   CONTROL   9
Introduction to control systems, mathematical model of physical systems in transfer function and state space forms, response of dynamic systems, concept of pole and zero of a system, realization of transfer functions.

UNIT V   STABILITY ANALYSIS   9
Stability criteria bode plots, routh and Nyquist criteria.
                                                                    TOTAL: 45 PERIODS
OUTCOMES:
Upon completion of this course student can able to
- Understand the dynamic characteristics of measurement system.
- Understand the mechanical measurements and industrial instrumentation.
- Understand the working principle of data display and recording devices.
- Understand the working principle of control system.
- Perform Stability Analysis.

TEXT BOOKS:
1. B.C.Nakra, K.K.Choudry, "Instrumentation, Measurement and analysis", Tata McGraw Hill 2003
2. Nagrath. J.J. and Gopal, "control system engineering", New age international (p) ltd., 2000.

REFERENCES:
1. Rangan. C.S., Sarma. G.R., Mani. VSV, Instrumentation Devices and Systems", Tata McGraw Hill, 2000
2. Sowhney. A.K., "Electrical and Electronic Measurement and Instrumentation, "Dhanpat rai & Cu, 2003.
3. Benjamin C.Kuo, "Automatic Control System", prentice hall of India pvt ltd., 2002
4. Ernest O.Doeblin, "measurement systems applications and design", McGraw Hill International editions, 1990
5. Renganathan. S., "transducer engineering", Allied publishers, 1990.

PR8004   **MACHINE VISION**   **L T P C**
                                                                                    3 0 0 3

OBJECTIVE:
- To understand the principle, importance and application of machine vision system in Manufacturing and measurement.

UNIT I   INTRODUCTION TO MACHINE VISION   6
Machine Vision use of machine vision – tasks for a vision system – relation to other fields – place of vision in CIM.

UNIT II   IMAGE ACQUISITION AND CONVERSION   6
Colour systems – light sources – lighting techniques – image formation by lensing – image scanning – television cameras – sensors, charge coupled devices – camera and system interface – frame buffers and frame grabbers – digital and smart camers.

UNIT III   IMAGE PROCESSING DECISION MAKING   12
Processing of binary images – thresholding, geometrical properties, topological properties – processing of gray scale images statistical operations, spatial operations, segmentation edge detection, morphological operations – image analysis – factors extraction – decision making.

UNIT IV   PATTERN RECOGNITION   9
Fundamentals – parametric classifiers – nonparametric, classifiers nearest neighbor CART, neural networks, generic classifiers.

UNIT V   MACHINE VISION APPLICATIONS   12
Applications in user industries automotive, semiconductor, electronic manufacturing, printing industries etc. – generic applications founding manufacturing metrology, inspection assembly verification – application analysis and implementation.

                                                                  TOTAL: 45 PERIODS
OUTCOMES:
Upon completion of this course student can able to
- Understand the Machine vision principle.
- Understand the image acquisition and conversion principle.
- Understand the image processing procedures.
- Use machine vision techniques to pattern recognizing.
- Understand the use of machine vision in manufacturing industries in process implementation, assembly.

TEXT BOOK
1. Milan sonka, Vaclav hlavac, roger boyie, "Image Processing", "Analysis and machine vision" Cengage Learning India Pvt Ltd (2008)

REFERENCES:
1. Richard O.Duda, Peter E. Hurt, Pattern Classification and Scene Analysis,Johnweily Publisher, 2000.
2. Rafael C. Gonzaies, Richard E. Woods, Digital Image processing ,pearson, 2009
3. Nella zuech, 'Understanding & applying machine vision Marceldekker Inc. 2000.

MG8491   **OPERATIONS RESEARCH**   **L T P C**
                                                                         3 0 0 3

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

UNIT I   LINEAR MODELS   15
The phase of an operation research study – Linear programming – Graphical method– Simplex algorithm – Duality formulation – Sensitivity analysis.

UNIT II   TRANSPORTATION MODELS AND NETWORK MODELS   8
Transportation Assignment Models –Traveling Salesman problem-Networks models – Shortest route – Minimal spanning tree – Maximum flow models –Project network – CPM and PERT networks – Critical path scheduling – Sequencing models.

UNIT III   INVENTORY MODELS   6
Inventory models – Economic order quantity models – Quantity discount models – Stochastic inventory models – Multi product models – Inventory control models in practice.

UNIT IV   QUEUEING MODELS   6
Queueing models - Queueing systems and structures – Notation parameter – Single server and multi server models – Poisson input – Exponential service – Constant rate service – Infinite population – Simulation.

UNIT V   DECISION MODELS   10
Decision models – Game theory – Two person zero sum games – Graphical solution- Algebraic solution– Linear Programming solution – Replacement models – Models based on service life – Economic life– Single / Multi variable search technique – Dynamic Programming – Simple Problem.

                                                              TOTAL: 45 PERIODS
OUTCOME:
- Upon completion of this course, the students can able to use the optimization techniques for use engineering and Business problems

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

REFERENCES:
1. Bazara M.J., Jarvis and Sherali H., "Linear Programming and Network Flows", John Wiley, 2009.
2. Budnick F.S., "Principles of Operations Research for Management", Richard D Irwin, 1990.
3. Philip D.T. and Ravindran A., "Operations Research", John Wiley, 1992.
4. Shennoy G.V. and Srivastava U.K., "Operation Research for Management", Wiley Eastern, 1994.
5. Tulsian and Pasdey V., "Quantitative Techniques", Pearson Asia, 2002.

GE8071   **DISASTER MANAGEMENT**   **L T P C**
                                                                                     3 0 0 3

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

UNIT I   INTRODUCTION TO DISASTERS   9
Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II   APPROACHES TO DISASTER RISK REDUCTION (DRR)   9
Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III   INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT   9
Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV   DISASTER RISK MANAGEMENT IN INDIA   9
Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V   DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD
                          WORKS   9
Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

                                                                  TOTAL: 45 PERIODS
OUTCOMES:
The students will be able to
   - Differentiate the types of disasters, causes and their impact on environment and society
   - Assess vulnerability and various methods of risk reduction measures as well as mitigation.
   - Draw the hazard and vulnerability profile of India, Scenarious in the Indian context, Disaster damage assessment and management.

TEXT BOOKS:
1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. 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.

GE8074   **HUMAN RIGHTS**   **L T P C**
                                                                       3 0 0 3
OBJECTIVE:
  • To sensitize the Engineering students to various aspects of Human Rights.

 UNIT I   **9**
Human Rights – Meaning, origin and Development.   Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

UNIT II   **9**
Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

UNIT III   **9**
Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV   **9**
Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V   **9**
Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.
                                                            TOTAL : 45 PERIODS
 OUTCOME:
  • Engineering students will acquire the basic knowledge of human rights.

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

ME8099   **ROBOTICS**   **L   T   P   C**
                                                                                    3   0   0   3

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

UNIT I   FUNDAMENTALS OF ROBOT   9
Robot - Definition - Robot Anatomy - Co ordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load- Robot Parts and their Functions-Need for Robots-Different Applications.

UNIT II   ROBOT DRIVE SYSTEMS AND END EFFECTORS   9
Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

UNIT III   SENSORS AND MACHINE VISION   9
Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data-Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms, Applications-Inspection, Identification, Visual Serving and Navigation.

UNIT IV   ROBOT KINEMATICS AND ROBOT PROGRAMMING   9
Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.

UNIT V   IMPLEMENTATION AND ROBOT ECONOMICS   9
RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

                                                                     TOTAL: 45 PERIODS
OUTCOMES:
Upon the completion of this course the students will be able to
CO1   Explain the concepts of industrial robots, classification, specifications and coordinate systems. Also summarize the need and application of robots in different sectors.
CO2   Illustrate the different types of robot drive systems as well as robot end effectors.
CO3   Apply the different sensors and image processing techniques in robotics to improve the ability of robots.
CO4   Develop robotic programs for different tasks and familiarize with the kinematics motions of robot.
CO5   Examine the implementation of robots in various industrial sectors and interpolate the economic analysis of robots.

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

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

PR8071	LEAN SIX SIGMA	L T P C
		3 0 0 3

OBJECTIVE:

To gain insights about the importance of lean manufacturing and six sigma practices.

UNIT I   LEAN & SIX SIGMA BACKGROUND AND FUNDAMENTALS   9
Historical Overview – Definition of quality – What is six sigma -TQM and Six sigma - lean manufacturing and six sigma- six sigma and process tolerance – Six sigma and cultural changes – six sigma capability – six sigma need assessments - implications of quality levels, Cost of Poor Quality (COPQ), Cost of Doing Nothing – assessment questions

UNIT II   THE SCOPE OF TOOLS AND TECHNIQUES   9
Tools for definition – IPO diagram, SIPOC diagram, Flow diagram, CTQ Tree, Project Charter – Tools for measurement – Check sheets, Histograms, Run Charts, Scatter Diagrams, Cause and effect diagram, Pareto charts, Control charts, Flow process charts, Process Capability Measurement, Tools for analysis – Process Mapping, Regression analysis, RU/CS analysis, SWOT, PESTLE, Five Whys, interrelationship diagram, overall equipment effectiveness, TRIZ innovative problem solving – Tools for improvement – Affinity diagram, Normal group technique, SMED, 5S, mistake proofing, Value stream Mapping, forced field analysis – Tools for control – Gantt chart, Activity network diagram, Radar chart, PDCA cycle, Milestone tracker diagram, Earned value management.

UNIT III   SIX SIGMA METHODOLOGIES   9
Design For Six Sigma (DFSS),Design For Six Sigma Method - Failure Mode Effect Analysis (FMEA), FMEA process - Risk Priority Number (RPN)- Six Sigma and Leadership, committed leadership – Change Acceleration Process (CAP)- Developing communication plan – Stakeholder.

UNIT IV   SIX SIGMA IMPLEMENTATION AND CHALLENGES   9
Tools for implementation – Supplier Input Process Output Customer (SIPOC) – Quality Function Deployment or House of Quality (QFD) – alternative approach –implementation – leadership training, close communication system, project selection – project management and team – champion training – customer quality index – challenges – program failure, CPQ vs six sigma, structure the deployment of six sigma – cultural challenge – customer/internal metrics.

UNIT V   EVALUATION AND CONTINUOUS IMPROVEMENT METHODS   9

Evaluation strategy – the economics of six sigma quality, Return on six Sigma (ROSS), ROI , poor project estimates – continuous improvement – lean manufacturing – value, customer focus, Perfection, focus on waste, overproduction – waiting, inventory in process (IIP), processing waste, transportation, motion, making defective products, underutilizing people – Kaizen – 5S.

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course student can able to
- Understand the fundamentals of Lean and Six sigma.
- Understand the tools and techniques used in analysis.
- Understand the six sigma methodologies.
- Understand the implementation and challenges in six sigma.
- Understand the evaluation and continuous improvement methods.

REFERENCES:

1. Forrest W. Breyfogle, III, James M. Cupello, Becki Meadows, Managing Six Sigma: A Practical
2. Fred Soleimannejed , Six Sigma, Basic Steps and Implementation, Author House, 2004
    Guide to Understanding, Assessing, and Implementing the Strategy That Yields Bottom-Line
3. James P. Womack, Daniel T.Jones, Lean Thinking, Free Press Business, 2003
4. Michael L.George, David Rownalds, Bill Kastle, What is Lean Six Sigma, McGraw – Hill 2003
    Success, John Wiley & Sons, 2000
5. Thomas Pyzdek, The Six Sigma Handbook, McGraw-Hill, 2000.

ME8092	**COMPOSITE MATERIALS AND MECHANICS**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVES:
- To understand the fundamentals of composite material strength and its mechanical behavior
- Understanding the analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber.
- Thermo-mechanical behavior and study of residual stresses in Laminates during processing.
- Implementation of Classical Laminate Theory (CLT) to study and analysis for residual stresses in an isotropic layered structure such as electronic chips.

UNIT I   INTRODUCTION, LAMINA CONSTITUTIVE EQUATIONS & MANUFACTURING   9
Definition –Need – General Characteristics, Applications. Fibers – Glass, Carbon, Ceramic and Aramid fibers. Matrices – Polymer, Graphite, Ceramic and Metal Matrices – Characteristics of fibers and matrices. Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Qij), Typical Commercial material properties, Rule of Mixtures. Generally Orthotropic Lamina –Transformation Matrix, Transformed Stiffness. Manufacturing: Bag Moulding Compression Moulding – Pultrusion – Filament Winding – Other Manufacturing Processes

UNIT II   FLAT PLATE LAMINATE CONSTITUTE EQUATIONS   9
Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates,   Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.

UNIT III   LAMINA STRENGTH ANALYSIS   9
Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized   Hill's   Criterion   for   Anisotropic   materials.   Tsai-Hill's   Failure   Criterion   for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure

UNIT IV   THERMAL ANALYSIS   9
Assumption of Constant C.T.E's. Modification of Hooke's Law. Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T.E's. C.T.E's for special Laminate Configurations – Unidirectional, Off-axis, Symmetric Balanced Laminates, Zero C.T.E laminates, Thermally Quasi-Isotropic Laminates

UNIT V   ANALYSIS OF LAMINATED FLAT PLATES   9
Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies

TOTAL: 45 PERIODS

OUTCOMES:
Upon the completion of this course the students will be able to
CO1   Summarize the various types of Fibers, Equations and manufacturing methods for
          Composite materials
CO2   Derive Flat plate Laminate equations
CO3   Analyze Lamina strength
CO4   Analyze the thermal behavior of Composite laminates
CO5   Analyze Laminate flat plates

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

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

ME8097   **NON DESTRUCTIVE TESTING AND EVALUATION**   **L   T   P   C**
                                                                   3   0   0   3

OBJECTIVE:
- To study and understand the various Non Destructive Evaluation and Testing methods, theory and their industrial applications.

UNIT I   OVERVIEW OF NDT   9
NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterisation. Relative merits and limitations, Various physical characteristics of materials and their applications in NDT., Visual inspection – Unaided and aided.

UNIT II   SURFACE NDE METHODS   9
Liquid Penetrant Testing - Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetisation methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

UNIT III   THERMOGRAPHY AND EDDY CURRENT TESTING (ET)   9
Thermography- Principles, Contact and non contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation - infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.

UNIT IV   ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION (AE)   9
Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique – Principle, AE parameters, Applications

UNIT V   RADIOGRAPHY (RT)   9
Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films - graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography

TOTAL : 45 PERIODS

OUTCOMES:
Upon the completion of this course the students will be able to
CO1   Explain the fundamental concepts of NDT
CO2   Discuss the different methods of NDE
CO3   Explain the concept of Thermography and Eddy current testing
CO4   Explain the concept of Ultrasonic Testing and Acoustic Emission
CO5   Explain the concept of Radiography

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

REFERENCES:
1. ASM Metals Handbook,"Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
2. ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook,Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol. 7, Ultrasonic Testing
3. Charles, J. Hellier," Handbook of Nondestructive evaluation", McGraw Hill, New York 2001.
4. Paul E Mix, "Introduction to Non-destructive testing: a training guide", Wiley, 2nd Edition New Jersey, 2005

ME8073	UNCONVENTIONAL MACHINING PROCESSES	L	T	P	C
		3	0	0	3

OBJECTIVE:
- To learn about various unconventional machining processes, the various process parameters and their influence on performance and their applications

UNIT I   INTRODUCTION AND MECHANICAL ENERGY BASED PROCESSES   9

Unconventional machining Process – Need – classification – merits, demerits and applications. Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining - Ultrasonic Machining. (AJM, WJM, AWJM and USM). Working Principles – equipment used – Process parameters – MRR- Applications.

UNIT II   THERMAL AND ELECTRICAL ENERGY BASED PROCESSES   9

Electric Discharge Machining (EDM) – Wire cut EDM – Working Principle-equipments-Process Parameters-Surface Finish and MRR- electrode / Tool – Power and control Circuits-Tool Wear – Dielectric – Flushing –– Applications. Laser Beam machining and drilling, (LBM), plasma, Arc machining (PAM) and Electron Beam Machining (EBM). Principles – Equipment –Types - Beam control techniques – Applications.

UNIT III   CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES   9

Chemical machining and Electro-Chemical machining (CHM and ECM)- Etchants – Maskant - techniques of applying maskants - Process Parameters – Surface finish and MRR-Applications. Principles of ECM- equipments-Surface Roughness and MRR Electrical circuit-Process Parameters-ECG and ECH - Applications.

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:
Upon the completion of this course the students will be able to
CO1 Explain the need for unconventional machining processes and its classification
CO2 Compare various thermal energy and electrical energy based unconventional machining processes.
CO3 Summarize various chemical and electro-chemical energy based unconventional machining processes.
CO4 Explain various nano abrasives based unconventional machining processes.
CO5 Distinguish various recent trends based unconventional machining processes.

TEXT BOOKS:
1. Vijay.K. Jain "Advanced Machining Processes" Allied Publishers Pvt. Ltd., New Delhi, 2007
2. Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw-Hill, New Delhi, 2007.

REFERENCES:
1. Benedict. G.F. "Nontraditional Manufacturing Processes", Marcel Dekker Inc., New York, 1987.
2. Mc Geough, "Advanced Methods of Machining", Chapman and Hall, London, 1998.
3. Paul De Garmo, J.T.Black, and Ronald.A.Kohser, "Material and Processes in Manufacturing" Prentice Hall of India Pvt. Ltd., 8thEdition, New Delhi , 2001.

MF8072	**TOTAL PRODUCTIVE MAINTENANCE**	**L T P C**
		3 0 0 3

OBJECTIVES:
At the end of this course the student should be able to understand
* To understand maintenance concepts
* To understand the modern practices in maintenance

UNIT I   MAINTENANCE CONCEPTS   9
Objectives and functions **–** Tero technology **–** Reliability Centered Maintenance (RCM) **–** maintainability prediction **–** availability and system effectiveness- maintenance costs **–** maintenance organization

UNIT II   MAINTENANCE MODELS   9
Minimal repair **–** 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 Techniques **–** Vibration Monitoring, Signature Analysis **–** Wear Debris Monitoring **–** Maintenance Management Information System - Expert systems **–** Corrosion Monitoring and Control.

                                                                                    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. Borris, Steve. Total Productive Maintenance. McGraw-Hill Professional, 2005.
2. Terry Wireman, Total Productive Maintenance. Industrial Press Inc., 2004
3. Seiichi Nakajima, **"Introduction to TPM"**, Productivity Press, Chennai, 1992.
4. Gopalakrishnan, P. and Banerji, A.K., **"Maintenance and Spare Parts Management"**, Prentice **–** Hall of India Pvt. Ltd., 1991.

REFERENCES:
1. K S Madhavan, TOTAL PRODUCTIVE MAINTENANCE, Shingo Institute of Japanese Management 2014.
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"**, Butterworth, London, 1991.

PR8005   **PRODUCTION MANAGEMENT**   **L T P C**
                                                                3 0 0 3
OBJECTIVES:
- To study the evolution of Management
- To study the functions and Production management
- To learn the application of the principles in an organization

UNIT I   PRINCIPLES OF MANAGEMENT AND PERSONNEL MANAGEMENT   9
General principles of management – management functions – organization – types – comparison – functions of personnel management – recruitment training leadership/motivation – communication – Conflict industrial relations – trade union.

UNIT II   INVENTORY MANAGEMENT   9
Purpose of Inventory – Cost related to inventors – Basic EOQ model – variations in EOQ model – Finite Production quality discounts – ABC Analysis – MRP Analysis.

UNIT III   OPERATIONS MANAGEMENT   9
Plant Location – Layout – Materials Handling – Method Study – Time Study – Ergonomics – Aggregate Planning – Value Analysis.

UNIT IV   FINANCIAL MANAGEMENT   9
Capital – Types – sources – break even analysis – financial statements – income statement – balance – balance sheet – capital budgeting – working capital management – inventory pricing.

UNIT V   MARKETING MANAGEMENT   9
Functions of marketing – Sales promotion methods – advertising – product packaging – marketing variables – distribution channels – organization – market research market research techniques.

TOTAL: 45 PERIODS

OUTCOMES:
Upon the completion of this course, students will
- Understand the principles of management and personnel management.
- Understand the principle of inventory management.
- Understand the principles of operations management.
- Understand the principles of financial management.
- Understand the principles of marketing management.

TEXT BOOKS:
1. Kesavan. R., C.Elanchezhian and T.Sundar Selwyn, "Engineering management", Eswar Press, 2005
2. Panneerselvam. K., "Production and Operations Management", Prentice Hall of India, 2003.

REFERENCES:
1. Koont and G'donnel, "Essentials of Management", McGraw Hill 1992.
2. Philips Kotler, "Principles of Marketing", Prentice Hall of India, 1995
3. I.M. Pandey, "Financial Management", Vikas Publishing house, 1995
4. K.K.Ahuja, "Personal Management", Kalyane Publication 1992
5. Martand T. Telesand, "Industrial and Business Management", S.Chand & Co., 2001

PR8006   ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT   L T P C
3 0 0 3

OBJECTIVE:
- To enable students to understand and interpret the basic financial statements, to comprehend the basics in managing finance and to know pricing mechanism.

UNIT I   INTRODUCTION   9
Introduction to Engineering Economics – Engineering efficiency – Economic efficiency. Scope of Engineering Economics – Elements of Cost, Marginal Cost, Marginal Revenue, Sunk and Opportunity cost, Break Even Analysis, Elementary economic analysis, Demand and Supply.

UNIT II   FINANCIAL ACCOUNTING   9
Accounting principles – basic records depreciation – depreciation methods – preparation and interpretation of profit and loss statement – balance sheet – fixed assets – current assets.

UNIT III   PROFIT VALUE ANALYSIS   9
Cost volume profit analysis – relevant costs in decision making profit management analysis – break even analysis – margin of safety, Angle of incidence & multi product break even analysis.

UNIT IV   WORKING CAPITAL MANAGEMENT   9
Current assets and liability decisions – estimation of working capital requirements – Management of accounts receivable – Inventory – cash – inventory valuation methods.

UNIT V   CAPITAL BUDGETING   9
Significance of capital budgeting – payback period – present value method – Accounting rate of return method, Internal Rate of Return.

TOTAL: 45 PERIODS

OUTCOMES :
Upon the completion of this course, students will
- Understand the principles of Engineering Economics.
- Able to prepare and interpret financial statements.
- Able to perform Profit analysis.
- Able to manage the working capital.
- Understand the logic behind the capital budgeting.

TEXTBOOKS:
1. R. Kesavan, C.Elanchezhian and T.Sundar Selwyn, "Engineering Economics and Financial Accounting", Laxmi Publications 2011
2. Maheswaran. S.N., "Management Accounting and Financial Control", Sultan Chand, 2011

REFERENCES:
1. James. C., Vanhorn, "Fundamentals of Financial Management" PHI, 2012
2. Charles T.Homgren, "Cost Accounting", PHI, 2012

EE8091	MICRO ELECTRO MECHANICAL SYSTEMS	L T P C
		3 0 0 3

OBJECTIVES
- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- To educate on the rudiments of Micro fabrication techniques.
- To introduce various sensors and actuators
- To introduce different materials used for MEMS
- To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

UNIT I INTRODUCTION 9
Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.

UNIT II SENSORS AND ACTUATORS-I 9
Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications – Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys

UNIT III SENSORS AND ACTUATORS-II 9
Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.

UNIT IV MICROMACHINING 9

Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies - Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistriction methods – LIGA Process - Assembly of 3D MEMS – Foundry process.

UNIT V POLYMER AND OPTICAL MEMS 9

Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

TOTAL : 45 PERIODS

OUTCOMES
- Ability to understand and apply basic science, circuit theory, Electro-magnetic field theory control theory and apply them to electrical engineering problems.
- Ability to understand and analyse, linear and digital electronic circuits.

TEXT BOOKS:
1. Chang Liu, "Foundations of MEMS", Pearson Education Inc., 2006.
2. Stephen D Senturia, "Microsystem Design", Springer Publication, 2000.
3. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.

REFERENCES:
1. James J.Allen, "Micro Electro Mechanical System Design", CRC Press Publisher, 2010
2. Julian w. Gardner, Vijay K. Varadan, Osama O. Awadelkarim, "Micro Sensors MEMS and Smart Devices", John Wiley & Son LTD,2002
3. Mohamed Gad-el-Hak, editor, " The MEMS Handbook", CRC press Baco Raton, 2000
4. Nadim Maluf," An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.
5. Thomas M.Adams and Richard A.Layton, "Introduction MEMS, Fabrication and Application," Springer 2012.

PR8007 **DESIGN OF MACHINE TOOL STRUCTURE** **L T P C**
3 0 0 3

OBJECTIVES:
- To understand different machine tools used for maching.
- To understand the design criteria for machine tool structures.
- To know the designing of slideways
- To understand the vibration in the machine tool during operation.

UNIT I INTRODUCTION 10

Classification of machining processes, machine tools – machine tool construction – factors – performance criteria – trends in modern machine tool – kinematic arrangement of different types of machine tools – work holding and tool holding devices – calculation of cutting forces and power requirements for turning, milling, boring and grinding – force distribution on different parts of drilling, milling and grinding machine tools.

UNIT II   STRENGTH AND RIGIDITY OF MACHINE TOOL STRUCTURES   10
Basic principles of design – comparison of materials used in machine tool construction – dependence of process capability on rigidity – static compliance – design of lathe beds – materials – typical construction – torsional modulus of regangular and box sections – methods of increasing rigidities.

UNIT III   SLIDEWAYS   9
Slide ways – types – materials – constructions – clearance adjustments – Hydrostatically lubricated slide ways – slide way design – pressure distribution – antifriction ways – design – construction.

UNIT IV   SPINDLES AND SPINDLE SUPPORTS   8
Spindle units – materials – spindle design – spindle bearings – types of materials – constructions.

UNIT V   MACHINE TOOL DYNAMICS   9
Dynamic system – elastic system – working processes – vibration in machine tools – self excited vibration and dynamic stability – basic principles of chatter – effects of vibration – vibration elimination – damping – isolation of vibration – dynamic absorber with damping.

TOTAL: 45 PERIODS

OUTCOMES:
Upon the completion of this course, students will
- Understand the construction features of machine tool structure.
- Have ability to design machine tools based on strength and rigidity.
- Understand the mechanism of slide ways.
- Understand the construction features of spindles and spindle supports.
- Understand the principles of machine tool dynamics.

TEXT BOOKS:
1. Sen. G.C., and A.Battacharya, "Principles of machine tools", New central book agency, 2009
2. Metha. N.K., "Machine Tool Design and Numerical control", Tata McGraw Hill publishing company, 2012.

REFERENCES:
1. Myer Kutz, Mechanical Engineers' Handbook: Materials and Mechanical Design, Volume 1, Third Edition John Wiley & Sons, 2006
2. Manfred week, "Hand Book of Machine Tools – Vol1, Vol 2, Vol.3" John Wiley & Sons, 1984.
3. Acherkan.N, "Machine Tool Design", Vol 3, MIR publishers, 1978

MG8091	ENTERPRENEURSHIP DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVE:
- To develop and strengthen entrepreneurial quality and motivation in students and to impart basic entrepreneurial skills and understanding to run a business efficiently and effectively.

UNIT I   ENTREPRENEURSHIP   9
Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

UNIT II   MOTIVATION   9
Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

UNIT III   BUSINESS   9
Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

UNIT IV   FINANCING AND ACCOUNTING   9
Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax.

UNIT V   SUPPORT TO ENTREPRENEURS   9
Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures - Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

TOTAL : 45 PERIODS

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

TEXT BOOKS :

1. Donald F Kuratko, "Entreprenuership – Theory, Process and Practice", 9th Edition, Cengage Learning, 2014.
2. Khanka. S.S., "Entrepreneurial Development" S.Chand & Co. Ltd., Ram Nagar, New Delhi, 2013.

REFERENCES :
1. EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad, 1986.
2. Hisrich R D, Peters M P, "Entrepreneurship" 8th Edition, Tata McGraw-Hill, 2013.
3. Mathew J Manimala, "Enterprenuership theory at cross roads: paradigms and praxis" 2nd Edition Dream tech, 2005.
4. Rajeev Roy, "Entrepreneurship" 2nd Edition, Oxford University Press, 2011.

MG8892   **MARKETING MANAGEMENT**   L T P C
                                                                                  3 0 0 3

OBJECTIVE:
- To enable students to deal with newer concepts of marketing concepts like strategic marketing segmentation, pricing, advertisement and strategic formulation. The course will enable a student to take up marketing as a professional career.

UNIT I   MARKETING PROCESS   9

Definition, Marketing process, dynamics, needs, wants and demands, marketing concepts, environment, mix, types. Philosophies, selling versus marketing, organizations, industrial versus consumer marketing, consumer goods, industrial goods, product hierarchy.

UNIT II   BUYING BEHAVIOUR AND MARKET SEGMENTATION   9

Cultural, demographic factors, motives, types, buying decisions, segmentation factors - demographic - Psycho graphic and geographic segmentation, process, patterns.

UNIT III   PRODUCT PRICING AND MARKETING RESEARCH   9

Objectives, pricing, decisions and pricing methods, pricing management. Introduction, uses, process of marketing research.

UNIT IV   MARKETING PLANNING AND STRATEGY FORMULATION   9

Components of marketing plan-strategy formulations and the marketing process, implementations, portfolio analysis, BCG, GEC grids.

UNIT V   ADVERTISING, SALES PROMOTION AND DISTRIBUTION   9

Characteristics, impact, goals, types, and sales promotions - point of purchase - unique selling proposition. Characteristics, wholesaling, retailing, channel design, logistics, and modern trends in retailing, Modern Trends, e-Marketing.

TOTAL: 45 PERIODS

OUTCOME:
- The learning skills of Marketing will enhance the knowledge about Marketer's Practices and create insights on Advertising, Branding, Retailing and Marketing Research.

TEXT BOOKS:
1. Philip Kolter & Keller, "Marketing Management", 14th Edition, Prentice Hall of India, 2012.
2. Chandrasekar, K.S., "Marketing Management Text and Cases", 1st Edition, Tata McGraw Hill – Vijaynicole 2010.

REFERENCES:
1. Adrain palmer, " Introduction to Marketing Theory and practice", Oxford university press IE 2004.
2. Czinkota & Kotabe, "Marketing Management", Thomson learning, Indian edition 2007
3. Donald S. Tull and Hawkins, "Marketing Research", Prentice Hall of India-1997.
4. Graeme Drummond and John Ensor, "Introduction to marketing concepts", Elsevier, Indian Reprint, 2007.
5. Philip Kotler and Gary Armstrong "Principles of Marketing" Prentice Hall of India, 2000.
6. Ramasamy and Nama kumari, "Marketing Environment: Planning, implementation and control the Indian context", 1990.
7. Steven J.Skinner, "Marketing", All India Publishers and Distributes Ltd. 1998.

ME8074	VIBRATION AND NOISE CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVE:
- The student will be able to understand the sources of vibration and noise in automobiles and make design modifications to reduce the vibration and noise and improve the life of the components

UNIT I   BASICS OF VIBRATION   9
Introduction, classification of vibration: free and forced vibration, undamped and damped vibration, linear and non linear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies.

UNIT II   BASICS OF NOISE   9
Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis.

UNIT III   AUTOMOTIVE NOISE SOURCES   9
Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine necessary contributed noise, transmission noise, aerodynamic noise, tire noise, brake noise.

UNIT IV   CONTROL TECHNIQUES   9
Vibration isolation, tuned absorbers, un-tuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.

UNIT V   SOURCE OF NOISE AND CONTROL   9
Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers

                                                                                          TOTAL: 45 PERIODS

OUTCOMES:
Upon the completion of this course the students will be able to
CO1   Summarize the Basics of Vibration
CO2   Summarize the Basics of Noise
CO3   Explain the Sources of Automotive Noise
CO4   Discuss the Control techniques for vibration
CO5   Describe the sources and control of Noise

TEXT BOOK:
  1. Singiresu S.Rao, "Mechanical Vibrations", 6th Edition, Pearson Education, 2016

REFERENCES:
1. Balakumar Balachandran and Edward B. Magrab, "Fundamentals of Vibrations", 1st Editon, Cengage Learning, 2009
2. Benson H. Tongue, "Principles of Vibrations", 2nd Edition, Oxford University, 2007
3. Bernard Challen and Rodica Baranescu - "Diesel Engine Reference Book", Second Edition, SAE International, 1999.
4. David Bies and Colin Hansen, "Engineering Noise Control – Theory and Practice",4th Edition, E and FN Spon, Taylore & Francise e-Library, 2009
5. Grover. G.T., "Mechanical Vibrations", Nem Chand and Bros., 2009

MG8791

<div align="center">

SUPPLY CHAIN MANAGEMENT

L T P C
3 0 0 3
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OBJECTIVE:
- To provide an insight on the fundamentals of supply chain networks, tools and techniques.

UNIT I   INTRODUCTION   9
Role of Logistics and Supply chain Management: Scope and Importance- Evolution of Supply Chain -Decision Phases in Supply Chain - Competitive and Supply chain Strategies – Drivers of Supply Chain Performance and Obstacles.

UNIT II   SUPPLY CHAIN NETWORK DESIGN   9
Role of Distribution in Supply Chain – Factors influencing Distribution network design – Design options for Distribution Network Distribution Network in Practice-Role of network Design in Supply Chain – Framework for network Decisions.

UNIT III   LOGISTICS IN SUPPLY CHAIN   9
Role of transportation in supply chain – factors affecting transportations decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation.

UNIT IV   SOURCING AND COORDINATION IN SUPPLY CHAIN   9
Role of sourcing supply chain supplier selection assessment and contracts- Design collaboration - sourcing planning and analysis - supply chain co-ordination - Bull whip effect – Effect of lack of co-ordination in supply chain and obstacles – Building strategic partnerships and trust within a supply chain.

UNIT V   SUPPLY CHAIN AND INFORMATION TECHNOLOGY   9
The role IT in supply chain- The supply chain IT frame work Customer Relationship Management – Internal supply chain management – supplier relationship management – future of IT in supply chain –E-Business in supply chain.

<div align="right">

TOTAL: 45 PERIODS
</div>

OUTCOME:
- The student would understand the framework and scope of supply chain networks and functions.

TEXTBOOK :
1. Sunil Chopra, Peter Meindl and Kalra, **"Supply Chain Management, Strategy, Planning, and operation"**, Pearson Education, 2010.

REFERENCES:
1   David J.Bloomberg , Stephen Lemay and Joe B.Hanna, **"Logistics"**, PHI 2002.
2   James B.Ayers, **"Handbook of Supply chain management"**, St.Lucle press, 2000.
3   Jeremy F.Shapiro, **"Modeling the supply chain"**, Thomson Duxbury, 2002.
4   Srinivasan G.S, **"Quantitative models in Operations and Supply Chain Management"**, PHI, 2010.

GE8076   **PROFESSIONAL ETHICS IN ENGINEERING**   **L T P C**
                                                                                3 0 0 3

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

UNIT I   HUMAN VALUES   10
Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II   ENGINEERING ETHICS   9
Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III   ENGINEERING AS SOCIAL EXPERIMENTATION   9
Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV   SAFETY, RESPONSIBILITIES AND RIGHTS   9
Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V   GLOBAL ISSUES   8
Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

                                                                  TOTAL: 45 PERIODS
OUTCOME:
- Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

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

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

Web sources:
1.   www.onlineethics.org
2.   www.nspe.org
3.   www.globalethics.org
4.   www.ethics.org