ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

B.E. INDUSTRIAL ENGINEERING

REGULATIONS – 2015

CHOICE BASED CREDIT SYSTEM

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) :

Our B.E. (Industrial Engineering) graduates will be able to:

I. Find gainful employment in manufacturing and service sector.
II. Get elevated to managerial position and lead the organization competitively.
III. Enter into higher studies leading to post-graduate and research degrees.
IV. Become consultant and provide solutions to the practical problems of any organization.
V. Become an entrepreneur and be part of a supply chain or make and sell products in the open market.

PROGRAMME OUTCOMES (POs):

After going through the four years of study, our Industrial Engineering Graduates will exhibit ability to:

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

Attested

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

B.E. INDUSTRIAL ENGINEERING
Mapping of Course Outcome and Programme Outcome

		Course Name	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
YEAR 1	Semester 1	Foundational English	✓						✓		✓			✓
		Mathematics – I	✓	✓		✓	✓					✓	✓	✓
		Engineering Physics	✓	✓		✓	✓					✓	✓	✓
		Engineering Chemistry	✓	✓		✓	✓					✓	✓	✓
		Engineering Graphics	✓	✓	✓	✓			✓				✓	✓
		Basic Sciences Laboratory	✓	✓		✓	✓					✓	✓	✓
		Engineering Practices Laboratory		✓	✓	✓						✓	✓	✓
	Semester 2	Technical English	✓						✓		✓			✓
		Mathematics-II	✓	✓		✓	✓					✓	✓	✓
		Computing Techniques	✓	✓		✓	✓					✓	✓	✓
		Fundamentals of Electrical Engineering				✓		✓	✓	✓	✓			
		Manufacturing Technology- I	✓	✓	✓									
		Material Science	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Manufacturing Technology Laboratory – I	✓	✓	✓	✓								
		Computer Practices Lab	✓	✓		✓	✓					✓	✓	✓
		Course Name	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
YEAR 2	Semester 3	Probability and Statistics	✓	✓	✓									
		Strength of Materials	✓	✓	✓									
		Manufacturing Technology –II	✓	✓	✓									
		Engineering Economy and Cost Estimation	✓	✓	✓		✓					✓		
		Engineering Mechanics	✓	✓	✓									
		Strength of Materials Laboratory	✓	✓	✓									
		Manufacturing Technology Laboratory – II	✓	✓	✓	✓								
	Semester 4	Environmental Science and Engineering							✓	✓				✓
		Fluid Mechanics and Machinery	✓	✓	✓									
		Electronics Engineering	✓	✓	✓									
		Mechanics of Machines	✓	✓	✓									
		Work System Design		✓	✓	✓	✓							
		Production and Operations Management	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
		Fluid Mechanics and Machinery Laboratory	✓	✓	✓	✓								
		Work System Design Laboratory		✓		✓	✓							

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		Course Name	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
YEAR 3	Semester 5	Operations Research-I	✓	✓	✓	✓	✓	✓			✓		✓	✓
		Quality Control and Assurance	✓	✓	✓		✓				✓			✓
		Machine Design	✓	✓	✓									
		Thermodynamics	✓	✓	✓									
		Professional Elective I												
		Open Elective I												
		Optimization Lab	✓	✓	✓	✓	✓						✓	✓
		Computer Aided Machine Drawing	✓		✓		✓							
	Semester 6	Operations Research - II	✓	✓	✓	✓	✓	✓			✓		✓	✓
		Applied Ergonomics	✓	✓	✓	✓			✓					
		Facility Layout and Materials Handling		✓	✓		✓						✓	
		Reliability Engineering	✓	✓	✓	✓	✓				✓		✓	✓
		Professional Elective-II												
		Open Elective – II												
		Ergonomics Lab	✓		✓	✓								
		Data Analytics Lab	✓	✓		✓	✓							

		Course Name	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
YEAR 4	Semester 7	Simulation Modeling and Analysis	✓	✓	✓	✓	✓					✓		✓
		Design of Experiments	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Supply Chain and Logistics Management	✓		✓		✓	✓		✓			✓	✓
		Professional Elective-III												
		Professional Elective – IV												
		Industrial Training/Mini Project/Internship	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Discrete Simulation Lab		✓	✓	✓	✓							✓
		Communication Skills and Soft Skills									✓	✓		✓
	Semester 8	Manufacturing Automation		✓	✓	✓	✓		✓				✓	
		Professional Elective – V												
		Professional Elective - VI												
		Project work		✓	✓	✓	✓				✓	✓		
		Comprehension		✓	✓						✓	✓		
		Automation Lab	✓		✓		✓							✓

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REGULATIONS – 2015

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CURRICULA AND SYLLABI I - VIII SEMESTERS

SEMESTER I

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

SEMESTER II

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS7251	Technical English	HS	4	4	0	0	4
2.	MA7251	Mathematics II	BS	4	4	0	0	4
3.	GE7151	Computing Techniques	ES	3	3	0	0	3
4.	EE7253	Fundamentals of Electrical Engineering	ES	3	3	0	0	3
5.	ME7252	Manufacturing Technology- I	ES	3	3	0	0	3
6.	PH7251	Materials Science	BS	3	3	0	0	3
PRACTICAL								
7.	ME7261	Manufacturing Technology Laboratory - I	ES	4	0	0	4	2
8.	GE7161	Computer Practices Laboratory	ES	4	0	0	4	2
			TOTAL	**28**	**20**	**0**	**8**	**24**

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SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	CE7251	Strength of Materials	ES	3	3	0	0	3
2.	GE7153	Engineering Mechanics	ES	4	4	0	0	4
3.	IE7301	Engineering Economy and Cost Estimation	PC	3	3	0	0	3
4.	MA7357	Probability and Statistics	BS	4	4	0	0	4
5.	ME7352	Manufacturing Technology-II	PC	3	3	0	0	3
PRACTICAL								
6.	CE7261	Strength of Materials Laboratory	ES	4	0	0	4	2
7.	ME7361	Manufacturing Technology Laboratory – II	PC	4	0	0	4	2
			TOTAL	**25**	**17**	**0**	**8**	**21**

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	CE7352	Fluid Mechanics and Machinery	ES	3	3	0	0	3
2.	EC7354	Electronics Engineering	ES	3	3	0	0	3
3.	GE7251	Environmental Science and Engineering	HS	3	3	0	0	3
4.	IE7401	Work System Design	PC	3	3	0	0	3
5.	IE7451	Production and Operations Management	PC	3	3	0	0	3
6.	ME7353	Mechanics of Machines	PC	3	3	0	0	3
PRACTICAL								
7.	CE7361	Fluid Mechanics and Machinery Laboratory	ES	4	0	0	4	2
8.	IE7411	Work System Design Laboratory	PC	4	0	0	4	2
			TOTAL	**26**	**18**	**0**	**8**	**22**

SEMESTER V

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	IE7501	Operations Research - I	PC	3	3	0	0	3
2.	IE7502	Quality Control and Assurance	PC	3	3	0	0	3
3.	ME7451	Machine Design	PC	5	3	2	0	4
4.	ME7452	Thermodynamics	PC	5	3	2	0	4
5.		Professional Elective I	PE	3	3	0	0	3
6.		Open Elective I*	OE	3	3	0	0	3
PRACTICAL								
7.	IE7511	Optimization Laboratory	PC	4	0	0	4	2
8.	ME7561	Computer Aided Machine Drawing	PC	4	0	0	4	2
			TOTAL	**30**	**18**	**4**	**8**	**24**

SEMESTER VI

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	IE7601	Applied Ergonomics	PC	3	3	0	0	3
2.	IE7602	Facility Layout and Materials Handling	PC	3	3	0	0	3
3.	IE7603	Operations Research - II	PC	3	3	0	0	3
4.	IE7604	Reliability Engineering	PC	3	3	0	0	3
5.		Professional Elective II	PE	3	3	0	0	3
6.		Open Elective II*	OE	3	3	0	0	3
PRACTICAL								
7.	IE7611	Data Analytics Laboratory	PC	4	0	0	4	2
8.	IE7612	Ergonomics Laboratory	PC	4	0	0	4	2
			TOTAL	**26**	**18**	**0**	**8**	**22**

SEMESTER VII

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	IE7701	Simulation Modeling and Analysis	PC	3	3	0	0	3
2.	IE7702	Supply Chain and Logistics Management	PC	3	3	0	0	3
3.	IE7751	Design of Experiments	PC	3	3	0	0	3
4.		Professional Elective III	PE	3	3	0	0	3
5.		Professional Elective IV	PE	3	3	0	0	3
PRACTICAL								
6.	HS7561	Communication Skills and Soft Skills	HS	3	1	0	2	2
7.	IE7711	Discrete Simulation Laboratory	PC	4	0	0	4	2
8.	IE7712	Industrial Training/Mini Project /Internship*#	EEC	4	0	0	4	2
			TOTAL	**26**	**16**	**0**	**10**	**21**

* the students will undergo inplant training / Internship during previous vacation

SEMESTER VIII

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	IE7801	Manufacturing Automation	PC	3	3	0	0	3
2.		Professional Elective V	PE	3	3	0	0	3
3.		Professional Elective VI	PE	3	3	0	0	3
PRACTICAL								
4.	IE7811	Automation Laboratory	PC	4	0	0	4	2
5.	IE7812	Comprehension	EEC	4	0	0	4	2
6.	IE7813	Project work#	EEC	20	0	0	20	10
			TOTAL	**37**	**9**	**0**	**28**	**23**

TOTAL NO. OF CREDITS:179

***Course from the curriculum of other UG Programmes**
The contact periods will not appear in the slot time table

HUMANITIES AND SOCIAL SCIENCES (HS)

SL. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS7151	Foundational English	HS	4	4	0	0	4
2.	HS7251	Technical English	HS	4	4	0	0	4
3.	GE7251	Environmental Science and Engineering	HS	3	3	0	0	3
4.	HS7561	Communication Skills and Soft Skills	HS	3	1	0	2	2

BASIC SCIENCES (BS)

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

ENGINEERING SCIENCES (ES)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	GE7152	Engineering Graphics	ES	5	3	2	0	4
2.	GE7162	Engineering Practices Laboratory	ES	4	0	0	4	2
3.	GE7151	Computing Techniques	ES	3	3	0	0	3
4.	EE7253	Fundamentals of Electrical Engineering	ES	3	3	0	0	3

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5.	ME7252	Manufacturing Technology- I	ES	3	3	0	0	3
6.	ME7261	Manufacturing Technology Laboratory I	ES	4	0	0	4	2
7.	GE7161	Computer Practices Laboratory	ES	4	0	0	4	2
8.	CE7251	Strength of Materials	ES	3	3	0	0	3
9.	GE7153	Engineering Mechanics	ES	4	4	0	0	4
10.	GE7261	Strength of Materials Laboratory	ES	4	0	0	4	2
11.	CE7352	Fluid Mechanics and Machinery	ES	3	3	0	0	3
12.	EC7354	Electronics Engineering	ES	3	3	0	0	3
13.	CE7361	Fluid Mechanics and 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.	ME7352	Manufacturing Technology -II	PC	3	3	0	0	3
2.	IE7301	Engineering Economy and Cost Estimation	PC	3	3	0	0	3
3.	ME7361	Manufacturing Technology Laboratory II	PC	4	0	0	4	2
4.	ME7353	Mechanics of Machines	PC	3	3	0	0	3
5.	IE7401	Work System Design	PC	3	3	0	0	3
6.	IE7451	Production and Operations Management	PC	3	3	0	0	3
7.	IE7411	Work System Design Laboratory	PC	4	0	0	4	2
8.	IE7501	Operations Research-I	PC	3	3	0	0	3
9.	IE7502	Quality Control and Assurance	PC	3	3	0	0	3
10.	ME7451	Machine Design	PC	5	3	2	0	4
11.	ME7452	Thermodynamics	PC	5	3	2	0	4
12.	IE7511	Optimization Laboratory	PC	4	0	0	4	2
13.	ME7561	Computer Aided Machine Drawing	PC	4	0	0	4	2
14.	IE7603	Operations Research - II	PC	3	3	0	0	3
15.	IE7601	Applied Ergonomics	PC	3	3	0	0	3
16.	IE7602	Facility Layout and Materials Handling	PC	3	3	0	0	3
17.	IE7604	Reliability Engineering	PC	3	3	0	0	3
18.	IE7612	Ergonomics Laboratory	PC	4	0	0	4	2
19.	IE7611	Data Analytics Laboratory	PC	4	0	0	4	2
20.	IE7701	Simulation Modeling and Analysis	PC	3	3	0	0	3
21.	IE7751	Design of Experiments	PC	3	3	0	0	3
22.	IE7702	Supply Chain and Logistics Management	PC	3	3	0	0	3
23.	IE7711	Discrete Simulation Laboratory	PC	4	0	0	4	2
24.	IE7801	Manufacturing Automation	PC	3	3	0	0	3
25.	IE7811	Automation Laboratory	PC	4	0	0	4	2

PROFESSIONAL ELECTIVES (PE)

SL. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	GE7071	Disaster Management	PE	3	3	0	0	3
2.	GE7074	Human Rights	PE	3	3	0	0	3
3.	GE7652	Total Quality Management	PE	3	3	0	0	3
4.	IE7001	Accounting and Finance for Management	PE	3	3	0	0	3
5.	IE7002	Advanced Optimization Techniques	PE	3	3	0	0	3
6.	IE7003	Applied Multi-Variate Statistical Analysis	PE	3	3	0	0	3
7.	IE7004	Computational Methods and Algorithms	PE	3	3	0	0	3
8.	IE7005	Decision Support and Intelligent Systems	PE	3	3	0	0	3
9.	IE7006	Evolutionary Optimization	PE	3	3	0	0	3
10.	IE7007	Information Systems Analysis and Design	PE	3	3	0	0	3
11.	IE7008	Maintenance Engineering and Management	PE	3	3	0	0	3
12.	IE7009	Modeling of Manufacturing Systems	PE	3	3	0	0	3
13.	IE7010	Operations Scheduling	PE	3	3	0	0	3
14.	IE7011	Principles of Computer Integrated Manufacturing Systems	PE	3	3	0	0	3
15.	IE7012	Product Design and Value Engineering	PE	3	3	0	0	3
16.	IE7013	Productivity Management and Re-engineering	PE	3	3	0	0	3
17.	IE7014	Robotics Engineering	PE	3	3	0	0	3
18.	IE7015	Systems Engineering	PE	3	3	0	0	3
19.	IE7071	Human Resource Management	PE	3	3	0	0	3
20.	IE7072	Metrology and Inspection	PE	3	3	0	0	3
21.	IE7073	Project Management	PE	3	3	0	0	3
22.	IE7074	Safety Engineering and Management	PE	3	3	0	0	3
23.	ME7077	Entrepreneurship Development	PE	3	3	0	0	3
24.	MF7073	Electronics Manufacturing Technology	PE	3	3	0	0	3
25.	MF7074	Flexible Manufacturing Systems	PE	3	3	0	0	3
26.	MG7451	Principles of Management	PE	3	3	0	0	3
27.	GE7072	Foundation Skills in Integrated Product Development	PE	3	3	0	0	3

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EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	IE7712	Industrial Training/Mini Project/Internship	EEC	4	0	0	4	2
2.	IE7812	Comprehension	EEC	4	0	0	4	2
3.	IE7813	Project work	EEC	20	0	0	20	10

SUMMARY

SL. NO.	SUBJECT AREA	CREDITS AS PER SEMESTER								CREDITS TOTAL
		I	II	III	IV	V	VI	VII	VIII	
1.	HS	04	04	00	03	00	00	02	00	**13**
2.	BS	12	07	04	00	00	00	00	00	**23**
3.	ES	06	13	09	08	00	00	00	00	**36**
4.	PC	00	00	08	11	18	16	11	05	**69**
5.	PE	00	00	00	00	03	03	06	06	**18**
6.	OE	00	00	00	00	03	03	00	00	**06**
7.	EEC	00	00	00	00	00	00	02	12	**14**
	Total	**22**	**24**	**21**	**22**	**24**	**22**	**21**	**23**	**179**
8.	**Non Credit / Mandatory**									

HS7151 FOUNDATIONAL ENGLISH L T P C
4 0 0 4

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

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

CONTENTS

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

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

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

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

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

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

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

TOTAL:60 PERIODS

OUTCOMES:

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

TEXTBOOK:

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

REFERENCES:

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

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

OBJECTIVES:

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

UNIT I DIFFERENTIAL CALCULUS 12

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

UNIT II FUNCTIONS OF SEVERAL VARIABLES 12

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

UNIT III INTEGRAL CALCULUS 12

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

UNIT IV MULTIPLE INTEGRALS 12

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

UNIT V DIFFERENTIAL EQUATIONS 12

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

TOTAL: 60 PERIODS

OUTCOMES:

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

TEXTBOOKS:

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

REFERENCES:

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

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

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

OBJECTIVE:

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

UNIT I PROPERTIES OF MATTER 9

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

UNIT II ACOUSTICS AND ULTRASONICS 9

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

UNIT III THERMAL AND MODERN PHYSICS 9

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

UNIT IV APPLIED OPTICS 9

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

UNIT V CRYSTAL PHYSICS 9

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

TOTAL: 45 PERIODS

OUTCOME:

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

TEXTBOOKS:

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

REFERENCES:

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

CY7151 ENGINEERING CHEMISTRY

L	T	P	C
3	0	0	3

OBJECTIVE

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

UNIT I POLYMER CHEMISTRY 9

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

UNIT II SURFACE CHEMISTRYAND CATALYSIS 9

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

UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY 9

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

UNIT IV CHEMICAL THERMODYNAMICS 9

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

UNIT V NANOCHEMISTRY 9

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

TOTAL: 45 PERIODS

OUTCOME

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

TEXTBOOKS

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

REFERENCES

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

GE7152 ENGINEERING GRAPHICS L T P C
3 2 0 4

OBJECTIVES

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

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION) 1

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

UNIT I PLANE CURVES AND FREE HANDSKETCHING 14

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

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES 14

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

UNIT III PROJECTION OF SOLIDS 14

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

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 14

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

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 15

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

COMPUTER AIDED DRAFTING (DEMONSTRATION ONLY) 3

Introduction to drafting packages and demonstration of their use.

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

OUTCOMES:

On Completion of the course the student will be able to

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

TEXT BOOK:

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

REFERENCES:

1. K.R.Gopalakrishna., “Engineering Drawing” (Vol I&II combined) Subhas Stores, Bangalore, 2007
2. Luzzader, Warren.J., and Duff,John M.,,’’ Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production”, Eastern Economy Edition, Prentice Hall of India Pvt Ltd, New Delhi, 2005
3. M.B.Shah and B.C.Rana, “Engineering Drawing”, Pearson, 2nd Edition, 2009
4. K.Venugopal and V.Prabhu Raja, “Engineering Graphics”, New Age International (P)Limited ,2008.
5. K. V.Natarajan, “A text book of Engineering Graphics”, 28th Edition, Dhanalakshmi Publishers, Chennai, 2015.
6. BasantAgarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
7. N.S Parthasarathy and Vela Murali, “ Engineering Drawing”, Oxford University Press, 2015

Publication of Bureau of Indian Standards:

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

Special points applicable to University Examinations on Engineering Graphics:

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

BS7161	BASIC SCIENCES LABORATORY	L	T	P	C
	(Common to all branches of B.E. / B.Tech Programmes)	0	0	4	2

PHYSICS LABORATORY: (Any Seven Experiments)

OBJECTIVE:

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

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of disc
2. Non-uniform bending - Determination of young's modulus
3. Uniform bending – Determination of young's modulus
4. Lee's disc Determination of thermal conductivity of a bad conductor
5. Potentiometer-Determination of thermo e.m.f of a thermocouple
6. Laser- Determination of the wave length of the laser using grating
7. Air wedge - Determination of thickness of a thin sheet/wire
8. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
9. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
10. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
11. Post office box -Determination of Band gap of a semiconductor.
12. Spectrometer- Determination of wavelength using gating.
13. Viscosity of liquids - Determination of co-efficient of viscosity of a liquid by Poiseuille‟s flow

OUTCOME:

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

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

1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline/thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
11. Determination of molecular weight of poly vinyl alcohol using Ostwald viscometer.
12. Pseudo first order kinetics-ester hydrolysis.
13. Corrosion experiment-weight loss method.
14. Determination of CMC.
15. Phase change in a solid.

TOTAL: 60 PERIODS

TEXTBOOKS

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

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

OBJECTIVES

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

GROUP – A (CIVIL & ELECTRICAL)

1. CIVIL ENGINEERING PRACTICES **15**

PLUMBING

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

• Laying pipe connection to the suction side of a pump.

• Laying pipe connection to the delivery side of a pump.

• Practice in connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK

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

STUDY

• Study of joints in door panels and wooden furniture

• Study of common industrial trusses using models.

2. ELECTRICAL ENGINEERING PRACTICES **15**

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

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

3. MECHANICAL ENGINEERING PRACTICES

WELDING

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

DEMONSTRATION ON FOUNDRY OPERATIONS.

4. ELECTRONIC ENGINEERING PRACTICES **15**

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

TOTAL: 60 PERIODS

OUTCOMES

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

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

OBJECTIVES

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

CONTENTS

UNIT I ANALYTICAL READING **12**

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

UNIT II SUMMARISING **12**

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

UNIT III DESCRIBING VISUAL MATERIAL 12

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

UNIT IV WRITING/ E-MAILING THE JOB APPLICATION 12

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

UNIT V REPORT WRITING 12

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

TEACHING METHODS:

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

EVALUATION PATTERN:

Internals – 50%
End Semester – 50%

TOTAL:60 PERIODS

OUTCOMES

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

TEXTBOOK:

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

REFERENCES:

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

Attested

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

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

OBJECTIVES:

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

UNIT I MATRICES 12

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

UNIT II VECTOR CALCULUS 12

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

UNIT III ANALYTIC FUNCTION 12

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

UNIT IV COMPLEX INTEGRATION 12

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

UNIT V LAPLACE TRANSFORMS 12

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

TOTAL: 60 PERIODS

OUTCOMES:

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

TEXTBOOKS:

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

REFERENCES:

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

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

OBJECTIVE

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

UNIT I INTRODUCTION **9**

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

UNIT II C PROGRAMMING BASICS **9**

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

UNIT III ARRAYS AND STRINGS **9**

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

UNIT IV POINTERS **9**

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

UNIT V FUNCTIONS AND USER DEFINED DATA TYPES **9**

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

TOTAL : 45 PERIODS

OUTCOME

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

- Write C program for simple applications
- Formulate algorithm for simple problems
- Analyze different data types and arrays

- Perform simple search and sort**.**
- Use programming language to solve problems.

TEXTBOOKS:

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

REFERENCES:

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

EE7253 FUNDAMENTALS OF ELECTRICAL ENGINEERING L T P C
3 0 0 3

OBJECTIVE :

To impart knowledge on

- Electric circuits
- Working principles of Electrical Machines
- Various measuring instruments

UNIT I ELECTRIC CIRCUITS 9

Introduction to electric circuits – Ohms Law – Kirchhoff’s Law – series and parallel networks, alternating voltage and current- waveform, RMS value, average value power, power factor, single phase circuit

UNIT II DC MACHINES 9

Introduction – DC machine construction – shunt, series and compound windings – motor & generator – EMF and torque equation – efficiency –starters and speed control of DC motors.

UNIT III TRANSOFRMER AND THREE-PHASE CIRCUITS 9

Introduction – transformer – construction and principle of operation – EMF equation–losses and efficiency , auto transformers, Three-phase supply – Star and Delta connections – power in three-phase systems – measurement of power– advantages.

UNIT IV AC MACHINES 9

Introduction – rotating magnetic field – synchronous field – construction of three-phase induction motors – principle of operation – slip –losses and efficiency – torque equation–torque speed characteristics – starting methods, single phase induction motor– types - starting methods – applications, working principle of three phase synchronous machines.

UNIT V MEASUREMENTS 9

Classification of instruments – moving coil and moving iron voltmeters and ammeters – Multimeters – dynamometer type wattmeter– energy meter – Megger – Instrument transformers (CT & PT)

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand the working concepts of electrical machines and measurement devices
- Ability to identify suitable machines and measuring devices for particular application.

TEXT BOOKS:

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. V.K Mehta and Rohit Mehta, “Principle of Electrical Engineering”, S Chand & Co, 2008

REFERENCES

1. Thereja.B.L., “Fundamentals of Electrical Engineering and Electronics”, S Chand & Co.Ltd., 2008.
2. R.K.Rajput,” Electrical Engineering”, Laxmi Publications, I Edition, 2007

ME7252 MANUFACTURING TECHNOLOGY – I

L	T	P	C
3	0	0	3

OBJECTIVE:

- To introduce the students to the concepts of basic manufacturing processes and fabrication techniques, such as metal casting, metal joining, metal forming and manufacture of plastic components.

UNIT I METAL CASTING PROCESSES 9

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

UNIT II METAL JOINING PROCESSES 9

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

UNIT III BULK DEFORMATION PROCESSES 9

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

UNIT IV SHEET METAL PROCESSES 9

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

UNIT V MANUFACTURE OF PLASTIC COMPONENTS 9

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

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to apply the different manufacturing process and use this in industry for component production.

TEXT BOOKS:

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

REFERENCES:

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

PH7251	MATERIALS SCIENCE	L	T	P	C
	(Common to Manufacturing, Industrial, Mining, Aeronautical, Automobile and Production Engineering)	3	0	0	3

OBJECTIVE:

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

UNIT I PHASE DIAGRAMS 9

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

UNIT II FERROUS ALLOYS AND HEAT TREATMENT 9

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

UNIT III MECHANICAL PROPERTIES 9

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

UNIT IV MAGNETIC, DIELECTRIC AND SUPERCONDUCTING MATERIALS 9

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

UNIT V NEW MATERIALS 9

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

TOTAL: 45 PERIODS

OUTCOME:

Upon completion of this course, the students will

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

TEXTBOOKS:

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

REFERENCES:

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

ME7261 MANUFACTURING TECHNOLOGY LAB I

L	T	P	C
0	0	4	2

OBJECTIVES

- To give the students hands on experience in the basic manufacturing processes like metal casting, metal joining, metal forming and manufacture of plastic components.

LIST OF EXPERIMENTS

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

TOTAL: 60 PERIODS

OUTCOMES

- Upon completion of this course the students can demonstrate the capability to fabricate metal / plastic components using basic manufacturing processes.

GE7161 COMPUTER PRACTICES LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES

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

LIST OF EXPERIMENTS

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

TOTAL: 60 PERIODS

OUTCOMES

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

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

LABORATORY REQUIREMENTS FOR BATCH OF 30 STUDENTS

30 Systems with C compiler

CE7251	STRENGTH OF MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVE:

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

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS **9**

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

UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM **9**

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

UNIT III TORSION **9**

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

UNIT IV DEFLECTION OF BEAMS **9**

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

9

UNIT V THIN CYLINDERS, SPHERES AND THICk CYLINDERS

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

TOTAL: 45 PERIODS

OUTCOMES:

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

TEXT BOOKS:

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

REFERENCES:

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

GE7153 ENGINEERING MECHANICS

L	T	P	C
4	0	0	4

OBJECTIVE :

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

UNIT I STATICS OF PARTICLES **12**

Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles -Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force, Unit Vectors.

Equilibrium of a Particle- Newton's First Law of Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space.

UNIT II EQUILIBRIUM OF RIGID BODIES **12**

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

UNIT III DISTRIBUTED FORCES **16**

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

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

UNIT IV FRICTION **8**

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

UNIT V DYNAMICS OF PARTICLES **12**

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles.

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

(L – 45 + T – 15) TOTAL: 60 PERIODS

OUTCOMES:

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

TEXT BOOK

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

REFERENCES

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

IE7301 ENGINEERING ECONOMY AND COST ESTIMATION L T P C
3 0 0 3

OBJECTIVES:

- To study and understand the concept of Engineering Economics and apply in the real world.
- To gain knowledge in the field of cost estimation to enable the students to estimate the cost of various manufacturing processes.

UNIT I INTRODUCTION TO MANAGERIAL ECONOMICS AND DEMAND ANALYSIS 9

Definition of Managerial Economics - Nature and scope of Managerial Economics - Managerial Economics and other disciplines. Objectives of the firm - Factors influencing Managerial decisions - Basic concepts of Managerial Economics. Demand Analysis – Defining demand, Types of demand and Determinants of demand, Elasticity of demand and demand forecasting.

UNIT II PRODUCTION AND COST ANALYSIS 9

Production Analysis – Production function, Returns to a factor, Returns to scale, ISO quants and Least cost combination of inputs. Cost Analysis – Cost concepts, Determinants of cost, Short-run cost-output Relationship, Long-run cost output relationship, Economies and Diseconomies of scale and Estimating cost – Output Relationship.

UNIT III PRICING 9

Determinants of price – Pricing under different objectives – Pricing under different market structures – Price discrimination – Pricing of Joint products – Pricing methods in practice.

UNIT IV ESTIMATION OF MATERIAL AND LABOUR COSTS 9

Introduction to Estimation and Costing – Elements of costs – Allocation of overheads – Estimation of Material cost – Estimation of Labour cost, Indirect Expenses and Depreciation.

UNIT V ESTIMATION OF OPERATIONAL COST 9

Estimation in Machine shop – Estimation in Forging shop –Estimation in welding shop.

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Students will become familiar with principles of micro economics and demand forecasting

CO2: Good understanding and knowledge in production and detailed cost analysis

CO3: The principles of pricing methodologies are familiarized

CO4: Estimation of Material and Labor cost procedure are known

CO5: Determination of Operational cost in industries are practiced

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

TEXT BOOKS:

1. V.L.Mote, Samuel Paul and G.S.Gupta, " Managerial Economics – concepts and cases", McGraw Hill Education (India), 2011.
2. Yogesh Maheshwari, "Managerial Economics", Third edition, PHI 2012.
3. T.R.Banga and S.C.Sharma, "Mechanical Estimating and Costing", 16th Edition, Khanna Publishers, 2012.

REFERENCES:

1. A.Ramachandra Aryasri and V. V. Ramana Murthy, "Engineering Economics and Financial Accounting", McGraw Hill Education (India), New Delhi, 2004.
2. R.Paneerselvam, "Engineering Economics", PHI, 2013.

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

OBJECTIVES:

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

UNIT I RANDOM VARIABLES 12

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

UNIT II TWO-DIMENSIONAL RANDOM VARIABLES 12

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

UNIT III TESTS OF SIGNIFICANCE 12

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

UNIT IV DESIGN OF EXPERIMENTS 12

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

UNIT V STATISTICAL QUALITY CONTROL 12

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

TOTAL : 60 PERIODS

OUTCOMES:

- Students will be able characterize probability models using probability mass (density) functions & cumulative distribution functions.
- The students can independently participate in the processes of analysis, planning, formulating strategies of development, decision-making, governing and management, and independent making of tactical and strategic decisions related to the statistics.

TEXT BOKS:

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

REFERENCES:

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

ME7352 MANUFACTURING TECHNOLOGY – II

L	T	P	C
3	0	0	3

OBJECTIVES:

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

UNIT I THEORY OF METAL CUTTING 9

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

UNIT II TURNING MACHINES 9

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

UNIT III RECIPROCATING, MILLING AND GEAR CUTTING MACHINES 9

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

UNIT IV ABRASIVE PROCESSES AND BROACHING 9

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

UNIT V COMPUTER NUMERICAL CONTROL MACHINE TOOLS 9

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

TOTAL: 45 PERIODS

OUTCOME:

- Upon completion of this course, the students will be able to understand and compare the functions and applications of different metal cutting operations, machine tools and gain knowledge in programming of CNC machines.

TEXT BOOKS:

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

REFERENCES:

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

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

OBJECTIVES:

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

LIST OF EXPERIMENTS

1. Tension test on mild steel rod
2. Compression test on wood
3. Double shear test on metal
4. Torsion test on mild steel rod
5. Impact test on metal specimen (Izod and Charpy)
6. Hardness test on metals (Rockwell and Brinell Hardness Tests)
7. Deflection test on metal beam
8. Compression test on helical spring
9. Deflection test on carriage spring

TOTAL: 60 PERIODS

OUTCOMES:

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

REFERENCES:

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

ME7361 MANUFACTURING TECHNOLOGY LABORATORY - II

L	T	P	C
0	0	4	2

OBJECTIVE:

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

LIST OF EXPERIMENTS

1. Taper Turning and Eccentric Turning using lathe
2. External and Internal Thread cutting using lathe
3. Knurling
4. Shaping – Square and Hexagonal Heads
5. Drilling and Reaming
6. Contour milling - vertical milling machine
7. Spur and helical gear cutting using milling machine
8. Gear generation using gear hobber
9. Gear generation using gear shaper
10. Grinding – Cylindrical, Surface and Centerless grinding
11. Tool angle grinding with tool and Cutter Grinder
12. Spline Broaching
13. Measurement of cutting forces in Milling /Turning Process
14. CNC Part Programming

TOTAL: 60 PERIODS

OUTCOME:

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

- Utilise various machine tools
- Develop CNC part programs.

CE 7352 FLUID MECHANICS AND MACHINERY

L	T	P	C
3	0	0	3

OBJECTIVE:

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

UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS 9

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

UNIT II FLOW THROUGH CIRCULAR CONDUITS 9

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

UNIT III DIMENSIONAL ANALYSIS 9

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

UNIT IV PUMPS 9

Impact of jets - Euler's equation - Theory of rotodynamic machines – various efficiencies– velocity components at entry and exit of the rotor- velocity triangles - Centrifugal pumps– working principle - work done by the impeller - performance curves - Reciprocating pump-

working principle – indicator diagram – work saved by fitting air vessels – Rotary pumps – classification – comparison of working principle with other pumps – advantages.

UNIT V TURBINES 9

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

TOTAL: 45 PERIODS

OUTCOME:

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

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

TEXT BOOKS:

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

REFERENCES:

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

EC7354	ELECTRONICS ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

UNIT I SEMICONDUCTORS AND RECTIFIERS 9

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

UNIT II AMPLIFIERS AND OSCILLATORS 9

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

UNIT III LINEAR INTEGRATED CIRCUITS 9

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

UNIT IV DIGITAL ELECTRONICS 9

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

UNIT V TRANSDUCERS AND DISPLAY DEVICES 9

Thermistors, Semiconductor stainguages, LVDT, Tachometer, Ultrasonic and Thermal flowmeter, pressure force and weight measurement, Seven segment display, LED and LCD

TOTAL: 45 PERIODS

OUTCOME:

- Ability to identify electronics components and use of them to design circuits

TEXT BOOK:

1. Malvino, 'Electronic Principles', McGraw Book Co., 1993..

REFERENCES:

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

GE7251 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C

3 0 0 3

OBJECTIVES:

To the study of nature and the facts about environment.

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

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14

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

Field study of common plants, insects, birds

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

UNIT II ENVIRONMENTAL POLLUTION 8

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

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

UNIT III NATURAL RESOURCES 10

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

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

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act– Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

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

TOTAL: 45 PERIODS

OUTCOME:

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

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

TEXT BOOKS:

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

REFERENCES:

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

IE7401 **WORK SYSTEM DESIGN** **L T P C**
3 0 0 3

OBJECTIVE:

- To impart knowledge in the area of Method study and Time study so that students can implement these principles and techniques to improve productivity in manufacturing and Service sectors.

UNIT I PRODUCTIVITY **9**

Total time for a job or operation, total work content and ineffective time, – Production and Productivity - Productivity and standard of living, Factors affecting Productivity, Introduction to Productivity measurement Models.

UNIT II METHODS ENGINEERING **9**

Methods Engineering-Steps – Recording Tools and techniques - Design of work place layout - Motion study – micro motion study - THERBLINGs - cycle graph and chronocyclegraph - SIMO chart - Principles of motion economy.

UNIT III WORK MEASUREMENT **9**

Time study- performance rating – allowances - Development of Standard data - learning effect - Work measurement in Automated Processes - Computerized Labour standards.

UNIT IV APPLIED WORK MEASUREMENT **9**

Work sampling - Group Timing Technique (GTT) - predetermined time systems, types, Methods Time Measurement (MTM) - Introduction to MOST standard - Wage incentive plans.

UNIT V WORK DESIGN FOR OFFICE WORK **9**

Organization and methods (O & M) - Work measurement of office work - Work Analysis Techniques applied to support staff - Form design and Control.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to

CO1: Record and analyze selected tasks using different flowcharts
CO2: Apply method study to improve a task. Apply principles of motion economy to improve performance
CO3: Conduct a time study to improve the efficiency of the system.
CO4: Estimate Rating factors, allowances and standard times to assess the work condition and environment.

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

TEXT BOOK:

1. Barnes, R.M, “Motion and Time Study, Design and measurement of work”, John Wiley sons (Asia), Seventh edition, 2003.
2. ILO, “Introduction to Work Study”, Oxford and IBH publishing, 2008.

REFERENCES:

1. Benjamin W.Niebel, Andris Freivalds, “Methods, standards and Work Design”, McGraw hill, Eleventh edition, 2002.
2. Maynard H.B, “Industrial Engineering Hand book”, McGraw-Hill, 2008
3. Prem Vrat, G.D. Sardana and B.S. Sahay, Productivity Management – A Systems Approach, Narosa Publishing House, 1998

Attested

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

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

AIM:

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

OBJECTIVES

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

UNIT I INTRODUCTION 9

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

UNIT II FORECASTING 9

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

UNIT III AGGREGATE PLANNING AND MATERIAL REQUIREMENT PLANNING 9

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

UNIT IV CAPACITY MANAGEMENT 9

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

UNIT V PRODUCTION ACTIVITY CONTROL AND LEAN MANUFACTURING 9

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

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

TOTAL: 45 PERIODS

OUTCOMES

CO1: To understand the various parts of the operations and production management processes and their interaction with other business functions

CO2: To develop the ability to identify operational methodologies to assess and improve an organizations performance

CO3: To develop essential skills of modelling, managing and optimizing operations decisions in manufacturing and service organizations.

CO4: Utilize a variety of quantitative and qualitative methods and tools used in managing and improving operations decisions.

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

REFERENCES:

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

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

OBJECTIVE:

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

UNIT I KINEMATICS OF MECHANISMS 9

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

UNIT II GEARS AND GEAR TRAINS 9

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

UNIT III FRICTION IN MACHINE ELEMENTS 9

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

UNIT IV FORCE ANALYSIS 9

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

UNIT V BALANCING AND VIBRATION 9

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

TOTAL: 45 PERIODS

OUTCOME:

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

TEXT BOOK:

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

REFERENCES:

1. Rattan, S.S, "Theory of Machines", 3rd Edition, Tata McGraw-Hill, 2009.
2. Thomas Bevan, 'Theory of Machines', 3rd Edition, CBS Publishers and Distributors,2005.
3. Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2005
4. Benson H. Tongue, "Principles of Vibrations", Oxford University Press, 2nd Edition,2007
5. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw-Hill, 2009.
6. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines', Affiliated East-West Pvt. Ltd., New Delhi, 1988.
7. Rao.J.S. and Dukkipati.R.V. 'Mechanisms and Machine Theory', Wiley-Eastern Ltd., New Delhi, 1992.
8. John Hannah and Stephens R.C., 'Mechanics of Machines', Viva Low-Prices Student Edition, 1999.
9. Grover. G.T., "Mechanical Vibrations", Nem Chand and Bros., 1996
10. William T. Thomson, Marie Dillon Dahleh, Chandramouli Padmanabhan, "Theory of Vibration with Application**",** 5th edition Pearson Education, 2011
11. V.Ramamurthi, Mechanics of Machines, Narosa Publishing House, 2002.
12. Allen S. Hall Jr., "Kinematics and Linkage Design", Prentice Hall, 1961

CE7361 FLUID MECHANICS AND MACHINERY LABORATORY L T P C

0 0 4 2

OBJECTIVE:

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

LIST OF EXPERIMENTS

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

TOTAL: 60 PERIODS

OUTCOMES:

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

REFERENCES:

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

IE7411 WORK SYSTEM DESIGN LABORATORY L T P C
0 0 4 2

OBJECTIVE:

- To understand the theory better and apply in practice, practical training is given in the following areas:

1. Graphic tools for method study
2. Peg board experiment
3. Stop watch time study
4. Performance rating exercise
   a. Walking rating
   b. Card dealing
5. Work sampling
6. Methods Time Measurement
7. Video Based Time Study

TOTAL: 60 PERIODS

OUTCOMES:

Students should be able

CO1: To record and analyze selected tasks using different flowcharts
CO2: To conduct a time study to improve the efficiency of the system.
CO3: To design, analyze and apply the above mentioned techniques to measure Productivity.

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

IE7501 OPERATIONS RESEARCH - I L T P C
3 0 0 3

OBJECTIVE:

- To learn the basics of deterministic optimization methods.

UNIT I LINEAR PROGRAMMING 9

Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method. Solutions to LPP using simplex algorithm – Two phase method – Big M method

UNIT II ADVANCES IN LINEAR PROGRAMMING – I 9

Revised simplex method - primal dual relationships – Dual simplex algorithm – Sensitivity analysis –changes in RHS value – changes in Coefficient of constraint – Adding new constraint – Adding new variable.

UNIT III ADVANCES IN LINEAR PROGRAMING – II 9

Integer Programming – Branch and bound algorithm – Gomory's cutting plane method-Additive algorithm – mixed integer programming – Benders partitioning algorithm- Goal programming

UNIT IV NETWORK ANALYSIS – I 9

Transportation problems : Northwest corner rule , Least cost method , Voges's approximation method - stepping stone method - MODI method – Unbalanced transportation – Assignment problem – Hungarian algorithm – Travelling salesman problem – project management

UNIT V NETWORK ANALYSIS - II 9

Minimum spanning tree problem: prim's algorithm, Kruskal's algorithm - **Shortest path problem:** Dijkstra's algorithms, Floyds algorithm, systematic method - **maximal flow problem :** Linear programming model, Maximal-flow minimum-cut theorem - Maximal flow algorithm

TOTAL: 45 PERIODS

OUTCOME:

CO1: Understand how to translate a real-world problem, given in words, into a mathematical formulation

CO2: An understanding of the role of algorithmic thinking in the solution of operations research problems;

CO3: Be able to build and solve Transportation Models and Assignment Models.

CO4: Understand Operations Research models and apply them to real-life problems;

TEXT BOOKS:

1. G.Srinivasan., "Operations Research Principles and Applications", PHI, 2010.
2. R.Panneerselvam, "Operations Research", PHI, 2009

REFERENCES:

1. Philips, Ravindran and Solberg, "Operations Research", John Wiley, 2007
2. Hamdy A Taha, "Operations Research – An Introduction", Pearson, 2014.
3. Ronald L Rardin, "Optimisation in Operations Research", Pearson, 2003.
4. Hillier and Lieberman, "Introduction to Operations Research", TMH, 2000.

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

IE7502 QUALITY CONTROL AND ASSURANCE L T P C
3 0 0 3

OBJECTIVES:

- To impart knowledge to enable the students to design and implement Statistical Process Control in any industry.
- To design and implement acceptance sampling inspection methods in industry.

UNIT I QUALITY FUNDAMENTALS 9

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

UNIT II CONTROL CHARTS FOR VARIABLES 9

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

UNIT III STATISTICAL PROCESS CONTROL 9

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

UNIT IV CONTROL CHARTS FOR ATTRIBUTES 9

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

UNIT V ACCEPTANCE SAMPLING 9

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

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Students will become familiar with details of quality costs, economies and planning

CO2: Control the quality of processes using control charts for variables in manufacturing /service industries.

CO3: Good understanding and in depth knowledge has been imparted in the process capability study.

CO4: Control the occurrence of defects in product or services industries

CO5: Determination of acceptance sampling procedures are practiced

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

TEXT BOOK:

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

REFERENCES:

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

ME7451 MACHINE DESIGN L T P C

Use of P S G Design Data Book is permitted in the University examination 3 2 0 4

OBJECTIVE

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

UNIT I STEADY STRESSES IN MACHINE MEMBERS 12

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

UNIT II SHAFTS, COUPLINGS, JOINTS AND BEARINGS 12

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

UNIT III ENERGY STORING ELEMENTS AND ENGINE COMPONENTS 12

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

UNIT IV DESIGN FOR FLEXIBLE ELEMENTS 12

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

UNIT V SPUR GEARS, HELICAL GEARS AND GEAR BOXES 12

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

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

OUTCOME

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

TEXTBOOKS

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

REFERENCES

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

ME7452 **THERMODYNAMICS** **L T P C**
3 2 0 4

OBJECTIVES:

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

UNIT I BASIC CONCEPTS OF THERMODYNAMICS 12

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

UNIT II FIRST AND SECOND LAW OF THERMODYNAMICS 12

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

UNIT III HEAT ENGINES 12

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

UNIT IV GASES AND VAPOUR MIXTURES 12

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

UNIT V HEAT TRANSFER 12

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

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

OUTCOMES:

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

TEXT BOOKS:

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

REFERENCES:

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

IE7511 **OPTIMIZATION LABORATORY** **L T P C**
0 0 4 2

OBJECTIVES:

- To give adequate exposure to applications of software packages in the area of Operations Research.

Problem Formulation, Solving Using C, C++, Excel and Optimization Package (TORA/Lindo/Lingo)
LP Models Transportation
Problem Assignment
Problems Maximal Flow
Minimal Spanning Tree
Shortest route
Project Management- PERT and CPM
Goal Programming

TOTAL: 60 PERIODS

OUTCOMES:

CO1: Use computer tools to solve a mathematical model for practical problems.
CO2: Acquire knowledge in using Optimization software Package (TORA/Lindo/Lingo)
CO3: Ability to develop C++ programming for solving optimization problem.
CO4: Able to design new simple models, like: CPM, MSPT to improve decision –making develop critical thinking and objective analysis of decision problems

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

ME 7561 **COMPUTER AIDED MACHINE DRAWING** **L T P C**
0 0 4 2

OBJECTIVES:

- To make the students understand and interpret drawings of machine components
- To prepare assembly drawings both manually and using standard CAD packages
- To familiarize the students with Indian Standards on drawing practices and standard components
- To gain practical experience in handling 2D drafting and 3D modeling software systems.

UNIT I DRAWING STANDARDS & FITS AND TOLERANCES 12

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

UNIT II INTRODUCTION TO 2D DRAFTING 16

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

UNIT III 3D GEOMETRIC MODELING AND ASSEMBLY 32

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

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

TOTAL:60 PERIODS

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

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

OUTCOMES:

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

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

TEXT BOOK:

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

REFERENCES:

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

IE7601 APPLIED ERGONOMICS L T P C
3 0 0 3

OBJECTIVE:

- To explain the general principles that govern the interaction of humans and their working environment for improving worker performance and safety.

UNIT I INTRODUCTION 9

Brief history of human factors Engineering/Ergonomics – Interdisciplinary nature- Principles of Human factors Engineering- Biostatic and Biodynamic Mechanics.

UNIT II HUMAN PERFORMANCE 9

Factors influencing performance – Information receiving and processing – Information theory and its application – Human response and errors – Signal detection theory.

UNIT III PHYSIOLOGICAL ASPECTS OF HUMAN AT WORK 9

Metabolism – Physiological factors involved in muscular activity – Measurement of energy expenditure – Quantitative work load analysis – Physical work capacity and its evaluation – Physiological fatigue – Work and rest schedules – Physical fitness tests.

UNIT IV WORK PLACE DESIGN 9

Problems of body size, Anthropometry measures, Work posture – Work space layout and work station design – Design of displays, controls and VDT work stations – Hand tool design, illumination.

Attested

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

UNIT V OCCUPATIONAL HEALTH AND SAFETY 9

Industrial accidents, Personnel Protective devices, Safety Management practices – Effect of Environment – heat, cold & noise – NIOSH regulations and Factories Act

TOTAL: 45 PERIODS

OUTCOMES:

The Student should be able

CO1: To apply Knowledge of basic human science and Engineering science
CO2: To apply ergonomic principles to design workplaces for the improvement of human performance
CO3: To conduct an ergonomic analysis and ergonomic recommendations for a modern work environment problems
CO4: Apply skills associated with ergonomic measurement methods and analytical techniques to workplace ergonomic problems.
CO5: To implement latest occupational health and safety to improve the work place.

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

TEXT BOOKS:

1. Bridger, R.S., “Introduction to Ergonomics”, McGraw Hill, 1995.
2. Martin Helander, “A guide to Ergonomics of Manufacturing”, TMH, 2006

REFERENCES:

1. Mecormik, T.J., “Human Factors Engineering”, TMH, 1990.
2. John Grimaldi, “Safety Management”, A.I.B.S., 5th Edition, Hazard Control Technology 2003.
3. Philips, Chandler A, “Human Factors Engineering”, John Wiley and Sons, Inc. 2000

IE7602 FACILITY LAYOUT AND MATERIALS HANDLING L T P C
3 0 0 3

OBJECTIVE:

- To explain the basic principles in facilities planning, location, layout designs and material handling systems

UNIT I PLANT LOCATION 9

Introduction , Factors affecting location decisions , Location theory , Qualitative models , Semi-Quantitative models -Composite measure , Brown & Gibbs model , Break-Even analysis model, Single facility location problems – Median model, Gravity location model, Mini-Max model, Multi-facility location problems, Network and warehouse location problems.

UNIT II FACILITY LAYOUT DESIGN 9

Need for Layout study , Factors influencing plant layout ,Objectives of a good facility layout, Classification of layout , Layout procedure – Nadler’s ideal system approach, Immer’s basic steps, Apple’s layout procedure, Reed’s layout procedure –Layout planning – Systematic Layout Planning – Information gathering, flow analysis and activity analysis, relationship diagram, space requirements and availability, designing the layout. Utilities planning

UNIT III COMPUTERISED LAYOUT PLANNING 9

Concepts, Designing process layout – CRAFT, ALDEP, CORELAP – Trends in computerized layout, Algorithms and models for Group Technology.

UNIT IV DESIGNING PRODUCT LAYOUT 9

Line balancing - Objectives, Line balancing techniques – Largest Candidate rule- Kilbridge and Wester method- RPW method- COMSOAL.

UNIT V MATERIAL HANDLING AND PACKAGING 9

Objectives and benefits of Material handling, Relationship between layout and Material handling, Principles of material handling, Unit load concept, Classification of material handling equipments, Equipment selection, Packaging.

TOTAL: 45 PERIODS

OUTCOMES:

Students should be able to

CO1 – apply and evaluate appropriate facility location models.
CO2 – Effectively design and analyze facility layouts.
CO3 – design, measure, and analyze material flow to improve the efficiency of the system
CO4 – implement cost effective and improved the system.

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

TEXT BOOK:

1. Francis, R.L., and White, J.A, “Facilities layout and Location”, Prentice Hall of India, 2002.

REFERENCES:

1. Tompkins, White et al., “Facilities planning”, John Wiley & Sons, inc. 2003.
2. James, Apple, “Material Handling System design”, Ronald Press, 1980.
3. Krajewski, J. and Ritzman, “Operations Management – Strategy and Analysis”, Addison – Wesley publishing company, 5th Edition, 1999.
4. Pannerselvam.R, “Production and Operations Management”, PHI, 2nd Edition, 2005

IE7603 OPERATIONS RESEARCH - II L T P C
3 0 0 3

OBJECTIVE:

- To impart knowledge about dynamic programming, inventory models, waiting line models, Decision and game theory techniques.

UNIT I DETERMINISTIC INVENTORY MODELS 9

Purchase model with no shortages – Manufacturing model with no shortages – purchase model with shortages – Manufacturing model with shortages – Model with price breaks.

UNIT II PROBABILISTIC INVENTORY MODELS 9

Probabilistic inventory model – Single period model – A lot size, Reorder point model – Variable lead time - Multiproduct-selective inventory control

UNIT III QUEUING THEORY 9

Queuing theory terminology – Single server, multi server, limited queue capacity, limited population capacity

UNIT IV DECISION AND GAME THEORY **9**

Decision making under certainty – Decision making under risk – Decision making under uncertainty – Decision tree analysis - Game Theory – Two person zero sum games, pure and mixed strategies – Theory of dominance - Graphical Solution – Solving by LP

UNIT V DYNAMIC PROGRAMMING **9**

Dynamic programming technique – stage coach problem – reliability problem- capital budgeting problem- manpower planning problem – inventory problem - linear programming – integer programming problem.

TOTAL: 45 PERIODS

OUTCOMES:

CO1: The students will be able to handle issues in Inventory management.

CO2: The students acquire capability in applying dynamic program and using of queuing models for day today problem

CO3: Students will be able to estimate the solution to a problem, apply appropriate techniques to arrive at a solution, test the correctness of the solution, and interpret their results

CO4: An ability to use visualization and optimization tools to expose ideas and solutions.

TEXT BOOKS:

1. G.Srinivasan., "Operations Research Principles and Applications", PHI, 2010.
2. R.Panneerselvam, "Operations Research", PHI, 2009

REFERENCES:

1. Philips, Ravindran and Solberg, "Operations Research", John Wiley,2007
2. Hamdy A Taha, "Operations Research – An Introduction", Pearson, 2014.
3. Ronald L Rardin, "Optimisation in Operations Research", Pearson, 2003.

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

IE7604 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

OUTCOMES:

1. Students will be able to conduct failure data analysis.
2. Students will be able to estimate reliability of standard systems as well as complex systems.
3. Students will be able to explore reliability management tools and techniques.
4. Students will be able to contribute in maintainability and availability demonstration programs.

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

REFERENCES:

1. Charles E.Ebeling, “An Introduction to Reliability and Maintainability Engineering”, TMH, 2007
2. Roy Billington and Ronald N. Allan, “Reliability Evaluation of Engineering Systems”, Springer, 2007.

IE7611 DATA ANALYTICS LABORATORY L T P C

0 0 4 2

AIM:

To carry out exercises with the help of software packages in the areas of linear and multivariate regression, factor analysis, discriminant analysis, reliability and design of experiments

OBJECTIVES:

- To understand how the analysis of data derives from the statement of a problem or hypothesis and the availability of data
- To understand how to conduct a variety of statistical analyses, including testing of statistical assumptions, data transformations, and validation of statistical findings
- To be able to design a data analysis strategy that answers a hypothesis, including specifications for data elements, requirements of the statistic, and limitations to the interpretation.
- To understand how to present and interpret the results of statistical analyses.

1. Determine the linear regression model for fitting a straight line and calculate the least squares estimates, the residuals and the residual sum of squares.
2. Determine the multivariate regression model for fitting the straight line.
3. Perform the Correlation analysis to determine the relationships among the variables.
4. Perform the factor analysis for the given set of model data using both Exploratory and Confirmatory methods and evaluate the model adequacy.

5. Determine which continuous variable discriminate among the given group and determine which variable is the best predictor.
6. Determine the process is within the control or not by developing the control charts for attributes and variables and estimate the process capability.
7. Estimate the parameters (MTTF, MTBF, failure rate, bathtub curve etc) of components and systems to predict its reliability.
8. Develop the single factor and two factor design of experiment model to predict the significance factor.
9. Develop 2^k factorial and 2^{k-p} fractional factorial experiment to determine the parameters which affect the system.

TOTAL: 60 PERIODS

OUTCOMES:

CO1: Ability to independently formulate, perform and assess hypothesis
CO2: Ability to apply various data analysis techniques
CO3: Ability to interpret the results
CO4: Ability to present the results properly to extract meaningful information from data sets for effective decision making

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

IE7612 **ERGONOMICS LABORATORY** **L T P C**
0 0 4 2

OBJECTIVE:

To test the principles of human factors engineering in a laboratory

1. Effect of speed of walking on tread mill using heart rate and energy expenditure
2. Effect of workload on heart rate using Ergo cycle.
3. Evaluation of physical fitness using step test
4. Effect of work-rest schedule on physical performance (Ergo cycle / tread mill)
5. Development of anthropometric data for male and female.
6. Application of anthropometric data for the design of desk for students
7. Evaluation of physical facilities (chairs, tables etc.)Through comfort rating.
8. Analysis of noise level in different environment
9. Study of Illumination of work places.
10. Evaluation of physical fitness using metabolic Analyzer.

TOTAL: 60 PERIODS

OUTCOMES:

The Students should be able to

CO1: Design equipment and the workplace to fit people
CO2: Design the industry with ergonomics consideration
CO3: Conduct an ergonomic analysis for physical ergonomics topics

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

IE7701 SIMULATION MODELING AND ANALYSIS L T P C
3 0 0 3

OBJECTIVE

To cover various aspects of discrete dynamic, stochastic systems modeling and conducting experiments with those models on a computer.

UNIT I INTRODUCTION AND RANDOM NUMBERS 9

Systems – Modelling – Types – Systems components – Simulation basics- Random numbers – Methods of generation : Manual, table, algorithms – mid square, multiplier, constant multiplier, additive and multiplicative congruential algorithms

UNIT II RANDOM VARIATES GENERATION AND TESTING 9

Random variates for standard distributions like uniform, exponential, poisson, binomial, normal etc – Testing of Random variates – Input Data Modeling - Monte Carlo Simulation.

UNIT III DESIGN OF SIMULATION EXPERIMENTS 9

Steps on Design of Simulation Experiments – Development of models using of High level language for systems like Queing, Inventory, Replacement, Production etc., - Model validation and verification, Output analysis. Use of DOE tools.

UNIT IV SIMULATION LANGUAGES 9

Need for simulation Languages – Study of GPSS and introduction to ARENA.

UNIT V CASE STUDIES USING SIMULATION LANGUAGES 9

Waiting line models, inventory models, and production models.

TOTAL: 45 PERIODS

OUTCOMES:

1. Will be able to generate random numbers and variates.
2. Will be able to test the statistical stability of random variates
3. Will be able to develop simulation models for real life systems
4. Will be able use simulation language to simulate and analyze systems

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

TEXT BOOK:

1. Jerry Banks, John S Corson, Barry.L. Nelson, David M.Nicol and P.Shahabudeen, Discrete Event Systems Simulation, Pearson education, Fourth edition, 2007.
2. Thomas J Schriber, “Simulation Using GPSS”, John Wiley, 2002.

REFERENCES:

1. Law A M and Kelton W D, Simulation Modelling and analysis, Tata McGraw Hill, 2003.
2. David Kelton, Rondall P Sadowski and David T Sturrock, “Simulation with Arena”, Mc-Graw Hill, 2004
3. http://www.bcnn.net

IE7702 SUPPLY CHAIN AND LOGISTICS MANAGEMENT L T P C
3 0 0 3

AIM

- To provide broad knowledge on Supply Chain and Logistics Management

OBJECTIVES

- To understand the role of logistics and supply, Competitive and Supply chain Strategies and Drivers of Supply Chain
- To understand about the distribution networks, network Design and Transportation in Supply Chain.
- To learn about Sourcing and coordination in Supply Chain
- To understand about supply chain IT framework and emerging issues in supply chain

UNIT I INTRODUCTION 9

Role of Logistics and Supply chain Management: Scope and Importance - Evolution of Supply Chain –Examples of supply Chains - 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 - 3PL- 4PL- Global Logistics **-** Reverse Logistics; Reasons, Activities and **issues.**

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 IT AND EMERGING CONCEPTS IN SUPPLY CHAIN 9

The role IT in supply chain-The supply chain IT framework -Customer Relationship Management – Internal supply chain management – supplier relationship management – future of IT in supply chain –E-Business in supply chain

Introduction to Warehouse Management, Risk in Supply Chain, Lean supply Chains, Sustainable supply Chains

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Ability to understand the framework and scope of supply chain networks and functions.
CO2: Ability to design Distribution, Transportation and network design principles in a selected enterprise.
CO3: Ability to understand Sourcing, Coordination, Information Technology and current issues in SCM.
CO4: Ability to apply SCM concepts in a selected enterprise.

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

TEXT BOOKS:

1. Sunil Chopra, Peter Meindl and D.V. Kalra, "Supply Chain Management: Strategy, Planning, and Operation, ,Pearson Education, 2013.
2. Srinivasan G.S, "Quantitative models in Operations and Supply Chain Management", PHI, 2010.
3. A. Ravi Ravindran, Donald P. Warsing, Jr",Supply Chain Engineering: Models and Applications, "CRC Press, 2012.
4. Senthil Kumar ,Omkumar.M, "Warehouse layout Planning and Part Feeding Methods", Yesdee, 2014.

IE7751 DESIGN OF EXPERIMENTS L T P C
3 0 0 3

AIM:

- This course aims to introduce students how to statistically plan, design and execute industrial experiments for process understanding and improvement in both manufacturing and service environments

OBJECTIVES:

- To demonstrate knowledge and understanding of Classical Design of Experiments (DOE)
- To demonstrate knowledge and understanding of Taguchi's approach
- To develop skills to design and conduct experiments using DOE and Taguchi's approach
- To develop competency for analysing the data to determine the optimal process parameters that optimize the process.

UNIT I FUNDAMENTALS OF EXPERIMENTAL DESIGNS 9

Hypothesis testing – single mean, two means, dependant/ correlated samples – confidence intervals, Experimentation – need, Conventional test strategies, Analysis of variance, F-test, terminology, basic principles of design, steps in experimentation – choice of sample size – Normal and half normal probability plot – simple linear and multiple linear regression, testing using Analysis of variance.

UNIT II SINGLE FACTOR EXPERIMENTS 9

Completely Randomized Design- effect of coding the observations- model adequacy checking - estimation of model parameters, residuals analysis- treatment comparison methods- Duncan's multiple range test, Newman-Keuel's test, Fisher's LSD test, Tukey's test- testing using contrasts- Randomized Block Design – Latin Square Design- Graeco Latin Square Design – Applications.

UNIT III FACTORIAL DESIGNS 9

Main and Interaction effects - Two and three factor full factorial designs- Fixed effects and random effects model - Rule for sum of squares and Expected Mean Squares- 2^K Design with two and three factors- Yate's Algorithm- fitting regression model- Randomized Block Factorial Design - Practical applications.

UNIT IV SPECIAL EXPERIMENTAL DESIGNS 9

Blocking and Confounding in 2^K Designs- blocking in replicated design- 2^K Factorial Design in two blocks- Complete and partial confounding- Confounding 2^K Design in four blocks- Two level Fractional Factorial Designs- one-half fraction of 2^K Design, design resolution, Construction of one-half fraction with highest design resolution, one-quarter fraction of 2^K Design- introduction to response surface methods, central composite design.

UNIT V TAGUCHI METHODS **9**

Design of experiments using Orthogonal Arrays, Data analysis from Orthogonal experiments- Response Graph Method, ANOVA- attribute data analysis- Robust design- noise factors, Signal to noise ratios, Inner/outer OA design- case studies.

TOTAL : 45 PERIODS

OUTCOMES:

CO1: To understand the fundamental principles of Classical *Design of Experiments*
CO2: To apply DOE for process understanding and optimisation
CO3: To describe the Taguchi's approach to experimental design for process performance robustness
CO4: To apply Taguchi based approach to evaluate quality

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

TEXT BOOK:

1. Douglas C. Montgomery, "Design and Analysis of Experiments", John Wiley & sons, 2012.

REFERENCES:

1. Krishnaiah K, and Shahabudeen P, "Applied Design of Experiments and Taguchi Methods", PHI, India, 2011.
2. Phillip J. Ross, "Taguchi Techniques for Quality Engineering", Tata McGraw-Hill, India, 2005.
3. Box, G. E., Hunter,W.G., Hunter, J.S., Hunter,W.G., "Statistics for Experimenters: Design, Innovation, and Discovery", 2nd Edition, Wiley, 2005.

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

COURSE DESCRIPTION

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

OBJECTIVES

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

CONTENTS

UNIT I WRITING SKILLS

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

UNIT II SOFT SKILLS

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

UNIT III PRESENTATION SKILLS

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

UNIT IV GROUP DISCUSSION SKILLS

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

UNIT V INTERVIEW SKILLS

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

TOTAL: 45 PERIODS

OUTCOMES:

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

REFERENCES:

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

EXTENSIVE READERS

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

WEB RESOURCES

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

IE7711 **DISCRETE SIMULATION LABORATORY** **L T P C**
0 0 4 2

OBJECTIVE:

To give hands on experience with reference to computer based discrete system simulation experiments

1. Random Number Generation
   Mid Square, Constant Multiplier, Congruential
2. Random variates Generation
   Exponential, Poisson, Normal, Binomial
3. Testing of Random variates
   Chi-Square, KS, Run,Poker
4. Monte Carlo Simulation : Random Walk Problem
5. Monte Carlo Simulation : Paper vendor problem
6. Single Server Queuing Model
7. Multi Server Queuing Model
8. Alternate service queueing model
9. Inventory Model
10. Use of Simulation Language ; Servers in series queuing system
11. Use of Simulation Model : Queue with balking

TOTAL: 60 PERIODS

OUTCOMES

1. Will have hands on experience in generation of random numbers and variates.
2. Will have hands on experience in testing the statistical stability of random variates
3. Will have hands on experience in developing simulation models for real life systems
4. Will have hands on experience in the use simulation language to simulate and analyze systems

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

IE7712 **INDUSTRIAL TRAINING / MINI PROJECT / INTERNSHIP** **L T P C**
0 0 4 2

OBJECTIVE:

- The student has the option of undergoing either industrial training or can carry out a mini project.

INDUSTRIAL TRAINING:

The objective is to give an exposure to the industrial environment and learn how they function.
A minimum of 4 weeks of industrial training is required. He/she can undergo training either at a stretch or in two spells of a minimum of two weeks each. The training should have been completed in the immediate preceding one or two summers. A comprehensive report is to be submitted at the beginning of the VIIth semester. A certificate from the industry signed by an appropriate authority should be submitted along with the report. It will be evaluated by a two member committee constituted by the Head of the Department based on the report and oral examination.

TOTAL: 60 PERIODS

OUTCOMES:
CO1. Able to be better prepared for the workplace and experience doing real work.
CO2. . To get hands-on training about the skill sets required, Learn demands of the industry and also work ethics.
CO3. To develop leadership and mentoring skills,
CO4. Create exposure for the company, bring new perspectives and fresh ideas into the work environment.

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

MINI PROJECT

OBJECTIVE:

The objective is to develop skill in applying industrial engineering techniques to real/ practical problems.

A student is expected to select a topic in the industrial engineering area such as forecasting, production planning, scheduling, operations research, facilities planning and layout, transportation and distribution, quality, supply chain, and simulation. Identify a problem and collect necessary data and analyse using appropriate tool / technique. Data can be collected from industry or standard data sets available in literature can be used.

A comprehensive report is to be submitted towards the end of the VIIth semester. It will be evaluated by a two member committee constituted by the Head of the Department based on the report and oral examination.

OUTCOMES:

CO1: The students will get practical exposure on industrial engineering techniques.
CO2: Analyze and Design the equipment and the workplace to fit people.
CO3: Study of Illumination of work places
CO4: Able to take up computational and experimental projects.

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

IE7801 **MANUFACTURING AUTOMATION** **L T P C**
3 0 0 3

OBJECTIVES:

- To give a brief exposure to automation principles and control technologies.
- To introduce the concept of fixed automation using transfer lines.
- To train the students in the programmable automation such as CNC and industrial robotics.
- To provide knowledge on the use of automated material handling, storage and data capture

UNIT I MANUFACTURING OPERATIONS 9

Automation in production systems, principles and strategies, Product/production relationships, Production concepts and mathematical models, manufacturing economics.

UNIT II CONTROL TECHNOLOGIES 9

Automated systems – elements, functions, levels, Continuous Vs discrete control, Computer process control, Sensors, Actuators, ADC, DAC, Programmable logic controllers – ladder logic diagrams.

UNIT III TRANSFER LINES 9

Automated production lines – applications, Analysis – with and without buffers, automated assembly systems, line unbalancing concept.

UNIT IV NUMERICAL CONTROL AND ROBOTICS 9

NC - CNC – Part programming – DNC – Adaptive control – Robot anatomy – Specifications – End effectors – Industrial applications.

UNIT V AUTOMATED HANDLING AND STORAGE 9

Automated guided vehicle systems, AS/RS, Carousel storage, Automatic data capture - Bar code technology.

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Selection of automated equipment with cost justification

CO2: Selection of buffer size and location in transfer lines.

CO3: Ability to prepare a simple CNC program, select a robot configuration for given application.

CO4: Recommend an appropriate automated material handling, storage and data capture method.

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

TEXT BOOK:

1. Mikell P.Groover, Automation, “Production Systems and Computer Integrated Manufacturing” PHI, 2008.

REFERENCES:

1. Mikell P.Groover, Emory W. Zimmers, Jr., “CAD/CAM: Computer - Aided Design and Manufacturing”, PHI, 2007

IE7811 AUTOMATION LABORATORY L T P C
0 0 4 2

OBJECTIVE:

To give hands on experience on

- CNC programming on Lathe and Milling Machine
- Programming of Robotics
- Programming of PLC

1. Part programming and Machining of Simple Turning using CNC Lathe
2. Part programming and Machining of Taper Turning using CNC Lathe
3. Part programming and Machining using Multiple Turning cycle in CNC Lathe
4. Part programming and Simulation of Thread Cutting using CNC Lathe
5. Part programming and Machining of Contour using CNC Milling Machine
6. Part programming and Machining of Circular Pocket using CNC Milling Machine
7. Part programming and Machining of Rectangular Pocket using CNC Milling Machine
8. Part programming and Machining using Mirroring Cycle in CNC Milling Machine
9. Programming Exercise for Robots
10. Programming of PLC using Ladder Logic Diagram

TOTAL: 60 PERIODS

OUTCOMES:

CO1: Ability to write CNC programming using G-code and M-code
CO2: Ability to write programming for robot control
CO3: Ability to use PLC for actuation

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

IE7812 **COMPREHENSION** **L T P C**
0 0 4 2

The objective of this comprehension is to achieve an understanding of the fundamentals of contemporarymanufacturingsystemsincludingmaterials,manufacturingprocess,productand process control, computer integrated manufacture and quality. The students working groups and solve a variety of problems given to them. The problems given to the students should be of real like industrial problems selected by a group of faculty members of the concerned department. Minimum of three small problems have to be solved by each group of students. The evaluation is based on continuous assessment by a group of faculty members constituted by the professor in-charge of the course.

TOTAL: 60 PERIODS

IE7813 **PROJECT WORK** **L T P C**
0 0 20 10

A project topic must be selected either from published list sort he students themselves may propose suitable topics in consultation with the faculty/guide. It can be a theoretical research projector industry oriented. The objective is to apply the principles/techniques they have learnt to a new or existing problem situation leading to a solution. Generally it is a group project.

The progress of the project is evaluated based on the guidelines provided in the regulation.

TOTAL: 300 PERIODS

GE7071 **DISASTER MANAGEMENT** **L T P C**
3 0 0 3

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction

- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I INTRODUCTION TO DISASTERS 9

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

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

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

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

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

UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9

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

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

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

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

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

TEXT BOOK:

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

REFERENCES

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

GE7074 HUMAN RIGHTS L T P C
3 0 0 3

OBJECTIVES :

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

UNIT I 9

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

UNIT II 9

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

UNIT III 9

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

UNIT IV 9

Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V 9

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

TOTAL : 45 PERIODS

OUTCOME :

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

REFERENCES:

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

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

AIM

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

OBJECTIVES

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

UNIT I INTRODUCTION 9

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

UNIT II TQM PRINCIPLES 9

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

UNIT III TQM TOOLS & TECHNIQUES I 9

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

UNIT IV TQM TOOLS & TECHNIQUES II 9

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

UNIT V QUALITY MANAGEMENT SYSTEM 9

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

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Ability to apply TQM concepts in a selected enterprise.
CO2: Ability to apply TQM principles in a selected enterprise.
CO3: Ability to apply the various tools and techniques of TQM.
CO4: Ability to apply QMS and EMS in any organization.

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

TEXT BOOK:

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

REFERENCE:

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

IE7001 ACCOUNTING AND FINANCE FOR MANAGEMENT L T P C
3 0 0 3

OBJECTIVES

- To understand the Basics of accounting and accounting standards.
- To understand how to prepare P&L statements, Balance sheets and other accounting statements.
- To learn and apply the various cost accounting methods.
- To understand how to prepare a budget and make investment decisions.

UNIT I INTRODUCTION 9

Basics of accounting – Management Accounting – Financial accounting – cost accounting – comparison of financial accounting, cost accounting and management Accounting – generally accepted accounting principles – Accounting standards – Accounting cycle.

UNIT II FINANCIAL ACCOUNTING 9

Salient features of Balance Sheet and Profit and Loss statement, cash flow and Fund flow Analysis (Elementary), working capital management, ratio analysis – Depreciation.

UNT III COST ACCOUNTING 9

Cost accounting systems: Job Costing, process costing, allocation of overheads, Activity based costing, variance analysis – marginal costing – Break even analysis.

UNTI IV BUDGETING 9

Requirements for a sound budget, fixed budget – preparation of sales and production budget, flexible budgets, zero based budgets and budgetary control.

UNIT V FINANCIAL MANAGEMENT 9

Investment decisions – Investment appraisal techniques – payback period method, accounting rate of return, net present value method, internal rate of return and profitability index method-cost of capital.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Ability to apply accounting principles in a selected enterprise.
CO2: Ability to prepare P&L A/C, Balance sheet and other accounting statements.
CO3: Ability to apply the various cost accounting methods.
CO4: Ability to prepare a budget and make investment decisions.

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

REFERENCES:

1. Bhattacharya. S.K. and John Deardon, “Accounting for Management – Text and cases”, Vikas publishing House, New Delhi, 1996.
2. James, C.Van Horne, “Fundamental of Financial Management” Pearson Education, 12th Edition, 2002
3. V.R.Palanivelu, “Accounting for Management”, Lexmi Publication (P) Ltd., 2007.

IE7002 ADVANCED OPTIMIZATION TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

- To gain knowledge about nonlinear and multi-objective optimization models.
- To get exposure to meta heuristic algorithms.

UNIT I RANDOM PROCESS 9

Modeling the process –steady state probabilities - Reducible Markov chains – Absorbing Markov chains – Ergodic Markov chains

UNIT II NON-LINEAR OPTIMIZATION - I 9

Types of Non-linear programming problems, unconstrained optimization, KKT conditions for constrained optimization, Quadratic programming

UNIT III NON-LINEAR OPTIMIZATION - II 9

Separable programming, Convex programming, Non-convex programming, Geometric programming, Stochastic programming

UNIT IV NON-TRADITIONAL OPTIMIZATION - I 9

Meta Heuristics like Genetic Algorithms, Simulated annealing, Tabu search, Ant Colony Optimization with applications to Industrial Engineering.

UNIT V NON-TRADITIONAL OPTIMIZATION - II 9

Neural network basics – learning rules – single layer – multi-layer networks , Basic concepts of fuzzy sets, membership functions. Basic operations on fuzzy sets, Properties of fuzzy sets, Fuzzy relations.

Propositional logic and Predicate logic, fuzzy If – Then rules, fuzzy mapping rules and fuzzy implication functions, Applications

TOTAL: 45 PERIODS

OUTCOMES:

- Students will have knowledge of various latest optimization techniques and will be able to select and apply suitable technique as warranted by real life situation.

TEXT BOOKS:

1. Frederick K. Hiller, Bodhibrata Nag, Preetam Basu, Geralld J. Lieberman**,** Introduction to Operations Research, Mc-Graw Hill, 2011
2. S. Rajasekaran and G.A.Vijaylakshmi Pai.. Neural Networks Fuzzy Logic, and Genetic Algorithms, Prentice Hall of India, 2006

REFERENCES:

1. Singiresu S Rao, “Engineering Optimization”, Wiley, 1998.
2. Kalyanmoy Deb, “Optimization for Engineering Design”, PHI, 2012.

IE7003 APPLIED MULTI-VARIATE STATISTICAL ANALYSIS L T P C
3 0 0 3

OBJECTIVE:

- To impart knowledge on the applications of multivariate statistical analysis

UNIT I MULTIVARIATE METHODS 9

Review of basic matrix operations and random vectors, Eigen values and Eigen vectors. An overview of multivariate methods, Multivariate normal distribution.

UNIT II REGRESSION 9

Inferences about population parameters - Simple Regression, and Correlation – Estimation using the regression line, correlation analysis, Multiple Regression– Logistic Regression - Canonical Correlation analysis-Multivariate analysis of variance.

UNIT III FACTOR ANALYSIS 9

Principal components analysis – Objectives, estimation of principal components, testing for independence of variables, Factor analysis model – Method of estimation – Factor rotation – Factor Scores

UNIT IV DISCRIMINANT ANALYSIS 9

Discriminant analysis – Classification with two multi Variate normal populations- Evaluating classification function – Classification with several populations – Fishers Method for Discriminating among several Populations.

UNIT V CLUSTER ANALYSIS 9

Cluster analysis – Clustering methods, Hierarchical clustering methods – Single Linkage, Complete Linkage, Average Linkage, Ward's Hierarchical Clustering Method, Non Hierarchical Clustering methods - K-means Method, Validation and profiling of clusters

TOTAL: 45 PERIODS

OUTCOMES:

Students should be able to

CO1: Predict the values of one or more variables on the basis of observations on the other variables.

CO2: Formulate the specific statistical hypotheses, in terms of the parameters of multivariate populations

CO3: Data reduction or structural simplification as simply as possible without sacrificing valuable information and will make interpretation easier.

CO4: Sorting and Grouping "similar" objects or variables are created, based upon measured characteristics.

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

IE7004 COMPUTATIONAL METHODS AND ALGORITHMS L T P C
3 0 0 3

OBJECTIVE

- A brief introduction to algorithmic design tools with some applications.

UNIT I REVIEW OF A LANGUAGE 9

Review of C/C++ - writing and debugging large programs - Controlling numerical errors.

UNIT II ALGORITHM DESIGN METHODS 9

Greedy – Divide and conquer – Backtracking – Branch & bound – Heuristics- Meta heuristics

UNIT III BASIC TOOLS 9

Structured approach – Networks – Trees – Data structures

UNIT IV COMPUTATIONAL PERFORMANCE 9

Time complexity – Space complexity – Algorithm complexity

UNIT V APPLICATIONS 9

Sorting – Searching - Networks – Scheduling – Optimization models – IE applications

TOTAL: 45 PERIODS

Attested

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

OUTCOMES

Student will be able to design algorithm computational tools used in manufacturing process.

- Will be able to use a structured language for programming
- Will be able to use various algorithm design methods
- Will be able to develop algorithms using various tools
- Will be able to develop algorithms for IE applications

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1		✓										
2			✓	✓								
3		✓	✓									
4		✓	✓	✓	✓							✓

TEXT BOOK:

1. Panneerselvam.R, ”Design and Analysis of Algorithms”, Prentice Hall of India, 2008

REFERENCES:

1. Goodman S F and Headtruemu ST , “Introduction to design of algorithms”, McGraw Hill, 2002.
2. Sahni, “Data Structures, algorithms and applications in C++”, McGraw Hill, 2003.
3. Dromey,R.G., “How to solve it with computers?”,PHI, 2002

IE7005 DECISION SUPPORT AND INTELLIGENT SYSTEMS L T P C

3 0 0 3

OBJECTIVE:

- To review and clarify the fundamental terms, concepts and theories associated with Decision Support Systems, computerized decision aids, expert systems, group support systems and executive information systems.
- To discuss and develop skills in the analysis, design and implementation of computerized Decision Support Systems.
- To examine the uses of various mathematical models, heuristics and simulation as a sub-system of DSS.
- To understand that most Decision Support Systems are designed to support rather than replace decision makers and the consequences of this perspective for designing DSS.

UNIT I INTRODUCTION 5

Managerial decision making, system modeling and support - preview of the modeling process-phases of decision making process.

UNIT II ANALYSIS 10

DSS components- Data warehousing, access, analysis, mining and visualization-modeling and analysis-DSS development.

UNIT III TECHNOLOGIES 10

Group support systems- Enterprise DSS- supply chain and DSS - Knowledge management methods, technologies and tools.

UNIT IV EXPERT SYSTEMS 10

Artificial intelligence and expert systems - Concepts, structure, types - Knowledge acquisition and validation - Difficulties, methods, selection.

UNIT V SEMANTIC NETWORKS **10**

Representation in logic and schemas, semantic networks, production rules and frames, inference techniques, intelligent system development, implementation and integration of management support systems.

TOTAL : 45 PERIODS

OUTCOMES:

CO1: Make decisions in the semi structured and unstructured problem situations.
CO2: Able to apply data warehousing and data mining principles in basic applications.
CO3: Develop knowledge management system with simple tools and techniques.
CO4: Develop intelligent based DSS.

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

REFERENCES:

1. Efraim Turban and Jay E Aronson, “Decision Support and Business Intelligent Systems”, PHI, Eighth edition, 2010.
2. S S Mitra, “Decision support systems, tools and techniques”, John Wiley, 1996.
3. Elain Rich and Kevin Knight, “Artificial intelligence”, TMH,1993.

IE7006 EVOLUTIONARY OPTIMIZATION **L T P C**
3 0 0 3

OBJECTIVES:

- To introduce different evolutionary optimization techniques for the problems related to the manufacturing systems

UNIT I **9**

Conventional Optimization techniques, Overview of evolutionary computation, Historical branches of evolutionary computation

UNIT II **9**

Search operators, Selection schemes, Ranking methods, Importance of representation

UNIT III **9**

Evolutionary combinatorial optimization: evolutionary algorithms, Constrained optimization, Evolutionary multi-objective optimization.

UNIT IV **9**

Genetic programming – Steps, Search operators on trees, examples, Hybrid genetic algorithms, Combining choices of heuristics

UNIT V **9**

Pareto optimality, Analysis of evolutionary algorithms

TOTAL: 45 PERIODS

OUTCOMES:

- The students will be able to make decisions in the semi structured and unstructured problem situations.

REFERENCES:

1. W Banzhaf et al , “Genetic Programming – An introduction”, Morgan Kanfmann Publications, 1999.
2. X Yao, “Evolutionary computations – Theory and Applications”, World Scientific Publications, 1999.
3. J Baeck, “Handbook of Evolutionary computation”, IOS Press, 1997.
4. Goldberg D E , Genetic Algorithms in search, optimization, Addison Wesley, 1989.
5. Ruhul sarker, Masoud Mohammadian, Yao, Evolutionary Optimization, Kluwers’s Academic Publishers, 2002.
6. Kalyanamoy Deb, “Optimization for engineering design”, PHI, 2012.

IE7007 INFORMATION SYSTEMS ANALYSIS AND DESIGN L T P C
3 0 0 3

OBJECTIVES:

- To describe the design data flow and ER diagrams
- To effectively manage the management information systems
- To analyze the technology and information systems
- To study the applications, designs and models for business organization

UNIT I OVERVIEW 9

Information concepts, System concepts, Examples of Information systems, Information Systems analysis overview, Information gathering – sources.

UNIT II DATA FLOW DIAGRAMS AND ER DIAGRAMS 9

System Requirements specifications, Feasibility analysis, Data flow diagrams – logical and physical DFDs, Process specification methods, Decision tables. Logical database design – ER model, Normalizing relations; Data input methods; Structured Systems Analysis and Design.

UNIT III MANAGEMENT INFORMATION SYSTEMS 9

Development of MIS, Choice of Information technology, Applications in manufacturing and service sector, Enterprise management systems.

UNIT IV TECHNOLOGY AND INFORMATION SYSTEMS 9

Database management systems, Object oriented technology, Client-server architecture, Local area network, network topology.

UNIT V APPLICATIONS 9

Data warehouse design and implementation, Models of E-business, MIS and E-business, Web enabled business management, Introduction to ERP, Case studies.

TOTAL : 45 PERIODS

OUTCOMES:

- The Student must be able to design data flow and ER diagrams, manage information system and apply modern concepts to business organizations.
  - CO1. Able to make an analysis on Information Systems
  - CO2. To implement design data flow and ER diagrams
  - CO3. Able to manage and analyze the technology and information systems
  - CO4. Able to improve designs and models for business organization

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

REFERENCES:

1. V. Rajaraman, “Analysis and Design of Information Systems”, PHI, 2004.
2. Jeffrey L Whitten et al, “Systems Analysis and Design Methods”, McGraHill, 2003.

IE7008 MAINTENANCE ENGINEERING AND MANAGEMENT L T P C
3 0 0 3

OBJECTIVE:

- To maximize profit and minimize downtime in maintenance
- To analyze the root cause for maintenance problems
- To effectively manage the spare parts for maintenance activity
- To reduces the losses and improve the Overall Equipment Effectiveness

UNIT I MAINTENANCE CONCEPT 9

Maintenance definition – Maintenance objectives – Maintenance challenges – Tero Technology – Maintenance costs - Scope of maintenance department.

UNIT II MAINTENANCE MODELS 9

Proactive/reactive maintenance – Maintenance policies – Imperfect maintenance – PM versus b/d maintenance – Optimal PM schedule and product characteristics – Inspection decisions: Maximizing profit - Minimizing downtime – Replacement decisions.

UNIT III MAINTENANCE QUALITY 9

Five zero concept – FMEA- FMECA – Root cause analysis – Repair time distribution – Analysis of downtime – Maintainability prediction – Design for maintainability – Reliability Centered Maintenance.

UNIT IV MAINTENANCE MANAGEMENT 9

Human factors – Maintenance staffing: Learning curves – Simulation – Optimal size of service facility – Optimal repair effort – Spare parts management – Maintenance planning – Maintenance scheduling.

UNIT V TOTAL PRODUCTIVE MAINTENANCE 9

TPM philosophy – Chronic and sporadic losses – Equipment defects – Six major losses – Overall equipment effectiveness – TPM pillars – Autonomous maintenance.

TOTAL : 45 PERIODS

OUTCOMES:

CO1. To implement maintenance policies for maximizing the profit
CO2. Able to make a diagnosis of maintenance problems
CO3. Able to improve uptime of machines by effective spare parts management
CO4. Able to improve the overall Equipment Effectiveness

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

Attested

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Anna University, Chennai-600 025.

REFERENCES:

1. Andrew K.S.Jardine & Albert H.C. Tsang, “Maintenance, Replacement and Reliability” Taylor and Francis, 2006.
2. Bikas Badhury & S.K.Basu, “Tero Technology: Reliability Engineering and Maintenance Management”, Asian Books, 2003.
3. Seichi Nakajima, “Total Productive Maintenance”, Productivity Press, 1993.
4. R.C. Mishra and K.Pathak., “Maintenance Engineering and Management”, PHI,2012

IE7009 MODELING OF MANUFACTURING SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

- To introduce the students different models used to describe the manufacturing systems and use of them for effective operations of manufacturing industries.

UNIT I INTRODUCTION 9

Manufacturing systems types and concepts, manufacturing automation, performance measures types, classification and uses of manufacturing system models FMS planning and scheduling – Part selection and loading problems.

UNIT II FOCUSSED FACTORIES 9

Focused flow lines – Work cells- work centers, Group technology, General serial systems – Analysis of paced and unpaced lines, system effectiveness, impact of random processing times

UNIT III MARKOV MODELS 9

Stochastic processes in manufacturing, Markov chain models – DTMC and CTMC, steady state analysis, Transient Analysis of Manufacturing Systems

UNIT IV QUEUING MODELS OF MANUFACTURING 9

Basic queuing models, Queuing networks in manufacturing – Jackson and Gordon Newell, product form solution

UNIT V PETRINET MODEL 9

Preliminary Definitions, Transition firing and reachability, Representational power, Properties of Petri Nets. Stochastic Petri Nets.

TOTAL : 45 PERIODS

OUTCOMES:

CO1. Can evaluate a given automated manufacturing system based on performance measures
CO2. Can apply group technology concepts to form Machine cells
CO3. Can model the Assembly line using Markov, Queuing and Petri Net model
CO4. Can analyze and model production lines using Markov, Queuing and Petri Net model

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

REFERENCES:

1. Ronald G Askin, “Modeling and Analysis of Manufacturing systems”, Wiley & sons,1993.
2. Viswanadham and Narahari, “Performance modeling of automated manufacturing systems”, PHI, 1998
3. Buzacot and Shantikumar, “Queueing networks in Manufacturing”, Wiley Sons, 2000.
4. Reisig W, “System Design Using Petrinets”, Springer, 2000.

IE7010 OPERATIONS SCHEDULING L T P C
3 0 0 3

OBJECTIVE:

- To impart knowledge on various scheduling algorithms applicable to single machine, parallel machines, flow shop and job shop models.

UNIT I SCHEDULING THEORY 9

Scheduling background - Scheduling function – Sequencing – Measures of performance – Scheduling theorems – Pure sequencing model assumptions.

UNIT II SINGLE MACHINE SCHEDULING 9

Hogdson’s algorithm – Smith’s application – Wilkerson-Irwin algorithm – Neighborhood search technique – Dynamic programming approach – Branch and Bound algorithm – Non simultaneous arrivals – Dependent job problems – Sequence dependent set up times.

UNIT III PARALLEL MACHINE SCHEDULING 9

Preemptive jobs: McNaughton’s algorithm – Non preemptive jobs – Heuristic procedures – Minimizing weighted mean flow time: H_1 & H_m heuristics – Dependent jobs: Hu’s algorithm– Muntz Coffman algorithm.

UNIT IV FLOW SHOP SCHEDULING 9

Characteristics – Johnson’s algorithm – Extension of Johnson’s rule – Campbell Dudek Smith algorithm – Palmer’s method – Start lag, Sop lag – Mitten’s algorithm –Ignall Schrage algorithm – Despatch index heuristic.

UNIT V JOB SHOP SCHEDULING 9

Characteristics – Graphical tools – Jackson’s algorithm – Feasible, Semi-active and active schedules – Single pass approach – Non delay schedule – Priority dispatching rules – Heuristic schedule generation – Open shop scheduling- Scheduling in services – Meta heuristics in scheduling

TOTAL: 45 PERODS

OUTCOMES:

- Students will be able to solve single machine sequencing problems with an objective to minimize mean flow time or mean tardiness.
- Students will be able to design a parallel machine schedule which can minimize mean flow time, or makespan.
- Students will be able to determine an optimal schedule for a flow shop.
- Students will be able to solve complex job shop problems, design and evaluate various feasible job shop schedules.

PROGRAMME OUTCOMES

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

REFERENCES:

1. Kenneth R.Baker, “Introduction to Sequencing and Scheduling”, John Wiley & Sons, New York, 2000.
2. Kenneth R.Baker, Dan Trietsch, “Principles of sequencing and scheduling”, John Wiley & Sons, New York, 2013.

IE7011 PRINCIPLES OF COMPUTER INTEGRATED MANUFACTURING SYSTEMS **L T P C 3 0 0 3**

OBJECTIVE:

- To provide some basic aspects of flexible automation.
- To introduce the fundamentals of computer aided design.
- To get in sights in to the enablers of CAD and CAM integration and business function.
- To introduce the fundamentals of integrated management systems such as communication, network and database management.

UNIT IGT AND FMS **9**

Part families, production flow analysis, cellular manufacturing, ROC, Flexible manufacturing systems- components, FMS applications, FMS analysis – Bottleneck model.

UNIT II COMPUTER-AIDED DESIGN **9**

Fundamentals of CAD – design process, manufacturing database – Computer graphics – functions, constructing the geometry, transformation, wire frame Vs solid modelling.

UNIT III MANUFACTURING SUPPORT SYSTEMS **9**

Product design and CAD, CAD/CAM and CIM, Computer aided process planning- Variant and generative approaches, Concurrent engineering and design for manufacture, Lean production, Agile manufacturing.

UNIT IV FUNDAMENTALS OF COMMUNICATIONS **9**

Information, Communications matrix, Computer communications, Network architecture, Tools and techniques.

UNIT V DATABASE AND CIM MANAGEMENT **9**

Manufacturing data, database technology, Database management, Management of CIM – role, cost justification, expert systems

TOTAL: 45 PERIODS

OUTCOMES:

- Analyze a cellular and flexible manufacturing system for its performance measures.
- Gain knowledge in the basics of computer aided design.
- Make competitive manufacturing systems with the use of appropriate tools and techniques.
- Develop integrated manufacturing system with the required network structure and manufacturing database.

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

REFERENCES:

1. Mickel P Groover, "Automation production systems and computer integrated manufacturing", PHI, second edition, 2008.
2. S.Kant Vajpayee, "Principles of Computer-Integrated Manufacturing", PHI, 2005.

IE7012 PRODUCT DESIGN AND VALUE ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- The course aims at providing the basic concepts of product design, product features and its architecture so that student can have a basic knowledge in the common features a product has and how to incorporate them suitably in product.

UNIT I VALUE ENGINEERING BASICS 9

Origin of Value Engineering, Meaning of value, Definition of Value Engineering and Value analysis, Difference between Value analysis and Value Engineering, Types of Value, function - Basic and Secondary functions, concept of cost and worth, creativity in Value Engineering.

UNIT II VALUE ENGINEERING JOB PLAN AND PROCESS 9

Seven phases of job plan, FAST Diagram as Value Engineering Tool, Behavioural and organizational aspects of Value Engineering, Ten principles of Value analysis, Benefits of Value Engineering.

UNIT III IDENTIFYING CUSTOMER NEEDS and PRODUCT SPECIFICATIONS 9

Product Development process – Product development organizations.Gather raw data – Interpret raw data- organize the needs into a hierarchy – Relative importance of the needs. Specifications – Refining specifications.

UNIT IV CONCEPT GENERATION, SELECTION AND PRODUCT ARCHITECTURE 9

Clarify the problem – Search internally – Search externally – Explore systematically. Concept Screening – Concept scoring. Product architecture – Implication of architecture – Establishing the architecture – Related system level design issues.

UNIT V INDUSTRIAL DESIGN, PROTOTYPING AND ECONOMICS OF PRODUCT DEVELOPMENT 9

Need for industrial design – Impact of industrial design – Industrial design process – Management of industrial design process – Assessing the quality of industrial design. Estimate the manufacturing cost – Reduce the component cost – Reduce the assembly cost – Reduce the support cost – Impact of DFM decisions on other factors. Principles of prototyping – Planning for prototypes. Elements of economic analysis – Base – Case financial model – Sensitivity analysis – Influence of the quantitative factors.

TOTAL: 45 PERIODS

OUTCOMES:

CO1. To learn Value Engineering Basics, Job Plan and Process
CO2. To implement Value Engineering Tools and analysis
CO3. To Identifying Customer Needs and Product Specifications
CO3. Able to improve uptime of machines by effective spare parts management

CO4. To analyze the need for industrial design, prototyping and economics of Product development

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

TEXT BOOKS:

1. Karal, T.Ulrich Steven D.Eppinger, "Prodcut Design and Development", McGraw Hill, International Editions, 2003.
2. Mudge, Arthur E. "Value Engineering"- A systematic approach, McGraw Hill, New York, 2000.

REFERENCES:

1. S.Rosenthal, "Effective Product Design and Development", Irwin, 1992.
2. Charles Gevirtz, "Developing New products with TQM", McGraw Hill, International Editions, 1994.

IE7013 PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING L T P C
3 0 0 3

OBJECTIVE:

- To introduce the basic principles of Productivity Models and the applications of Re-Engineering Concepts required for various organizations.

UNIT I INTRODUCTION 9

Basic concept and meaning of Productivity – Significance of Productivity – Factors affecting Productivity – Productivity cycle, Scope of Productivity Engineering and Management.

UNIT II PRODUCTIVITY MEASUREMENT AND EVALUATION 9

Productivity measurement in International, National and Industrial level – Total Productivity Model – Productivity measurement in Manufacturing and Service sectors – Performance Objective Productivity (POP) model – Need for Productivity Evaluation – Evaluation Methodology.

UNIT III PRODUCTIVITY PLANNING AND IMPLEMENTATION 9

Need for Productivity Planning – Short term and long term productivity planning – Productivity improvement approaches, Principles - Productivity Improvement techniques – Technology based, Material based, Employee based, Product based techniques – Managerial aspects of Productivity Implementation schedule, Productivity audit and control.

UNIT IV REENGINEERING PROCESS 9

Definition, Fundamentals of process reengineering – Principles, Methodology and guidelines for Organization Transformation, DSMCQ and PMP organization Transformation models – Process Improvement Models like PMI, Edosomwan, LMICIP and NPRDC Models.

UNIT V BPR TOOLS AND IMPLEMENTATION 9

Analytical and Process Tools and Techniques - Role of Information and Communication Technology in BPR – Requirements and steps in BPR Implementation – Case studies.

TOTAL: 45 PERIODS

OUTCOMES:

The Student will be able to:

- CO1 - Measure and evaluate productivity
- CO2 - Plan and implement various productivity techniques.

- CO3 - Reengineer the process for improving the productivity
- CO4 - Implement BPR tools for improving the productivity.

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

REFERENCES:

1. Sumanth, D.J, "Productivity Engineering and Management", TMH, New Delhi, 1990.
2. Edosomwan, J.A, "Organizational Transformation and Process re- Engineering", British Cataloging in publications,1996.
3. Premvrat, Sardana, G.D. and Sahay, B.S, "Productivity Management - A systems approach", Narosa Publications, New Delhi, 1998.

IE7014 ROBOTICS ENGINEERING L T P C
3 0 0 3

OBJECTIVES :

- To select the appropriate drives and grippers required based on application
- To specify the sensors for particular application
- To control various robot links using kinematic equations
- To perform a justification check before implementation of robots in industry

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 Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of all these Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

UNIT III SENSORS AND MACHINE VISION 9

Sensory Devices - Non optical - Position sensors - Optical position sensors - Velocity sensors- Proximity sensors - Contact and noncontact type - Touel and slip sensors - Force and torque sensors- Introduction to Image Processing

UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING 9

Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2 Dimensional)- Homogeneous Transformation- D-H Representation of forward kinematics. Teach Pendant Programming, Lead through programming, Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands, End effecter commands, and Simple programs.

UNIT V ROBOT CELL DESIGN, CONTROL AND ECONOMICS 9

Work cell Control - Robot and machine Interface - Robot cycle time Analysis – Economic analysis of Robots - Pay back Method, EUAC Method, Rate of Return Method.

TOTAL : 45 PERIODS

Attested

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OUTCOMES:

CO1. Able to suggest a suitable robot drive, gripper and sensors required for particular application.
CO2. Perform selection of sensor for a particular task
CO3. Able to analyse robot arm kinematics and understand simple programs.
CO4. Able to analyse the robot cycle time and economics of robot implementation.

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

TEXT BOOK :

1. M.P.Groover, “Industrial Robotics – Technology, Programming and Applications”, second Edition Tata McGraw-Hill, 2012.

REFERENCES :

1. Fu.K.S. Gonzalz.R.C., and Lee C.S.G., “Robotics Control, Sensing, Vision and Intelligence”, McGraw-Hill Book Co., 1987.
2. Yoram Koren, “Robotics for Engineers”, McGraw-Hill Book Co., 1992.
3. Janakiraman.P.A., “Robotics and Image Processing”, Tata McGraw-Hill, 1995.
4. Richard D. Klafter., Thomas A. Chmielewski, Michael Negin, “Robotic Engineering: An Integrated Approach”, PHI.,1989.
5. Saeed B.Niku., “Introduction to Robotics: Analysis, Control, Applications”,PHI, 2003.

IE7015 SYSTEMS ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To introduce system engineering concepts to design the manufacturing system for optimum utilization of source for effective functioning.

UNIT I INTRODUCTION 9

Definitions of Systems Engineering, Systems Engineering Knowledge, Life cycles, Life-cycle phases, logical steps of systems engineering, Frame works for systems engineering.

UNIT II SYSTEMS ENGINEERING PROCESSES 9

Formulation of issues with a case study, Value system design, Functional analysis, Business Process Reengineering, Quality function deployment, System synthesis, Approaches for generation of alternatives.

UNIT III ANALYSIS OF ALTERNATIVES - I 9

Cross-impact analysis, Structural modeling tools, System Dynamics models with case studies, Economic models: present value analysis – NPV, Benefits and costs over time, ROI, IRR; Work and Cost breakdown structure,

UNIT IV ANALYSIS OF ALTERNATIVES – II 9

Reliability, Availability, Maintainability, and Supportability models; Stochastic networks and Markov models, Queuing network optimization, Time series and Regression models, Evaluation of large scale models

UNIT V DECISION ASSESSMENT **9**

Decision assessment types, Five types of decision assessment efforts, Utility theory, Group decision making and Voting approaches, Social welfare function; Systems Engineering methods for Systems Engineering Management,

TOTAL: 45 PERIODS

OUTCOMES:

- The Student will be able to apply systems engineering principles to make decision for optimization.
- Understanding of the systems engineering discipline and be able to use the core principles and processes for designing effective system.

TEXT BOOK:

- Andrew P. Sage, James E. Armstrong Jr. "Introduction to Systems Engineering", John Wiley and Sons, Inc, 2000.

REFERENCES:

1. Andrew P.Sage, "Systems Engineering", John Wiley & Sons, 1992.
2. Andrew P.Sage, William B.Rouse, "Hand book of Systems Engineering and Management", John Wiley & Sons, 1999.

IE7071 HUMAN RESOURCE MANAGEMENT **L T P C**
3 0 0 3

OBJECTIVE:

- To introduce the basic principles of group dynamics and associated concepts required for Human resource management in organizations

UNIT I INDIVIDUAL BEHAVIOR **9**

Personality –Types –Influencing Personality – Learning Process, Attribute – Perception – Motivation Theories

UNIT II GROUP BEHAVIOR **9**

Group Organization, Group Dynamics, Emergence of Informal Leader, Leadership Styles-theories, Group decision making, Inter personal Relations, Communication -Team.

UNIT III DYNAMICS OF ORGANIZATIONAL BEHAVIOR **9**

Organizational Climate, the Satisfactory – Organizational change – The Change Process and Change Management.

UNIT IV HUMAN RESOURCES PLANNING **9**

Requirements of Human Resources – HR audit, Recruitment-Selection-Interviews

UNIT V HUMAN RESOURCES DEVELOPMENT **9**

Employee Training-Career Development-Performance Appraisal- Compensation- safety and Health-Employee Relation-Management Development – Employee retention.

TOTAL : 45 PERIODS

OUTCOMES:

- To understand the process of effective Human Resource Management.

TEXT BOOK:

1. Stephen R. Robbins, "Organizational Behavior", PHI, 1998.

REFERENCES:

1. David A. Decenzo & Stephen R. Robbins, “Personnel/Human Resources Management”,PHI, 1997.
2. Fred Lutherans, “Organizational Behavior”, Oxford University Press, 2000.

IE7072 METROLOGY AND INSPECTION L T P C
3 0 0 3

OBJECTIVE:

- To impart knowledge about linear and angular measuring Instruments.

UNIT I LINEAR MEASUREMENT AND ANGULAR MEASUREMENT 9

Accuracy, Precision, Readability, Sensitivity etc., Linear measuring instruments-vernier – micrometer-Gauge blocks- dial indicator-comparators – Angle standards – vernier bevel protector-sine bar – autocollimator.

UNIT II STANDARDS FOR LINEAR AND ANGULAR MEASUREMENTS 9

Shop floor standards and their calibration, light interference, Method of coincidence, Slip gauge calibration, Measurement errors, Limits, fits, Tolerance, Gauges, Gauge design.

UNIT III MEASUREMENT APPLICATION 9

Measurement of screw threads and gears – Radius measurement – surface finish measurement - Measurement of straightness-flatness-parallelism – squareness- roundness – circularity

UNIT IV MODERN CONCEPTS 9

Image processing and its application in Metrology, Co-ordinate measuring machine, Types of CMM, Probes used, Application, Non-contact CMM using Electro-optical sensors for dimensional metrology.

UNIT V INTRODUCTION TO MEASUREMENT SYSTEMS 9

System configuration, basic characteristics of measuring devices, Displacement, force and torque measurement, standards, Calibration, Sensors, Basic principles and concepts of temperature, Pressure and flow measurement, Destructive testing – Nondestructive testing.

TOTAL: 45 PERIODS

OUTCOMES:

The student must be able to

- Understanding the basic theoretical technical and legislative aspects of metrology and testing.
- Measure a variety of engineering parts using a variety of measuring techniques.
- Present and analyze measurement results obtained.
- Acquire capability to select right method of non-destructive testing.

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

TEXT BOOK:

1. Galyer J.F. and Shotbolt C.R, "Metrology for Engineers" ELBS, 1992.

REFERENCES:

1. Hune, K.J, "Engineering Metrology", Kalyani Publishers, India, 1980.
2. Robinson, S.L. and Miller R.K, "Automated Inspection and Quality Assurance", Marcel Dekker Inc.1989.
3. Stout, K. "Quality Control in Automation", Prentice Hall, 1986.

IE7073 PROJECT MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- To outline the need for Project Management
- To highlight different techniques of activity planning

UNIT I INTRODUCTION TO PROJECT MANAGEMENT AND PROJECT SELECTION 9

Objectives of Project Management- Importance of Project Management- Types of Projects- Project Management Life Cycle- Project Selection – Feasibility study: Types of feasibility- Steps in feasibility study.

UNIT II PROJECT PLANNING AND IMPLEMENTATION 9

Work break down structure- Estimate work packages – Identify task relationship – project schedule

UNIT III PROJECT MONITORING AND CONTROL 9

Resource aggregation - Resource leveling - limited resource allocation – project monitoring and control.

UNIT IV PROJECT CLOSURE 9

Process project audit – post project audit – normal project closure – premature closure – perpetual project - project closure process – Risk management.

UNIT V SPECIAL TOPICS IN PROJECT MANAGEMENT 9

Project management for modern information system – critical success factors for IT project - software project selection and initiation - project management discipline – project overall planning

TOTAL : 45 PERIODS

OUTCOMES:

- Evaluate and select the most desirable projects.
- Apply appropriate approaches to plan a new project.
- Apply appropriate methodologies to develop a project schedule.
- Identify important risks facing a new project.

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

REFERENCES :

1. Arun Kanda, "Project Management A Life Cycle Approach", Prentice Hall of India, 2011.
2. R.Panneerselvam and P.Senthilkumar, "Project Management", Prentice Hall of India, 2009.
3. R.B.Khanna, "Project Management", Prentice Hall of India, 2011.

IE7074 SAFETY ENGINEERING AND MANAGEMENT L T P C
3 0 0 3

OBJECTIVE:

- To impart knowledge on safety engineering fundamentals and safety management practices.

UNIT I INTRODUCTION 9

Evolution of modern safety concepts – Fire prevention – Mechanical hazards – Boilers, Pressure vessels, Electrical Exposure.

UNIT II CHEMICAL HAZARDS 9

Chemical exposure – Toxic materials – Radiation Ionizing and Non-ionizing Radiation - Industrial Hygiene – Industrial Toxicology.

UNIT III ENVIRONMENTAL CONTROL 9

Industrial Health Hazards – Environmental Control – Industrial Noise - Noise measuring instruments, Control of Noise, Vibration, - Personal Protection.

UNIT IV HAZARD ANALYSIS 9

System Safety Analysis –Techniques – Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP analysis and Risk Assessment.

UNIT V SAFETY REGULATIONS 9

Explosions – Disaster management – catastrophe control, hazard control , Factories Act, Safety regulations Product safety – case studies.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to

CO1 – Identify and prevent chemical, environmental mechanical, fire hazard
CO2 – Collect, analyze and interpret the accidents data based on various safety techniques.
CO3 – Apply proper safety techniques on safety engineering and management
CO4 – design the system with environmental consciousness by implementing safety regulation

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

REFERENCES:

1. John V.Grimaldi, “Safety Management”, AITB S Publishers, 2003.
2. Safety Manual, “EDEL Engineering Consultancy”, 2000.
3. David L.Goetsch, “Occupational Safety and Health for Technologists”, Engineers and Managers, Pearson Education Ltd. 5th Edition, 2005.

ME7077 ENTREPRENEURSHIP DEVELOPMENT L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I ENTREPRENEURSHIP 9

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

UNIT II MOTIVATION 9

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

UNIT III BUSINESS 9

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

UNIT IV FINANCING AND ACCOUNTING 9

Finance: Need, Sources, Capital Structure, Term Loans – Financial Institutions – Accounting: Need, Objectives, Process, Journal, Ledger, Trial Balance, Final Accounts – Working Capital Management: Significance, Assessment, Factors, Sources, Management.

UNIT V SUPPORT TO ENTREPRENEURS 9

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

TOTAL: 45 PERIODS

OUTCOME:

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

TEXT BOOKS:

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

REFERENCES:

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

MF7073 ELECTRONICS MANUFACTURING TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I INTRODUCTION TO ELECTRONICS MANUFACTURING 9

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

UNIT II COMPONENTS AND PACKAGING 9

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

UNIT III SURFACE MOUNT TECHNOLOGY PROCESS 9

Introduction to the SMT Process, SMT equipment and material handling systems, handling of components and assemblies - moisture sensitivity and ESD, safety and precautions needed, IPC and other standards, stencil printing process - solder paste material, storage and handling, stencils and squeegees, process parameters, quality control. Component placement- equipment type, flexibility, accuracy of placement, throughput, packaging of components for automated assembly, Cp and Cpk and process control. soldering- reflow process, process parameters, profile generation and control, solder joint metallurgy, adhesive, underfill and encapsulation process - applications, materials, storage and handling, process and parameters.

UNIT IV INSPECTION AND TESTING 9

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

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

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

TOTAL: 45 PERIODS

OUTCOMES:

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

TEXT BOOKS:

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

REFERENCES:

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

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

OBJECTIVES:

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

UNIT I PLANNING, SCHEDULING AND CONTROL OF FLEXIBLE MANUFACTURINGSYSTEMS 9

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

UNIT II COMPUTER CONTROL AND SOFTWARE FOR FLEXIBLE MANUFACTURING SYSTEMS 9

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

UNIT III FMS SIMULATION AND DATA BASE 9

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

UNIT IV GROUP TECHNOLOGY AND JUSTIFICATION OF FMS 9

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

UNIT V APPLICATIONS OF FMS AND FACTORY OF THE FUTURE 9

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

TOTAL: 45 PERIODS

OUTCOMES:

CO1. Ability to perform Planning, Scheduling and control of FMS
CO2. Demonstrate the software requirements to control the FMS and select a software from various alternatives
CO3. Can perform simulation of FMS and also specify a Database scheme for FMS
CO4. Can classify the parts into part families using group technology

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

TEXT BOOK:

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

REFERENCES:

1. Groover M.P., “Automation, production systems and computer integrated manufacturing”, Prentice Hall of India Pvt., New Delhi, 2007.
2. Kalpakjian S., “Manufacturing Engineering and Technology”, Addison-Wesley Publishsing Co., 2013.
3. Radhakrishnan P. and Subramanyan S., “CAD/CAM/CIM”, Wiley Eastern Ltd., New Age International Ltd., 1994.

4. Raouf A. and Daya B.M., “Flexible manufacturing systems: recent development”, Elsevier Science, 1995.
5. Ohno T., “Toyota production system: beyond large-scale production”, Productivity Press (India) Pvt. Ltd., 1992.

MG7451 PRINCIPLES OF MANAGEMENT L T P C
3 0 0 3

AIM :
To learn the different principles and techniques of management in planning, organizing, directing and controlling.

OBJECTIVES
- To study the Evolution of Management
- To study the functions and principles of management
- To learn the application of the principles in an organization

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9
Definition of Management –Science or Art – Manager Vs Entrepreneur- types of managers-managerial roles and skills – Evolution of Management –Scientific, human relations , system and contingency approaches– Types of Business organization- Sole proprietorship, partnership, company-public and private sector enterprises- Organization culture and Environment – Current trends and issues in Management.

UNIT II PLANNING 9
Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III ORGANISING 9
Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – delegation of authority – Centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management.

UNIT IV DIRECTING 9
Foundations of individual and group behaviour– Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT.

UNIT V CONTROLLING 9
System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting.

TOTAL: 45 PERIODS

OUTCOMES:
- Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling and have same basic knowledge on international aspect of management

TEXT BOOKS:
1. Stephen P. Robbins and Mary Coulter, “ Management”, Prentice Hall (India)Pvt. Ltd., 10th Edition, 2009.
2. JAF Stoner, Freeman R.E and Daniel R Gilbert, “Management”, Pearson Education, 6th Edition, 2004.

REFERENCES:

1. Stephen A. Robbins and David A. Decenzo and Mary Coulter, “Fundamentals of Management” Pearson Education, 7th Edition, 2011.
2. Robert Kreitner and Mamata Mohapatra, “ Management”, Biztantra, 2008.
3. Harold Koontz and Heinz Weihrich “Essentials of management” Tata McGraw Hill,1998.
4. Tripathy PC and Reddy PN, “Principles of Management”, Tata Mcgraw Hill, 1999.

GE7072	FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the global trends and development methodologies of various types of products and services
- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
- To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT 9

Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends **- Introduction to Product Development Methodologies and Management -** Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies **-** Product Life Cycle – Product Development Planning and Management.

UNIT II REQUIREMENTS AND SYSTEM DESIGN 9

Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - **System Design & Modeling -** Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

UNIT III DESIGN AND TESTING 9

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – **Challenges in Integration of Engineering Disciplines** - Concept Screening & Evaluation - **Detailed Design -** Component Design and Verification – **Mechanical, Electronics and Software Subsystems** - High Level Design/Low Level Design of S/W Program **-** Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – **Prototyping -** Introduction to Rapid Prototyping and Rapid Manufacturing - **System Integration, Testing, Certification and Documentation**

UNIT IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT 9

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - **Sustenance -**Maintenance and Repair – Enhancements - **Product EoL -** Obsolescence Management – Configuration Management - EoL Disposal

UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9

The Industry - Engineering Services Industry - Product Development in Industry versus Academia –**The IPD Essentials -** Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Define, formulate and analyze a problem
- Solve specific problems independently or as part of a team
- Gain knowledge of the Innovation & Product Development process in the Business Context
- Work independently as well as in teams
- Manage a project from start to finish

TEXTBOOKS:

1. Book specially prepared by NASSCOM as per the MoU.
2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
3. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.

REFERENCES:

1. Hiriyappa B, “Corporate Strategy – Managing the Business”, Author House, 2013.
2. Peter F Drucker, “People and Performance”, Butterworth – Heinemann [Elsevier], Oxford, 2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, “Enterprise Resource Planning – Concepts”, Second Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013