MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)

(Approved by AICTE, New Delhi, Accredited by NAAC, NBA & Affiliated to Anna University)
Rasipuram - 637 408, Namakkal Dist., Tamil Nadu.

Curriculum/Syllabus

Programme Code : ME

Programme Name : B.E-Mechanical Engineering

Regulation : R-2016

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Rasipuram - 637 408, Namakkal Dt, Tamil Nadu.

Ph. No.: 04287-220837

Email: principal@mec.edu.in.

CURRICULUM
Under Graduate - Regulation 2016

DEPARTMENT OF MECHANICAL ENGINEERING

MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)

Estd. 2000

(Approved by AICTE, New Delhi, Accredited by NAAC, NBA & Affiliated to Anna University)
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AGENDA FOR THE 2nd BOARD OF STUDIES MEETING

Department of Mechanical Engineering

Dt. 29.07.2017

Venue: CAD/CAM Lab

1) Passing of the following details:

   a) List of courses in the Basket of Professional Core (PC), Professional Elective (PE), Employability Enhancement Courses (EEC) for R2016 under Choice Based Credit System (CBCS), for the batch of students admitted in 2016-2017 in B.E – Mechanical Engineering Programme.

   b) Scheme and Syllabi for Professional Core (PC), Professional Elective (PE), Employability Enhancement Courses (EEC) for R2016 under Choice Based Credit System (CBCS), for the batch of students admitted in 2016-2017 in B.E – Mechanical Engineering Programme.

2) Panel of Expert for question paper setting and evaluation.

3) Any other matter with permission of the chair.

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Institution Vision and Mission:

Vision

- To be a Centre of Excellence in Engineering, Technology and Management on par with International Standards.

Mission

- To prepare the students with high professional skills and ethical values
- To impart knowledge through best practices
- To instill a spirit of innovation through Training, Research and Development
- To undertake continuous assessment and remedial measures
- To achieve academic excellence through intellectual, emotional and social stimulation

Department Vision and Mission:

Vision:

The Mechanical Engineering Department strives to be globally recognized for outstanding Education and research so as to produce well qualified engineers, who are innovative, Entrepreneurial and successful in advanced fields of Engineering and Research.

Mission:

M1: (Quality Education) - To create technically proficient individuals who meet global standards of excellence across multiple sectors.

M2: (Research and Development) - To maintain state-of-the-art research facilities and providing opportunities for students and faculties with opportunities to create, interpret, apply and disseminate knowledge.

M3: (Professionalism) - To inspire and mentor students to excel as successful professionals and entrepreneurs in their careers.

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DEPARTMENT PROGRAM EDUCATIONAL OBJECTIVES, PROGRAM OUTCOMES & PROGRAM SPECIFIC OUTCOMES

Program Educational Objectives (PEO):

PEO1: (Imparting Fundamentals) - To develop the ability of the graduates in comprehending, analyzing and synthesizing data in order to design and develop mechanical systems.

PEO2: (Analytical Skills) - To create a unique and futuristic space to nurture erudite Scholars/Exemplary Engineers by integrating emerging contents to solve industrial and environmental problems with modern Mechanical engineering tools.

PEO3: (Team Building Skills) - To inculcate communication skills, team skills, professional skills, innovative and ethical attitude among the graduates for enabling them to become a successful professional and entrepreneur.

PEO4: (Moral Values & innovative skills) - To engage in professional service by developing new technology and products that will promote sustainable economic development to improve the quality of life.

Program Outcomes (PO):

1. **Engineering knowledge:** An ability to apply knowledge of Mathematics, Physical Sciences and Engineering.
2. **Problem analysis:** Ability to design and conduct experiments, as well as to analyze and interpret data.
3. **Design/development of solutions:** An ability to design a system, component, or process to meet desired needs within realistic constraints such as Economic, Environmental, Social, Health and Safety, Manufacturability and Sustainability.
4. **Conduct investigations of complex problems:** An ability to identify, formulate and solve Mechanical Engineering Problems.
5. **Modern tool usage:** An ability to use the Techniques, Skills, and Modern Mechanical Engineering Tools necessary for Engineering Practice.
6. **Engineer and society:** An ability to understand contemporary Technical and Professional issues in the practice of Mechanical Engineering.
7. **Environment and sustainability:** An ability to provide Engineering solutions in Global, Economic, Environmental, and Societal context.
8. **Ethics:** An ability to lead with Professional and Ethical Responsibility.

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9. **Individual and team work:** An ability to function on Multidisciplinary teams.
10. **Communication:** An ability to communicate effectively.
11. **Project management and finance:** An ability to administrate the Project Management and Finance.
12. **Lifelong learning:** An ability to recognize the need of Life-Long Learning

Program Specific Outcomes (PSO):

- Advanced equipments and tools: An ability to handle Advanced Machine Tools.
- Modelling and analyzing mechanical components: An ability to Model & Analyze intricate components in specific to Manufacturing Industry
- Modern methods: An ability to demonstrate Modern Testing Methods used in Current Industries.

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MUTHAYAMMAL ENGINEERING COLLEGE
(AUTONOMOUS)
DEPARTMENT OF MECHANICAL ENGINEERING
GROUPING OF COURSES

1. Humanities and Social Sciences (HS)

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1	16SHA01	Technical English	HS	5	3	2	0	4
2	16SHA02	Communicative English	HS	7	3	0	4	5
3	16SHA03	Business English	HS	5	3	2	0	4
4	16SHA04	Basics of Japanese	HS	5	3	2	0	4
5	16SHA05	Functional Japanese	HS	5	3	2	0	4
6	16SHA06	Basics of German	HS	5	3	2	0	4
7	16SHA07	Functional German	HS	5	3	2	0	4
8	16SHA08	Principles of Management and Engineering Ethics	HS	3	3	0	0	3

2. Basic Sciences (BS)

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1	16SHB01	Matrices, Calculus and Ordinary Differential Equations	BS	5	3	2	0	4
2	16SHB02	Complex Variables, Laplace Transforms and Vector Calculus	BS	5	3	2	0	4
3	16SHB03	Transforms and Partial Differential Equations	BS	5	3	2	0	4
4	16SHB04	Random Processes	BS	5	3	2	0	4
5	16SHB05	Probability and Queuing Theory	BS	5	3	2	0	4
6	16SHB06	Numerical Methods	BS	5	3	2	0	4
7	16SHB07	Statistics and Numerical Methods	BS	5	3	2	0	4
8	16SHB08	Discrete Mathematics	BS	5	3	2	0	4
9	16SHB09	Operations Research	BS	5	3	2	0	4
10	16SHB21	Engineering Physics	BS	5	3	0	2	4
11	16SHB22	Material Science	BS	3	3	0	0	3
12	16SHB23	Physics for Electrical Engineering	BS	3	3	0	0	3
13	16SHB24	Physics for Mechanical Engineering	BS	3	3	0	0	3
14	16SHB31	Engineering Chemistry	BS	5	3	0	2	4
15	16SHB32	Environmental Science and Engineering	BS	3	3	0	0	3

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3. Engineering Sciences (ES)

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1	16MEC01	Fundamentals of Computing and Programming	ES	5	3	0	2	4
2	16MEC02	Advanced C Programming	ES	5	3	0	2	4
3	16MEC03	Basics of Civil and Mechanical Engineering	ES	4	4	0	0	4
4	16MEC04	Basics of Electrical and Electronics Engineering	ES	4	4	0	0	4
5	16MEC05	Engineering Drawing	ES	4	2	0	2	3
6	16MEC06	Engineering Practices for Mechanical Sciences	ES	4	0	0	4	2
7	16EEC07	Electrical Drives and Controls	ES	5	3	0	2	4
8	16MEC08	Engineering Mechanics	ES	5	3	2	0	4
9	16MEC09	Microprocessor and Microcontrollers	ES	5	3	0	2	4
10	16MEC10	Object Oriented Programming	ES	6	2	0	4	4
11	16MEC11	Biomechanics	ES	3	3	0	0	3
12	16MEC12	Measurements and Instruments	ES	3	3	0	0	3
13	16MEC13	Renewable Energy Sources	ES	3	3	0	0	3
14	16MEC14	Fundamentals of Nanoscience	ES	3	3	0	0	3
15	16MEC15	Production Processes	ES	5	3	0	2	4

4. Professional Core (PC)

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1	16MED01	Computer Aided Drafting and Modeling Laboratory	PC	4	0	0	4	2
2	16MED02	Machine Drawing	PC	4	0	0	4	2
3	16MED03	Engineering Materials and Metallurgy	PC	3	3	0	0	3
4	16MED04	Engineering Thermodynamics	PC	5	3	2	0	4
5	16MED05	Fluid Mechanics and Machinery	PC	5	3	0	2	4
6	16MED06	Mechatronics	PC	5	3	0	2	4
7	16MED07	Strength of Materials	PC	5	3	0	2	4
8	16MED08	Kinematics of Machinery	PC	3	3	0	0	3
9	16MED09	Manufacturing Technology	PC	5	3	0	2	4
10	16MED10	Applied Hydraulics and Pneumatics	PC	3	3	0	0	3
11	16MED11	Thermal Engineering	PC	5	3	0	2	4
12	16MED12	Automobile Engineering	PC	3	3	0	0	3
13	16MED13	Heat and Mass Transfer	PC	5	3	0	2	4
14	16MED14	Design of Machine Elements	PC	5	3	2	0	4
15	16MED15	Gas Dynamics and Jet Propulsion	PC	3	3	0	0	3
16	16MED16	Dynamics of Machines	PC	5	3	0	2	4
17	16MED17	Design of Transmission Systems	PC	3	3	0	0	3
18	16MED18	Computer Aided Design	PC	5	3	0	2	4

19	16MED19	Metrology and Measurements	PC	5	3	0	2	4
20	16MEE20	Power Plant Engineering	PC	3	3	0	0	3
21	16MED21	Finite Element Analysis	PC	5	3	0	2	4
22	16MED22	Engineering Economics and Cost analysis	PC	3	3	0	0	3
23	16MED23	Total Quality Management	PC	3	3	0	0	3
24	16MED24	Principles of Management	PC	3	3	0	0	3
25	16MED25	Computer Integrated Manufacturing systems	PC	3	3	0	0	3

5. Professional Electives (PE)

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1	16MEE01	Design of jigs, fixtures and Press Tools	PE	5	3	2	0	4
2	16MEE02	Refrigeration and Air conditioning	PE	5	3	2	0	4
3	16MEE03	Advanced IC Engines	PE	5	3	2	0	4
4	16MEE04	Computational Fluid Dynamics	PE	5	3	2	0	4
5	16MEE05	Thermal Turbo Machines	PE	5	3	2	0	4
6	16MEE06	Vibration and Noise Control	PE	5	3	2	0	4
7	16MEE07	Design of Pressure Vessel and Piping	PE	5	3	2	0	4
8	16MEE08	Quality Control and Reliability Engineering	PE	5	3	2	0	4
9	16MEE09	Unconventional Machining Processes	PE	3	3	0	0	3
10	16MEE10	Maintenance Engineering	PE	3	3	0	0	3
11	16MEE11	Process Planning and Cost Estimation	PE	3	3	0	0	3
12	16MEE12	Flexible Manufacturing Systems	PE	3	3	0	0	3
13	16MEE13	Composite Materials	PE	3	3	0	0	3
14	16MEE14	Industrial robotics	PE	3	3	0	0	3
15	16MEE15	Micro Electro Mechanical Systems	PE	3	3	0	0	3
16	16MEE16	Advanced Manufacturing Systems	PE	3	3	0	0	3
17	16MEE17	Additive Manufacturing Techniques	PE	3	3	0	0	3
18	16MEE18	Lean Manufacturing	PE	3	3	0	0	3

6. Open Elective (OE)

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1	16ECE04	Bio Medical Engineering	OE	3	3	0	0	3
2	16ITD21	IOT and application	OE	3	3	0	0	3
3	16CEE09	Industrial Waste Management	OE	3	3	0	0	3

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7. Employability Enhancement Courses (EEC)

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1	16MEF07	Project work Phase -I	EEC	6	0	0	6	3
2	16MEF02	Project work Phase -II	EEC	30	0	0	30	15
3	16MEF03	Comprehension	EEC	2	0	0	2	1
4	16MEF04	Design and Fabrication Project	EEC	4	0	0	4	2

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Department	Mechanical Engineering
Programme	B.E

SEMESTER - I

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
THEORY							
1.	16SHA01	Technical English	3	2	0	4	5
2.	16SHB01	Matrix, Calculus and Ordinary Differential Equations	3	2	0	4	5
3.	16SHB22	Material Science	3	0	0	3	3
4.	16SHB31	Engineering Chemistry	2	0	4	4	6
5.	16MEC01	Fundamentals of Computing and Programming	2	0	4	4	6
6.	16MEC04	Basics of Electrical and Electronics Engineering	4	0	0	4	4
7.	16MEC06	Engineering Practices for Mechanical Sciences	0	0	4	2	4
		Total Credits				**25**	

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Department	Mechanical Engineering
Programme	B.E

SEMESTER - II

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
THEORY							
	16SHA02	Communicative English	3	0	4	5	7
2.	16SHB02	Complex Variables, Laplace Transforms and Vector Calculus	3	2	0	4	5
3.	16SHB21	Engineering Physics	2	0	4	4	6
4.	16SHB32	Environmental Science and Engineering	3	0	0	3	3
5.	16MEC05	Engineering Drawing	1	0	4	3	5
6.	16MEC08	Engineering Mechanics	3	2	0	4	5
7.	16MEC02	Advanced C Programming	2	0	4	4	6
		Total Credits				**27**	

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Department	Mechanical Engineering
Programme	B.E

SEMESTER - III

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
THEORY							
1.	16SHB03	Transforms and Partial Differential Equations	3	2	0	4	5
2.	16MED03	Engineering Materials and Metallurgy	3	0	0	3	3
3.	16MED04	Engineering Thermodynamics	3	2	0	4	5
4.	16MED05	Fluid Mechanics and Machinery	3	0	2	4	5
5.	16MEC15	Production Processes	3	0	2	4	5
6.	16EEC07	Electrical Drives and Controls	3	0	2	4	5
		Total Credits				**23**	

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Programme	B.E

SEMESTER - IV

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
THEORY							
1.	16SHB07	Statistics and Numerical Methods	3	2	0	4	5
2.	16MED07	Strength of Materials	3	0	2	4	5
3.	16MED08	Kinematics of Machinery	3	0	0	3	3
4.	16MED09	Manufacturing Technology	3	0	2	4	5
5.	16MED10	Applied Hydraulics and Pneumatics	3	0	0	3	3
6.	16MED11	Thermal Engineering	3	0	2	4	5
		Total Credits				**22**	

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Department	Mechanical Engineering
Programme	B.E

SEMESTER - V

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
THEORY							
1.	16MED12	Automobile Engineering	3	0	0	3	3
2.	16MED13	Heat and Mass Transfer	3	0	2	4	5
3.	16MED14	Design of Machine Elements	3	2	0	4	5
4.	16MED15	Gas Dynamics and Jet Propulsion	3	0	0	3	3
5.	16MED16	Dynamics of Machines	3	0	2	4	5
6.	16MED24	Principles of Management	3	0	0	3	3
		Total Credits				**21**	

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Department	Mechanical Engineering
Programme	B.E

SEMESTER - VI

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
THEORY							
1.	16MED17	Design of Transmission Systems	3	0	0	3	3
2.	16MED22	Engineering Economics and Cost analysis	3	0	0	3	3
3.	16MED18	Computer Aided Design	3	0	2	4	5
4.	16MED06	Mechatronics	3	0	2	4	5
5.	16MED19	Metrology and Measurements	3	0	2	4	5
6.	16MEE20	Power Plant Engineering	3	0	0	3	3
7.	16MEE**	Professional Elective – I	3	2	0	4	5
		Total Credits				**25**	

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Department	Mechanical Engineering
Programme	B.E

SEMESTER - VII

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
THEORY							
1.	16MED21	Finite Element Analysis	3	0	2	4	5
2.	16MED25	Computer Integrated Manufacturing Systems	3	0	0	3	3
3.	16MEE**	Professional Elective – II	3	0	0	3	3
4.	16*****	Open Elective – I	3	0	0	3	3
5.	16*****	Open Elective – II	3	0	0	3	3
6.	16*****	Open Elective – III	3	0	0	3	3
7.	16MEF07	Project work Phase I	0	0	6	3	6
		Total Credits				**22**	

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Department	Mechanical Engineering
Programme	B.E

SEMESTER - VIII

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
PRACTICAL							
1.	16MEF02	Project work Phase II	0	0	30	15	30
		Total Credits				**15**	

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Course Component Summary

Subject Area	Credits per Semester									
	I	II	III	IV	V	VI	VII	VIII	Total	Percentage %
HS	4	5	-	-	-	-	-	-	9	5
BS	11	11	4	4	-	-	-	-	30	17
ES	10	11	8	-	-	-	-	-	29	16
PC	-	-	11	18	21	21	7	-	78	43
PE	-	-	-	-	-	4	3	-	7	4
OE	-	-	-	-	-	-	9	-	9	5
EEC	-	-	-	-	-	-	3	15	18	10
MC	-	-	-	-	-	-	-	-	-	0
Total	25	27	23	22	21	25	22	15	180	100

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HUMANITIES AND SOCIAL SCIENCES

(HS)

For

Mechanical Engineering

16SHA01 **TECHNICAL ENGLISH** **L T P C**
3 2 0 4

COURSE OBJECTIVES

- To enable learners of Engineering and Technology develop their basic communication skills in English.
- To emphasize specially the development of speaking skills amongst learners of Engineering and Technology.
- To ensure that learners use the electronic media such as internet and supplement the learning materials used in the classroom.
- To inculcate the habit of reading and writing leading to effective and efficient communication.
- To make the learners to use the phrase and clauses error free.

COURSE OUTCOMES

16SHA01.CO1 Use grammar in their written and spoken communication
16SHA01.CO2 Examine different spoken discourses/excerpts in different accents
16SHA01.CO3 Interpret learners' communication and conversation skills intelligibly through real life situations
16SHA01.CO4 Demonstrate the habit of reading and the meaning of lexical and Contextual strategies.
16SHA01.CO5 Differentiate any information in written communication.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16SHA01.CO1	-	-	-	-	-	-	-	-	-	X	X	X	-	-	-
16SHA01.CO2	-	-	-	-	-	-	-	-	X	X	-	X	-	-	-
16SHA01.CO3	-	-	-	-	-	-	-	X	X	X	-	X	-	X	-
16SHA01.CO4	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-
16SHA01.CO5	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-

UNIT I GRAMMAR & VOCABULARY **9+6**

Word formation with prefixes and suffixes – synonyms and antonyms – verb patterns- subject-verb agreement – tenses – voices – use of conditionals – comparative adjectives (affirmative and negative) – expanding– nominal compounds – articles – use of prepositions - phrasal verbs – British and American vocabulary – error detection – abbreviations and acronyms.

UNIT II LISTENING **9+6**

Extensive listening – listening for general content – listening to fill up gapped texts – intensive listening – listening for specific information: retrieval of factual information – listening to identify topic, context, function, speaker's opinion, attitude, etc. – global understanding skills and ability to infer, extract gist and understand main ideas – note-taking: guided and unguided

UNIT III SPEAKING **9+6**

Verbal and non verbal communication – speech sounds – syllables – word stress (structures and content words) – sentences stress – intonation – pronunciation drills, tongue twisters – formal and informal English – oral practice – developing confidence – introducing oneself – asking for or eliciting objects – expressing opinions (agreement / disagreement) – giving instructions

UNIT IV READING **9+6**

Exposure to different reading techniques – reading for gist and global meaning – predicting the content – text – identifying the topic sentence and its role in each paragraph – scanning – inferring / identifying lexical and contextual meanings – reading for structure and detail – transfer of information / guided note-making – understanding discourse coherence – sequencing of sentences – cloze reading.

UNIT V WRITING **9+6**

Introductions to the characteristics of technical style – writing definitions and descriptions –paragraph writing (topic sentence and its role, unity, coherence and use of cohesive expressions) – process description (use of sequencing connectives) – comparison and contrast – classifying the data – analyzing / interpreting the data – formal letter writing (letter to the editor, letter for seeking practical training, and letter for undertaking project works in industries) – editing (punctuation, spelling and grammar)

TOTAL: 45+30

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TEXT BOOKS

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Raman, Meenakshi & Sangeetha Sharma.	Technical Communication: Principles and Practice. Oxford University Press,	Oxford University Press, New Delhi.	2011
2	Rizvi, Ashraf. M.	Effective Technical Communication.	Tata McGraw-Hill, New Delhi.	2005

REFERENCE BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Regional Institute of English	English for Engineers.	Cambridge University Press, New Delhi.	2006
2	Department of English, Anna University, Chennai	Mindscapes: English For Technologists and Engineers	Orient BlackSwan Private Limited, Chennai	2012
3	Rutherford, Andrea.	Basic Communication Skills for Technology	Pearson, New Delhi.	2001
4	Viswamohan, Aysha.	English for Technical Communication.	Tata McGraw-Hill, New Delhi.	2008
5	Dr.Gunasekaran	Technical English Practice Book	Vishnu Print Media, Chennai	2016

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4. http://study.com/academy/lesson/characteristics-of-technical-communication.html
5. https://letterpile.com/writing/Four-Types-of-Writing

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16SHA02 **COMMUNICATIVE ENGLISH** **L T P C**
3 0 4 5

COURSE OBJECTIVES

- To understand the importance of listening and speaking in language acquisition process
- To engage in conversation intelligibly
- To use English accurately, appropriately and fluently in different situations (academic, social and professional) and familiarize themselves with all speech sounds in English
- To write academic, communicative and creative pieces of writing
- To devise different tasks / methods to enhance their learners' communication skills.

COURSE OUTCOMES

16SHA02.CO1 Write coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range
16SHA02.CO2 Extend communication with others confidently through language functions and process
16SHA02.CO3 Translate clearly, confidently and comprehensibly with one or many listeners using appropriate communicative strategies.
16SHA02.CO4 Interpret different genres of texts adopting various reading strategies
16SHA02.CO5 Demonstrate their proficiency in writing cohesively and coherently

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16SHA02.CO1	-	-	-	-	-	-	-	-	X	X	X	X	-	-	-
16SHA02.CO2	-	-	-	-	-	-	-	X	-	X	X	X		X	-
16SHA02.CO3	-	-	-	-	-	-	-	X	X	X	X	X	-	X	-
16SHA02.CO4	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-
16SHA02.CO5	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-

UNIT I GRAMMAR & VOCABULARY **9+12**

Phrases & Clauses- Kinds of Sentences - Types of sentences and sentence patterns – GRE Vocabulary - Synonyms - Antonyms - Word Formation- Error Spotting- Sentence Correction- Word Analogy- Idioms and Phrases- Direct and Indirect Speech- 'If' Conditionals

UNIT II LISTENING **9+12**

Listening processes: top-down and bottom-up skills - Listening strategies - Sounds of English: Consonants, vowels and diphthongs - Phonemic transcription, tongue twisters, words often mispronounced - Word stress and sentence stress: content words, structural words, strong forms, weak forms - Intonation patterns - Language functions : [Inviting-accepting/declining invitation - Offering /accepting/ refusing help - Thanking/ responding to thanks - Congratulating , Complimenting - Apologizing/ accepting an apology - Asking for / giving / refusing permission - Asking for advice / giving advice - Asking about likes, preferences / expressing likes / dislikes - Asking for information / giving information

UNIT III SPEAKING **9+12**

Greeting - Introducing Oneself -Invitation - Making Request - Expressing Gratitude - Complimenting and Congratulating - Expressing Sympathy - Apologizing - Asking for Information - Seeking Permission - Complaining and Expressing Regret - Using English in Real Life Situation [At the Bank/ post office/ College office - At the Green Grocer - At the Temple - At the College Canteen or Restaurant - At the Police station - At the Railway Station/ Bus Station - At the Medical Shop - At the Library - Interviews - Booking a Room in a Hotel - At the Travel Agency

UNIT IV READING **9+12**

Importance of Reading - Why develop reading habits among students and How - Reading techniques [Skimming , Scanning , Intensive reading , Extensive] Question types [Inferring , Assumption, Evaluative , Extrapolative], Reading different text types [Menu ,Email , Letters , Cartoons , Advertisements, Recipe , Articles , Literary texts – stories, plays, poems, Biographies] – identifying lexical and Contextual meaning- Understanding Discourse Coherence – sequencing of sentences- Cloze Reading - Academic Reading

UNIT V WRITING **9+12**

Developing Proficiency in Writing - Text Types - Academic Writing [Paragraphs , Essays] - Writing for communicative purposes [Letters – official and personal , Messages / Notices, Reports , Emails, Advertisements ,Application for a job (covering letter and CV) - Creative Writing (Stories, Poems, Dialogues)

TOTAL : 45+60

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LIST OF EXPERIMENTS:

1. Self Introduction
2. Role Play or Extempore
3. IELTS Listening
4. IELTS Speaking
5. IELTS Reading
6. IELTS Writing
7. Group Discussion
8. Interview Skills
9. Resume Writing
10. Presentation Skills

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Raman, Meenakshi & Sangeetha Sharma.	Technical Communication: Principles and Practice.	Oxford University Press, New Delhi.	2011
2	Rizvi, Ashraf. M	Effective Technical Communication.	Tata McGraw-Hill New Delhi.	2005

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Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1	Regional Institute of English	English for Engineers.	Cambridge University Press, New Delhi.	2006.
2	Dr.Gunasekaran,	Technical English Practice Book.	Vishnu Print Media, Chennai	2016
3	Rutherford, Andrea.	Basic Communication Skills for Technology.	Pearson, New Delhi.	2001
4	Viswamohan, Aysha.	English for Technical Communication.	Tata McGraw-Hill, New Delhi.	2008
5	Raman, Meenakshi & Sangeetha Sharma.	Technical Communication: Principles and Practice.	Oxford University Press, New Delhi	2011

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3. www.brainboxx.co.uk/A3_ASPECTS/pages/reading.htm
4. www.sparklebox.co.uk/literacy/vocabulary/word-lists/connectives/#.V613NH195kg
5. www.letterwritingguide.com/

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16SHA03	BUSINESS ENGLISH	L T P C 3 2 0 4

COURSE OBJECTIVES

- To enable learners of Engineering and Technology develop their basic Business communication skills.
- To Understand the formal and informal communication in the business organization
- To ensure that learners to understand the fundamentals of Business writing
- To inculcate the effective email writing skills for better business communication.
- To make the learners to use the phrase and clauses error free.

COURSE OUTCOMES

16SHA03.CO1 Communicate with one or many by using appropriate communicative strategies.

16SHA03.CO2 Write business correspondence by constructing clear sentences and paragraphs using the appropriate selection of words

16SHA03.CO3 Use economized words and emphasis in Sentence Design.

16SHA03.CO4 Able to use electronic technology in business communication

16SHA03.CO5 Use the phrases and sentences clearly in their written communication

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16SHA03.CO1	-	-	-	-	-	-	-	-	-	X	X	X	-	-	-
16SHA03.CO2	-	-	-	-	-	-	-	-	X	X	-	X	-	-	-
16SHA03.CO3	-	-	-	-	-	-	-	X	X	X	-	X	-	X	-
16SHA03.CO4	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-
16SHA03.CO5	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-

UNIT I FUNDAMENTALS OF BUSINESS WRITING 9+6

Adaptation and the selection of words- Non Discriminatory writing- economizing on words- giving sentences unity-arranging sentences for clarity- Accent on positive Language- Coherence- Transitional words

UNIT II BASIC PATTERNS OF BUSINESS LETTERS 9+6 Asking for Information- Asking for Action- Orders-Inquiries about people-claims –Refusing Request- Adjustment Refusals-Credit Refusal- Structure of the Sales Letter- Letter of Authorization- Letter of Recommendation

UNIT III FUNDAMENTALS OF REPORT WRITING 9+6

Determining the Report Purpose- Determining the Components-Gathering the Information Needed- Interpreting and Applying the Findings- Organizing the Report Information- Writing the Report

UNIT IV OTHER FORMS OF BUSINESS COMMUNICATION 9+6

Public Speaking and Oral Reporting- Overcome Nervousness- Making Formal Speech-Audience Analysis-Use of Voice- Use of Visual Aids- Conducting and Participating in Meetings- Interviewing People- Using Telephone-Email Writing

UNIT V CORRECTNESS OF COMMUNICATION 9+6

Standards of Punctuation – Apostrophe, Brackets, Colon, Comma etc…Standards for Grammar- Adjective-Adverb Confusion, Subject-Verb Agreement, Dangling Modifier, Parallelism, word use etc…

TOTAL : 45+30

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Lesikar, Bamford	Basic Business Communication 1st Canadian Edition (IRWIN DORSEY)	Von Hoffmann Press	1993
2.	Rizvi, Ashraf. M.	Effective Technical Communication.	Tata McGraw-Hill New Delhi.	2005

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1.	Regional Institute of English	English for Engineers.	Cambridge University Press New Delhi.	2006.
2	Department of English, Anna University, Chennai	Mindscapes : English For Technologists and Engineers	Orient Black Swan Private Limited, Chennai	2012
3	Rutherford, Andrea.	Basic Communication Skills for Technology.	Pearson New Delhi.	2001
4	Viswamohan, Aysha.	English for Technical Communication	Tata McGraw-Hill, New Delhi.	2008
5	Raman, Meenakshi & Sangeetha Sharma.	Technical Communication: Principles and Practice	Oxford University Press, New Delhi.	2011

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3. www.bbc.co.uk/worldservice/learningenglish/business/talkingbusiness
4. www.teachingenglish.org.uk/teaching-adults/resources/english-business
5. www.businessenglish.com/index_en.html

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16SHA04	BASICS OF JAPANESE	L T P C 3 2 0 4

COURSE OBJECTIVES

- To teach pronunciation and intonation of Japanese sounds and to enable students to comprehend and speak simple sentences in Japanese
- To introduce Japanese language at the basic level, to enable students to read and write the phonetic scripts, Hiragana and Katakana, and approx.100 Kanji,
- To teach some aspects of Japanese society and culture.
- To enable students to comprehend and write simple sentences in Japanese.
- To enable students to comprehend and make simple conversation in different situations using basic sentence patterns

COURSE OUTCOMES

16SHA04.CO1 Communicate with one or many by using appropriate communicative strategies.
16SHA04.CO2 Write Japanese correspondence by constructing clear sentences and paragraphs using the appropriate selection of words
16SHA04.CO3 Use economized words and emphasis in Sentence Design.
16SHA04.CO4 Able to use Japanese language for communication
16SHA04.CO5 Use Japanese phrases and sentences clearly in their written communication

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16SHA04.CO1	-	-	-	-	-	-	-	-	-	X	X	X	-	-	-
16SHA04.CO2	-	-	-	-	-	-	-	-	X	X	-	X	-	-	-
16SHA04.CO3	-	-	-	-	-	-	-	X	X	X	-	X	-	X	-
16SHA04.CO4	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-
16SHA04.CO5	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-

UNIT I INTRODUCTION TO LETTERS **9+6**

Introduction of the Japanese writing system, i.e. Hiragana, Katakana and Kanji (100-120), word-building, writing foreign names and loan words in Katakana

UNIT II BASIC WORDS **9+6**

Japanese Greetings; Basic sentence patterns to be applied in self introduction, identifying things; time of the day; calendar; counting using Japanese numerical classifiers

UNIT III BASIC PHRASES & CLAUSES **9+6**

Describing things; making comparisons; talking of daily activities; kinship terms used for address and reference; seasons; giving and receiving; shopping; making requests; talking of one's likes and dislikes

UNIT IV BASIC TENSES **9+6**

Making Sentences – Present, Past and Future, Progressive & Perfect Tenses

UNIT V CULTURE AND SOCIETY **9+6**

An introduction to some aspects of Japanese culture such as festivals, Japanese seasons, Japanese people and their love for nature; Japanese food, sports; society; geography; education system; Japan and the world etc. The objective is to create general awareness in students about life in Japan.

TOTAL: 45+30

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	George Trombley , Yukari Takenaka	Japanese from Zero! 1: Proven Techniques to Learn Japanese for Students and Professionals Volume 1-6th Edition	Bay Foreign Language Books Ltd,	2015
2	Living Language	Japanese reading & writing guide, and free online learning Paperback	Box Pck Pa edition	2012

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1	Pimsleur	Japanese Level 1 CD: Learn to Speak and Understand Japanese with Pimsleur Language Programs 3rd edition (Comprehensive)	Pimsleur	2002
2	Pimsleur	Japanese Level 2 CD: Learn to Speak and Understand Japanese with Pimsleur Language Programs 3rd Edition	Pimsleur	2002
3	Pimsleur	Japanese Level 3 CD: Learn to Speak and Understand Japanese with Pimsleur Language Programs 3rd Edition	Pimsleur	2002
4	Eriko Sato	Practice Makes Perfect Basic Japanese 1st Edition, McGraw-Hill Education1st edition	Pimsleur	2014
5	Mr Tae K Kim	A Guide to Japanese Grammar: A Japanese approach to learning Japanese grammar ,	CreateSpace Independent Publishing Platform	January23, 2014

WEB URLs

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2. www.guidetojapanese.org/learn
3. www.coscom.co.jp
4. www.japanese-online.com
5. http://nihongo-e-na.com/eng

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16SHA05 **FUNCTIONAL JAPANESE** **L T P C**
3 2 0 4

COURSE OBJECTIVES

- Students will be introduced to the basic structures of Japanese and encouraged to utilize them in appropriate situations.
- Students will be able to talk about themselves, their family, their likes and dislikes, their immediate happenings, etc. in simple sentences.
- Students will be able to complete basic communicative tasks in different social contexts such as shopping, ordering food, inviting others to do something with you.
- Students will be able to write short passages on the similar topics.
- Students will also learn aspects of Japanese culture that relate to the lesson topics.

COURSE OUTCOMES

16SHA05.CO1 Communicate with one or many by using appropriate communicative strategies.
16SHA05.CO2 Write Japanese correspondence by constructing clear sentences and paragraphs using the appropriate selection of words
16SHA05.CO3 Use economized words and emphasis in Sentence Design.
16SHA05.CO4 Able to use Japanese language for communication
16SHA05.CO5 Use Japanese phrases and sentences clearly in their written communication

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16SHA05.CO1	-	-	-	-		-	-	-	-	X	X	X	-	-	-
16SHA05.CO2	-	-	-	-	-	-	-	-	X	X	-	X	-	-	-
16SHA05.CO3	-	-	-	-	-	-	-	X	X	X	-	X	-	X	-
16SHA05.CO4	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-
16SHA05.CO5	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-

UNIT I BASIC GRAMMATICAL STRUCTURE **9+6**

Expressing State-of-Being, Conjugating to the negative state-of-being, conjugating to the past state-of-being, Polite Form and Verb Stems Addressing People, Questions in polite form, relative clauses

UNIT II BASIC VOCABULARY **9+6**

Vocabulary- Family, Friends, Room, Home, Health, School, Hobbies, Student's Life Shopping etc…

UNIT III BASIC PHRASES – I **9+6**

Simple conversation in situations such as describing things, making comparisons, talking of daily activities, giving and receiving of gifts, talking of illnesses and visit to a doctor

UNIT IV BASIC PHRASES **9+6**

Simple conversation in situations such as shopping, making requests, talking of one's likes and dislikes, talking on telephone etc. and Asking Questions

UNIT V CULTURE AND SOCIETY **9+6**

An introduction to some aspects of Japanese culture such as festivals, Japanese seasons, Japanese people and their love for nature; Japanese food, sports; society; geography; education system; Japan and the world etc. The objective is to create general awareness in students about life in Japan.

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TOTAL : 45+30

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	George Trombley, Yukari Takenaka	Japanese from Zero! 1: Proven Techniques to Learn Japanese for Students and Professionals (Volume 1) 6th Edition"	Bay Foreign Language Books Ltd,	2015
2	Living Language	Living Language Japanese, Complete Edition: Beginner through advanced course, including 3 coursebooks, 9 audio CDs, Japanese reading & writing guide, and free online learning Paperback – Unabridged	Living Language; Box Pck Pa edition	2012

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Pimsleur	Japanese Level 1 CD: Learn to Speak and Understand Japanese with Pimsleur Language Programs 3rd Edition	Pimsleur	2002
2	Pimsleur	Japanese Level 2 CD: Learn to Speak and Understand Japanese with Pimsleur Language Programs 3rd Edition	Pimsleur	2002
3	Pimsleur	Japanese Level 3 CD: Learn to Speak and Understand Japanese with Pimsleur Language Programs 3rd Edition;	Pimsleur	2002
4	Eriko Sato	Practice Makes Perfect Basic Japanese 1st Edition	McGraw-Hill Education	2014
5	Mr Tae K Kim,	A Guide to Japanese Grammar: A Japanese approach to learning Japanese grammar	Independent Publishing Platform	2014

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5. http://nihongo-e-na.com/eng/

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16SHA06	BASIC GERMAN	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES

- To teach pronunciation and intonation of German sounds and to enable students to comprehend and speak simple sentences in German
- To introduce German language at the basic level, to enable students to read and write the phonetic scripts of German,
- To teach some aspects of German society and culture.
- To enable students to comprehend and write simple sentences in German.
- To enable students to comprehend and make simple

COURSE OUTCOMES

16SHA06.CO1 Communicate with one or many by using appropriate communicative strategies.
16SHA06.CO2 Write German correspondence by constructing clear sentences and paragraphs using the appropriate selection of words
16SHA06.CO3 Use economized words and emphasis in Sentence Design.
16SHA06.CO4 Able to use German language for communication
16SHA06.CO5 Use German phrases and sentences clearly in their written communication

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16SHA06.CO1	-	-	-	-		-	-	-	-	X	X	X	-	-	-
16SHA06.CO2	-	-	-	-	-	-	-	-	X	X	-	X	-	-	-
16SHA06.CO3	-	-	-	-	-	-	-	X	X	X	-	X	-	X	-
16SHA06.CO4	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-
16SHA06.CO5	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-

UNIT I BASIC GERMAN 9+6

Alphabet - Numbers - Personal pronouns - Verb endings in the present tense - Verbs with vowel change - Possessive adjectives - Plural of nouns - The accusative case - The imperative - Seperable verbs - Modal verbs: können, müssen - Word order

UNIT II BASIC GRAMMAR – I 9+6

Nouns and Articles : Nouns gender: masculine (der Mann) feminine (die Frau neuter das Kind) plural (die Leute) formation of the feminine (die Lehrerin, die Direktorin)compound nouns (das Mineralwasser die Geburtstagsparty) case: nominative (Der Mathelehrer heißt Herr Lenz). accusative (Hast du den Mantel gekauft?) dative(Wir fahren mit dem Bus) and Articles

UNIT III - BASIC GRAMMAR – II 9+6

Pronouns- Personal, Nominative, accusative, dative, reflexive, interrogative; Adjectives- attributive, possessive, comparative, superlative; Adverbs; Numbers- cardinal and ordinal

UNIT IV BASIC TENSES 9+6

Making Sentences – Present, Past and Future, Progressive & Perfect Tenses and conditional, frequently used Prepositions and Conjunctions

UNIT V CULTURE AND SOCIETY 9+6

An introduction to some aspects of German culture such as festivals, German people, German food, sports; society; geography; education system; German and the world etc.

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TOTAL: 45+30

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1	Edward Swick M.A	The Everything Learning German Book: Speak, write, and understand basic German in no time; 2 edition	Adams Media;	2009
2	Eugene Jackson	German Made Simple: Learn to Speak and Understand German Quickly and Easily; Revised Edition	Made Simple Press; Revised edition	2006

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Living Language	Beginner through advanced course, including 3 course books, 9 audio CDs, and free online learning Audio CD Unabridged	Living Language; Com/Pap/Ps edition	2011
2	Ultimate German Beginner	Intermediate (Coursebook) (Ultimate Beginner-Intermediate) Revised & enlarged Edition	Living Language; Revised & enlarged edition	2004
3	Jolene Wochenske	Practice Makes Perfect Basic German (Practice Makes Perfect Series) 1 edition	McGraw-Hill Education	2011
4	Ed Swick	Practice Makes Perfect German Conversation (Practice Makes Perfect Series) 1 edition;	McGraw-Hill Education	2012
5	Astrid Henschel	Practice Makes Perfect German Verb Tenses, 2nd Edition: With 200 Exercises + Free Flashcard App 2nd Edition	McGraw-Hill Education; 2 edition	2013

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1. https:/babbel.com/learn-german-free
2. http://deutsch-lernen.com/
3. http://learning-german-online.org/
4. http://fluentin3months.com/german-learning-resources/
5. https://goethe.de/en/spr/ueb.html

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16SHA07 **FUNCTIONAL GERMAN** **L T P C**
3 2 0 4

COURSE OBJECTIVES

- Students will be introduced to the basic structures of German and encouraged to utilize them in appropriate situations.
- Students will be able to talk about themselves, their family, their likes and dislikes, their immediate happenings, etc. in simple sentences.
- Students will be able to complete basic communicative tasks in different social contexts such as shopping, ordering food, inviting others to do something with you.
- Students will be able to write short passages on the similar topics.
- Students will also learn aspects of German culture that relate to the lesson topics

COURSE OUTCOMES

16SHA07.CO1 Communicate with one or many by using appropriate communicative strategies.
16SHA07.CO2 Write German correspondence by constructing clear sentences and paragraphs using the appropriate selection of words
16SHA07.CO3 Use economized words and emphasis in Sentence Design.
16SHA07.CO4 Able to use German language for communication
16SHA07.CO5 Use German phrases and sentences clearly in their written communication

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16SHA07.CO1	-	-	-	-		-	-	-	-	X	-	-	-	-	-
16SHA07.CO2	-	-	-	-	-	-	-	-	X	X	-	X	-	-	-
16SHA07.CO3	-	-	-	-	-	-	-	X	X	X	-	X	-	X	-
16SHA07.CO4	-	-	-	-	-	-	-	-	-	X	X	X	-	-	-
16SHA07.CO5	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-

UNIT I BASIC PRONUNCIATION **9+6**

How To Pronounce German Vowels, German Consonants, German Diphthongs (Gliding Vowels)

UNIT II BASIC VOCABULARY **9+6**

Vocabulary- Family, Friends, Room, Home, Health, School, Hobbies, Student's Life, Shopping etc…

UNIT III BASIC PHRASES - I **9+6**

Basic German Words / Phrases, Saying Hello in German / Introducing Yourself / Saying Goodbye in German, Simple conversation in situations such as describing things, making comparisons, talking of daily activities, giving and receiving of gifts, talking of illnesses and visit to a doctor,

UNIT IV BASIC PHRASES-II **9+6**

Simple conversation in situations such as shopping, making requests, talking of one's likes and dislikes, talking on telephone etc. and Asking Questions

UNIT V CULTURE AND SOCIETY **9+6**

An introduction to some aspects of German culture such as festivals, seasons, German people and their lifestyle; German food, sports; society; geography; education system; German and the world etc.

TOTAL: 45+30

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Edward Swick M.A	The Everything Learning German Book: Speak, write, and understand basic German in no time; 2 edition	Adams Media;	2009
2	Eugene Jackson	German Made Simple: Learn to Speak and Understand German Quickly and Easily; Revised Edition	Made Simple Press; Revised edition	2006

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Living Language	Beginner through advanced course, including 3 course books, 9 audio CDs, and free online learning Audio CD Unabridged	Living Language; Com/Pap/Ps edition	2011
2	Ultimate German Beginner	Intermediate (Coursebook) (Ultimate Beginner-Intermediate) Revised & enlarged Edition	Living Language; Revised & enlarged edition	2004
3	Jolene Wochenske	Practice Makes Perfect Basic German (Practice Makes Perfect Series) 1 edition	McGraw-Hill Education	2011
4	Ed Swick	Practice Makes Perfect German Conversation (Practice Makes Perfect Series) 1 edition;	McGraw-Hill Education	2012
5	Astrid Henschel	Practice Makes Perfect German Verb Tenses, 2nd Edition: With 200 Exercises + Free Flashcard App 2nd Edition	McGraw-Hill Education; 2 edition	2013

WEB URLs

1. https:/babbel.com/learn-german-free
2. http://deutsch-lernen.com/
3. http://learning-german-online.org/
4. http://fluentin3months.com/german-learning-resources
5. https://goethe.de/en/spr/ueb.html

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16SHA08 PRINCIPLES OF MANAGEMENT AND ENGINEERING ETHICS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To create an exposure to the students regarding the basic concepts of management.
- To inculcate the significance of planning in decision making.
- To create an awareness about the organisation structure adopted by different firms.
- To make them understand the code of ethics.
- To make them aware of the responsibilities ensuring safety.

COURSE OUTCOMES

16SHA08.CO1 Capable of applying the functions of management relevant to the present scenario.
16SHA08.CO2 Able to take appropriate decisions under different circumstances.
16SHA08.CO3 Able to implement different strategies to manage the employees.
16SHA08.CO4 Able to follow the ethics in their profession.
16SHA08.CO5 Aware of all the rights and safety measures.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16SHA08.CO1	X	-	-	-	-	X	X	X	X	X	-	X	-	X	-
16SHA08.CO2	X	-	-	-	-	X	X	X	X	X	-	X	-	X	-
16SHA08.CO3	X	X	X	X	-	X	X	X	X	X	-	X	-	X	-
16SHA08.CO4	X	X	X	X	-	X	X	X	X	X	-	X	-	X	-
16SHA08.CO5	X	X	-	-	X	X	X	X	X	X	X	X	-	X	-

UNIT I INTRODUCTION **9**

Introduction - Definition of Management - Management significance - Management as an Art or Science - Roles of Managers - Functions of Management - Principles of Management - Current trends and its uses of Management

UNIT II PLANNING AND ORGANIZING **9**

Nature and Importance of Planning - Methods of Planning – Organization Structure - Job design - Recruitment and selection - Training methods

UNIT III COMMUNICATION AND CONTROL **9**

Meaning – Objectives – Importance - Process of Communication - Barriers to communication-Effective Communication - Control: definition - Objectives and process of control - types of control - and information technology

UNIT IV ENGINEERING ETHICS **9**

Introduction of Engineering ethics - Code of ethics - Individual, professional and Institutional values - Leadership in Engineering and Industry – Commitment – Empathy - Self Confidence - Models of Professional roles

UNIT V SAFETY RESPONSIBILITIES AND RIGHTS **9**

Assessment of Safety and Risk - Risk Benefit analysis - Occupational crime - Professional rights - Environmental Ethics - Engineers as Managers - Code of Conduct - Corporate Social Responsibility - Emerging Trends - Analytical cases

TOTAL HOURS: 45

TEXT BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1	L.M.Prasad	Principles and Practice of Management	Sultan Chand & Sons	2012
2	V.S.Senthilkumar	Engineering Ethics	Prentice Hall India Learning Private Limited	2014

REFERENCE BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1	A.C.Tripathi	Principles of Management	Tata McGraw Hill Education	2012
2	Andrew J.Dubrin	Essential of Management	Thomson Southwestern	2012
3	Stephen P. Robbins, David A. De Cenzo and Mary Coutler	Fundamentals of Management	Prentice Hall of India	2012
4	Charless B. Fleddermann	Engineering Ethics	Prentice Hall India Learning Private Limited	2012
5	John R. Boatright	Ethics and the Conduct of Business	Pearson EDucation	2013

WEB URLs

1. https://www.youtube.com/watch?v=glr5vBJnJAE
2. https://www.youtube.com/watch?v=azrUt008Uf0
3. https://www.youtube.com/watch?v=mDZrBxzfmOg
4. https://www.youtube.com/watch?v=upUN460U56A
5. https://www.youtube.com/watch?v=dguYC_qlF48

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BASIC SCIENCES

(BS)

For

Mechanical Engineering

16SHB01	MATRICES, CALCULUS AND ORDINARY DIFFERENTIAL EQUATIONS	L T P C 3 2 0 4

COURSE OBJECTIVES

- To realize the use of matrix algebra techniques in engineering applications and to develop for future applications.
- To familiarize the student with differential calculus concepts. This is needed in almost all branches of engineering.
- To learn the functions with several variables which finds applications in many engineering branches
- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

COURSE OUTCOMES

16SHB01.CO1 Generalize the matrix algebra techniques with engineering application
16SHB01.CO2 Apply the concepts of differential calculus in real time situations
16SHB01.CO3 Interpret on functions with several variables
16SHB01.CO4 Compute a strong platform of differential equation for complex problems
16SHB01.CO5 Illustrate multiple integral techniques in industrial scenario

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16SHB01.CO1	X	X	X	-	-	-	-	-	-	-	-	X	-	X	-
16SHB01.CO2	X	X	-	-	-	-	-	-	-	-	-	X	-	X	-
16SHB01.CO3	X	X	X	-	-	-	-	-	-	-	-	X	-	X	-
16SHB01.CO4	X	X	X	-	-	-	-	-	-	-	-	X	-	X	-
16SHB01.CO5	X	X	X	-	-	-	-	-	-	-	-	X	-	X	-

UNIT - I MATRICES **9+6**

Characteristic equation – Eigenvalues and Eigenvectors of a real matrix – Properties of eigenvalues and eigenvectors – Cayley-Hamilton Theorem (Without Proof) – Orthogonal transformation of a symmetric matrix to Diagonal form – Reduction of a quadratic form to canonical form by orthogonal transformation

UNIT – II APPLICATIONS OF DIFFERENTIAL CALCULUS **9+6**

Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes –Properties of envelope and evolutes

UNIT – III FUNCTIONS OF SEVERAL VARIABLES **9+6**

Functions of two variables – Taylor series - Partial derivatives – Maxima and minima – Constrained maxima and minima – Lagrange's multipliers method – Jacobians

UNIT – IV ORDINARY DIFFERENTIAL EQUATIONS **9+6**

Linear differential equations of second and higher order with constant coefficient when the R.H.S is e^{ax}, x^n $n>0$, sin ax, cos ax, $e^{ax}x^n$, e^{ax}sinbx, e^{ax}cosbx – Cauchy's and Legendre's linear equations – simultaneous first order linear equations with constant co-efficients – Method of variation of parameter when the R.H.S is sec ax, cosec ax, tan ax, cot ax – Applications of ODE related simple harmonic motion.

UNIT – V MULTIPLE INTEGRALS **9+6**

Double integrals in Cartesian coordinates – Change of order of integration – Area between two curves – Area of double integral - Triple integration in Cartesian coordinates – Volume as triple integrals

TOTAL: 45 + 30

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Bali N. P Manish Goyal	A Text book of Engineering Mathematics, 9th edition	Laxmi Publications Pvt Ltd.	2016
2.	Grewal. B.S	Higher Engineering Mathematics, 43rd Edition	Khanna Publications, Delhi	2014

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REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Glyn James	Advanced Modern Engineering Mathematics, 4th Edition	Pearson Education	2016
2.	Erwin Kreyszig	Advanced Engineering Mathematics, 9th Edition	John Wiley and Sons, New Delhi	2014
3.	Jain R.K., Iyengar S.R.K.	Advanced Engineering Mathematics, 4th edition	Alpha Science International Ltd	2014
4.	Dass, H.K., Er. RajnishVerma	Higher Engineering Mathematics, 3rd Revised Edition	S. Chand Private Ltd	2014
5.	Peter V. O.Neil	Advanced Engineering Mathematics, 7th Edition	Cengage learning	2012

WEB URLs

1. prezi.com/lsvapbmxxlp9/real-world-application-of-matrices/
2. nptel.ac.in/courses/111108081/
3. www.youtube.com/watch?v=FmhMUTmUjhM
4. www.analyzemath.com/appliedmath.html
5. nptel.ac.in/courses/122104017/

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16SHB02 COMPLEX VARIABLES, LAPLACE TRANSFORMS & VECTOR CALCULUS **LTPC 3 2 0 4**

COURSE OBJECTIVES

- To construct relatively simple quantitative models of change, and to deduce their consequences.
- To develop an understanding of the standard techniques of complex variable theory
- To enable the student to apply complex integration theory with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow of electric current.
- To learn the inverse Laplace transformations for solving real time Engineering problems.
- This course equips students to have basic knowledge in matrix algebra techniques with its engineering applications

COURSE OUTCOMES

16SHB02.CO1 Solve vector calculus by evaluation of integrals
16SHB02.CO2 Contrast the analytic function method to real world problems
16SHB02.CO3 Associate the complex integration theory in fluid and aero dynamics problems
16SHB02.CO4 Estimate the Laplace transform to electrical circuits, harmonic oscillation
16SHB02.CO5 Interpret the usage of inverse Laplace Transform to the real life situations

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16SHB02.CO1	X	X	X	-	-	-	-	-	-	-	-	X	-	X	-
16SHB02.CO2	X	X	-	-	-	-	-	-	-	-	-	X	-	X	-
16SHB02.CO3	X	X	-	-	-	-	-	-	-	-	-	X	-	X	-
16SHB02.CO4	X	X	X	-	-	-	-	-	-	-	-	X	-	X	-
16SHB02.CO5	X	X	X	-	-	-	-	-	-	-	-	X	-	X	-

UNIT - I VECTOR CALCULUS **9+6**

Gradient, divergence and curl – Line, surface and volume integrals – Green's, Gauss divergence theorem and Stokes' theorem (excluding proofs) – Verification of the above theorems and evaluation of integrals using them

UNIT – II ANALYTIC FUNCTIONS **9+6**

Functions of a complex variable – Analytic function: Necessary conditions – Cauchy-Riemann equations and sufficient conditions (excluding proofs) – Properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping: w =az, 1/z and bilinear transformation.

UNIT – III COMPLEX INTEGRATION **9+6**

Cauchy's integral theorem (excluding proof) and Cauchy's integral formula(excluding proof) – Taylor's and Laurent's series expansions(excluding proof) – Singular points – Classifications – Cauchy's residue theorem – Contour integration- circle and semi-circle Contour (excluding poles on the real axis).

UNIT – IV LAPLACE TRANSFORMS **9+6**

Laplace transforms – Sufficient condition for existence – Transforms of elementary functions – Basic properties - Derivatives and integrals of transforms – Transforms of derivatives and integrals of functions - – Initial and final value theorems - Problems - Transform of periodic functions

UNIT – V INVERSE LAPLACE TRANSFORMS AND IT'S APPLICATIONS **9+6**

Inverse Laplace transforms – convolution - convolution theorem - Problems – Partial fraction method – Problems – Applications of Laplace transforms – Solution of linear ODE of second order with constant coefficients – Solution of Boundary Value Problems – Solution of Integro Differential Equations.

TOTAL: 45 + 30

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Glyn James	Advanced Modern Engineering Mathematics, 4th Edition	Pearson Education	2016
2.	Grewal. B.S	Higher Engineering Mathematics, 43rd Edition	Khanna Publications, Delhi	2014

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Bali N. P Manish Goyal	A Text book of Engineering Mathematics, 9th edition	Laxmi Publications Pvt Ltd.	2016
2.	Erwin Kreyszig	Advanced Engineering Mathematics, 9th Edition	John Wiley and Sons, New Delhi	2014
3.	Tony Croft, Anthony Croft, Robert Davison, Martin Hargreaves, James Flint	Engineering Mathematics: A Foundation for Electronic, Electrical, Communications and Systems Engineers, 4th Revised Edition	Pearson Education	2012
4.	Peter V. O.Neil	Advanced Engineering Mathematics, 7th Edition	Cengage learning	2012
5.	J.Sureshkumar	Engineering Mathematics – II, 4th Edition	SK..JSK…,Publishers	2016

WEB URLs

1. http://mathinsight.org/
2. http://nptel.ac.in/courses/111107056/7
3. www.nptelvideos.in/2012/11/mathematics-ii.html
4. http://freevideolectures.com/Course/2349/Networks-and-Systems/23
5. http://nptel.ac.in/courses/122104018/node87.html

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16SHB03 TRANSFORMS & PARTIAL DIFFERENTIAL EQUATIONS

L	T	P	C
3	2	0	4

COURSE OBJECTIVES

- To introduce Fourier series analysis which is central to many applications in engineering
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To develop Z transform techniques for discrete time systems
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes
- To develop the basic knowledge in solving the boundary value problems

COURSE OUTCOMES

16SHB03.CO1 Retrieve the resonance knowledge of Fourier series analysis
16SHB03.CO2 Determine Fourier transform techniques for many engineering problems
16SHB03.CO3 Interpret the Z-transform for discrete-time systems
16SHB03.CO4 Articulate partial differential equation to solve real world problems
16SHB03.CO5 Implement the boundary value problem to real world applications

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16SHB03.CO1	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-
16SHB03.CO2	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-
16SHB03.CO3	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-
16SHB03.CO4	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-
16SHB03.CO5	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-

UNIT - I FOURIER SERIES **9+6**

Dirichlet"s conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval"s identity – Harmonic analysis

UNIT – II FOURIER TRANSFORMS **9+6**

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

UNIT – III Z - TRANSFORMS AND DIFFERENCE EQUATIONS **9+6**

Z- transforms - Elementary properties – Initial and final value theorem – Inverse Z - transforms – Partial fraction method – Residue method – Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transforms

UNIT – IV PARTIAL DIFFERENTIAL EQUATIONS **9+6**

Formation of partial differential equations – Singular integrals – Solutions of standard types of first order partial differential equations - Lagrange"s linear equation - Linear partial differential equations of second and higher order with constant coefficients of homogeneous when the R.H.S is e^{ax+by}, $x^m y^n$ m,n>0, sin (ax+by), cos (ax+by)

UNIT – V BOUNDARY VALUE PROBLEMS **9+6**

Classification of PDE - Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Fourier series solution in Cartesian coordinates – Steady state solution of two dimensional equation of heat conduction (excluding insulated edges) on finite square plates (excluding circular plates).

TOTAL: 45 + 30

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Erwin Kreyszig	Advanced Engineering Mathematics, 9th Edition	John Wiley and Sons, New Delhi	2014
2.	Grewal. B.S	Higher Engineering Mathematics, 43rd Edition	Khanna Publications, Delhi	2014

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1.	Glyn James	Advanced Modern Engineering Mathematics, 4th Edition	Pearson Education	2016
2.	Bali N. P Manish Goyal	A Text book of Engineering Mathematics, 9th edition	Laxmi Publications Pvt Ltd.	2016
3.	Datta.K.B.	Mathematical Methods of Science and Engineering	Cengage Learning India Pvt Ltd, Delhi	2013
4.	Ray Wylie. C, Barrett.L.C	Advanced Engineering Mathematics, 6th Edition	Tata Mc Graw Hill Education Pvt Ltd, New Delhi	2012
5.	Ramana.B.V.	Higher Engineering Mathematics	Tata Mc Graw Hill Publishing Company, New Delhi	2008

WEB URLs

1. www.thefouriertransform.com/
2. www.tutorialspoint.com/signals_and_systems/z_transforms_properties.htm
3. nptel.ac.in/courses/111103021/
4. www.fourier-series.com
5. www.youtube.com/watch?v=Fh8m6ZdFaqU
   www.jirka.org/diffyqs/htmlver/diffyqsse31.html

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16SHB04	PROBABILITY & RANDOM PROCESSES	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES

- Analyze random or unpredictable experiments and investigate important features of random experiments.
- Construct probabilistic models for observed phenomena through distributions which play an important role in many engineering applications.
- To provide necessary basic concepts in random processes for applications such as random signals, linear systems etc in communication engineering.
- To acquire the knowledge the concept of convergence of random sequence and the study of random signals
- To be familiar with application of auto correlation and cross correlation function and spectral density

COURSE OUTCOMES

16SHB04.CO1	The students will have a fundamental knowledge of the probability concepts.
16SHB04.CO2	It helps to use standard distributions to the real life problems.
16SHB04.CO3	The students will have an exposure of various distribution functions and help in acquiring skills in handling situations involving more than one variable.
16SHB04.CO4	Associate random variables by designing joint distributions and correlate the random variables.
16SHB04.CO5	Gained knowledge in correlation and spectral densities

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16SHB04.CO1	X	X	X	-	-	-	-	-	-	-	-	X	-	X	-
16SHB04.CO2	X	X	-	-	-	-	-	-	-	-	-	X	-	X	-
16SHB04.CO3	X	X	-	-	-	-	-	-	-	-	-	X	-	X	-
16SHB04.CO4	X	X	X	-	-	-	-	-	-	-	-	X	-	X	-
16SHB04.CO5	X	X	X	-	-	-	-	-	-	-	-	X	-	X	-

UNIT - I PROBABILITY AND RANDOM VARIABLES **9+6**

Axioms of probability–conditional probability– Baye's theorem, random variables– Discrete and continuous random variables – MGF

UNIT – II STANDARD DISTRIBUTIONS **9+6**

Discrete distributions : Binomial, Poisson, Geometric, Negative Binomial and their properties – Continuous distributions : Uniform, Exponential, Gamma, Normal distributions and their properties

UNIT – III TWO - DIMENSIONAL RANDOM VARIABLES **9+6**

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and regression – Transformation of random variables

UNIT – IV RANDOM PROCESSES **9+6**

Classification – Stationary process – Markov process - Poisson process – Discrete parameter Markov chain – Chapman Kolmogorov equations

UNIT – V CORRELATION AND SPECTRAL DENSITIES **9+6**

Auto correlation - Cross correlation - Properties – Power spectral density – Cross spectral density - Properties – Wiener-Khintchine relation – Relationship between cross power spectrum and cross correlation function

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TOTAL: 45 + 30

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Oliver. C Ibe.	Fundamentals of Applied Probability and Random Processes, 2nd Edition	Academic Press	2014
2.	Stark. H., Woods. J.W.	Probability and Random Processes with Applications to Signal Processing, 4th Edition	Pearson Education, Asia	2014

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	HweiP.Hsu	Schaum"s Outline of Theory and Problems of Probability, Random Variables and Random Processes	Mc Graw Hill Publishing Company, New Delhi	2014
2.	Henry Stark , John W. Woods	Probability, Statistics, and Random Processes for Engineers" , 2nd Edition	Pearson Education	2014
3.	Miller. S.L., Childers. D.G.	Probability and Random Processes with Applications to Signal Processing and Communications , 2nd Edition	Academic Press (Elsevier)	2012
4.	Yates. R.D., Goodman. D.J.	Probability and Stochastic Processes, 2nd Edition	Wiley India Pvt. Ltd., Bangalore	2012
5.	Peyton Peebles	Problems and Solutions in Probability, Random Variables and Random Signal Principles (SIE), 1st Edition	Mc Graw Hill Publishing Company, New Delhi	2012

WEB URLs

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2. www.mathsisfun.com
3. http://nptel.ac.in/courses/105103027/13
4. http://nptel.ac.in/courses/117105085/
5. https://www.youtube.com/watch?v=AeRQG6bg51Y

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16SHB05	PROBABILITY AND QUEUEING THEORY	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES

- Analyze random or unpredictable experiments and investigate important features of random experiments.
- Construct probabilistic models for observed phenomena through distributions which play an important role in many engineering applications.
- To provide necessary basic concepts in random processes for applications such as random signals, linear systems etc in communication engineering.
- To Acquire the knowledge the concept of convergence of random sequence and the study of random signals
- Identify the Markovian queueing model in the given system, find the performance measures and analyze the result

COURSE OUTCOMES

16SHB05.CO1	The students will have a fundamental knowledge of the probability concepts.
16SHB05.CO2	It helps to use standard distributions to the real life problems.
16SHB05.CO3	The students will have an exposure of various distribution functions and help in acquiring skills in handling situations involving more than one variable.
16SHB05.CO4	Associate random variables by designing joint distributions and correlate the random variables.
16SHB05.CO5	Gained knowledge in Markovian queueing model and non Markovian queueing model

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16SHB05.CO1	X	X	X	-	-	-	-	-	-	-	-	X	-	X	-
16SHB05.CO2	X	X	-	-	-	-	-	-	-	-	-	X	-	X	-
16SHB05.CO3	X	X	-	-	-	-	-	-	-	-	-	X	-	X	-
16SHB05.CO4	X	X	X	-	-	-	-	-	-	-	-	X	-	X	-
16SHB05.CO5	X	X	X	-	-	-	-	-	-	-	-	X	-	X	-

UNIT - I PROBABILITY AND RANDOM VARIABLES **9+6**

Axioms of probability–conditional probability– Baye's theorem, random variables– Discrete and continuous random variables – MGF

UNIT – II STANDARD DISTRIBUTIONS **9+6**

Discrete distributions : Binomial, Poisson, Geometric, Negative Binomial and their properties – Continuous distributions : Uniform, Exponential, Gamma, Normal distributions and their properties

UNIT – III TWO - DIMENSIONAL RANDOM VARIABLES **9+6**

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and regression – Transformation of random variables

UNIT – IV RANDOM PROCESSES **9+6**

Classification – Stationary process – Markov process - Poisson process – Discrete parameter Markov chain – Chapman Kolmogorov equations

UNIT – V QUEUEING MODELS **9+6**

Markovian queues M/M/1 , M/M/C , Finite and infinite capacity M/G/1 queue – Pollaczek Khinchin formula.

TOTAL: 45 + 30

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Oliver. C Ibe.	Fundamentals of Applied Probability and Random Processes, 2nd Edition	Academic Press	2014
2.	John F. Shortle, James M.Thompson, Carl M. Harris Donald Gross	Fundamentals of Queueing Theory, 4th Edition	Wiley	2012

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	HweiP.Hsu	Schaum"s Outline of Theory and Problems of Probability, Random Variables and Random Processes	Tata Mc Graw Hill Edition, New Delhi	2014
2.	Hamdy ATaha	Operations Research	Pearson Education, Asia	2014
3.	Robertazzi	Computer Networks and Systems: Queueing Theory and performance evaluation, 3rd Edition	Springer	2013
4.	Yates. R.D., Goodman. D.J.	Probability and Stochastic Processes, 2nd Edition	Wiley India Pvt. Ltd., Bangalore	2012
5.	Trivedi.K.S.,	Probability and Statistics with Reliability, Queueing and Computer Science Applications, 2nd Edition	John Wiley and Sons	2008

WEB URLs

1. www.khanacademy.org/math/probability/random-variables-topic/random-variables-prob-dist/v/random-variables
2. www.mathsisfun.com
3. http://nptel.ac.in/courses/105103027/13
4. http://nptel.ac.in/courses/117105085/
5. www.eventhelix.com/RealtimeMantra/CongestionControl/m_m_1_queue.htm#.V6riiPR0gwQ

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16SHB06 **NUMERICAL METHODS** **L T P C**
3 2 0 4

COURSE OBJECTIVES

- To solve a set of algebraic equations representing steady state models formed in engineering problems
- To deal with interpolation and approximation for the application of finite element analysis
- To find the trend information from discrete data set through numerical differentiation and summary information through numerical integration
- To predict the system dynamic behavior through solution of ODEs modeling the system
- To solve PDE models representing spatial and temporal variations in physical systems through numerical methods

COURSE OUTCOMES

16SHB06.CO1	The students will have a clear perception of the power of numerical techniques
16SHB06.CO2	The students can deal with interpolation and approximation for the application of finite element analysis
16SHB06.CO3	Students would be able to demonstrate the applications of numerical techniques to problems drawn from industry, management and other engineering fields.
16SHB06.CO4	It equips the knowledge in numerical differentiation and numerical integration
16SHB06.CO5	This course makes students easy in solving initial and boundary value problems

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16SHB06.CO1	X	X	X	-	-	-	-	-	-	-	-	X	-	X	-
16SHB06.CO2	X	X	-	-	-	-	-	-	-	-	-	X	-	X	-
16SHB06.CO3	X	X	-	-	-	-	-	-	-	-	-	X	-	X	-
16SHB06.CO4	X	X	X	-	-	-	-	-	-	-	-	X	-	X	-
16SHB06.CO5	X	X	X	-	-	-	-	-	-	-	-	X	-	X	-

UNIT - I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS **9+6**

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method – Solution of linear system of a equations - Gauss elimination method –Gauss Jordon method - Iterative methods of Gauss Jacobi and Gauss-Seidel - Horner's Method – Eigen value of a matrix by power method

UNIT – II INTERPOLATION AND APPROXIMATION **9+6**

Interpolation with unequal intervals – Lagrange's interpolation – Newton's divided difference interpolation – Interpolation with equal intervals – Newton's forward and backward difference formulae.

UNIT – III NUMERICAL DIFFERENTIATION AND INTEGRATION **9+6**

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

UNIT – IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS **9+6**

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

UNIT – V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS **9+6**

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

TOTAL: 45 + 30

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	S. K. Gupta	Numerical Methods for Engineers , 3rd Edition	New Age International Pvt Ltd Publishers	2015
2.	Chapra. S.C., Canale.R.P.	Numerical Methods for Engineers, 6th Edition	Tata McGraw Hill, , New Delhi	2012

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REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Grewal. B.S.	Numerical Methods in Engineering & Science: with Programs in C and C++, 10th Edition	Khanna Publishers, New Delhi	2010
2.	M.K. Jain	Numerical Methods for Scientific & Engineering Computation, 6th Edition	New Age International Publishers	2010
3.	Sankara Rao. K.	Numerical methods for Scientists and Engineers, 3rd Edition	Prentice Hall of India Private, New Delhi	2007
4.	Brian Bradie	A friendly introduction to Numerical analysis	Pearson Education, Asia, New Delhi	2007
5.	Gerald. C. F. Wheatley. P. O.	Applied Numerical Analysis,6th Edition	Pearson Education, Asia, New Delhi	2006

WEB URLs

1. http://nptel.ac.in/courses/122102009/
2. http://nptel.ac.in/courses/111101003/
3. https://www.youtube.com/watch?v=m2p6hrQGaxQ
4. https://mat.iitm.ac.in/home/sryedida/public_html/caimna/ode/rk/rk.html
5. https://mat.iitm.ac.in/home/sryedida/public_html/caimna/pde/fifth/example.html

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16SHB07 **STATISTICS AND NUMERICAL METHODS** **L T P C**
3 2 0 4

COURSE OBJECTIVES

- To understand concepts of testing of hypothesis
- To develop design of experiments model for research problems
- To solve a set of algebraic equations representing steady state models formed in engineering problems
- To find the trend information from discrete data set through numerical differentiation and summary information through numerical integration
- To predict the system dynamic behaviour through solution of ODEs modeling the system

COURSE OUTCOMES

16SHB07.CO1 Determine testing of hypothesis to real life problems
16SHB07.CO2 Enhance design of experiments model for research
16SHB07.CO3 Demonstrate the applications of numerical techniques to various engineering fields.
16SHB07.CO4 Equip the knowledge in numerical differentiation and numerical integration
16SHB07.CO5 Implement ordinary differential equations to the real life problems

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16SHB07.CO1	X	X	X	-	-	-	-	-	-	-	X	X	-	X	-
16SHB07.CO2	X	X	X	-	-	-	-	-	-	-	X	X	-	X	-
16SHB07.CO3	X	X	X	-	-	-	-	-	-	-	X	X	-	X	-
16SHB07.CO4	X	X	X	-	-	-	-	-	-	-	X	X	-	X	-
16SHB07.CO5	X	X	X	-	-	-	-	-	-	-	X	X	-	X	-

UNIT - I TESTING OF HYPOTHESIS **9+6**

Sampling distributions - Tests for single mean, Difference of means (large and small samples) – Tests for single variance and equality of variances – chi-square test for goodness of fit – Independence of attributes.

UNIT – II DESIGN OF EXPERIMENTS **9+6**

Completely randomized design – Randomized block design – Latin square design – One way- Two way Classification.

UNIT – III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS **9+6**

Newton-Raphson method- Gauss Elimination method – Gauss-Jordan methods – Iterative methods of Gauss-Jacobi and Gauss-Seidel - Horner's Method – Eigen values of a matrix by Power method .

UNIT – IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION **9+6**

Lagrange's and Newton's divided difference interpolation –Newton's forward and backward difference interpolation - Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal and Simpson's 1/3 rules

UNIT – V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS **9+6**

Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first and second order equations – Adam's and Milne's predictor corrector methods for solving first order equations

TOTAL: 45 + 30

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	S. K. Gupta	Numerical Methods for Engineers , 3rd Edition	New Age International Pvt Ltd Publishers	2015
2.	Walpole. R.E., Myers. R.H., Myers. S.L., Ye. K.	Probability and Statistics for Engineers and Scientists, 8th Edition	Pearson Education, Asia	2013

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REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Douglas C. Montgomery, George C. Runger	Applied Statistics and Probability for Engineers (International Student Version)", 6th Edition	John Wiley & Sons, Inc.	2016
2.	Spiegel. M.R., Schiller. J., Srinivasan.R.A.	Schaum's Outlines on Probability and Statistics, 4th Edition	Tata McGraw Hill Education	2013
3.	Chapra. S.C., Canale.R.P.	Numerical Methods for Engineers, 6th Edition	Tata McGraw Hill, , New Delhi	2012
4.	Johnson. R.A., and Gupta. C.B.	Miller,Freund's Probability and Statistics for Engineers,11th Edition	Pearson Education, Asia	2011
5.	Grewal. B.S.	Numerical Methods in Engineering & Science: with Programs in C and C++, 10th Edition	Khanna Publishers, New Delhi	2010

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1. http://stattrek.com/tutorials/statistics-tutorial.aspx
2. http://nptel.ac.in/courses/111104075/5
3. http://nptel.ac.in/courses/122102009/
4. http://nptel.ac.in/courses/111101003/
5. https://www.youtube.com/watch?v=m2p6hrQGaxQ

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16SHB08 **DISCRETE MATHEMATICS** **L T P C**
3 2 0 4

COURSE OBJECTIVES

- To extend student's Logical and Mathematical maturity
- To deal with abstraction and the counting principles
- To identify the basic properties of graphs and model simple applications
- To introduce most of the basic terminologies used in computer science courses
- To study the concepts and properties of algebraic structures

COURSE OUTCOMES

16SHB08.CO1 Have knowledge of the concepts needed to test the logic of a program.
16SHB08.CO2 Ability to distinguish between the notion of discrete and continuous mathematical structures
16SHB08.CO3 Have an understanding in identifying structures on many levels.
16SHB08.CO4 Be aware of a class of functions which transform a finite set into another finite set which relates to input and output functions in computer science.
16SHB08.CO5 Be exposed to concepts and properties of algebraic structures such as groups, rings and fields.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16SHB08.CO1	X	X	X	-	-	-	-	-	-	-	X	X	-	X	-
16SHB08.CO2	X	X	X	-	-	-	-	-	-	-	X	X	-	X	-
16SHB08.CO3	X	X	X	-	-	-	-	-	-	-	X	X	-	X	-
16SHB08.CO4	X	X	X	-	-	-	-	-	-	-	X	X	-	X	-
16SHB08.CO5	X	X	X	-	-	-	-	-	-	-	X	X	-	X	-

UNIT - I LOGIC AND PROOFS **9+6**

Propositional Logic – Propositional equivalences-Predicates and quantifiers-Nested Quantifiers -Rules of inference-introduction to Proofs-Proof Methods and strategy.

UNIT – II COMBINATORICS **9+6**

Mathematical inductions-Strong induction and well ordering-.The basics of counting-The pigeonhole principle – Permutations and combinations-Recurrence relations-Solving Linear recurrence relations-generating functions-inclusion and exclusion and applications.

UNIT – III GRAPHS **9+6**

Graphs and graph models-Graph terminology and special types of graphs-Representing graphs and graph isomorphism -connectivity-Euler and Hamilton paths.

UNIT – IV ALGEBRAIC STRUCTURES **9+6**

Algebraic systems-Semi groups and monoids-Groups-Subgroups and homomorphisms- Cosets and Lagrange's theorem- Ring & Fields (Definitions and examples)

UNIT – V LATTICES AND BOOLEAN ALGEBRA **9+6**

Partial ordering-Posets-Lattices as Posets- Properties of lattices-Lattices as Algebraic systems –Sub lattices –direct product and Homomorphism-Some Special lattices- Boolean Algebra

TOTAL: 45 + 30

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Narsingh Deo	Graph Theory with Applications to Engineering and Computer Science, Reprint edition	Dover Publications Inc.	2016
2.	Tremblay J.P, Manohar R	Discrete Mathematical Structures with application to computer science,30th Reprint	Tata Mc Graw Hill Pub.Co.Ltd,New Delhi,	2011

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REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Bernard Kolman , Robert C.Busby, Sharan Culter Ross	Discrete Mathematical Structures, 6th Edition	Pearson Education Pvt Ltd. ,New Delhi	2015
2.	Richard Johnsonbaugh	Discrete Mathematics , 7th Edition	Pearson Education Asia, New Delhi	2014
3.	Seymour Lipschutz, Mark Lipson, Varsha H. Patil	Discrete Mathematics Schaum's Outlines , Revised 3rd Edition	Mc Graw Hil Pub.Co.Ltd.,New Delhi	2013
4.	Ralph. P.Grimaldi	Discrete and combinatorial Mathematics : An Applied Introduction, 5th Edition	Pearson Education Asia,Delhi	2012
5.	Kenneth H. Rosen	Discrete Mathematics and its Applications, 7th Edition	Tata Mc Graw Hill Pub . co.Ltd.,New Delhi,Special Indian Edition	2011

WEB URLs

1. www.dmtcs.org/dmtcs-ojs/index.php/dmtcs
2. www.tutorialspoint.com/discrete_mathematics/
3. http://nptel.ac.in/courses/106106094/#
4. www.artofproblemsolving.com/articles/discrete-math
5. http://dlmf.nist.gov/23.5

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16SHB09 **OPERATIONS RESEARCH** **L T P C**
3 2 0 4

COURSE OBJECTIVES

- To provide knowledge and training in using optimization techniques.
- To learn about the transportation and assignment models
- To know the basics of integer programming and its applications.
- To develop an understanding of classical optimization theory.
- To provide knowledge objects and operations scheduling.

COURSE OUTCOMES

16SHB09.CO1 The knowledge gained on this course helps the students to do engineering optimization.
16SHB09.CO2 Enable the students to prepare transportation and assignment model for business enterprise.
16SHB09.CO3 The students can able to use the optimization techniques for use engineering and Business problems.
16SHB09.CO4 This course equips students to have basic knowledge in classical optimization theory.
16SHB09.CO5 It provides the knowledge to do production planning, inventory control and management.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16SHB09.CO1	X	X	X	-	-	-	-	-	-	-	X	X	-	X	-
16SHB09.CO2	X	X	X	-	-	-	-	-	-	-	X	X	-	X	-
16SHB09.CO3	X	X	X	-	-	-	-	-	-	-	X	X	-	X	-
16SHB09.CO4	X	X	X	-	-	-	-	-	-	-	X	X	-	X	-
16SHB09.CO5	X	X	X	-	-	-	-	-	-	-	X	X	-	X	-

UNIT - I LINEAR PROGRAMMING MODELS **9+6**

Mathematical Formulation - Graphical Solution of linear programming models – Simplex method – Artificial variable Techniques- Variants of Simplex method

UNIT – II TRANSPORTATION AND ASSIGNMENT MODELS **9+6**

Mathematical formulation of transportation problem- Methods for finding initial basic feasible solution – optimum solution - degeneracy – Mathematical formulation of assignment models – Hungarian Algorithm – Variants of the Assignment problem

UNIT – III INTEGER PROGRAMMING **9+6**

Cutting plan algorithm – Branch and bound methods, Multistage(Dynamic) programmimg .

UNIT – IV CLASSICAL OPTIMISATION THEORY **9+6**

Unconstrained external problems,Newton – Ralphson method –Equality constraints –Jacobian methods – Lagrangian method – Kuhn-Tucker conditions – simple problems

UNIT – V OBJECT SCHEDULING **9+6**

Network diagram representation – Critical Path Method – Time charts and resource leveling –PERT.

TOTAL: 45 + 30

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	D.S. Hira , P.K. Gupta	Operations Research, 7th Revised Edition (Reprint)	S.Chand & Co. Pvt.Ltd	2015
2.	Hamdy ATaha	Operations Research, 9th Edition	Pearson Education Asia	2014

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Mital.K.V. Mohan, Chander	Optimization Methods in Operations Research and Systems Analysis, 4th Edition	New Age International Publishers	2016
2.	Anand Sharma	Operation Research, 1st Edition	Himalaya Publishing House	2014
3.	Srinivasan. G	Operations Research: Principles and applications, 2nd Edition	PHIL Learning Private Limited	2010
4.	Paneer Selvam	Operation Research	Prentice Hall of India , 2nd Edition	2009
5.	N D Vohra	Quantitative Techniques in Management, 4th Edition	Tata Mc Graw Hill	2009

WEB URLs

1. www.maths.adelaide.edu.au/matthew.roughan/Lecture_notes/OORII/03lecture_notes.html
2. nptel.ac.in/courses/110106059/
3. www.youtube.com/watch?v=a2QgdDk4Xjw&list=PL849A8B56B8320421
4. www.math.utah.edu/~cherk/teach/opt/course.html
5. www.youtube.com/watch?v=vUMGvpsb8dc

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16SHB21 **ENGINEERING PHYSICS** **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To understand the concepts in elasticity and transfer of heat energy through materials
- To acquire the knowledge in acoustical engineering and ultrasonic
- To enrich the principles involved in laser technology and its applications
- To understand the concept and significance in fiber optics
- To educate the basic concepts in quantum physics

COURSE OUTCOMES

16SHB21.CO1 Summarize the properties of elasticity and thermal conductivity of materials
16SHB21.CO2 Quote the contemporary issues on acoustics and ultrasonic studies
16SHB21.CO3 Discuss the properties of laser technology for engineering applications
16SHB21.CO4 Illustrate the types of optical fibers and its applications
16SHB21.CO5 Explain the concept of quantum computing in wave theory

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16SHB21.CO1	X	X	X	-	X	-	-	-	-	-	-	X	-	-	-
16SHB21.CO2	X	X	-	-	X	-	-	-	-	-	-	X	X	-	-
16SHB21.CO3	X	X	X	-	X	-	-	-	-	-	-	X	-	-	X
16SHB21.CO4	X	X	X	-	-	-	-	-	-	-	-	X	-	-	X
16SHB21.CO5	X	X	X	-	-	-	-	-	-	-	-	X	-	-	-

UNIT I PROPERTIES OF MATTER AND THERMAL PHYSICS **9**

Elasticity – Hook's law – Relationship between three modulii of elasticity (Qualitative) – stress and strain diagram – Poisson's ratio – factors affecting elasticity – bending moment – depression of a cantilever – young's modulus by uniform bending – I shaped girders. Modes of heat transfer – thermal conductivity – Newton's law of cooling – linear heat flow – lee's disc method – radial heat flow – rubber tube method – conduction through compound media (series and parallel method)

UNIT II ACOUSTICS AND ULTRASONICS **9**

Introduction of acoustics – Classification of sound-Weber-Fechner law- Reverberation – Reverberation time – Factors affecting acoustics of building and its remedy - Absorption coefficient – Measurement of Absorption coefficient. Introduction– properties - Detection of ultrasonic waves, Magnetostriction effect - Magnetostriction generator – piezoelectric effect - piezoelectric generator— Cavitations - Velocity measurement – acoustic grating method – SONAR - Non Destructive Testing – pulse echo system, through transmission and reflection modes.

UNIT III LASERS **9**

Introduction – Principle of Spontaneous emission and stimulated emission. Population inversion - pumping methods. Einstein's A and B coefficients – derivation - Types of lasers – He-Ne, CO_2, Nd-YAG, Semiconductor lasers (homojunction & heterojunction) - Industrial Applications - Lasers in welding, cutting, heat treatment – Medical applications - Holography (construction & reconstruction).

UNIT IV FIBRE OPTICS AND ITS APPLICATIONS **9**

Principle and propagation of light in optical fibers – Numerical aperture and Acceptance angle - Classification based on materials, refractive index profile – Double crucible technique of fibre drawing – Splicing - Loss in optical fiber – attenuation, dispersion, bending - Fibre optical communication system (Block diagram) – Fiber optic Light sources - Detectors - sensors – temperature & displacement - Endoscope.

UNIT V QUANTUM PHYSICS AND APPLICATION **9**

Black body radiation – Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh – Jean's Law from Planck's theory – Compton effect (Qualitative) - experimental verification – Matter waves – de Broglie's theory - Schrödinger's wave equation– Time independent and time dependent equations – Particle in one dimensional box - Physical significance of wave function - Electron Microscope – Scanning Electron Microscope (SEM) - Transmission Electron Microscope (TEM) – Advantages, disadvantages and application.

TOTAL: 45 Hours

LIST OF EXPERIMENTS: **TOTAL: 30 Hours**

1. (a) Determination of Wavelength and particle size using Laser
   (b) Determination of acceptance angle in an optical fiber.
2. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
3. Determination of wavelength of mercury spectrum – spectrometer grating
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Determination of Young's modulus by uniform bending method
6. Determination of Young's modulus by Non uniform bending method
7. Determination of Coefficient of viscosity of a liquid –Poiseuille's method
8. Determination of Dispersive power of a prism – Spectrometer
9. Determination of thickness of a thin wire – Air wedge method
10. Determination of Rigidity modulus – Torsion pendulum

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Marikani A	Engineering Physics	PHI, New Delhi	2013
2	Rajagopal K	Engineering Physics	PHI, New Delhi	2011

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Tamilarasan.K &Prabhu.K	Engineering Physics-I	Mc Graw Hill Education	2015
2	Palanisamy P.K	Engineering Physics	SCITECH Publications	2013
3	Senthilkumar G	Engineering Physics I	VRB Publishers	2013
4	Gaur R.K. and Gupta S.L.	Engineering Physics	Dhanpat Rai publishers	2006
5	Sudarmozhi.G.	Engineering Physics I	Bharathi Publishers	2015

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4. www.slideshare.net/RNBAJIYA/optical
5. www.slideshare.net/kumartvl/quantum

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16SHB22 **MATERIAL SCIENCE** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the types of atomic structures in crystalline materials
- To understand the basic concepts in magnetism and superconductivity
- To impart knowledge on conducting and semiconducting materials
- To educate the concept of dielectric materials
- To understand the basic concepts in modern engineering materials

COURSE OUTCOMES

16SHB22.CO1 Outline the atomic structure of materials
16SHB22.CO2 Distinguish between conducting and semiconducting materials
16SHB22.CO3 Summarize the properties and applications of magnetic and superconducting materials
16SHB22.CO4 Categorize the properties and applications of dielectric materials
16SHB22.CO5 Discuss the applications of modern engineering materials

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16SHB22.CO1	X	X	-	X	-	-	-	-	-	-	-	X	-	-	-
16SHB22.CO2	X	-	X	-	-	-	-	-	-	-	-	X	-	-	-
16SHB22.CO3	X	X	X	-	-	-	-	-	-	-	-	X	-	-	-
16SHB22.CO4	X	X	-	-	-	-	-	-	-	-	-	X	-	-	-
16SHB22.CO5	X	-	-	X	-	-	-	-	-	-	-	X	X	-	X

UNIT I CRYSTAL PHYSICS **9**

Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius –Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Diamond and Graphite structures (Qualitative) – Crystal growth techniques – Bridgeman technique and Czochralski method.

UNIT II CONDUCTORS AND SEMICONDUCTORS **9**

Classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann-Franz law – Quantum theory - Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – carrier concentration in metals.Properties of semiconductors - classification – Elemental and Compound semiconductors – Intrinsic and Extrinsic semiconductors - carrier concentration derivation in intrinsic semiconductors - band gap determination - Hall effect – Determination of Hall coefficient –Experimental method - Applications of Hall Effect.

UNIT III MAGNETIC AND SUPERCONDUCTING MATERIALS **9**

Origin of magnetic moment – Types – Dia, para, Ferro, anti ferromagnetic materials – Domain theory – Hysteresis – Soft and hard magnetic materials – Ferrites – preparation, properties and applications.Properties of superconducting materials - BCS theory of superconductivity (Qualitative) - Types of super conductors – High T_c superconductors – Applications of superconductors – SQUID, Cryotron, Magnetic levitation.

UNIT IV DIELECTRIC MATERIALS **9**

Basic definitions - Electrical susceptibility – dielectric constant – Types of polarization - electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarisation – internal field – Claussius –Mosotti relation (derivation) – dielectric loss – dielectric breakdown – uses of dielectric materials(capacitor and transformer) – ferroelectricity and applications

UNIT V ADVANCED ENGINEERING MATERIALS **9**

Metallic glasses: Preparation, properties and applications – metallic glasses as transformer cores.Shape memory alloys (SMA): Types and Characteristics - properties of NiTi alloy- advantages and disadvantages of SMA - applications. Nanomaterials: Synthesis– Eleectro deposition, Plasma arcing - properties of nanoparticles and applications. Carbon nanotubes: Types - Single walled and multi walled nanotubes – Synthesis of carbon nanotube - pulsed laser deposition, chemical vapour deposition – Properties and applications

TOTAL: 45 Hours

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Palanisamy P K	Materials Science	Scitech Publishers	2007
2	V Rajendran	Materials Science	Tata McGraw Hill publications	2008

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Arumugam,	Materials Science	Anuradha Publications	2010
2	William Smith	Materials science	Tata McGraw Hill publications	2015
3	Raghavan V	Materials science	Prentice Hall India Ltd.	2007
4	O.P.Kanna	Material Science and Metallurgy	Dhanpat Rai Publications	2012
5	G.Sudarmozhi	Material Science	Bharathi Publishers	2015

WEB URLs

1. www.lehigh.edu/~jdg4/classwork/crystalstructure.ppt
2. www.slideshare.net/shkrairo/superconductivity-and-its-applications
3. www.powershow.com/view/1d2c15-YTU3Y/
4. www.slideshare.net/vaishnavibathina/unit-3-35590134
5. www.slideshare.net/saurabhnandy007/carbon-nanotubes-25272300

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16SHB23 PHYSICS FOR ELECTRICAL ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

To enable the students to,

- Define and explain electrical and thermal conductivity of conducting materials.
- Explain the theory of semi-conducting materials and its applications.
- Explain the properties and applications of magnetic and superconducting materials.
- Explain polarization process in dielectric materials and their temperature and frequency dependence and the causes of dielectric breakdown.
- Recognize the novel properties of new engineering materials

COURSE OUTCOMES

16SHB23.CO1	An ability to identify the type of crystalline structure.
16SHB23.CO2	An ability to apply properties on magnetism and superconducting materials
16SHB23.CO3	An ability to apply knowledge on superconducting materials and its applications
16SHB23.CO4	An ability to apply knowledge on dielectric materials
16SHB23.CO5	An ability to use the synthesis techniques in modern materials

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16SHB23.CO1	X	X	-	X	-	-	-	-	-	-	-	X	-	-	-
16SHB23.CO2	X	-	X	-	-	-	-	-	-	-	-	X	-	-	-
16SHB23.CO3	X	X	X	-	-	-	-	-	-	-	-	X	-	-	-
16SHB23.CO4	X	X	-	-	-	-	-	-	-	-	-	X	-	-	-
16SHB23.CO5	X	-	-	X	-	-	-	-	-	-	-	X	X	-	X

UNIT I CONDUCTING MATERIALS 9

Conductors – classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann – Franz law – Lorentz number – Draw backs of classical theory – Quantum theory –band theory of solids (qualitative treatment only) - Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – carrier concentration in metals – conducting materials in thermal relay and themostats

UNIT II SEMICONDUCTING MATERIALS 9

Intrinsic semiconductors – Energy band diagram – direct and indirect band gap semiconductors - Carrier concentration in intrinsic semiconductors - Fermi level – Variation of Fermi level with temperature – Electrical conductivity – Band gap determination – Extrinsic semiconductors – Carrier concentration in N-type and P-type semiconductors (Qualitative Treatment only) – Variation of Fermi level with temperature and impurity concentration – Compound semiconductors – Hall effect – Determination of Hall coefficient – Hall effect applications – Ohmic contacts – Schottky diode.

UNIT III MAGNETIC AND SUPERCONDUCTING MATERIALS 9

Origin of magnetic moment – Bohr magneton – Dia and para and Ferromagnetic materials – Domain theory – Hysteresis – Soft and hard magnetic materials – Ferrites – applications of ferrites in telecommunication, radar and magnetic hard disc.Superconductivity - Properties - Types of super conductor – BCS theory of superconductivity (Qualitative) - High Tc superconductors – Applications of superconductors: SQUID, cryotron, magnetic levitation in trains

UNIT IV DIELECTRIC MATERIALS 9

Electrical susceptibility – Dielectric constant – Electronic, ionic, orientational and space charge polarization – Frequency and temperature dependence of polarization – Internal field – Clausius – Mosotti relation (derivation) – Physical significance of Maxwell's equations - Dielectric loss – Dielectric breakdown – Uses of dielectric materials in capacitor and transformer – application of dielectrics in microwave oven and dielectric strain gauge.

UNIT V NEW ENGINEERING MATERIALS 9

Metallic glasses - preparation, properties and applications Shape memory alloys (SMA) - characteristics, properties of NiTi alloy, applications, advantages and disadvantages of SMA Nanoscience and Nanotechnology – significance of the nanoscale - different types of nanostructures (Confinement Dimensions 0-D, 1-D, 2-D and 3-D) - Categories of nanomaterials - Fabrication of nonomaterials - Ball milling method and Chemical vapour deposition technique - Carbon nanotubes - Types of carbon nanotubes - CNT structure – properties and applications.Biomaterials (metals and alloys, ceramics) - classification and applications

TOTAL: 45Hours

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	B.N.Sankar& S.O.Pillai	Engineering Physics I	New Age International Publishers	2015
2	M. Arumugam,	Materials Science	Anuradha Publications	2006

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	B. K. Pandey and S. Chaturvedi	Engineering Physics	Cengage Learning India Pvt. Ltd., Delhi,	2012
2	Rajendran, V, and Marikani A	Materials science	TMH Publications	2004
3	Jayakumar, S.	Materials science	R.K. Publishers, Coimbatore	2008
4	Palanisamy P.K	Materials science	Scitech Publications (India) Pvt. Ltd	2007
5	Sudarmozhi.G.	Engineering Physics II.	Bharathi Publishers,	2015

WEB URLs

1. www.lehigh.edu/~jdg4/classwork/crystalstructure.ppt
2. www.slideshare.net/shkrairo/superconductivity-and-its-applications
3. www.powershow.com/view/1d2c15-YTU3Y/
4. www.slideshare.net/vaishnavibathina/unit-3-35590134
5. www.slideshare.net/saurabhnandy007/carbon-nanotubes-25272300

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16SHB24 **PHYSICS FOR MECHANICAL ENGINEERING** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- Define the various moduli of elasticity and explain streamline and turbulent flow of liquid and apply Poiseuille's formula to determine the coefficient of viscosity of a liquid.
- Describe experimental methods to determine thermal conductivity and state the laws of thermodynamics and their applications in the field of Engineering.
- Define and explain electrical and thermal conductivity of conducting materials.
- Explain the theory of semi-conducting materials and its applications.
- Recognize the novel properties of new engineering materials

COURSE OUTCOMES

16SHB24.CO1 An ability to identify the types crystalline structure
16SHB24.CO2 An ability to apply properties on magnetism and superconducting materials
16SHB24.CO3 An ability to apply knowledge on superconducting materials and its applications
16SHB24.CO4 An ability to apply knowledge on dielectric materials
16SHB24.CO5 An ability to use the synthesis techniques in modern materials

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16SHB24.CO1	X	X	-	X	-	-	-	-	-	-	-	X	-	-	-
16SHB24.CO2	X	-	X	-	-	-	-	-	-	-	-	X	-	-	-
16SHB24.CO3	X	X	X	-	-	-	-	-	-	-	-	X	-	-	-
16SHB24.CO4	X	X	-	-	-	-	-	-	-	-	-	X	-	-	-
16SHB24.CO5	X	-	-	X	-	-	-	-	-	-	-	X	X	-	X

UNIT I PROPERTIES OF MATTER AND HYDRODYNAMICS **9**

Elasticity - Poisson's ratio and relation between moduli (qualitative) - Stress-strain diagram- Factors affecting elasticity - Bending of beams - Cantilever - expression for bending moment – Measurement of Young's modulus by uniform and non-uniform bending - I shaped girders - Stream line flow - Turbulent flow- Poiseuille's formula for flow of liquid through a capillary tube – Determination of coefficient of viscosity of a liquid

UNIT II HEAT AND THERMODYNAMICS **9**

Thermal conductivity - Forbe's and Lee's disc methods- Radial and cylindrical flow of heat -Thermal conductivity of rubber and glass - Thermal insulation of buildings - Thermal insulating materials - Thermal equilibrium - Zeroth law of thermodynamics - Internal Energy - First law of thermodynamics - Indicator diagram - Isothermal process - Work done in an isothermal expansion - Adiabatic process - Work done in an adiabatic expansion – Reversible and irreversible processes - Second law of thermodynamics - Carnot engine - Efficiency of Canot's cycle - Carnot's cycle as heat engine and refrigerator - Carnot's theorem - Comparative study of Ideal Otto and diesel engines and their efficiency (no derivation) - Entropy - temperature diagram of Carnot's cycle.

UNIT III CONDUCTING MATERIALS **9**

Conductors - classical free electron theory of metals - Electrical and thermal conductivity - Wiedemann-Franz law - Lorentz number - Drawbacks of classical theory - Quantum theory -band theory of solids(qualitative treatment only) - Fermi distribution function - Effect of temperature on Fermi Function - Density of energy states - Carrier concentration in metals - application of conducting materials in induction furnace

UNIT IV SEMICONDUCTING MATERIALS **9**

Intrinsic semiconductors – Energy band diagram – direct and indirect band gap semiconductors -Carrier concentration in intrinsic semiconductors - Fermi level – Variation of Fermi level with temperature – Electrical conductivity – Band gap determination – Extrinsic semiconductors – Carrier concentration in N-type and P-type semiconductors (Qualitative Treatment only) – Variation of Fermi level with temperature and impurity concentration – Compound semiconductors – Hall effect – Determination of Hall coefficient – Hall effect applications - application of semiconductors in strain measurements

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UNIT V NEW ENGINEERING MATERIALS **9**

Metallic glasses: Preparation - properties – applications Shape memory alloys: Characterisitics - properties of Ni-Ti alloy – application- advantages and disadvantages of SMA Advanced Ceramics: Introduction – characteristics – structural ceramics Nanoscience and Nanotechnology – significance of the nanoscale - different types of nanostructures (Confinement Dimensions 0-D, 1-D, 2-D and 3-D) - Categories of nanomaterials - Fabrication of nonomaterials - Ball milling method and Chemical vapour deposition technique - Carbon nanotubes - Types of carbon nanotubes - CNT structure – properties and applications.Biomaterials (metals and alloys, ceramics) - classification and applications.

TOTAL: 45 Hours

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	B.N.Sankar& S.O.Pillai	Engineering Physics I	New Age International Publishers	2015
2	M. Arumugam,	Materials Science	Anuradha Publications	2006

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3	Jayakumar, S.	Materials science	R.K. Publishers, Coimbatore	2008
4	Palanisamy P.K	Materials science	Scitech Publications (India) Pvt. Ltd	2007
5	Sudarmozhi.G.	Engineering Physics II.	Bharathi Publishers,	2015

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1. www.lehigh.edu/~jdg4/classwork/crystalstructure.ppt
2. www.slideshare.net/shkrairo/superconductivity-and-its-applications
3. www.powershow.com/view/1d2c15-YTU3Y/
4. www.slideshare.net/vaishnavibathina/unit-3-35590134
5. www.slideshare.net/saurabhnandy007/carbon-nanotubes-25272300

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16SHB31 **ENGINEERING CHEMISTRY** **L T P C**
3 0 2 4

COURSE OBJECTIVES

- The students familiar with characteristics of water and know the specification of boiler feed water. To understand the softening of hard water by using various purification techniques.
- To understand the principles involved in corrosion. The students able to apply these principles towards the prevention of corrosion.
- The students will understand the basic concepts of polymers chemistry and its applications. The students have sound knowledge of plastics and rubbers.
- The students understand the reaction of nuclear fission and fusion reaction and promote the knowledge about process of nuclear reactors.
- To understand various chemical reactions involved in the batteries.

COURSE OUTCOMES

16SHB31.CO1 Identify appropriate water purification techniques to convert hard water to soft water
16SHB31.CO2 Describe the principles of electrochemistry to prevent corrosion
16SHB31.CO3 Arrange the polymeric materials based on their applications
16SHB31.CO4 Summarize the concepts of batteries, fuel cells and their usage
16SHB31.CO5 Categorize abrasives and refractories for engineering field

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16SHB31.CO1	X	X	-	-	X	X	-	X	-	-	-	-	-	-	-
16SHB31.CO2	X	-	X	-	X	-	X	-	-	-	-	-	-	-	-
16SHB31.CO3	X	-	X	-	-	-	X	-	-	-	-	-	-	X	-
16SHB31.CO4	X	-	X	-	X	X	-	-	-	-	-	-	-	X	-
16SHB31.CO5	X	-	X	-	X	-	X	-	-	-	-	-	-	-	-

UNIT I WATER TECHNOLOGY **9**

Characteristics – Domestic water treatment – disinfection methods (chlorination, ozonation and UV treatment) – Boiler feed water-requirements-disadvantages of using hard water in boilers – internal conditioning (phosphate, calgon, colloidal and carbonate conditioning methods)-external conditioning – zeolite and demineralization process – desalination and reverse osmosis.

UNIT II CORROSION AND CORROSION CONTROL **9**

Corrosion – chemical corrosion- electrochemical corrosion – types-galvanic corrosion – differential aeration corrosion – factors influencing corrosion - corrosion control – sacrificial anodic method and impressed current cathodic protection method – corrosion inhibitors – paints-constituents and functions – electroplating of copper and electroless plating of nickel.

UNIT III POLYMERS **9**

Polymers – definition – polymerization – types and mechanism of polymerization – addition polymerization (free radical mechanism), condensation polymerization and copolymerization – properties of polymers - Plastics, classification – preparation, properties and uses of PVC, Teflon, nylon-6,6 and PET-Rubber – vulcanization of rubber – butyl rubber, SBR .

UNIT IV NON CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES **9**

Nuclear energy – fission and fusion reactions – nuclear chain reactions – characteristics – light water nuclear reactor for power generation – breeder reactor – solar energy conversion – solar cells – wind energy-Fuel cells – hydrogen and oxygen fuel cell – batteries – alkaline battery – lead acid battery, nickel-cadmium battery and lithium battery.

UNIT V ENGINEERING MATERIALS **9**

Refractories – classification - acidic, basics and neutral refractories – properties – manufacture of alumina, magnesite and zirconia bricks-Abrasives – natural and synthetic abrasives – manufacture ,properties and uses of silicon carbide and boron carbide- application of abrasives- Glass-manufacture, types, properties and uses

TOTAL: 45

LIST OF EXPERIMENTS: **TOTAL: 30**

1. Determination of hardness of water by EDTA method
2. Determination of alkalinity in water sample
3. Determination of dissolved oxygen content of water sample by Winkler's method.
4. Estimation of chloride content of water sample by argentometric method
5. Estimation of hydrochloric acid by pH meter
6. Determination of strength of CH_3COOH and HCl in a mixture using conductivity meter
7. Conductometric titration of HCl vs NaOH
8. Conductometric precipitation titration using $BaCl_2$ and Na_2SO_4
9. Determination of molecular weight of polyvinylalcohol using Ostwald viscometer
10. Estimation of iron content of the given solution using potentiometer

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Dr.P.Santhi & S.Elavarasan	Engineering Chemistry	Sri Kandhan Publications	Aug 2016
2.	Dr.A.Ravikrishnan	Engineering Chemistry I & II	Sri Krishna Hitech Publishing Company Pvt. Ltd	June 2016

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	B P.C.Jain and Monica Jain	Engineering Chemistry	Dhanpat Rai Pub, Co., New Delhi	2013
2.	S.S. Dara	A text book of engineering chemistry	S.Chand & Co.Ltd., New Delhi	2013
3.	Shradha Sinha	Advanced Engineering Chemistry	Krishna Prakasan Media (P) Ltd., Meerut	2015
4.	B.Sivasankar	Engineering Chemistry	Tata McGraw-Hill Publishing Company,Ltd.,New Delhi	2008
5.	V.R.Gowariker N.V.Viswanathan and JayadevSreedhar	Polymer Science	New Age International P (Ltd.,),Chennai	2006

WEB URLs

1. www.bbc.co.uk/schools/gcsebitesize/science/triple_aqa/water/hard_soft_water/revision/4/
2. www.nace.org/Corrosion-101/
3. www2.chemistry.msu.edu/faculty/reusch/virttxtjml/polymers.htm
4. www.nei.org/Knowledge-Center/How-Nuclear-Reactors-Work
5. www.vidyarthiplus.in/2012/01/engineering-chemistry1abrasives.html

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16SHB32 ENVIRONMENTAL SCIENCE AND ENGINEERING **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To give a comprehensive insight into ecosystem, biodiversity and natural recourses.
- To create an awareness on the various environmental pollution aspects and issues.
- To educate the ways and means to protect the environment from various types of pollution.
- To understand the role of government and non-government organization in environment managements.
- Discuss the impact of human population on the environment

COURSE OUTCOMES

16SHB32.CO1	Describe ecosystem, biodiversity and loss of biodiversity
16SHB32.CO2	Restate equitable use of natural resources for sustainable life style
16SHB32.CO3	Outline the sources, effects and control methods of various environmental pollution
16SHB32.CO4	State various environmental act and non-government organization for human welfare
16SHB32.CO5	Judge the impacts on the environment by human population

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16SHB32.CO1	X	-	-	-	-	X	X	-	-	-	-	X	-	-	-
16SHB32.CO2	X	X	X	-	-	X	X	-	-	-	-	X	-	-	-
16SHB32.CO3	X	-	X	-	X	-	X	X	-	-	-	X	-	-	-
16SHB32.CO4	X	-	-	-	-	X	-	X	-	-	-	X	-	-	-
16SHB32.CO5	X	X	-	-	-	X	X	-	-	-	-	X	-	-	-

UNIT I ECOSYSTEMS AND BIODIVERSITY **9**

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 to biodiversity definition – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – 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 exsitu conservation of biodiversity.

UNIT II NATURAL RESOURCES **9**

Forest resources: Use and over-exploitation, deforestation, cause – effect-control measures – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems –Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity – 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.

UNIT III ENVIRONMENTAL POLLUTION **9**

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 – disaster management: floods, earthquake, cyclone and landslides.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT **9**

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people – environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, – environment protection act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Forest conservation act – role of nongovernmental organization- Public awareness.

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UNIT V HUMAN POPULATION AND THE ENVIRONMENT 9

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.

TOTAL: 45

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Dr.A.Ravikrishnan	Environmental Science and Engineering	Sri Krishna Hitech Publishing Company Pvt.Ltd	June 2016
2.	Gilbert M. Masters	Introdution to Environmental Engineering and Science	Pearson Education Pvt., Ltd., Second Edition. ISBN 81-297-0277-0	2004

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Dharmendra S. Sengar	Environmental Law	Prentice hall of India PVT LTD, New Delhi	2007
2.	R.K.Trivedi	Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol-I and II,	BS Publications	2010
3.	R.Rajagopalan	Environmental Studies	From Crisis to Cure, Oxford University Press	2015
4.	Benny Joseph	Environmental Science and Engineering	Tata McGraw-Hill,NewDelhi	2006
5.	T.G.Miller	Environmental Science	Wadsworth Publishing Co.	2007

WEB URLs

1. www.yourarticlelibrary.com/environment/ecosystem/ecosystems-concept-structure-and-functions-of-ecosystems-with-diagram/28211/
2. www.importantindia.com/12331/types-of-natural-resources-in-india/
3. www.conserve-energy-future.com/causes-and-effects-of-environmental-pollution.php
4. http://agritech.tnau.ac.in/agriculture/agri_majorareas_watershed_rainwaterharvesting.html
5. www.yourarticlelibrary.com/essay/role-of-information-technology-in-environment-and-human-health/30230/

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ENGINEERING SCIENCES

(ES)

For

Mechanical Engineering

16MEC01 FUNDAMENTALS OF COMPUTING AND PROGRAMMING

L	T	P	C
3	0	2	4

COURSE OBJECTIVES

- Apply skills and concepts for basic use of computer hardware, software, networks and the Internet in the workplace and in future coursework
- The students will be able to enhance their analyzing and problem solving skills
- Understand the basic components and structure of a C program
- The Students will be able to write programs in C
- To understand the services provided and the design of an operating system

COURSE OUTCOMES

16MEC01.CO1 Articulate classification, application and components of computer
16MEC01.CO2 Carry out procedures in word processing, presentation, spreadsheet and database management
16MEC01.CO3 Discuss the structure of a C program
16MEC01.CO4 Demonstrate simple C programs using control and loop statements.
16MEC01.CO5 Illustrate basic characteristics of operating system and computer network components.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEC01.CO1	X	X	X	-	X	X	-	-	-	-	X		X	-	-
16MEC01.CO2	X	X	X	-	-	-	-	-	-	-	X	X	X	-	-
16MEC01.CO3	X	X	X	-	X	X	-	-	X	-	-	-	-	X	-
16MEC01.CO4	X	X	X	X	X	-	-	-	-	-	X	-	-	-	X
16MEC01.CO5	X	X	X	-	-	-	-	-	-	X	-	X	X	-	-

UNIT I COMPUTER BASICS 6

Evolution of Computer-Generation of Computer-Computer Organization-Applications of computer- Computer memory and storage-Input Output Media-Number systems-Algorithm-Flowchart-pseudo code-Program control structure-Programming languages-Computer software-definition-categories of software

UNIT II MS OFFICE 6

Basics of Word Processing: Creating and Editing a documents- Formatting a Document, Mail Merge Excel: Creating a Worksheet (Using Excel)-Formatting Your Worksheet -Finalizing Your Worksheet PowerPoint: Creating a Presentation (Working with PowerPoint) -Finalizing Your Presentation-PowerPoint Quick Reference Access: Creating a Database (Using Access) -Finalizing Your Database

UNIT III INTRODUCTION TO C LANGUAGE 6

Basic concepts in a C program: constants-variables-declaration and initialization of Variables-data types and statements. Operators and Expressions-precedence and association-type conversions-managing input/output functions-with programming examples

UNIT IV DECISION MAKING, LOOPING AND BRANCHING 6

Decision making statements: if, if-then-else, nested if-else, cascaded if else and switch statements-Looping statements: for, while, do-while-Branching statements: go to-break and continue- application programming examples

UNIT V OPERATING SYSTEM 6

Operating system: definition-types of operating systems. Networking: Basic components of a network-Network Topology-exploring the types of networks-characteristics of networks

TOTAL: 30

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LIST OF EXPERIMENTS:

1. Study the features of Office package
2. Create Presentation and Visualization using graphs, charts, 2D, 3D
3. Problem formulation, Problem Solving and Flowcharts
4. Simple statements and expressions using C Programming
5. Scientific problem solving using decision making
6. Scientific problem solving using looping
7. Solving problems using String functions

TOTAL: 60

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	E. Balagurusamy	Fundamentals of Computers	Tata McGraw-Hill	2009
2.	Vikas Gupta	Computer Concepts & C Programming	Dreamtech Press	2010

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Behrouz A. Forouzan, Richard F Gilberg	Computer Science: A Structured programming approach using C	Thomson India Edition.	2007
2.	Byron Gottfried	Programming with C	Schaum's Outlines	2010
3.	Anita Goel	Computer Fundamentals	Pearl Software	2014
4.	S.S. Shrivastava	MS-Office	Laxmi Publications	2015
5.	Pradip Dey, Manas Ghosh	Fundamentals of Computing and Programming in C	Oxford University Press	2009

WEB URLs

1. https://www.microsoft.com/en-in/learning/office-training.aspx
2. http://courses.cs.vt.edu/csonline/OS/Lessons/Introduction/index.html
3. https://blog.udemy.com/networking-tutorials-for-beginners/
4. http://www.cprogramming.com/tutorial/c-tutorial.html
5. https://www.codingunit.com/c

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16MEC02 ADVANCED C PROGRAMMING

L	T	P	C
3	0	2	4

COURSE OBJECTIVES

- The students will be able to enhance their analyzing and problem solving skills and use the same for writing programs in C
- Arm the students with the basic programming concepts.
- Introduce different techniques pertaining problem solving skills
- Understand the dynamics of memory by the use of pointers.
- And to emphasis on guided practical sessions

COURSE OUTCOMES

16MEC02.CO1 Write programs using single dimensional and multi dimensional arrays
16MEC02.CO2 Use memory access operations using pointers
16MEC02.CO3 Solve real time applications using Functions
16MEC02.CO4 Utilize memory efficiently using structures and union
16MEC02.CO5 Design programs to perform operations on files

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEC02.CO1	X	X	X	X	-	-	-	-	-	-	-	-	-	X	-
16MEC02.CO2	X	X	X	X	-	-	-	-	-	-	-	-	X	X	-
16MEC02.CO3	X	X	X	-	-	-	-	-	-	-	-	-	-	X	-
16MEC02.CO4	X	X	X	-	-	-	-	-	-	-	-	-	X	X	X
16MEC02.CO5	X	X	X	-	-	-	-	-	-	-	-	X	X	-	-

UNIT I ARRAYS 6

Declaring and initializing One-Dimensional Array and array Operations, Two-Dimensional Array and its Operation, Insertion, Deletion, Matrix addition operation- Multi-Dimensional Arrays- Drawbacks of Linear Arrays

UNIT II POINTERS & PREPROCESSOR DIRECTIVES 6

Pointers - Introduction and Features of Pointers, Declaration of Pointer- Void Pointers- Array of Pointers- Pointers to Pointers - Introduction - #define and #undef Directives- #include ,#line Directive- Predefined macros in ANSI C- Standard I/O Predefined Streams in stdio.h- Predefined macros in ctype.h

UNIT III FUNCTIONS 6

Basics of Functions - Built-in and user defined Functions- Using String, Math and other built-in functions, Advantages of using Functions- Working of a Function- Declaring, Defining and calling user defined Functions- The return Statement- Call by Value and call by Reference- Function as an Argument- Recursion- Advantages and Disadvantages of Recursion

UNIT IV STRUCTURE AND UNION 6

Introduction and Features of Structures, Declaration and Initialization of Structures, Array of Structures, Pointers to Structure, typedef, Enumerated Data Type- Union, Union of Structures

UNIT V FILES 6

Introduction- File Operations, Opening a File, Reading a File,Closing a File- Text Modes- Binary Modes- File Functions, fprintf(), fscanf(),getc(),putc(), fgetc(),fputc(),fseek(), feof()-Command Line Arguments

TOTAL: 30

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LIST OF EXPERIMENTS:

1. Program using Linear Array
2. Program using Two Dimensional Arrays
3. Program using functions
4. Program using Pointers (both data pointers and function pointers)
5. Program using Structures & Union
6. Program using Data File Handling
7. Program using Text File Handling
8. Program using Recursion

TOTAL: 60

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Kamthane A.N	Programming in 'C'	Pearson Education	2012
2.	E Balagurusamy	Programming in ANSI C	*Tata McGraw Hill*	2012

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	John Perry	Advanced C Programming	PWS Publications	1998
2.	Herbert Schildt	C: The Complete Reference	Osborne/McGraw-Hill Fourth Edition	2000
3.	Yuksel Uckan	Problem Solving Using C	McGraw Hill	1999
4.	Paul Deitel , Harvey M. Deitel.	C: How to Program	Prentice Hall, 6th Edition	2010
5.	Brian W.Kernigham and Pike R	The Practice of Programming	Addison Wesley	1999

WEB URLs

1. http://www.programiz.com/c-programming/c-arrays
2. http://www.cprogramming.com/tutorial/c/lesson6.html
3. https://www.codingunit.com/c-tutorial-structures-unions-typedef
4. http://www.studytonight.com/c/file-input-output.php
5. http://fresh2refresh.com/c-programming/c-preprocessor-directives/

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16MEC03 BASIC CIVIL AND MECHANICAL ENGINEERING **L T P C**
4 0 0 4

COURSE OBJECTIVES

- To posses knowledge about different type of surveying and Civil Engineering materials.
- To recognize the building components and structures.
- To explore various types of power generation, pumps and turbines.
- To realize about IC Engines and Boilers.
- To classify Refrigeration and Air Conditioning. .

COURSE OUTCOMES

16MEC03.CO1 Demonstrate field measurement in surveying.
16MEC03.CO2 Explore basic ideas of building components and structures.
16MEC03.CO3 Familiar about the power generation, pumps and turbines.
16MEC03.CO4 Outline basic ideas among the IC Engines and Boilers.
16MEC03.CO5 Familiar about Refrigeration and Air Conditioning.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEC03.CO1	-	-	-	-	-	X	-	-	-	X	-	-	-	-	-
16MEC03.CO2	-	-	-	-	-	X	-	-	-	X	-	-	-	-	-
16MEC03.CO3	X	X	-	-	X	X	-	X	-	-	-	X	X	-	-
16MEC03.CO4	X	X	-	-	X	X	-	X	-	-	-	X	X	-	-
16MEC03.CO5	X	X	-	-	X	X	-	X	-	-	-	X	X	X	X

A.CIVIL ENGINEERING

UNIT I: SURVEYING AND CIVIL ENGINEERING MATERIALS 12

Surveying: Objects – types – classification – principles – measurements of distances – angles – leveling – determination of areas – illustrative examples. Civil Engineering Materials: Bricks – stones – sand – cement – concrete – steel sections.

UNIT II : BUILDING COMPONENTS AND STRUCTURES 12

Foundations: Types, Bearing capacity – Requirement of good foundations. Superstructure: Brick masonry – stone masonry – beams – columns – lintels – roofing – flooring – plastering – Mechanics – Internal and external forces – stress – strain – elasticity – Types of Bridges and Dams – Basics of Interior Design and Landscaping.

B. MECHANICAL ENGINEERING

UNIT III: POWER PLANT ENGINEERING 12

Introduction, Classification of Power Plants – Working principle of steam, Gas, Diesel, Hydro-electric and Nuclear Power plants – Merits and Demerits – Pumps and turbines – working principle of Reciprocating pumps (single acting and double acting) – Centrifugal Pump.

UNIT IV: IC ENGINES 12

Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Boiler as a power plant.

UNIT V: REFRIGERATION AND AIR CONDITIONING SYSTEM 12

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system – Layout of typical domestic refrigerator – Window and Split type room Air conditioner.

TOTAL: L: 60=60

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Shanmugam G and Palanichamy M S	Basic Civil and Mechanical Engineering	McGraw Hill Publishing Co., New Delhi	2016
2.	Shanmugasundaram and K. Mylsamy	Basic Civil and Mechanical Engineering	Cengage Learning India Private Limited	2012

REFERENCE BOOKS:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Ramamrutham S	Basic Civil Engineering	Dhanpat Rai Publishing Co. (P) Ltd.	2015
2.	Seetharaman S	Basic Civil Engineering	Anuradha Agencies	2015
3.	Venugopal K. and Prahu Raja V	Basic Mechanical Engineering	Anuradha Publishers, Kumbakonam	2016
4.	Shantha Kumar S R J	Basic Mechanical Engineering	Hi-tech Publications, Mayiladuthurai	2014
5	Selvaraj P, Periyasamy M and S.Selvakumar	Basic Civil and Mechanical Engineering	Scitech Publications (India) Pvt Ltd	2013

WEB URLs

1. http://nptel.ac.in/courses/105107122/
2. https://buildingtechnology.wordpress.com/2011/01/22/functions-of-building-components/
3. https://buildingtechnology.wordpress.com/2011/01/22/functions-of-building-components/
4. http://nptel.ac.in/courses/112104033/
5. https://www.youtube.com/watch?v=AyAd-gLO9CE

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16MEC04 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING **L T P C**
4 0 0 4

COURSE OBJECTIVES

- To explain the basic theorems used in Electrical circuits and the different components.
- To study the function of electrical machines.
- To explain the fundamentals of semiconductor and applications.
- To understand the principles of digital electronics.
- To impart knowledge of measuring instruments.

COURSE OUTCOMES

16MEC04.CO1 Apply fundamental concepts in electrical circuits
16MEC04.CO2 Explain the methods of measurements and electrical instruments
16MEC04.CO3 Illustrate the principles of operations in electrical machines
16MEC04.CO4 Contrast the operations and characteristics of Semiconductor devices
16MEC04.CO5 Abstract the digital electronics system

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEC04.CO1	X	X	X	-	-	-	-	-	-	X	-	X	X	-	-
16MEC04.CO2	X	X	X	-	-	-	-	-	-	X	-	X	X	-	-
16MEC04.CO3	X	X	X	-	-	-	-	-	-	X	-	X	X	-	-
16MEC04.CO4	X	X	X	-	-	-	-	-	-	X	-	X	X	-	-
16MEC04.CO5	X	X	X	-	-	-	-	-	-	X	-	X	X	-	-

UNIT I ELECTRICAL CIRCUITS **9**

Ohm's Law - Kirchhoff's Laws - Resistors in series and parallel circuits - Mesh and node analysis for DC Circuits - Introduction to AC Circuits - Form factor - Power and Power factor - Single Phase RL, RC and RLC Series circuits - Three Phase Balanced Circuits.

UNIT II MEASUREMENTS AND INSTRUMENTATION **9**

Methods of measurements - Operating principles of Moving Coil and Moving Iron instruments - Induction type Energy meter – Smart Meters– Classification and Selection of transducers - LVDT- Piezoelectric and Hall Effect Transducers.

UNIT III ELECTRICAL MACHINES **9**

Construction details, Principle of operation, Basic Equations and applications of DC Generators, DC Motors, Single Phase Transformer, Single Phase Induction Motor. Principle of operation of Three Phase Transformer and Three Phase Induction Motor.

UNIT IV SEMICONDUCTOR DEVICES AND APPLICATIONS **9**

Characteristics of PN Junction Diode and Zener Diode- Half wave and full wave Rectifiers - Bipolar Junction Transistor - CE Configuration and Characteristics - Small Signal Amplifier.

UNIT V DIGITAL ELECTRONICS **9**

Binary Number System - Logic Gates - Boolean algebra - Half Adders and Full Adders - Flip-Flops - Registers and Counters - A/D and D/A Conversion.

TOTAL: 45

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Mittle N	Basic Electrical Engineering	Tata McGraw Hill	2011.
2.	Gupta JB	A Course in Electronic and Electrical Measurements	S. K. Kataria & Sons	2003.

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Muthusubramanian R	Basic Electrical, Electronics and Computer Engineering	Tata McGraw Hill	2006.
2.	Nagsarkar T K	Basics of Electrical Engineering	Oxford press	2005.
3.	Kalsi HS	Electronic Instrumentation	Tata McGraw Hill	2004.
4.	Premkumar N	Basic Electrical Engineering	Anuradha Publishers	2003.

WEB URLs

1. https://www.youtube.com/watch?v=xwFacS9PsCE
2. https://www.youtube.com/watch?v=oV7TpfoiYNY
3. https://www.youtube.com/watch?v=qmcriUdYBW0&list=PL59861DBF8EC85491
4. https://www.youtube.com/watch?v=0Y3XZVw1aFU&list=PLdGOfYE56ql8qIau2Xo5pqM-JVYw26IMQ
5. https://www.youtube.com/watch?v=M0mx8S05v60&list=PLBlnK6fEyqRjMH3mWf6kwqiTbT798eAOm

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16MEC05 ENGINEERING DRAWING

L	T	P	C
2	0	2	3

COURSE OBJECTIVES

- Enable the construction of various curves in engineering practices.
- Draw the projection of three dimensional objects representation of machine structure and explain standards of orthographic views by different methods.
- Analyze the principles of projection of various planes by different angle to project points, lines and planes.
- Draw the principles of projection of simple solid by the axis is inclined to one reference plane by change of position method.
- Plan the interior components of machinery (or) buildings by sectioning the solid, and to study the development of simple solids for fabrication of sheet metals.

COURSE OUTCOMES

16MEC05.CO1 Construct various special curves in engineering practices
16MEC05.CO2 Draw the orthographic projection from isometric view
16MEC05.CO3 Build orthographic projections of points, lines and planes
16MEC05.CO4 Develop the projection of simple solids
16MEC05.CO5 Model the section of solids and development of surfaces.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEC05.CO1	X	-	-	-	-	-	-	-	-	X	-	-	X	X	-
16MEC05.CO2	X	-	-	-	-	-	-	-	-	X	-	-	X	X	-
16MEC05.CO3	X	-	-	-	-	-	-	-	-	X	-	-	X	X	-
16MEC05.CO4	X	-	-	-	-	-	-	-	-	X	-	-	X	X	-
16MEC05.CO5	X	-	-	-	-	-	-	-	-	X	-	-	X	X	-

CONCEPTS AND CONVENTIONS 4

(Not for Examination) Importance of graphics in engineering applications, Use of drafting instrument, BIS conventions and specifications - Size, layout and folding of drawing sheets, Lettering and dimensioning.

COMPUTER AIDED DRAFTING (Not for Examination) 6

Importance 2d Drafting, sketching, modifying, transforming and dimensioning.

UNIT I: PLANE CURVES 13

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.

UNIT II: ISOMETRIC TO ORTHOGRAPHIC VIEWS 13

Representation of three dimensional objects, General Principles of Orthographic projection, Need for importance of multiple views and their placement, First angle projection, layout of views, Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

UNIT III: PROJECTION OF POINTS, LINES AND PLANE 13

(Free hand sketching)

Projection of points, Projection of straight lines located in the first quadrant, Determination of true lengths and true inclinations, Projection of polygonal surface and circular lamina inclined to both reference planes.

UNIT IV: PROJECTION OF SOLIDS 13

(Free hand sketching)

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.

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UNIT V SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES **13**

(Free hand sketching) Sectioning of simple solids like prisms, pyramids, cylinder and cone in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other, (Obtaining true shape of section is not required). Development of lateral surfaces of simple and truncated solids, Prisms, pyramids, cylinders and cones.

TOTAL: L: 15 + P: 60 = 75

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Natrajan K.V	A text book of Engineering Graphics"	Dhanalakshmi Publishers, Chennai	2015

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Gopalakrishnan K.R	"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	Shah M.B., and Rana B.C	"Engineering Drawing"	Pearson, 2nd Edition	2009
4	Venugopal K. and Prabhu Raja V	"Engineering Graphics"	New Age International (P) Limited	2008
5	Bhatt N.D. and Panchal V.M	"Engineering Drawing"	Charotar Publishing House, 50th Edition	2010

WEB URLs

1. https://www.youtube.com/watch?v=mOv2kbZID2Q
2. https://www.youtube.com/watch?v=NEKJ9S28Fh8
3. https://www.youtube.com/watch?v=I1OxuLWrfbA
4. https://www.youtube.com/watch?v=OSISqnclmWA
5. https://www.youtube.com/watch?v=ruu5yHoxcek

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16MEC06 ENGINEERING PRACTICES FOR MECHANICAL SCIENCES **L T P C**
0 0 4 2

COURSE OBJECTIVES:

- To choose the pipe connections in PVC and G.I pipes.
- To prepare various joints using carpentry tools and power tools.
- To interpret fitting tools and prepare various metal joints.
- To understand and practice different welding joints by arc and gas welding machine.
- To dismantle and identify the parts of Air conditioners and explain its working.
- To experiment different types of domestic wiring.

COURSE OUTCOMES

16MEC06.CO1 Tell the importance of general safety precautions on different shop floors
16MEC06.CO2 Identify the hand tools, instruments and their usage
16MEC06.CO3 Carry out the plumbing and carpentry work
16MEC06.CO4 Operate welding machine, lathe machine and sheetmetal work
16MEC06.CO5 Analyze the material removal rate of workpiece to attain specific shape

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEC06.CO1	-	-	-	-	-	X	-	-	-	X	-	-	-	-	-
16MEC06.CO2	-	-	-	-	-	X	-	-	-	X	-	-	-	-	-
16MEC06.CO3	X	X	-	-	X	X	-	X	-	-	-	X	X	-	-
16MEC06.CO4	X	X	-	-	X	X	-	X	-	-	-	X	X	-	-
16MEC06.CO5	X	X	-	-	X	X	-	X	-	-	-	X	X	X	X

UNIT I: CIVIL ENGINEERING PRACTICE **25**

PLUMBING WORKS

Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, Elbows and household fittings.

1. Basic pipe connections (PVC) involving the fittings like Valves, Taps, and Bends.
2. Mixed pipe (PVC and G.I) connections involving the fitting like Valves, Taps, and Bends

CARPENTRY WORKS

Study of Carpentry Tools

1. Preparation of T-Joint
2. Preparation of Lap joint
3. Preparation of Dovetail Joint

UNIT II : MECHANICAL ENGINEERING PRACTICE **25**

FITTING WORK

1. Study of Fitting work Tools
2. Preparation of L joint
3. Preparation of V-joint

WELDING

1. Study of Welding Equipments and Tools
2. Preparation of Butt joint
3. Preparation of Lap joint
4. Preparation of Tee joint

MACHINE ASSEMBLY PRACTICE

1. .Air conditioner repair and maintenance
2. Assembly and Dismantling for the two wheeler wheel.

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UNIT III: ELECTRICAL ENGINEERING PRACTICE **10**

1. Residential house wiring
2. Fluorescent lamp wiring.
3. Stair-case Wiring and Door bell wiring

TOTAL: P: 60=60

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Kannaiah P. & Narayana K.L	Manual on Workshop Practice	Scitech Publications	2014
2.	Bawa H.S	Workshop Practice	Tata McGraw – Hill Publishing Company Limited,	2007

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16EEC07 ELECTRICAL DRIVES AND CONTROL **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the basic concepts of different types of electrical machines and their performance.
- To study the drive motor characteristics.
- To understand the starting methods.
- To study the different methods of starting D.C motors and induction motors.
- To study the different methods of starting A.C motors and induction motors.

COURSE OUTCOMES

16EEC07.CO1 Analyze the fundamental characteristics of electrical drives
16EEC07.CO2 Describe the drive motor characteristics
16EEC07.CO3 Discuss the starting methods of AC and DC motors
16EEC07.CO4 Explain the conventional and solid state speed control of DC drives
16EEC07.CO5 Analyze the importance of conventional and solid state speed control of AC drives

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EEC07.CO1	X	X	X	-	-	-	-	-	-	X	-	X	X	-	-
16EEC07.CO2	X	X	X	-	-	-	-	-	-	X	-	X	X	-	-
16EEC07.CO3	X	X	X	-	-	-	-	-	-	X	-	X	X	-	-
16EEC07.CO4	X	X	X	-	-	-	-	-	-	X	-	X	X	-	-
16EEC07.CO5	X	X	X	-	-	-	-	-	-	X	-	X	X	-	-

UNIT I INTRODUCTION **8**

Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives – heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors

UNIT II DRIVE MOTOR CHARACTERISTICS **9**

Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors – Braking of Electrical motors – DC motors: Shunt, series and compound - single phase and three phase induction motors.

UNIT III STARTING METHODS **8**

Types of D.C Motor starters – Typical control circuits for shunt and series motors – Three phase squirrel cage and slip ring induction motors.

UNIT IV CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C. DRIVES **10**

Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control system - Using controlled rectifiers and DC choppers –applications.

UNIT V CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C. DRIVES **10**

Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme – Using inverters and AC voltage regulators – applications.

TOTAL: 45 PERIODS

Upon Completion of this subject, the students can able to explain different types of electrical•OUTCOMES: machines and their performance

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Vedam Subrahmaniam	"Electric Drives (Concepts and Applications"	Tata McGraw-Hill	2001
2.	Nagrath .I.J. & Kothari .D.P	"Electrical Machines"	Tata McGraw-Hill	1998

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REFERENCES:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Pillai.S.K	A First Course on Electric Drives	Wiley Eastern Limited	1998
2.	Singh. M.D K.B.Khanchandani	Power Electronics	Tata McGraw-Hill	1998
3.	Partab. H	Art and Science and Utilisation of Electrical Energy	Dhanpat Rai and Sons	1994

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4. https://www.youtube.com/watch?v=0Y3XZVw1aFU&list=PLdGOfYE56ql8qIau2Xo5pqM-JVYw26IMQ
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16MEC08 **ENGINEERING MECHANICS** **L T P C**
3 2 0 4

COURSE OBJECTIVES

- To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.
- To understand the concept of equilibrium of particles and rigid bodies.
- To understand the concept of first and second moment of area.
- To understand the concept of various types of frictions.
- To understand the principle of work energy method, Newton's law and impact of elastic bodies.

COURSE OUTCOMES

16MEC08.CO1 Tell the fundamental laws of physics and vector operations to solve engineering problems
16MEC08.CO2 Solve engineering problems on equilibrium of bodies in 2D and 3D spaces.
16MEC08.CO3 Predict center of gravity and moment of inertia of any given section.
16MEC08.CO4 Apply work energy principle and newton's law of motion to moving bodies.
16MEC08.CO5 Demonstrate the effect of frictional force in real time application.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEC08.CO1	X	X	X	X	-	X	-	-	-	-	-	X	X	-	-
16MEC08.CO2	X	X	X	X	-	X	-	-	-	-	-	X	X	-	-
16MEC08.CO3	X	X	X	X	-	X	-	-	-	-	-	X	X	-	-
16MEC08.CO4	X	X	X	X	-	X	-	-	-	-	-	X	X	-	-
16MEC08.CO5	X	X	X	X	-	X	-	-	-	-	-	X	X	-	-

UNIT I: BASICS AND STATICS OF PARTICLES **15**

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

UNIT II: EQUILIBRIUM OF RIGID BODIES **15**

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

UNIT III: PROPERTIES OF SURFACES AND SOLIDS **15**

Centroids and centre of mass– Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia

UNIT IV: DYNAMICS OF PARTICLES **15**

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion - Newton's laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.

UNIT V: FRICTION **15**

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction-. Rolling - resistance.

TOTAL:L : 45 + T :30 = 75

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TEXT BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Beer, F.P and Johnston Jr. E.R.,	"A text book of Engineering Graphics"	Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company,New Delhi	2004

REFERENCE BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Hibbeller, R.C and Ashok Gupta	"Engineering Mechanics: Statics and Dynamics"	11th Edition, Pearson Education	2010
2	Irving H. Shames and Krishna Mohana Rao. G	"Engineering Mechanics – Statics and Dynamics"	4th Edition, Pearson Education	2006
3	Meriam J.L. and Kraige L.G	" Engineering Mechanics"	Statics - Volume 1, Dynamics- Volume 2",	1993
4	Rajasekaran S and Sankarasubramanian G	"Engineering Mechanics	Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd	2005
5	Bhavikatti, S.S and Rajashekarappa.K.G	"Engineering Mechanics"	New Age International (P) Limited Publishers	1998

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3. https://web.iit.edu/sites/web/files/departments/academic.../Moment_Inertia.pdf
4. https://www.khanacademy.org/...momentum/momentum.../what-are-momentum-
5. https://www.svce.ac.in/departments/mech/lessonplan/evenlp/GE6253.doc

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16MEC11 BIOMECHANICS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To generalize the representation of forces.
- To develop the free body diagrams for human joints.
- To interpret the flow of fluid in the human body.
- To analyze the air flow in the human body.
- To understand the concept of implants.

COURSE OUTCOMES

16MEC11.CO1 Generalize the representation of forces.
16MEC11.CO2 Develop the free body diagrams for human joints.
16MEC11.CO3 Interpret the flow of fluid in the human body.
16MEC11.CO4 Analyze the air flow in the human body.
16MEC11.CO5 Understand the concept of implants.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEC11.CO1	X	X	X	-	-	X	X	X	-	X	-	X	X	-	-
16MEC11.CO2	X	X	X	X	-	-	X	X	-	X	-	X	X	-	-
16MEC11.CO3	X	X	X	X	-	-	X	X	-	X	-	X	X	-	-
16MEC11.CO4	X	X	X	X	-	-	X	X	-	X	-	X	X	-	-
16MEC11.CO5	X	X	X	X	-	-	X	X	-	X	-	X	X	-	-

UNIT I: INTRODUCTION OF MECHANICS **9**

Review of the principles of mechanics, Vector mechanics Resultant forces of Coplanar & Noncoplaner and Concurrent & non-concurrent forces, parallel force in space, Equilibrium of coplanar forces, Newton's laws of motion, Work and energy, Moment of inertia.

UNIT II: BIOMECHANICS OF JOINTS **9**

Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium, free body diagrams, types of joint, biomechanical analysis of elbow, shoulder, spinal column, hip knee and ankle.

UNIT III: BIOFLUID MECHANICS **9**

Introduction, viscosity and capillary viscometer, Rheological properties of blood, laminar flow, Coquette flow and Hagen-poiseuille equation, turbulent flow.

UNIT IV: RESPIRATORY MECHANICS **9**

Mechanism of air flow, respiratory cycle, lung ventilation model, methods of determining pressure, flow rate and volume; spirometry.

UNIT V: BIOMECHANICS OF IMPLANTS **9**

Design of orthopedic implant, specifications for a prosthetic joint, biocompatibility, requirement of a biomaterial, characteristics of different types of biomaterials, manufacturing process of implants, fixation of implants.

TOTAL: L: 45=45

TEXT BOOKS:

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	D. J. Schneck and J. D. Bronzino	Biomechanics- Principles and Applications	CRC Press, 2nd Edition	2002
2.	Robert L.Huston	Principles of Biomechanics	CRC Press	2000

REFERENCE BOOKS:

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Y C Fung	Biomechanics: Mechanical Properties of Living Tissues	Springer, 2nd edition	2010
2	N. Ozkaya and M. Nordin	Fundamentals of Biomechanics-Equilibrium, Motion and Deformation	Springer-India 2nd edition	2009
3	J. G Webster	Medical Instrumentation – Application & Design	John Wiley and sons Inc. 3rd edition	2003
4.	Bahl Ajay	Basics of Biomechanics	Jaypee Brothers Medical Publishers	2010
5.	Rajkumar	Biomechanics the Nucleus of Physiotherapy	Jaypee Brothers Medical Publishers	2010

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2. https://www.maxillofacialprosthetics.org/meetings/aampbrunski.pdf
3. www.worldscientific.com.
4. https://accessengineeringlibrary.com/browse/applied-biofluid-mechanics.
5. https://www.youtube.com/watch?v=r26BBb2ScPM

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Programme Code & Name: ME & B.E-Mechanical Engineering

16MEC12 MEASUREMENTS AND INSTRUMENTATION **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To demonstrate the basic concepts of measuring.
- To develop the electrical and electronic instruments for measuring.
- To educate on the comparison between various measurement techniques.
- To explore various storage and display devices.
- To design various transducers and data acquisition systems.

COURSE OUTCOMES

16MEC12.CO1 Demonstrate the basic concepts of measuring.
16MEC12.CO2 Develop the electrical and electronic instruments for measuring.
16MEC12.CO3 Educate on the comparison between various measurements techniques.
16MEC12.CO4 Explore various storage and display devices.
16MEC12.CO5 Design various transducers and data acquisition systems.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEC12.CO1	X	X	X	X	-	X	-	-	-	-	-	X	X	-	X
16MEC12.CO2	X	X	X	X	-	X	-	-	-	-	-	X	-	-	-
16MEC12.CO3	X	X	X	X	-	X	-	-	-	-	-	X	X	X	-
16MEC12.CO4	X	X	X	X	-	X	-	-	-	-	-	X	-	X	X
16MEC12.CO5	X	X	X	X	-	X	-	-	-	-	-	X	X	X	X

UNIT I: INTRODUCTION **9**

Functional elements of an instrument – Static and dynamic characteristics – Errors in measurement – Statistical evaluation of measurement data – Standards and calibration.

UNIT II: ELECTRICAL AND ELECTRONICS INSTRUMENTS **9**

Principle and types of analog and digital voltmeters, ammeters, multimeters – Single and three phase wattmeter and energy meters – Magnetic measurements – Determination of B-H curve and measurements of iron loss – Instrument transformers – Instruments for measurement of frequency and phase.

UNIT III: COMPARISON METHODS OF MEASUREMENTS **9**

D.C & A.C potentiometers- D.C & A.C bridges, transformer ratio bridges, self-balancing bridges. Interference & screening – Multiple earth and earth loops - Electrostatic and electromagnetic interference – Grounding techniques.

UNIT IV: STORAGE AND DISPLAY DEVICES **9**

Magnetic disk and tape – Recorders, digital plotters and printers, CRT display, digital CRO, LED, LCD& dot matrix display – Data Loggers.

UNIT V: TRANSDUCERS AND DATA ACQUISITION SYSTEMS **9**

Classification of transducers – Selection of transducers – Resistive, capacitive & inductive transducers – Piezoelectric, Hall effect, optical and digital transducers – Elements of data acquisition system – A/D, D/A converters – Smart sensors.

TOTAL: L: 45=45

TEXT BOOKS:

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	A.K. Sawhney	A Course in Electrical & Electronic Measurements & Instrumentation	Dhanpat Rai and Co	2004

2.	J. B. Gupta	A Course in Electronic and Electrical Measurements	S. K. Kataria & Sons, Delhi	2003

REFERENCE BOOKS:

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	H.S. Kalsi	Electronic Instrumentation	Tata McGraw Hill, 3rd Edition	2010
2.	D.V.S. Moorthy	Transducers and Instrumentation	Prentice Hall of India Pvt Ltd	2007
3.	A.J. Bouwens	Digital Instrumentation	Tata McGraw Hill	2001
4	Martin Reissland	Electrical Measurements	New Age International (P) Ltd., Delhi	2001
5.	Alan. S. Morris	Principles of Measurements and Instrumentation	Prentice Hall of India	2003

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3. https://www.youtube.com/watch?v=Q8PH6yl8DUw
4. https://www.youtube.com/watch?v=hhe78J8S8yM
5. https://www.youtube.com/watch?v=I_9Pwyxhe40

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16MEC13 RENEWABLE ENERGY SOURCES

L T P C
3 0 0 3

COURSE OBJECTIVES

- To identify new methodologies/ technologies for effective utilization of renewable energy sources.
- To understand the solar energy production and its applications.
- To enhance wind energy systems based on safety and standards.
- To design biomass gasifiers for bioenergy production.
- To outline other sources like tides, fuel cell etc.

COURSE OUTCOMES

16MEC13.CO1 Identify new methodologies/ technologies for effective utilization of renewable energy sources.
16MEC13.CO2 Understand the solar energy production and its applications.
16MEC13.CO3 Enhance wind energy systems based on safety and standards.
16MEC13.CO4 Design biomass gasifiers for bioenergy production.
16MEC13.CO5 Outline other sources like tides, fuel cell etc.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEC13.CO1	X	X	X	X	-	-	X	-	-	X	-	X	-	-	-
16MEC13.CO2	X	X	X	X	-	-	X	X	-	X	-	X	X	-	-
16MEC13.CO3	X	X	X	X	-	-	X	-	-	X	-	X	X	-	-
16MEC13.CO4	X	X	X	X	-	-	X	-	-	X	-	X	X	-	-
16MEC13.CO5	X	X	X	X	-	X	X	-	-	X	-	X	-	-	-

UNIT I: INTRODUCTION 9

World Energy Use – Reserves of Energy Resources – Environmental Aspects of Energy Utilisation – Renewable Energy Scenario in Tamilnadu, India and around the World - Potentials - Achievements / Applications – Economics of renewable energy systems.

UNIT II: SOLAR ENERGY 9

Solar Radiation – Measurements of Solar Radiation - Flat Plate and Concentrating Collectors – Solar direct Thermal Applications – Solar thermal Power Generation - Fundamentals of Solar Photo Voltaic Conversion – Solar Cells – Solar PV Power Generation – Solar PV Applications.

UNIT III: WIND ENERGY 9

Wind Data and Energy Estimation – Types of Wind Energy Systems – Performance - Site Selection – Details of Wind Turbine Generator – Safety and Environmental Aspects.

UNIT IV: BIO - ENERGY 9

Biomass direct combustion – Biomass gasifiers – Biogas plants – Digesters – Ethanol production – Bio diesel – Cogeneration - Biomass Applications.

UNIT V: OTHER RENEWABLE ENERGY SOURCES 9

Tidal energy – Wave Energy – Open and Closed OTEC Cycles – Small Hydro-Geothermal Energy Hydrogen and Storage - Fuel Cell Systems – Hybrid Systems.

TOTAL: L: 45= 45

TEXT BOOKS:

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	G.D. Rai	Non Conventional Energy Sources	Khanna Publishers, New Delhi	2011

2.	Twidell, J.W. & Weir	Renewable Energy Sources	EFN Spon Ltd., UK	2006

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REFERENCE BOOKS:

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	David M. Mousdale	Introduction to Biofuels,	CRC Press Taylor & Francis Group, USA	2010
2.	Chetan Singh Solanki	Solar Photovoltaic, Fundamentals, Technologies and Applications	PHI Learning Private Limited, New Delhi	2009
3.	S.P. Sukhatme	Solar Energy	Tata McGraw Hill Publishing Company Ltd., New Delhi	1997
4.	Sinduja S	Renewable Energy Sources	Anuradha Publications	2012
5.	Tasneem abbasi and T.A Abbasi	Renewable Energy Sources: Their Impact on Global Warming and Pollution	Prentice Hall India Learning Private Limited	2010

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3. https://www.youtube.com/watch?v=LNXTm7aHvWc
4. https://www.youtube.com/watch?v=EPS9mPNT5t8
5. https://www.youtube.com/watch?v=Mon06rujCOM

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16MEC14 FUNDAMENTALS OF NANOSCIENCE

L T P C
3 0 0 3

COURSE OBJECTIVES

- To familiarize the concepts of Nanotechnology in many discipline.
- To develop new fabrication methods of Nano materials.
- To focus on processes involved in pattering and lithography for nanoscale devices.
- To design biomass gasifiers for biomass applications.
- To categorize the characterization techniques for identifying Nano materials.

COURSE OUTCOMES

16MEC14.CO1 Familiarize the concepts of Nanotechnology in many disciplines.
16MEC14.CO2 Develop new fabrication methods of Nano materials.
16MEC14.CO3 Focus on processes involved in pattering and lithography for nano scale devices.
16MEC14.CO4 Design biomass gasifiers for biomass applications.
16MEC14.CO5 Categorize the characterization techniques for identifying Nano materials.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEC14.CO1	X	X	X	-	-	X	X	X	-	X	-	X	X	-	-
16MEC14.CO2	X	X	X	X	-	-	X	X	-	X	-	X	X	-	-
16MEC14.CO3	X	X	X	X	-	-	X	X	-	X	-	X	X	-	-
16MEC14.CO4	X	X	X	X	-	-	X	X	-	X	-	X	X	-	-
16MEC14.CO5	X	X	X	X	-	-	X	X	-	X	-	X	X	-	-

UNIT I: INTRODUCTION 9

Nanoscale Science and Technology - Implications for Physics, Chemistry, Biology and Engineering - Classifications of nanostructure materials - Nano particles - quantum dots, Nanowires – ultra – thin films - multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II: PREPARATION METHODS 9

Bottom-up Synthesis -Top-down Approach: Precipitation, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III: PATTERNING AND LITHOGRAPHY FOR NANOSCALE DEVICES 9

Introduction to optical/UV electron beam and X-ray Lithography systems and processes, Wet etching, dry (Plasma /reactive ion) etching, Etch resists-dip pen lithography

UNIT IV: PREPARATION ENVIRONMENTS 9

Biomass direct combustion – Biomass gasifiers – Biogas plants – Digesters – Ethanol production – Bio diesel – Cogeneration - Biomass Applications.

UNIT V: CHARACTERIZATION TECHNIQUES 9

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

TOTAL: L: 45=45

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TEXT BOOKS:

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	A.S. Edelstein and R.C. Cammearata,	Nanomaterials:Synthesis, Properties and Applications	Institute of Physics Publishing, Bristol and Philadelphia,	1996
2.	N John Dinardo	Nanoscale characterization of surfaces & Interfaces	Second edition, Weinheim Cambridge, Wiley-VCH	2000

REFERENCE BOOKS:

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	G Timp	Nanotechnology	AIP press/Springer	1999
2.	Akhlesh Lakhtakia	The Hand Book of Nano Technology, "Nanometer Structure", Theory, Modeling and Simulations	Prentice-Hall of India (P) Ltd, New Delhi	2007
3.	Shubra Singh M.S. and Ramachandra Rao	Nanoscience and Nanotechnology: Fundamentals of Frontiers	Wiley	2013
4.	Chattopadhyay K.K and Banerjee A.N.	Introduction to Nanoscience and Nanotechnology	Prentice Hall India Learning Private Limited	2009
5.	M. A. Shah and Tokeer Ahmad	Principles of Nanoscience and Nanotechnology	Narosa Publishing House	2010

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2. https://www.youtube.com/watch?v=XviwX0_XDvI
3. https://www.youtube.com/watch?v=ZEwRy2Zv0JA
4. https://www.youtube.com/watch?v=D3JY4LgyX6Q
5. https://www.youtube.com/watch?v=GY9lfO-tVfE

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Programme Code & Name: ME & B.E-Mechanical Engineering

16MEC15 PRODUCTION PROCESSES

L T P C
3 0 0 3

COURSE OBJECTIVES

- To familiarize with the casting processes.
- To interpret the various welding processes and examine the quality of welds.
- To contrast the cold and hot rolling processes.
- To explore the metal forming processes and manipulates the defects.
- To demonstrate the preparation of composite materials.

COURSE OUTCOMES

16MEC15.CO1 Interpret the concepts of casting processes
16MEC15.CO2 Identify the fabrication processes to join the different metals
16MEC15.CO3 Contrast the cold and hot rolling processes.
16MEC15.CO4 Illustrate the sheet metal processes
16MEC15.CO5 Demonstrate the processing of plastic materials and preparation of composite materials

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEC15.CO1	X	X	X	-	-	X	-	-	-	-	-	-	X	-	-
16MEC15.CO2	X	X	X	-	-	X	X	X	-	X	-	-	X	-	-
16MEC15.CO3	X	X	-	X	X	X	X	X	-	X	-	-	X	-	-
16MEC15.CO4	X	X	X	X	X	X	-	-	-	-	-	-	X	-	-
16MEC15.CO5	X	X	-	-	X	X	X	X	-	X	-	X	X	X	X

UNIT I: CASTING PROCESSES 9

Introduction–Patterns, Requirements of a good pattern, pattern materials, types of patterns, pattern allowances–Mould making, types of moulds, moulding processes, types of sand moulding–Core making, types of cores, core prints, core box-Moulding Sand Properties of moulding sand, types of moulding sand–Melting equipment, cupola furnace, crucible furnace, electric furnace–Gating system–Casting processes, Sand casting, Shell-mould casting, Investment casting, Die casting, centrifugal casting –Defects, Cleaning and Inspection of casting.

UNIT II: FABRICATION PROCESSES 9

Introduction–Classification of welding processes–Resistance welding, spot, seam, projection, butt welding–Gaswelding,oxy-acetylenewelding,equipments–Arcwelding,shielded arc welding, TIG, MIG, submerged arc welding, electro-slag welding, ultrasonic welding, plasma arc welding, laser beam welding, friction welding–Soldering and Brazing–Testing and Inspection of welded joints, Defects in welds.

UNIT III: BULK DEFORMATION PROCESSES 9

Introduction–Cold and hot working processes Rolling, classification of rolling, principle, rolling stand arrangement, defects in rolling–Forging, classification of forging, methods of forging, defects in forging–Extrusion, Classification of extrusion, Hot and cold extrusion processes, extrusion defects and equipments–Drawing, Drawing of rods, wire and tubes.

UNIT IV: METAL FORMING PROCESSES 9

Introduction-Metal stamping and forming, bending, deep drawing, stretch forming, metals pinning, blanking, piercing, embossing and coining, notching, punching, roll forming, rubber press forming, hydro-mechanical forming–Comparison of metal forming processes–Defects in sheet metal formed parts.

UNIT V: PLASTIC AND COMPOSITE MATERIAL PROCESSES 9

Processing of plastics, compression moulding, transfer moulding, injection moulding, blow moulding, thermo forming and calendaring-advantages of plastic materials–Introduction to composite material–Classification of composite materials–advantages of composite materials.

TOTAL: L: 45=45

TEXT BOOKS:

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	RajputR.K	ATextBookofManufacturingTechnology	Laxmipublications(P)ltd,NewDelhi,	2008
2.	SharmaP.C	ATextBookofProductionTechnology	S.ChandandCompany IVEdition,	2004

REFERENCE BOOKS:

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Rao P.N	MaufacturingTechnology	TataMcGrawHill publishing company limited,NewDelhi	2009
2.	HajraChoudhury	ElementsofWorkshop TechnologyVol.1&2	Media promoters Pvt Ltd. ,Mumbai	2007
3.	Serope Kalpajian and Steven R.Schmid	Manufacturing Engineering and Technology	PearsonEducationInc., SecondIndianReprint	2002
4.	JainR.K	ProductionTechnology	KhannaPublications	2001
5.	Luqman Midhat	Production Processes	CBS; 1ST edition	2010

WEB URLs

1. https://www.youtube.com/watch?v=yVZJP3u9Kek
2. https://www.youtube.com/watch?v=Zc3Fu1AVCjc
3. https://www.youtube.com/watch?v=lueB6RvqMSo
4. https://www.youtube.com/watch?v=XUMs3cWBlks
5. https://www.youtube.com/watch?v=pEgK3n4NN7k

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PROFESSIONAL CORE

(PC)

For

Mechanical Engineering

16MED01 COMPUTER AIDED DRAFTING AND MODELING LABORATORY **L T P C**
0 0 4 2

COURSE OBJECTIVES

- To develop skill to use software for creating 2 Dimensional models.
- To provide an overview of how computers are being used in mechanical component design.
- To make the students understand the computer graphics fundamentals.
- To familiarize orthographic views of simple solids.
- To build the students to identify with the various file types used in the CAD software.

COURSE OUTCOMES

16MED01.CO1 Ability to use the software packers for drafting and modeling.
16MED01.CO2 Demonstrate proficiency in CAD skills by creating complex 2D drawings from 3D solid modeling techniques.
16MED01.CO3 Plan critically and use creativity in the design of mechanical components and systems.
16MED01.CO4 Build, edit and parameterize properties of complex solid objects.
16MED01.CO5 Ability to export / import CAD drawings for different applications.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MED01.CO1	X	-	X	-	X	-	-	-	-	-	-	-	X	-	-
16MED01.CO2	X	-	X	-	X	-	-	-	-	-	-	-	X	-	-
16MED01.CO3	X	-	X	-	X	-	-	-	-	-	-	-	X	-	-
16MED01.CO4	X	-	X	-	X	-	-	-	-	-	-	-	X	-	-
16MED01.CO5	X	-	X	-	X	-	-	-	-	-	-	-	-	X	-

LIST OF EXERCISES USING SOFTWARE CAPABLE OF DRAFTING AND MODELING

1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, Relative, Polar, etc.) – Creation of simple figures like polygon and general multi-line figures.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like parabola, spiral, involutes using B spline or cubic spline.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc, and Dimensioning.
5. Drawing front view, top view and side view of objects from the given pictorial views (eg. V block, Base of a Mixie, Simple stool, Objects with hole and curves).
6. Drawing of a plan of residential building (Two bed rooms, kitchen, hall, etc.)
7. Drawing of a simple steel truss.
8. Drawing sectional views of prism, pyramid, cylinder, cone, etc,
9. Drawing isometric projection of simple objects.
10. Creation of 3D models of simple objects and obtaining 2D multi-view drawings from 3D Model.

Note: Plotting of drawings must be made for each exercise and attached to the records written by Students.

TOTAL P: 60=60

WEB URLs

1. www.youtube.com/watch?v=JAHaqaOMrgg
2. www.youtube.com/watch?v=4yZC1bnbJQQ
3. www.youtube.com/watch?v=sNIzyq3G1No
4. www.youtube.com/watch?v=ruu5yHoxcek
5. www.youtube.com/watch?v=BFutLtQt4i8

16MED02 **MACHINE DRAWING** **L T P C**
0 0 4 2

COURSE OBJECTIVES

- To know the specifications and symbols of standard machine components used in machine drawing.
- To understand the concept of tolerances and fits used for component design.
- To practice the drawings of machine components and detailing using standard CAD packages.
- To make the students understand and interpret drawings of machine components so as to prepare assembly drawings both manually and CAD package.

COURSE OUTCOMES

16MED02.CO1 Know the specifications and symbols used in machine drawing.
16MED02.CO2 Understand the concept of tolerances and fits used for component design.
16MED02.CO3 Practice the drawings of machine components and detailing using standard CAD packages.
16MED02.CO4 Make the students understand and interpret drawings of machine components so as to prepare assembly drawings both manually and CAD package.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MED02.CO1	X	-	X	-	X	-	-	-	-	-	-	-	X	-	-
16MED02.CO2	X	-	X	-	X	-	-	-	-	-	-	-	X	-	-
16MED02.CO3	X	-	X	-	X	-	-	-	-	-	-	-	X	-	-
16MED02.CO4	X	-	X	-	X	-	-	-	-	-	-	-	X	-	-

UNIT I: DRAWING STANDARDS 2

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.

UNIT II: FITS AND TOLERENCES 2

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 III: INTRODUCTION TO DRAFTING PACKAGE 6

Drawing, Editing, Dimensioning, Plotting Commands, Layering Concepts, Matching, Detailing, Detailed drawing, Basic principles of geometric dimensioning & tolerancing.

UNIT IV: ASSEMBLY DRAWING 50

(Preparation of 2D assembled views for the given part details)

Preparation of assembled views, both manually and using software package, given part details for components such as Shaft couplings – Plummer block – Screw jack – Lathe Tailstock –Universal joint – Machine Vice – Stuffing box – Crosshead – Safety Valves – Non-return valves – Connecting rod – Piston and crank shaft – Multi plate clutch – Preparation of Bill of materials and tolerance data sheet.

TOTAL L: 60 = 60

List of Exercises

1. Orthographic views of brackets and V- blocks
2. Screw threads and threaded fasteners.
3. BIS specifications – Welding symbols, riveted joints, keys
4. Referring to hand book for the selection of standard components like bolts,nuts, Screws, keys etc
5. Introduction to Modeling software – simple exercises using any one CAD package
6. Preparation of Assembly drawings – Piston and crank shaft.
7. Assembly of Plummer blocks bearing.
8. Assembly of flange Couplings.
9. Assembly of universal Joint.
10. Assembly of Lathe Tailstock.

TEXT BOOKS

S.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Gopalakrishna K.R.,	Machine Drawing	Subhas Stores Books Corner, Bangalore	2003
2	Narayana.K.L, Kanniah.P and Venkata Reddy.K	Machine Drawing	New Age International, New Delhi,	2006

REFERENCE BOOKS

S. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	N. D. Bhatt and V.M. Panchal	Machine Drawing	Charator Publishers	2010
2	Goutam Pohit and Goutam Ghosh	Machine Drawing with AutoCAD	Pearson Education	2004
3	Junnarkar, N.D	Machine Drawing	Pearson Education	2004
4	N. Siddeshwar, P. Kanniah, V.V.S. Sastri	Machine Drawing	Tata McGraw Hill	2006
5	S. Trymbaka Murthy	Computer Aided Machine Drawing	CBS Publishers, New Delhi	2007

WEB URLs

1. www.youtube.com/watch?v=31LSw8wyrrg
2. www.youtube.com/watch?v=6ZwbP7Fs0-Y
3. www.youtube.com/watch?v=KbcznIMlAss
4. www.youtube.com/watch?v=RGr2vzch-SI
5. www.youtube.com/watch?v=BFutLtQt4i8

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16MED03 ENGINEERING MATERIALS AND METALLURGY **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To learn about the micro-structure of materials, phase diagrams for different binary alloys.
- To impart knowledge on types of heat treatments.
- To identify the various mechanical properties of materials through different types of tests and their significance.
- To know about different types of alloy steels with their applications, non-ferrous alloys with particular reference to copper, aluminum, magnesium, zinc, nickel, titanium, lead and tin alloys.
- To gain knowledge on the types, structure, properties and applications of polymers, ceramics and composites.

COURSE OUTCOMES

16MED03.CO1 Intrepret material constituents from phase diagram.
16MED03.CO2 Identify various heat treatment process.
16MED03.CO3 Demonstrate the various deformation mechanisms and testing of various mechanical properties of materials."
16MED03.CO4 Explain the effects of alloying elements and Engineering applications of ferrous and non-ferrous metals
16MED03.CO5 Understand the engineering applications of non-metallic materials.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MED03.CO1	X	X	X	X	-	-	X	X	-	-	-	X	X	X	X
16MED03.CO2	X	X	X	X	-	-	X	X	-	-	-	X	X	X	X
16MED03.CO3	X	X	X	X	-	-	X	X	-	-	-	X	X	X	X
16MED03.CO4	X	X	X	X	-	-	X	X	-	-	-	X	X	X	X
16MED03.CO5	X	X	X	X	-	-	X	X	-	-	-	X	X	X	X

UNIT I: ALLOYS AND PHASE DIAGRAMS **9**

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

UNIT II: HEAT TREATMENT **9**

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

UNIT III: MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS **9**

Mechanisms of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), hardness tests, Impact test Izod and charpy, fatigue and creep failure mechanisms.

UNIT IV: FERROUS AND NON-FERROUS METALS **9**

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

UNIT V: NON-METALLIC MATERIALS 9

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of various thermosetting and thermoplastic polymers (PP, PS, PVC, PMMA, PET,PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE, Polymers – Urea and Phenol formaldehydes)- Engineering Ceramics –Properties and applications of Al2O3, SiC, Si3N4, PSZ and SIALON –Composites-Classifications- Metal Matrix and FRP - Applications of Composites.

TOTAL L:45=45

TEXT BOOKS

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Avner, S.H	Introduction to Physical Metallurgy	McGraw Hill Book Company	1994
2	Williams D Callister	Material Science and Engineering	Wiley India Pvt Ltd	Revised Indian Edition 2012

REFERENCE BOOKS

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Raghavan.V	Materials Science and Engineering	Prentice Hall of India Pvt. Ltd	2004
2	Kenneth G.Budinski and Michael K. Budinski	Engineering Materials	Prentice Hall of India Private Limited, 4th Indian Reprint	2010
3	Upadhyay. G.S. and Anish Upadhyay	Materials Science and Engineering	Viva Books Pvt. Ltd., New Delhi	2007
4	U.C.Jindal	Material Science and Metallurgy, "Engineering Materials and Mettalurgy	First Edition, Dorling Kindersley	2012
5	P. Khanna	Text Book of Material Science and Metallurgy	Dhanpat Rai Publication (P) Ltd., New Delhi	2007

WEB URLs

1. www.nptel.ac.in/courses/113106032/9%20-%20Phase%20diagrams.pdf
2. www.books.google.co.in/books?isbn=1856178099
3. www.journals.elsevier.com/materials-science-and-engineering-a
4. www.journals.elsevier.com/materials-science-and-engineering-b
5. www.journals.elsevier.com/materials-science-and-engineering-c

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16MED04 ENGINEERING THERMODYNAMICS L T P C
3 2 0 4

(Use of Standard and approved Steam Table, Mollier Chart, Compressibility Chart an Psychometric Chart permitted)

COURSE OBJECTIVES

- To familiarize the students the fundamentals of thermodynamics.
- To understand second law of thermodynamics and applications.
- To know the working of steam turbines.
- To acquire knowledge about the gas cycles.
- To know the psychometric process.

COURSE OUTCOMES

16MED04.CO1 Explain fundamental thermodynamic process and laws in thermodynamics
16MED04.CO2 Utilize second law of thermodynamics and its applications
16MED04.CO3 Analyse properties of steam and its applications
16MED04.CO4 Know the properties and applications of ideal and real gases
16MED04.CO5 Understand about psychrometric process and applications

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MED04.CO1	X	X	X	X	X	X	-	-	-	-	-	-	X	X	-
16MED04.CO2	X	X	-	-	-	-	-	-	-	-	-	-	X	-	-
16MED04.CO3	X	X	-	-	-	-	-	-	-	-	-	-	X	-	-
16MED04.CO4	X	X	-	-	-	-	-	-	-	-	-	-	X	-	-
16MED04.CO5	X	X	-	-	-	-	-	-	-	-	-	-	X	-	-

UNIT I : BASIC CONCEPTS AND FIRST LAW 9

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

UNIT II: SECOND LAW AVAILABILITY ANALYSIS 9

Heat Reservoir, source and sink. Heat Engine, Refrigerator, Heat pump. Statements of second law and its corollaries. Carnot cycle and Reversed Carnot cycle, Performance. Clausius inequality. Concept of entropy, T-s diagram, Tds Equations, entropy change for - pure substance, ideal gases – different processes, principle of increase in entropy. Applications of II Law. High and low grade energy. Available and non-available energy of a source and finite body. Energy and irreversibility. Expressions for the energy of a closed system and open systems. Energy balance and entropy generation. Irreversibility. I and II law Efficiency.

UNIT III: PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE 9

Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. p-v-T surface. Use of Steam Table and Mollier Chart. Determination of dryness fraction. Application of I and II law for pure substances. Ideal and actual Rankine cycles, Cycle Improvement Methods - Reheat and Regenerative cycles, Economiser, preheater, Binary and Combined cycles.

UNIT IV: IDEAL AND REAL GASES, THERMODYNAMIC RELATIONS 9

Properties of Ideal gas- Ideal and real gas comparison- Equations of state for ideal and real gases-Reduced properties-.Compressibility factor-.Principle of Corresponding states. –Generalized Compressibility Chart and its use-. Maxwell relations, Tds Equations, Difference and ratio of heat capacities, Energy equation, Joule-Thomson Coefficient, Clausius Clapeyron equation, Phase Change Processes. Simple Calculations

UNIT V: GAS MIXTURES AND PSYCHROMETRY 9

Mole and Mass fraction, Dalton's and Amagat's Law. Properties of gas mixture – Molar mass, gas constant, density, change in internal energy, enthalpy, entropy and Gibbs function. Psychometric properties, Psychometric charts. Property calculations of air vapour mixtures by using chart and expressions. Psychometric process – adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing. Simple Applications

TOTAL: L +T= 45+30 = 75

TEXT BOOKS

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Nag.P.K	Engineering Thermodynamics	4thEdition, Tata McGraw-Hill	2008
2	Natarajan E	Engineering Thermodynamics	Anuragam Publications	2012

REFERENCE BOOKS

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Cengel. Y and M.Boles	Thermodynamics - An Engineering Approach	7th Edition Tata McGraw Hill	2010
2	Holman.J.P	Thermodynamics	3rd Edition, McGraw-Hill	1995
3	Arora C.P	Thermodynamics	Tata McGraw-Hill	2003
4	Chattopadhyay,P	Engineering Thermodynamics	Oxford University Press	2010
5	Prasanna Kumar	Engineering Thermodynamics	Pearson Education	2013

WEB URLs

1. www.youtube.com/watch?v=lbPEaaKiCww
2. www.youtube.com/watch?v=YoekFxOizj4
3. www.youtube.com/watch?v=AyAd-gLO9CE
4. www.youtube.com/watch?v=WScwPIPqZa0
5. www.youtube.com/watch?v=e2IryaMQQ6A

16MED05 FLUID MECHANICS AND MACHINERY **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To understand the applications of fluid in various engineering requirements.
- To explain the various losses in pipes.
- To understand the importance of dimensional analysis.
- To interpret the various types of pumps and its principles.
- To comprehend the types of flow in turbines.

COURSE OUTCOMES

16MED05.CO1 Interpret the concepts of fluid properties and its characteristics
16MED05.CO2 Discuss major and minor losses associated with pipe flow in piping networks
16MED05.CO3 Identify the nature of physical quantities with dimensional analysis
16MED05.CO4 Demonstrate the performance of pumps
16MED05.CO5 Distinguish the performance characteristics of hydraulic turbines

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MED05.CO1	X	X	X	-	-	X	X	X	-	X	-	X	X	-	-
16MED05.CO2	X	X	X	X	-	-	X	X	-	X	-	X	X	-	-
16MED05.CO3	X	X	X	X	-	-	X	X	-	X	-	X	X	-	-
16MED05.CO4	X	X	X	X	-	-	X	X	-	X	-	X	X	-	-
16MED05.CO5	X	X	X	X	-	-	X	X	-	X	-	X	X	-	-

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, surface tension and capillarity. Flow characteristics concept of control volume - application of continuity equation, energy equation and momentum equation

UNIT II: FLOW THROUGH CIRCULAR CONDUITS 9

Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli - Boundary layer concepts – types of boundary layer thickness – Darcy Weisbach equation – friction factor - Moody diagram- commercial pipes - minor 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 roto-dynamic machines – various efficiencies– velocity components at entry and exit of the rotor- velocity triangles - Centrifugal pumps– working principle -work done by the impeller - performance curves - Reciprocating pump- working principle – Rotary pumps classification.

UNIT V: TURBINES 9

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

TOTAL: L: 45 + P: 30 = 75

List of Experiments

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

TEXT BOOKS

S. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Dr. P.N. Modi & Dr. S.M. Seth	Hydraulics and Fluid Mechanics Including Hydraulics Machines	Rajsons Publications pvt. Ltd. 20th edition	2015
2	Dr. R. K. Bansal	A Textbook of Fluid Mechanics and Hydraulic Machines	Laxmi Publications, Ninth edition	2017

REFERENCE BOOKS

S. No.	Author(s)	Title of the Book	Publisher	Year of Publication
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	Robert W.Fox, Alan T. McDonald, Philip J.Pritchard,	Fluid Mechanics	Wiley, 9th Edition	2015
4	Graebel. W.P	Engineering Fluid Mechanics	Taylor & Francis, Indian Reprint	2011
5	R.K.Rajput	A text book of Fluid Mechancis	S.Chand & co, New Delhi	2007

WEB URLs

1. www.youtube.com/watch?v=C2sX9Wg6twI&index=1&list=PLbMVogVj5nJSurQymuzzJM9MwLpEb75lq
2. www.youtube.com/watch?v=vhSCH_FPJC4
3. www.youtube.com/watch?v=RGpFmgKsTfY
4. www.youtube.com/watch?v=2HF_Z64OfQE
5. www.youtube.com/watch?v=JQmkQQVYnJU

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16MED06 **MECHATRONICS** **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To understand the working principles of various sensors.
- To acquire in depth knowledge on the uses of microprocessor.
- To know how to interface computer with components.
- To develop skills about PLC
- To familiarize about actuators and able to design Mechatronics system.

COURSE OUTCOMES

16MED06.CO1 Simulate simple physical systems and mechatronics design process
16MED06.CO2 Outline appropriate sensors and actuators for an engineering application
16MED06.CO3 Write simple microcontroller programs
16MED06.CO4 Explain linearization of nonlinear systems and elements of data acquisition
16MED06.CO5 Explain various applications of design of mechatronic systems

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MED06.CO1	X	X	X	X	X	-	-	-	X	X	-	X	-	X	-
16MED06.CO2	X	X	X	X	X	-	-	-	X	X	-	X	-	X	-
16MED06.CO3	X	X	X	X	X	-	-	-	X	X	-	X	-	X	-
16MED06.CO4	X	X	X	X	X	-	-	-	X	X	-	X	-	X	-
16MED06.CO5	X	X	X	X	X	-	-	-	X	X	-	X	-	X	-

UNIT I: INTRODUCTION 9

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

UNIT II: 8085 MICROPROCESSOR 9

Introduction – Architecture of 8085 – Pin Configuration – Addressing Modes –Instruction set, Timing diagram of 8085.

UNIT III: PROGRAMMABLE PERIPHERAL INTERFACE 9

Introduction – Architecture of 8255, Keyboard interfacing, LED display –interfacing, ADC and DAC interface, Temperature Control – Stepper Motor Control – Traffic Control interface.

UNIT IV: PROGRAMMABLE LOGIC CONTROLLER 9

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

UNIT V: ACTUATORS AND MECHATRONIC SYSTEM DESIGN 9

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

List of Experiments

1. Basic Pneumatic Trainer Kit with manual and electrical controls/PLC Control
2. Basic Hydraulic Trainer Kit
3. Hydraulics and Pneumatics Systems Simulation Softwares
4. 8051 - Microcontroller kit with stepper motor and drive circuit
5. Simulation Software and Sensors to measure Pressure Flow rate, direction, speed, velocity and force.

TOTAL: L +T= 45+ 30 = 75

TEXT BOOKS

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Bolton	Mechatronics	Printice Hall	2008
2	Ramesh S Gaonkar	Microprocessor Architecture, Programming, and Applications with the 8085	5th Edition, Prentice Hall	2008

REFERENCE BOOKS

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Michael B.Histand	Introduction to Mechatronics and Measurement systems	McGraw Hill International	2007
2	Smaili.A and Mrad.F	Mechatronics Integrated Technologies for Intelligent Machines	Oxford University Press	2007
3	Krishna Kant	Microprocessors & Microcontrollers	Prentice Hall of India	2007
4	Devadas Shetty and Richard A. Kolk	Mechatronics Systems Design	PWS publishing company	2007
5	Newton C. Braga	Mechatronics Source Book	Delmar Cengage Learning	2009

WEB URLs

1. www.engineering.nyu.edu/gk12/amps-cbri/pdf/Intro%20to%20Mechatronics.pdf
2. www.tutorialspoint.com/microprocessor/microprocessor_8085_architecture.html
3. www.electronics.dit.ie/staff/tscarff/8255PPI/8255.htm
4. www.amci.com/industrial-automation-resources/plc-automation-tutorials/what-plc/
5. www.engineering.nyu.edu/mechatronics/Control_Lab/Criag/Craig_RPI/SenActinMecha/S&A_Course_Int roduction.pdf

16MED07 STRENGTH OF MATERIALS

L	T	P	C
3	0	2	4

COURSE OBJECTIVES

- To study the ability of materials to withstand applied load conditions.
- To analyze the loading and support conditions of various cross sectional beams.
- To predict the parameters of a torsion shaft.
- To determine analytically the deflection of beams.
- To familiarize the physical parameters of cylinders and spherical shells.

COURSE OUTCOMES

16MED07.CO1 Understand the concepts of stress, strain behaviour in simple and compound bars, the importance of principal stress and principal planes

16MED07.CO2 Identify the load transferring mechanism in beams and stress distribution due to shearing force and bending moment

16MED07.CO3 Apply basic equation of simple torsion in designing of shafts and helical spring

16MED07.CO4 Calculate the slope and deflection in beams using different methods.

16MED07.CO5 Analyze thin and thick shells for the applied internal and external pressures.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MED07.CO1	X	X	X	X	-	-	-	-	-	-	-	X	X	X	X
16MED07.CO2	X	X	X	X	-	-	-	-	-	-	-	X	X	-	-
16MED07.CO3	X	X	X	X	-	-	-	-	-	-	-	X	X	X	X
16MED07.CO4	X	X	X	X	-	-	-	-	-	-	-	X	X	X	X
16MED07.CO5	X	X	X	X	-	-	-	-	-	-	-	X	X	-	-

UNIT I: STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

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

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

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

Slope and deflection of simply supported beams and cantilevers- Double integration- Macaulay's Method- moment area method- conjugate beam method.

UNIT V: THIN CYLINDERS, SPHERES AND THICK CYLINDERS 9

Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders – spherical shells subjected to internal pressure –Deformation in spherical shells – Lame's theorem.

LIST OF EXPERIMENTS

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

TOTAL: L : 45+ P : 30 = 75

TEXT BOOKS

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Bansal, R.K	Strength of Materials	Laxmi Publications (P) Ltd.,	2007
2	Egor. P.Popov	Engineering Mechanics of Solids	Prentice Hall of India, New Delhi	2010

REFERENCE BOOKS

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Jindal U.C	Strength of Materials	Asian Books Pvt. Ltd., New Delhi	2007
2	Subramanian R	Strength of Materials	Oxford University Press, Oxford Higher Education Series	2007
3	Ferdinand P. Been, Russell Johnson, J.r. and John J. Dewole	Mechanics of Materials	Tata McGraw Hill Publishing co. Ltd., New Delhi	2005
4	D. K. Singh	Mechanics of Solids	Pearson Education New Delhi	2006
5	B. K. Sarkar	Strength of Materials	Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi	2006

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2. www.nptel.iitm.ac.in/COURSEs/WebCOURSE-contents/IIT
3. nptel.iitm.ac.in/COURSEs/IIT-MADRAS/Strength_of_Materials/
4. www.onlinevideolecture.com/civil-engineering/nptel-iit-kharagpur/strength-ofmaterials/?COURSE_id=704
5. www.nptel.iitm.ac.in/video.php?subjectId=105105108

16MED08 KINEMATICS OF MACHINERY **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To calculate mobility (number of degrees-of-freedom) and enumerate rigid links and types of joints within mechanisms.
- To identify the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
- To understand the kinematics of cam and its follower.
- To understand the basics of gear mechanism and gear trains.
- To classify the effects of friction in motion transmission and in machine components.

COURSE OUTCOMES

16MED08.CO1 Classify links and pairs of different mechanisms
16MED08.CO2 Analyze the displacement, velocity, and acceleration of various mechanisms
16MED08.CO3 Demonstrate the kinematics of cam and its follower.
16MED08.CO4 Calculate the geometrical parameters of gears and gear trains.
16MED08.CO5 Interpret the effects of friction in machine components.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MED08.CO1	X	X	X	X	-	X	-	-	-	-	-	-	X	-	-
16MED08.CO2	X	X	X	X	-	X	-	-	-	-	-	-	X	-	-
16MED08.CO3	X	X	X	X	-	X	-	-	-	-	-	-	X	-	-
16MED08.CO4	X	X	X	X	-	X	-	-	-	-	-	-	X	-	-
16MED08.CO5	X	X	X	X	-	X	-	-	-	-	-	-	X	-	-

UNIT I: BASICS OF MECHANISMS **9**

Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, Mobility – Kutzbach criterion, Gruebler's criterion – Grashof's Law – Kinematic inversions of four-bar chain and slider crank chains – Limit positions – Mechanical advantage – Transmission Angle – Description of some common mechanisms

UNIT II: KINEMATICS OF LINKAGE MECHANISMS **9**

Displacement, velocity and acceleration analysis of simple mechanisms – Graphical method– Velocity and acceleration polygons – Velocity analysis using instantaneous centres – kinematic analysis of simple mechanisms – Coincident points – Coriolis component of Acceleration – Introduction to linkage synthesis problem.

UNIT III: KINEMATICS OF CAM MECHANISMS **9**

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

UNIT IV: GEARS AND GEAR TRAINS **9**

Law of toothed gearing – Involutes and cycloidal tooth profiles –Spur Gear terminology and definitions – Gear tooth action – contact ratio – Interference and undercutting – Non-standard gear teeth – Helical, Bevel, Worm, Rack and Pinion gears [Basics only] – Gear trains – Speed ratio, train value – Parallel axis gear trains – Epicyclic Gear Trains – Differentials – Automobile gear box.

UNIT V: INTRODUCTION AND OVERVIEW OF EXPERIMENTAL DESIGN 9

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

TOTAL: L: 45

TEXT BOOKS

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1	Rattan, S.S,	Theory of Machines	Tata McGraw-Hill	2012
2	Khurmi, R.S	Theory of Machines	S Chand Publications	2015

REFERENCE BOOKS

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1	Norton.R. L,	Design of Machinery",	McGraw Hill,	2010
2	J. J. Uicker, G. R. Pennock, and J. E. Shigley	Theory of Machines and Mechanism	Oxford Press	2009
3	Thomas Bevan,	Theory of Machines	CBS Publishers and Distributors	2005
4	Syad and R. L. Singal	Kinematics of Machinery	Tech Mac Publishers,Chennai	2007
5	Sadhu Singh	Theory of Machines	Pearson Education, New Delhi	2007

WEB URLs

1. www.nptel.ac.in/syllabus/112104121/
2. www.nptelvideos.in/2012/12/kinematics-of-machines.html
3. www.youtube.com/watch?v=EVqBzOGQlkI
4. www.textofvideo.nptel.iitm.ac.in/112104121/lec34.pdf
5. www.freevideolectures.com/COURSE/2359/Kinematics-of-Machines

16MED09 **MANUFACTURING TECHNOLOGY** **L T P C**
2 0 4 4

COURSE OBJECTIVES

- To impart knowledge on the concepts and basic mechanism of metal cutting.
- To understand the constructional features and working principle of centre lathe and special purpose lathes.
- To familiarize the working principle of various machining operations such as milling, shaping, planning and drilling.
- To understand the various abrasive processes and broaching.
- To provide a nutshell knowledge about super finishing processes.

COURSE OUTCOMES

16MED09.CO1 Enumerate the concepts and basic mechanism of metal cutting for different working conditions.
16MED09.CO2 Compare the constructional features and working principle of centre lathe and special purpose lathes.
16MED09.CO3 Distinguish the operations of milling, shaping, planning and drilling.
16MED09.CO4 Summarize the types of abrasive processes, machines used and Broaching machines
16MED09.CO5 Discuss about various super finishing processesand their capabilities .

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MED09.CO1	X	X	X	-	-	X	-	-	-	-	-	X	-	-	X
16MED09.CO2	X	X	-	X	X	X	-	-	-	-	-	X	-	-	X
16MED09.CO3	X	-	X	X	X	-	-	-	-	-	-	X	-	-	X
16MED09.CO4	X	X	-	-	-	-	-	-	-	-	-	X	-	-	X
16MED09.CO5	X	X	-	-	-	-	-	-	-	-	-	X	-	-	X

UNIT I: THEORY OF METAL CUTTING **6**

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

UNIT II: TURNING MACHINES **6**

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: SHAPER, MILLING AND GEAR CUTTING MACHINES **6**

Shaper - Types of operations. Drilling, reaming, boring, Tapping. Milling operations-types of milling cutter. Gear cutting – forming and generation principle and construction of gear milling ,hobbing and gear shaping processes –finishing of gears.

UNIT IV: ABRASIVE PROCESS AND BROACHING **6**

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

UNIT V: METAL FINISHING PROCESSES **6**

Objectives of Surface Preparation, Characteristics of Surfaces, Surface Finishing Processes, Super finishing processes – Lapping, honing, polishing, and buffing - Lathe Attachments Used for Super Finishing – micromachining – wafer machining.

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TOTAL: L + P : 30+ 60 = 90

List of Exercises

1. Contour milling using vertical milling machine
2. Spur gear cutting in milling machine
3. Gear Generation / Helical Gear Cutting in hobbing machine
4. Plain Surface grinding
5. Cylindrical grinding
6. Tool angle grinding with tool and Cutter Grinder
7. Measurement of cutting forces in Milling / Turning Process
8. Centreless grinding
9. Machining in Capstan / Turret lathes
10. Practices in Radial drilling machine

TEXT BOOKS

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Hajra Choudhury	Elements of Workshop Technology	Media Promoters	2007
2	Rao. P.N	Manufacturing Technology - Metal Cutting and Machine Tools	Tata McGraw-Hill	2005

REFERENCE BOOKS

S. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Richerd R Kibbe, John E. Neely, Roland O. Merges and Warren J.White	Machine Tool Practices	Prentice Hall of India	2010
2	Jain.R.K	Production Technology : Manufacturing Processes, Technology and Automation	Khanna Publishers	2011
3	Geofrey Boothroyd	Fundamentals of Metal Machining and Machine Tools	Mc Graw Hill	2007
4	Roy. A.Lindberg	Manufacturing Technology - Metal Cutting and Machine Tools	PHI/Pearson Education	2006
5	Dr. B. Kumar	Manufacturing Technology	Khanna Publishers	2009

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1. www.universe.bits-pilani.ac.in/uploads/4%20metal%20cutting.pdf
2. www.csee.umbc.edu/COURSEs/471/papers/turing.pdf
3. www.nptel.ac.in/COURSEs/112105127/pdf/LM-32.pdf
4. www.srividyaengg.ac.in/elearn1/questionbank/Mech/QB114434.pdf
5. www.onlineCOURSEs.nptel.ac.in/noc16_me21/announcements

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16MED10 APPLIED HYDRAULICS AND PNEUMATICS

L T P C
3 0 0 3

COURSE OBJECTIVES

- To know the applications of Fluid Power Engineering in Power transmission system.
- To familiarize hydraulic system and its components.
- To design hydraulic circuits for various application.
- To understand pneumatic systems, related components used in a system.
- To design the pneumatic system circuits.

COURSE OUTCOMES

16MED10.CO1 Outline the fundamentals of fluid power systems
16MED10.CO2 Identify the hydraulic system and its components
16MED10.CO3 Construct the hydraulic circuits with design principles
16MED10.CO4 Select components for a pneumatic system
16MED10.CO5 Develop the pneumatic circuits for various applications

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MED10.CO1	X	X	X	X	-	X	X	-	-	X	-	X	X	-	-
16MED10.CO2	X	X	X	-	-	X	X	-	-	X	-	X	X	-	-
16MED10.CO3	X	X	X	-	-	-	X	-	X	X	-	-	X	-	-
16MED10.CO4	X	X	X	-	-	X	X	-	-	X	-	-	X	-	-
16MED10.CO5	X	X	X	-	-	-	X	-	X	X	-	-	X	-	-

UNIT I: FLUID POWER SYSTEMS AND FUNDAMENTALS 9

Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydraulic fluids – General types of fluids –Fluid power symbols. Basics of Hydraulics-Applications of Pascals Law- Laminar and Turbulent flow – Reynold's number – Darcy's equation – Losses in pipe, valves and fittings.

UNIT II: HYDRAULIC SYSTEM & COMPONENTS 9

Sources of Hydraulic Power: Pumping theory – Pump classification – Gear pump, Vane Pump, piston pump, construction and working of pumps – pump performance – Variable displacement pumps. Fluid Power Actuators: Linear hydraulic actuators – Types of hydraulic cylinders – Single acting, Double acting special cylinders like tanden, Rodless, Telescopic, Cushioning mechanism, Construction of double acting cylinder, Rotary actuators – Fluid motors, Gear, Vane and Piston motors.

UNIT III: DESIGN OF HYDRAULIC CIRCUITS 9

Construction of Control Components : Directional control valve – 3/2 way valve – 4/2 way valve – Shuttle valve – check valve – pressure control valve – pressure reducing valve, sequence valve, Flow control valve – Fixed and adjustable, electrical control solenoid valves, Relays, ladder diagram. Accumulators and Intensifiers: Types of accumulators – Accumulators circuits, sizing of accumulators, intensifier – Applications of Intensifier – Intensifier circuit.

UNIT IV: PNEUMATIC SYSTEMS AND COMPONENTS 9

Pneumatic Components: Properties of air – Compressors – Filter, Regulator, and Lubricator Unit – Air control valves, Quick exhaust valves, pneumatic actuators. Fluid Power Circuit Design, Speed control circuits, synchronizing circuit, Pneumo hydraulic circuit, Sequential circuit design for simple applications using cascade method.

UNIT V: DESIGN OF PNEUMATIC CIRCUITS 9

Servo systems – Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves. Fluidics – Introduction to fluidic devices, simple circuits, Introduction to Electro Hydraulic Pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuits; failure and troubleshooting.

TOTAL: L: 45

TEXT BOOKS

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Anthony Esposito	Fluid Power with Applications	Pearson Education	2005
2	Majumdar S.R	Oil Hydraulics Systems- Principles and Maintenance	Tata McGraw-Hill	2001

REFERENCE BOOKS

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Srinivasan.R	Hydraulic and Pneumatic controls	Vijay Nicole	2006
2	Shanmugasundaram.K	Hydraulic and Pneumatic controls	Chand & Co	2006
3	Majumdar S.R	Pneumatic systems– Principles and maintenance	Tata McGraw Hill	1995
4	Anthony Lal	Oil hydraulics in the service of industry	Allied publishers	1982
5	Harry L. Stevart D.B	Practical guide to fluid power	Taraoeala sons and Port Ltd	1976

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3. www.youtube.com/watch?v=z9wsUWaN-oY
4. www.youtube.com/watch?v=j7ierAP0fWE
5. www.youtube.com/watch?v=MVQ1wbQELJM

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16MED11 THERMAL ENGINEERING **L T P C**
3 0 2 4

(Use of standard refrigerant property data book, Steam Tables, Mollier diagram and Psychometric chart permitted)

COURSE OBJECTIVES

- To know about gas power cycles.
- To familiarize the working of IC engines.
- To learn the thermodynamic concepts in steam nozzles and turbine.
- To apply the concept in steam turbine and in air compressors
- To understand the concept of Refrigeration and air conditioning system

COURSE OUTCOMES

16MED11.CO1 Analyze the various gas power cycles
16MED11.CO2 Understand the working principle of IC engines, its components and compute it's performance.
16MED11.CO3 Design and analyze the steam nozzle & turbines.
16MED11.CO4 Analyze the various types of compressor and select according to the applications.
16MED11.CO5 Understand the basic concepts of different types of refrigeration and air conditioning systems, and to compute cooling load calculations

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MED11.CO1	X	X	X	X	-	X	X	-	X	-	-	X	X	-	-
16MED11.CO2	X	X	X	X	X	X	X	-	X	-	-	X	X	X	-
16MED11.CO3	X	X	X	X	-	-	X	-	X	X	-	X	X	X	X
16MED11.CO4	X	X	X	X	X	X	X	-	X	-	-	X	X	-	X
16MED11.CO5	X	X	X	X	X	X	X	-	X	-	X	X	X	-	X

UNIT I : GAS POWER CYCLES **9**

Otto, Diesel, Dual, Brayton cycles, Calculation of mean effective pressure, and air standard efficiency-Comparison of cycles.

UNIT II : INTERNAL COMBUSTION ENGINES **9**

Classification - Components and their function. Valve timing diagram and port timing diagram – actual and theoretical p-V diagram of four stroke and two stroke engines. Simple and complete Carburetor. MPFI, Diesel pump and injector system. Battery and Magneto Ignition System - Principles of Combustion and knocking in SI and CI Engines. Lubrication and Cooling systems. Performance calculation.

UNIT III : STEAM NOZZLES AND TURBINES **9**

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, supersaturated flow. Impulse and Reaction principles, compounding, velocity diagram for simple and multi-stage turbines, speed regulations –Governors.

UNIT IV : AIR COMPRESSOR **9**

Classification and working principle of various types of compressors, work of compression with and without clearance, volumetric efficiency, Isothermal efficiency and isentropic efficiency of reciprocating compressors, Multistage air compressor and inter cooling –work of multistage air compressor

UNIT V : REFRIGERATION AND AIR CONDITIONING **9**

Refrigerants - Vapour compression refrigeration cycle- super heat, sub cooling – Performance calculations - working principle of vapour absorption system, Ammonia –Water, Lithium bromide –water systems (Description only) . Air conditioning system - Processes, Types and Working Principles. - Concept of RSHF, GSHF, ESHF- Cooling Load calculations

TOTAL: L + P : 45+30 = 75

LIST OF EXPERIMENTS

THERMAL ENGINEERING LAB

1. Valve Timing and Port Timing Diagrams.
2. Performance Test on 4stroke Diesel Engine.
3. Heat Balance Test on 4-stroke Diesel Engine.
4. Morse Test on Multicylinder Petrol Engine.
5. Retardation Test to find Frictional Power of a Diesel Engine.
6. Determination of Viscosity –Red Wood Viscometer.
7. Determination of Flash Point and Fire Point.

STEAM LAB

8. Study of Steam Generators and Turbines.
9. Performance and Energy Balance Test on a Steam Generator.
10. Performance and Energy Balance Test on Steam Turbine

TEXT BOOKS

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Rajput. R. K.,	Thermal Engineering	S.Chand publishers	2000
2	Kothandaraman.C.P	A COURSE in Thermal Engineering	Fifth Edition, Dhanpat Rai & sons	2002

REFERENCE BOOKS

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Sarkar, B.K	Thermal Engineering	Tata McGraw-Hill Publishers	2007
2	Arora.C.P	Refrigeration and Air Conditioning	Tata McGraw-Hill Publishers	1994
3	Ganesan V	Internal Combustion Engines	Tata Mcgraw-Hill	2007
4	Rudramoorthy, R	Thermal Engineering	Tata McGraw-Hill	2003
5	Ramalingam. K.k	Thermal Engineering	SCITECH Publications	2009

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3. www.youtube.com/watch?v=Knxs2J7-Bps
4. www.youtube.com/watch?v=1MiQCBIx1mM
5. www.youtube.com/watch?v=-ldFk-eyqI8

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16MED12 AUTOMOBILE ENGINEERING **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To identify the different structures in automobile engineering.
- To realize the engine auxiliary systems such as fuel injection system, electrical system and ignition system.
- To understand the working principles of transmission systems.
- To scrutinize the working principle of different types of steering and brake systems.
- To Familiarize about alternative fuels and hybrid vehicles.

COURSE OUTCOMES

16MED12.CO1 Identify and select the proper automotive system for the vehicle
16MED12.CO2 Describe the engine auxiliary system used in SI and CI engine.
16MED12.CO3 Distinguish between the manual transmissions systems with automatic transmission systems.
16MED12.CO4 Demonstrate the working of steering, brakes and the suspension system.
16MED12.CO5 Interpret the importance of alternative fuels..

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MED12.CO1	X	X	X	X	-	-	X	-	-	X	-	X	-	-	-
16MED12.CO2	X	X	X	X	-	-	X	X	-	X	-	X	X	-	-
16MED12.CO3	X	X	X	X	-	-	X	-	-	X	-	X	X	-	-
16MED12.CO4	X	X	X	X	-	-	X	-	-	X	-	X	X	-	-
16MED12.CO5	X	X	X	X	-	X	X	-	-	X	-	X	-	-	-

UNIT I: VEHICLE STRUCTURE AND ENGINES **9**

Types of automobiles, vehicle construction and different layouts, chassis, frame and, body, Vehicle aerodynamics (various resistances and moments involved), IC engines –components functions and materials, variable valve timing (VVT).

UNIT II: ENGINE AUXILIARY SYSTEMS **9**

Electronically controlled gasoline injection system for SI engines, electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system, Emission norms (Euro and BS).

UNIT III: TRANSMISSION SYSTEMS **9**

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints ,Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.

UNIT IV: STEERING, BRAKES AND SUSPENSION SYSTEMS **9**

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control.

UNIT V: ALTERNATIVE ENERGY SOURCES **9**

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell

Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.

TOTAL: L: 45 = 45

TEXT BOOKS:

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Kirpal Singh	Automobile Engineering", Vol 1 & 2, Seventh Edition	Standard Publishers, New Delhi	1997
2	Jain K.K. and Asthana .R.B	Automobile Engineering	Tata McGraw Hill Publishers, New Delhi	2002

REFERENCE BOOKS:

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Newton ,Steeds and Garet	Motor Vehicles	Butterworth Publishers	2010
2	Joseph Heitner	Automotive Mechanics, Second Edition	Second Edition, East-West Press	2004
3	Martin W, Stockel and Martin T Stockle	Automotive Mechanics Fundamentals	The Good heart Will Cox Company Inc, USA	2014
4	Heinz Heisler	Advanced Engine Technology	SAE International Publications USA	2016
5	Ganesan V	Internal Combustion Engines, Third Edition	Tata McGraw-Hill.	2007

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16MED13 HEAT AND MASS TRANSFER **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To understand, the basic concepts of conduction, convection and radiation and its applications.
- To differentiate free and forced convection and solve problems for each applications.
- To analyze the phase change heat transfer and sizing of heat exchangers.
- To acquire knowledge on radiation, the various laws of radiation, shape factor.
- To study convective mass transfer, its types and applications.

COURSE OUTCOMES

16MED13.CO1 Recognize the real time applications of solid medium heat transfer
16MED13.CO2 Describe the real time applications of fluid medium heat transfer
16MED13.CO3 Express the knowledge of design skills of heat exchangers
16MED13.CO4 Illustrate the real time applications of radiation mode of heat transfer
16MED13.CO5 Relate the skill of mass transfer and its applications.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MED13.CO1	X	X	-	X	X	-	-	-	-	X	-	-	X	-	X
16MED13.CO2	X	X	-	-	X	-	-	-	-	X	X	X	X	-	X
16MED13.CO3	X	X	X	X	X	-	-	-	-	X	-	X	X	X	X
16MED13.CO4	X	X	X	X	-	-	-	-	-	-	-	X	X	X	-
16MED13.CO5	X	X	X	X	-	-	-	-	-	X	-	X	X	-	-

UNIT I: CONDUCTION **9**

Basic Concepts – Mechanism of Heat Transfer – Conduction, Convection and Radiation – Fourier Law of Conduction - General Differential Conduction equation in Cartesian and Cylindrical Coordinate systems – One Dimensional Steady State Heat Conduction through Plane Wall, Cylindrical and Spherical systems – Composite Systems – Critical thickness of insulation - Conduction with Internal Heat Generation – Extended Surfaces – Numerical Methods of One dimensional Heat conduction- Unsteady Heat Conduction – Lumped Analysis, Infinite and semi Infinite solids using Heislers Chart.

UNIT II: CONVECTION **9**

Basic Concepts – Convective Heat Transfer Coefficients – Boundary Layer Concept – Types of Convection – Forced Convection – Dimensional Analysis – External Flow – Flow over Plates, Cylinders and Spheres – Internal Flow – Laminar, Turbulent and Combined flows – Flow over Bank of tubes – Free Convection – Dimensional Analysis – Flow over Vertical, Horizontal and Inclined Plates, Cylinders and Spheres.

UNIT III: PHASE CHANGE AND HEAT EXCHANGERS **9**

Nusselts theory of condensation - Regimes in boiling - Correlations in condensation and boiling - Types of Heat Exchangers- compact heat exchanger – Overall Heat Transfer Coefficient – Fouling Factors - LMTD and Effectiveness – NTU methods of Heat Exchanger Analysis

UNIT IV: RADIATION **9**

Basic Concepts, Laws of Radiation – Black Body Radiation – Grey body radiation –radiation shield - Shape Factor Algebra (Plates, parallel, perpendicular, parallel circular disc) – Gas radiations (qualitative study).

UNIT V: MASS TRANSFER **9**

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations. **TOTAL L + P = 45 + 30 = 75**

LIST OF EXPERIMENTS

1. Thermal conductivity measurement by guarded plate method.
2. Thermal conductivity of pipe insulation using lagged pipe apparatus.
3. Natural convection heat transfer from a vertical cylinder.
4. Forced convection inside tube.
5. Heat transfer from pin-fin(natural & forced convection modes)
6. Determination of Stefan-Boltzmann constant.
7. Determination of emissivity of a gray surface. 8. Effectiveness of Parallel/counter flow heat exchanger.

REFRIGERATION AND AIR CONDITIONING

8. Determination of COP of a refrigeration system.
9. Experiments on air-conditioning system.
10. Performance test on single/two stage reciprocating air compressor.

TEXT BOOKS:

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Frank P Incropera and David P DeWitt	Fundamentals of Heat and Mass Transfer	John Wiley and Sons, New York	2011
2	Yunus Cengel and Afshin Ghajar	Heat and Mass Transfer (SI Unit)	McGraw Hill, New York	2011

REFERENCE BOOKS

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Sachdeva R C	Fundamentals of Engineering Heat and Mass Transfer	New Age International	2010
2	Yunus Cengal	Heat and Mass Transfer	Tata McGraw Hill	2014
3	Holman J.P	Heat Transfer	Tata Mc Graw Hill	2009
4	Nag P.K	Heat Transfer	Tata McGraw-Hill, New Delhi	2011
5	Kothandaraman.C.P	Fundamentals of Heat and Mass Transfer	New Age International, New Delhi	2006

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16MED14 **DESIGN OF MACHINE ELEMENTS** **L T P C**
3 2 0 4

(Use of approved Design Data book is permitted)

COURSE OBJECTIVES

- To select the materials based on mechanical properties, different types of loading, simple, steady and variable stresses.
- To know the design procedure for various types of shafts, keys and couplings.
- To design the threaded fasteners, bolted joints including eccentric loading and welded joints for pressure vessels and structures.
- To design the various types of springs like helical, leaf, disc and torsional springs.
- To state the design procedure for various types of bearings and flywheel

COURSE OUTCOMES

16MED14.CO1 Compare and Select the materials based on mechanical properties for various stress types
16MED14.CO2 Apply the design procedure for various types of shafts, keys and couplings.
16MED14.CO3 Solve the problems related to threaded fasteners, bolted joints and welded joints
16MED14.CO4 Respond to the problems related to springs
16MED14.CO5 Design various types of bearings like sliding contact, rolling contact bearing and flywheels

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MED14.CO1	X	X	-	-	-	X	-	-	-	-	-	-	X	-	-
16MED14.CO2	X	X	X	-	-	X	-	-	-	-	-	-	X	-	-
16MED14.CO3	X	-	X	-	-	X	-	-	-	-	-	-	X	-	-
16MED14.CO4	X	X	X	-	-	X	-	-	-	-	-	-	X	-	-
16MED14.CO5	X	-	X	-	-	X	-	-	-	-	-	-	X	-	-

UNIT I: STEADY AND VARIABLE STRESSES **9**

Introduction to the design process - factor influencing machine design, selection of materials based on mechanical properties, preferred numbers – direct, bending and torsional stress equations – calculation of principle stresses for various load combinations, eccentric loading – design of curved beams – crane hook and 'c' frame - factor of safety - theories of failure – stress concentration – design for variable loading – Soderberg, Goodman and Gerber relations.

UNIT II: DESIGN OF SHAFTS AND COUPLINGS **9**

Design of Solid And Hollow Shafts Based on Strength And Rigidity – Design Of Keys - Design Of Rigid And Flexible Couplings.

UNIT III: DESIGN OF FASTNERS AND WELDED JOINTS **9**

Threaded fasteners - design of bolted joints including eccentric loading – design of welded joints for structures.

UNIT IV: DESIGN OF SPRINGS **9**

Design of helical, leaf and torsional springs under constant loads and varying loads – concentric torsion springs - belleville springs introduction to modern spring like wave spring, constant force spring (theory only).

UNIT V: DESIGN OF BEARINGS AND FLYWHEELS **9**

Design of bearings – sliding contact and rolling contact types. – cubic mean load – design of journal bearings – mckees equation – lubrication in journal bearings – calculation of bearing dimensions – design of flywheels involving stresses in rim and arm.

TOTAL: L: 45 + T: 30 =75

TEXT BOOKS

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Richard G Budynas J.Keith Nisbett	Shigley's Mechanical Engineering Design	Mc Graw Hill	2011
2	Khurmi R.S, Gupta J.K	Machine Design	Eurasia publishing house	2005

REFERENCE BOOKS

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Norton R.L	Design of Machinery	Tata mcgraw-hill book co	2002
2	Orthwein W	Machine Component Design	Jaico Publishing co	2003
3	Ugural A.C	Mechanical Design – An Integral Approach	Mcgraw-hill book co	2004
4	Spotts M.F., Shoup T.E	Design and Machine Elements	Pearson Education	2004
5	V B Bhandari	Design of Machine Elements	Tata Mcgraw-hill.	2007

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3. www.web.iitd.ac.in/~hirani/MEL311.pdf
4. www.youtube.com/watch?v=NDqCKuEdk-M
5. www.nait.ca/course_MCEN2334.htm

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16MED15 GAS DYNAMICS AND JET PROPULSION

L T P C
3 0 0 3

COURSE OBJECTIVES

- To understand the basic concepts of isentropic flows.
- To analyze the heat transfer and friction of flow through ducts.
- To infer about Normal shock and oblique shock.
- To summarizes the theory behind jet propulsion.
- To predict the parameters for space propulsion.

COURSE OUTCOMES

16MED15.CO1 Generalize the basic concepts of isentropic flows.
16MED15.CO2 Compute the variation of properties in a flow with friction and heat transfer
16MED15.CO3 Calculate the Normal and Oblique shock parameters in a compressible flow
16MED15.CO4 Associate the concepts and working priniples of aircraft engines
16MED15.CO5 Summarize the theory of rocket propulsion and types of rocket engines

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MED15.CO1	X	X	X	X	X	X	-	-	X	-	-	-	-	-	-
16MED15.CO2	X	X	X	X	X	X	-	-	X	-	-	-	-	-	-
16MED15.CO3	X	X	X	X	X	X	-	-	X	-	-	-	-	-	-
16MED15.CO4	X	X	X	X	X	X	-	-	X	-	-	-	-	-	-
16MED15.CO5	X	X	X	X	X	X	-	-	X	-	-	-	-	-	-

UNIT I : BASIC CONCEPTS AND ISENTROPIC FLOWS 9

Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone – Effect of Mach number on compressibility – Isentropic flow through variable ducts –Nozzle and Diffusers

UNIT II : FLOW THROUGH DUCTS 9

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties

UNIT III : NORMAL AND OBLIQUE SHOCKS 9

Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl – Meyer relations – Applications.

UNIT IV : JET PROPULSION 9

Theory of jet propulsion – Thrust equation – Thrust power and propulsive efficiency – Operating principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines.

UNIT V : SPACE PROPULSION 9

Types of rocket engines – Propellants-feeding systems – Ignition and combustion – Theory of rocket propulsion – Performance study – Staging – Terminal and characteristic velocity – Applications –space flights.

TOTAL: L: 45=45

16MED19 METROLOGY AND MEASUREMENTS

L T P C
3 0 2 4

COURSE OBJECTIVES

- To provide knowledge on various Metrological equipments available to measure the dimension of the components.
- To educate students on different measurement systems and on common types of errors
- To introduce measuring equipments used for linear and angular measurements
- To familiarize students with surface roughness measurements on machine components
- To give knowledge about thermocouples, thermometers and flow meters used for measurements

COURSE OUTCOMES

16MED19.CO1 Discuss various measurement standards
16MED19.CO2 Classify linear and angular measurements in Engineering applications.
16MED19.CO3 Review the various form measurement Techniques
16MED19.CO4 Catalogue the advances in laser metrology
16MED19.CO5 Measure physical properties using various instruments

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MED19.CO1	X	X	X	X	-	X	-	-	-	-	-	X	X	-	X
16MED19.CO2	X	X	X	X	-	X	-	-	-	-	-	X	-	-	-
16MED19.CO3	X	X	X	X	-	X	-	-	-	-	-	X	X	X	-
16MED19.CO4	X	X	X	X	-	X	-	-	-	-	-	X	-	X	X
16MED19.CO5	X	X	X	X	-	X	-	-	-	-	-	X	X	X	X

UNIT I: BASICS OF METROLOGY 5

Introduction to Metrology – Need – Elements – Work piece, Instruments – Persons – Environment – their effect on Precision and Accuracy – Errors – Errors in Measurements – Types – Control – Types of standards.

UNIT II: LINEAR AND ANGULAR MEASUREMENTS 10

Linear Measuring Instruments – Evolution – Types – Classification – Limit gauges – gauge design – terminology – procedure – concepts of interchange ability and selective assembly – Angular measuring instruments – Types – Bevel protractor clinometers angle gauges, spirit levels sine bar – Angle alignment telescope – Autocollimator – Applications.

UNIT III: ADVANCES IN METROLOGY 12

Basic concept of lasers Advantages of lasers – laser Interferometers – types – DC and AC Lasers interferometer – Applications – Straightness – Alignment. Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Basic concepts of Machine Vision System – Element – Applications.

UNIT IV: FORM MEASUREMENT 10

Principles and Methods of straightness – Flatness measurement – Thread measurement, gear measurement, surface finish measurement, Roundness measurement – Applications.

UNIT V: MEASUREMENT OF POWER, FLOW AND TEMPERATURE 8

Force, torque, power - mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement: Venturimeter, Orifice meter, rotameter, pitot tube – Temperature: bimetallic strip, thermocouples, electrical resistance thermometer – Reliability and Calibration – Readability and Reliability.

TOTAL: L + P: 45 +30=75

LIST OF EXPERIMENTS

1. Tool Maker's Microscope
2. Comparator
3. Sine Bar
4. Gear Tooth Vernier Caliper
5. Floating gauge Micrometer
6. Co ordinate Measuring Machine
7. Surface Finish Measuring Equipment
8. Vernier Height Gauge
9. Bore diameter measurement using telescope gauge
10. Bore diameter measurement using micrometer
11. Force Measurement
12. Torque Measurement
13. Temperature measurement
14. Autocollimator

TEXT BOOKS:

S.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Jain R.K	Engineering Metrology	Khanna Publishers	2005
2	Gupta. I.C.,	Engineering Metrology	Dhanpatrai Publications	2005

REFERENCE BOOKS:

S.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Charles Reginald Shotbolt,	Metrology for Engineers	Cengage Learning EMEA	1990
2	Backwith, Marangoni, Lienhard	Mechanical Measurements",	Pearson Education	2006
3	Jay.L.Bucher	The Metrology Handbook	Measurement Quality Division (ASQ)	2015
4	L.V. Ragavendra and L.Krishnamoorthy	Engineering Metrology and Measurements	Oxford Higher Education	2013
5	Anand K. Bewoor Vinay A . Kulgarni	Metrology and Measurements	McGraw Hill Companies	2016

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16MEE20 POWER PLANT ENGINEERING **L T P C**
3 0 0 3

OBJECTIVES:

- To Provide an overview of Power Plants and detailing the role of Mechanical Engineers in their operation and maintenance.
- To understand about Thermal power plants and working
- To know about Diesel engine power plants and working
- To know the working of Nuclear power plants and other power plants
- To understand Environmental problems related to power plants

OUTCOMES :

16MEE20.CO1 Describe the working principle of Coal based power plants.
16MEE20.CO2 Illustrate the working principle of diesel,gas turbine and compined cycle power plants.
16MEE20.CO3 Generalize the construction and working of nuclear power plant.
16MEE20.CO4 Explain the techniques to extract power from renewable energy sources
16MEE20.CO5 Summarize the economics and environmental issues of power plants.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEE20.CO1	X	X	X	X	X	X	-	-	-	-	-	X	-	-	-
16MEE20.CO2	X	-	-	X	-	-	-	-	-	-	-	X	-	-	-
16MEE20.CO3	X	X	X	X	X	X	-	-	-	-	-	X	-	-	-
16MEE20.CO4	X	-	X	X	X	X	-	-	-	-	-	X	-	-	-
16MEE20.CO5	X	X	X	X	X	X	-	-	-	-	-	X	-	-	-

UNIT I: COAL BASED THERMAL POWER PLANTS **9**

Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

UNIT II: DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS **9**

Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

UNIT III: NUCLEAR POWER PLANTS **9**

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium-Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measuresfor Nuclear Power plants.

UNIT IV: POWER FROM RENEWABLE ENERGY **9**

Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, *Solar* Photo Voltaic (SPV), SolarThermal, Geo Thermal, Biogas and Fuel Cell power systems.

UNIT V: ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS **9**

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria,relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

TOTAL : L: 45

List of Experiments

1. Introduction of 3D Modeling software

Creation of 3D assembly model of following machine elements using 3D Modeling software

1. Flange Coupling
2. Plummer Block
3. Screw Jack
4. Lathe Tailstock
5. Universal Joint
6. Machine Vice
7. Stuffing box
8. Crosshead
9. Safety Valves
10. Non-return valves
11. Connecting rod
12. Piston
13. Crankshaft

* Students may also be trained in manual drawing of some of the above components

2. Manual Part Programming.

(i) Part Programming - CNC Machining Centre a) Linear Cutting.

b) Circular cutting.

c) Cutter Radius Compensation. d) Canned Cycle Operations.

(ii) Part Programming - CNC Turning Centre a) Straight, Taper and Radius Turning.

b) Thread Cutting.

c) Rough and Finish Turning Cycle. d) Drilling and Tapping Cycle.

TEXT BOOKS:

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Ibrahim Zeid	Mastering CAD CAM	Tata McGraw-Hill Publishing Co.	2007
2.	Radhakrishnan.P	"CAD / CAM / CIM"	New age international	2008

REFERENCE BOOKS:

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Chris McMahon and Jimmie Browne	CAD/CAM Principles	Pearson Education	1999
2.	William M Neumann and Robert F.Sproul	Principles of Computer Graphics	McGraw Hill Book Co. Singapore,	1996
3.	Donald Hearn and M. Pauline Baker	Computer Graphics	Prentice Hall, Inc,	2014
4.	Foley, Wan Dam, Feiner and Hughes	Computer graphics principles & practice	Pearson Education	2003
5.	Chriss Mcmahon and Jimmie Browne	CAD/CAM	Addision Wesly, New York	2000

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TEXT BOOKS

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Anderson, J.D	Modern Compressible flow	3rd Edition, McGraw Hill	2003
2	Yahya, S.M	Fundamentals of Compressible Flow	New Age International (P) Limited	2014

REFERENCE BOOKS

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Ganesan. V	Gas Turbines	Tata McGraw Hill Publishing Co	2003
2	Cohen. H	Gas Turbine Theory	Longman Group Ltd	2010
3	Shapiro. A.H	Dynamics and Thermodynamics of Compressible fluid Flow	John wiley	2017
4	Sutton. G.P	Rocket Propulsion Elements	John wiley	2017
5	Zucrow. N.J	Aircraft and Missile Propulsion	John Wiley	2003

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3. www.youtube.com/watch?v=S0Z67cvqna0
4. www.youtube.com/watch?v=dXFT6bhVhro
5. www.youtube.com/watch?v=lmrwYdt3Ik0

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16MED16 DYNAMICS OF MACHINES **L T P C**
3 0 2 4

OBJECTIVES

- To learn about the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.
- To impart knowledge on static and dynamic balancing.
- To understand the concept of single degree of freedom of vibrations and its damping mechanism.
- To gain knowledge on the basic vibrations on the constrained body and its critical position of vibrations.
- To understand principles in mechanisms used for governing of machines.

COURSE OUTCOMES

16MED16.CO1 Calculate the static, dynamic ,Inertia forces and inertia torque on the reciprocating engines

16MED16.CO2 Analyze the concepts of balancing mechanisms of different types of engines and machines

16MED16.CO3 Predict the concept of free vibration and application

16MED16.CO4 Comprehend the vibration occurring in the moving system and its application.

16MED16.CO5 Analyze the concept of control mechanism and its application

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MED16.CO1	X	X	X	X	-	X	-	-	-	X	-	-	X	-	-
16MED16.CO2	X	X	-	X	-	X	-	-	-	X	-	X	X	-	-
16MED16.CO3	X	X	X	X	-	X	-	-	X	X	-	X	X	-	-
16MED16.CO4	X	X	X	X	-	X	-	-	X	X	-	X	X	-	-
16MED16.CO5	X	X	-	X	-	X	-	-	X	X	-	X	X	-	X

UNIT I : FORCE ANALYSIS **9**

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

UNIT II: BALANCING **9**

Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder engine – Balancing Multi-cylinder engines – Partial balancing in locomotive engines – Balancing of linkages – Balancing machines.

UNIT III : SINGLE DEGREE FREE VIBRATION **9**

Basic features of vibratory systems – Degrees of freedom – single degree of freedom – Free vibration – Equations of motion – Natural frequency – Types of Damping – Damped vibration – Torsional vibration of shaft – Critical speeds of shafts – Torsional vibration – Two and three rotor torsional systems.

UNIT IV : FORCED VIBRATION **9**

Response of one degree freedom systems to periodic forcing – Harmonic disturbances –
Disturbance caused by unbalance – Support motion –transmissibility – Vibration isolationvibration measurement.

UNIT V: MECHANISM FOR CONTROL **9**

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

TOTAL: L + P: 45 +30 = 75

LIST OF EXPERIMENTS

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

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Shigley	Theory of Machines and Mechanisms	Oxford University Press	2009
2.	Sadhu Singh	Theory of Machines	Pearson Education	2002

REFERENCES:

1.	Rattan. S.S	Theory of Machines	Tata McGraw-Hill	2009
2.	Thomas Bevan	Theory of Machines	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	2007
5	Ballaney.P.L	Theory of Machines	Khanna Publishers	2001

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2. www.uobabylon.edu.iq/uobColeges/ad_downloads/4_1293_515.pdf
3. www.scribd.com/Theory-of-Machines-and-Mechanisms-Uicker.
4. www.chegg.com › study › solutions manuals
5. www.makted.org.tr/kaynaklar/ders.../1.IntroductionToMechanisms.pdf

16MED17 DESIGN OF TRANSMISSION SYSTEMS **L T P C**
3 0 0 3

(Use of approved Design Data book is permitted)

OBJECTIVES

- To learn the procedure of simple selection and design the flexible elements
- To impart knowledge on spur gear force analysis dynamic effects gear materials.
- To impart knowledge on the principles and procedure for the design of helical gears
- To know about the bevel and worm gear design.
- To impart knowledge on the stresses occurred in clutch and breaks.

COURSE OUTCOMES

16MED17.CO1 Design the various transmission systems like belt, chain, rope
16MED17.CO2 Understand the design concepts of related to spur, parallel axis helical gears.
16MED17.CO3 Design the bevel, worm and cross helical gears based on the mechanisms chosen for building of various machines.
16MED17.CO4 Understand the design concepts of gear box for both constant speed and variable number of speeds in the transmission systems
16MED17.CO5 Know the design concepts of clutches and brakes to solve practical problems

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MED17.CO1	X	X	X	-	-	-	-	-	-	-	-	-	X	-	-
16MED17.CO2	X	X	X	-	-	-	-	-	-	-	-	-	X	X	-
16MED17.CO3	X	X	X	-	-	-	-	-	-	-	-	-	X	-	-
16MED17.CO4	X	X	X	-	-	-	-	-	-	-	-	-	X	-	-
16MED17.CO5	X	-	-	-	X	-	-	-	-	-	-	-	-	X	-

UNIT I : DESIGN OF TRANSMISSION SYSTEMS FOR FLEXIBLE LEMENTS **9**

Design of flat belt, V - Belt and pulleys - Design of Wire Ropes and pulleys - Selection of flat belts and pulleys – V belts and pulleys – Selection of Wire ropes and pulleys - Introduction to modern transmission systems.

UNIT II: DESIGN OF SPUR GEARS AND PARALLEL AXIS HELICAL GEARS **9**

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 – Pressure angle in the normal and transverse plane- Equivalent number of teeth-forces for helical gears.

UNIT III: DESIGN OF BEVEL AND WORM GEARS **9**

Design of Straight bevel gears: Tooth terminology- Tooth forces and stresses – Equivalent number of teeth. Worm Gear: Terminology – Thermal capacity – materials - forces and stresses and Efficiency - Design of Worm gear – Estimating the size of the worm gear pair.

UNIT IV : DESIGN OF GEAR BOXES **9**

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.

UNIT V: DESIGN OF CLUTCHES AND BRAKES **9**

Cam Design: Types-pressure angle and under cutting base circle determination-forces and surface stresses. Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutches-shoe and band brakes - external shoe brakes – Internal expanding shoe brake - Electromagnetic clutches

TOTAL:L: 45

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Bhandari V,	Design of Machine Elements	Tata McGraw-Hill Book Co	2010
2.	Juvinall, R	Fundamentals of Machine Component Design	John Wiley and Sons	2002

REFERENCE BOOKS:

1.	Orthwein W	Machine Component Design	Jaico Publishing Co	2003
2.	Prabhu, T.J	Design of Transmission Elements	Mani Offset	2000
3.	Hamrock B.J.,	Fundamentals of Machine Elements	McGraw - Hill Book Co	2009
4	Maitra, G.M. and L.V.Prasad	Hand book of Mechanical Design	Tata McGraw - Hill	2015
5	Joseph Shigley	Mechanical Engineering Design	Tata McGraw-Hill	2008

WEB URLs

1. www.sites.google.com/site/designoftransmissionsystems/Design-of-Flexible-Elements
2. www.nptel.ac.in/COURSEs/112106137/pdf/2_11.pdf
3. www.cs.cmu.edu/~rapidproto/mechanisms/chpt7.html
4. www.cybra.lodz.pl/Content/3714/DesignBasicInd.pdf
5. www.thomsonlinear.com/downloads/clutches_brakes/Clutches_Brakes_cten.pdf

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16MED18 **COMPUTER AIDED DESIGN** **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To provide an overview of how computers are being used in mechanical component design
- To make the students understand the computer graphics fundamentals, various data exchange formats that is used in design software
- To know the geometric modeling concepts different solids.
- To know the mating conditions of the different solids
- To build the students to identify with the various file types used in the CAD software

COURSE OUTCOMES

16MED18.CO1 Use the geometric transformations concepts in desgin, modeling of simple components.
16MED18.CO2 Apply the various representation of geometric curves, surfaces, solids elements.
16MED18.CO3 Demonstrate visual realism techniques to develop the geometrical models in design
16MED18.CO4 Combine mechanical parts drawing to functional models.
16MED18.CO5 Use the geometrical data exchanging formats to transfer CAD Models between various platforms.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MED18.CO1	X	-	X	-	X	-	-	-	-	-	-	-	X	-	-
16MED18.CO2	X	-	X	-	X	-	-	-	-	-	-	-	X	-	-
16MED18.CO3	X	-	X	-	X	-	-	-	-	-	-	-	X	-	-
16MED18.CO4	X	-	X	-	X	-	-	-	-	-	-	-	X	-	-
16MED18.CO5	X	-	X	-	X	-	-	-	-	-	-	-	-	X	-

UNIT I: FUNDAMENTALS OF COMPUTER GRAPHICS 9

Product cycle- Design process- sequential and concurrent engineering- Computer aided design – CAD system architecture- Computer graphics – co-ordinate systems- 2D and 3D transformations homogeneous coordinates - Line drawing -Clipping- viewing transformation

UNIT II: GEOMETRIC MODELING 9

Representation of curves- Hermite curve- Bezier curve- B-spline curves-rational curves-Techniques for surface modeling – surface patch- Coons and bicubic patches- Bezier and B-spline surfaces. Solid modeling techniques- CSG and B-rep

UNIT III: VISUAL REALISM 9

Hidden – Line-Surface-Solid removal algorithms – shading – colouring – computer animation.

UNIT IV: ASSEMBLY OF PARTS 9

Assembly modelling – interferences of positions and orientation – tolerance analysis-massproperty calculations – mechanism simulation and interference checking.

UNIT V: CAD STANDARDS 9

Standards for computer graphics- **Graphical Kernel System** (GKS) - standards for exchangeimages- **Open** Graphics Library **(OpenGL)** - Data exchange standards - IGES, STEP, CALS etc. - communication standards.

TOTAL: L + P: 45 + 30=75

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Nag. P.K.,	Power Plant Engineering	Tata McGraw – Hill	2010
2	C. Elanchezhian, L. Saravanakumar, B. Vijaya Ramnath	Power Plant Engineering	I.K.International Publishing house pvt ltd	2007

REFERENCE BOOKS:

1.	El-Wakil. M.M	Power Plant Technology	Tata McGraw – Hill Publishing Company Ltd.,	2010
2.	Thomas C. Elliott	Power Plant Engineering	Standard Handbook of McGraw – Hill	2003
3.	Godfrey Boyle	Renewable energy	Oxford University Press	2004
4	R.K.Rajput	Power Plant Engineering	Laxmi Publications	2016
5	S. C. Arora and S. Domkundwar	A COURSE in Power Plant Engineering	Dhanpatrai & Sons,	2008

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16MED21 FINITE ELEMENT ANALYSIS **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To obtain an understanding of the fundamental theory of the FEA method
- To understand the application and use of the FE method for heat transfer problems.
- To understand the use of the basic finite elements for structural applications using truss, beam, frame and plane elements.
- To understand the Overview of application packages such as ANSYS and DEFORM.
- To understand the basic step to involve the Solutions Techniques to Dynamic problems.

COURSE OUTCOMES

16MED21.CO1 Summarize the basics of finite element formulation.
16MED21.CO2 Demonstrate the finite element formulations to solve one dimensional Problems.
16MED21.CO3 Execute two dimensional scalar Problems using finite element formulations.
16MED21.CO4 Construct two dimensional Vector solutions
16MED21.CO5 Solve problems on iso parametric element and dynamic elements.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MED21.CO1	X	X	X	X	-	X	-	-	-	X	-	X	X	-	X
16MED21.CO2	X	X	X	X	-	X	-	-	-	X	-	X	-	-	-
16MED21.CO3	X	X	X	X	-	X	-	-	-	-	-	X	X	X	-
16MED21.CO4	X	X	X	X	-	X	-	-	-	-	-	X	-	X	X
16MED21.CO5	X	X	X	X	-	X	-	-	-	X	-	X	X	X	X

UNIT I: INTRODUCTION 9

Basics of FEM – Initial value and boundary value problems – weighted residual Galerkin and Raleigh Ritz methods – Integration by parts – Basics of Variational formulation.

UNIT II: ONE DIMENSIONAL ANALYSIS 9

Steps in FEA – Discretization, function – derivation of element characteristics matrix, shape function, assembly and imposition of boundary conditions – solution and post processing – One dimensional analysis in solid mechanics and heat transfer.

UNIT III: TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS 9

Second Order 2D Equations involving Scalar Variable Functions-Variational formulation-Finite Element Formulation-Triangular Elements-Shape function and Element Matrices and Vectors. Application to Field Problems-Thermal Problems-Higher Order Elements

UNIT IV: TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS 9

Equations of elasticity – Plane stress, plane strain and Axisymmetric problems – Body forces and temperature effects – Stress calculations - Plate and shell elements.

UNIT V: ISOPARAMETRIC FORMULATION 9

Natural co-ordinate systems – Isoparametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems– Solutions Techniques to Dynamic problems.

TOTAL:L+P:45+30 = 75

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LIST OF EXPERIMENTS

A. SIMULATION

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

B. ANALYSIS

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

TEXT BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Reddy. J.N.,	An Introduction to the Finite Element Method	Tata McGraw-Hill	2010
2.	Seshu, P	Text Book of Finite Element Analysis	Prentice-Hall of India Pvt. Ltd	2010

REFERENCE BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Bathe, K.J	Finite Element Procedures in Engineering Analysis	John Wiley & Sons	2003
2	Kobayashi S	Metal Forming and the Finite-Element Method	Oxford University Press, USA	2001
3	Lewis, R.W	The Finite Element Method in Heat Transfer Analysis	John Wiley & Sons	2010
4	Stanley Middleman Middleman	An Introduction to Fluid Dynamics 01 Edition	John Wiley & Sons	2015
5	Huang Usmani	Finite Element Analysis for Heat Transfer	Springer London	2012

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2. www.Principal_Publications/FEP_solutions.pdf
3. www.books.google.co.in/books?id=2mVqtW7BDpgC&printsec=frontcover#v=onepage&q&f=false
4. www.vmkvec.ac.in/departments/mechanical/me-manu-ft.pdf
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16MED22 ENGINEERING ECONOMICS AND COST ANALYSIS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To facilitate students to understand the fundamental economic concepts applicable to engineering.
- To learn the techniques of incorporating inflation factor in economic decision making.
- To know about the basic law of economics ,how to organize a business, the financial aspects related to business, different methods of appraisal of projects and pricing techniques.
- To understand the methods by which Demand Forecasting, Cost Analysis, Pricing and Financial Accounting are done in the Industry.
- To learn about the basics of economics and cost analysis related to product depreciation.

COURSE OUTCOMES:

16MED22.CO1 Summarize the basic Concepts of Engineering Economics, Law of demand and supply, Economic efficiency , Break-even analysis and product analysis.

16MED22.CO2 Explain the importance of value engineering, make or buy decision and Time value of money.

16MED22.CO3 Ability to analyze the various type Cash flows.

16MED22.CO4 Know the concepts of Cost Estimation and accounting , Elemental costs.

16MED22.CO5 Describe the various methods of depreciation, inflation and evaluation of public alternatives.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MED22CO1	X	-	-	-	X	X	X	-	-	-	X	X	-	X	-
16MED22.CO2	X	X	-	X	-	-	-	-	-	-	X	X	X	X	-
16MED22.CO3	X	X	-	-	-	X	X	-	-	-	X	-	X	-	-
16MED22.CO4	X	-	X	-	-	-	X	-	-	-	X	-	X	X	-
16MED22.CO5	X	X	X	-	-	-	X	-	-	-	X	-	-	X	-

UNIT I: ENGINEERING ECONOMICS **9**

Introduction – Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics , Break-even analysis - Elementary economic Analysis – Production Analysis – simple problems.

UNIT II: VALUE ENGINEERING **9**

Value engineering – Function, aims, Value engineering procedure- make or buy decisions –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor-problems in all the methods.

UNIT III : CASH FLOW **9**

Methods of comparison of alternatives – present worth method , Future worth method ,Annual equivalent method ,rate of return method, Examples in all the methods using Revenue dominated cash flow diagram, cost dominated cash flow diagram .

UNIT IV : COSTING **9**

Objective of cost estimation- costing – cost accounting- classification of cost- Elements of cost. Types of estimates – methods of estimates – data requirements and sources- collection of cost-allowances in estimation.

UNIT V: DEPRECIATION 9

Define Depreciation- Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation.

TOTAL:L: 45

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Panneer Selvam.R	Engineering Economics	Prentice Hall of India Ltd	2012
2.	Banga T.R., and Sharma S.C	Mechanical Estimation and Costing	Khanna Publishers	2011

REFERENCES BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Chan S.Park	Contemporary Engineering Economics	Prentice Hall of India	2011
2.	Donald.G. Newman, Jerome.P.Lavelle	Engineering Economics and analysis	Engg. Press, Texas	2010
3.	Degarmo, E.P., Sullivan, W.G and Canada, J.R	Engineering Economy	Macmillan, New York	2011
4.	Zahid A khan	Engineering Economy	Dorling Kindersley	2012
5.	Sasmita Mishra	Engineering Economics and Costing	Eastern economy Edition	2010

WEB URLs

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2. www.cshub.mit.edu/news/2017-public-webinar-schedule
3. www.youtube.com/user/MIT/videos
4. www.swlearning.com/pdfs/chapter/0324117922_1.PDF
5. www.en.wikiversity.org/wiki/Engineering Economics

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16MED23 **TOTAL QUALITY MANAGEMENT** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the Total Quality Management concept and principles and the various tools available to achieve Total Quality Management
- To understand the application of statistical approach for quality control
- To create an awareness about the ISO and QS certification process and its need for the industries
- To apply the quality concepts in product design, manufacturing etc in order to maximize customer Satisfaction
- Human involvement to improve quality and the development and transformation

COURSE OUTCOMES

16MED23.CO1 Understand the concept of total quality management
16MED23.CO2 Comprehend and illustrate the TQM principles
16MED23.CO3 Solve quality related problems using statistical process control
16MED23.CO4 Understand proven methodologies to enhance management processes
16MED23.CO5 Illustrate the salient features of quality systems

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MED23.CO1	X	-	-	-	-	X	X	X	X	X	-	X	-	X	-
16MED23.CO2	X	-	-	-	-	X	X	X	X	X	-	X	-	X	-
16MED23.CO3	X	X	X	X	-	X	X	X	X	X	-	X	-	X	-
16MED23.CO4	X	X	X	X	-	X	X	X	X	X	-	X	-	X	-
16MED23.CO5	X	X	-	-	X	X	X	X	X	X	X	X	-	X	-

UNIT I: INTRODUCTION 9

Definition of Quality – Dimensions of Quality – Quality Planning – Quality costs – Analysis Techniques for Quality Costs – Basic concepts of Total Quality Management – Historical Review – Quality Statements – Strategic Planning, Deming Philosophy – Crosby philosophy – Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen – Obstacles to TQM Implementation

UNIT II: TQM PRINCIPLES 9

Principles of TQM, Leadership – Concepts – Role of Senior Management – Quality Council, Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits– Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure

UNIT III: STATISTICAL PROCESS CONTROL (SPC) 9

The seven tools of quality – Statistical Fundamentals – Measures of central Tendency and Dispersion,Population and Sample, Normal Curve, Control Charts for variables X bar and R chart and attributes P, nP, C, and u charts, Industrial Examples, Process capability, Concept of six sigma – New seven Management tools

UNIT IV: TQM TOOLS 9

Benchmarking – Reasons to Benchmark – Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, and Benefits – Taguchi Quality Loss Function – Total Productive Maintenance (TPM) – Concept, Improvement Needs, and FMEA – Stages of FMEA- Case studies

UNIT V: QUALITY SYSTEMS 9

Need for ISO 9000 and Other Quality Systems – ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, ISO 9000:2005 (definitions), ISO 9001:2008 (requirements) and ISO 9004:2009 (continuous improvement), TS 16949, ISO 14000, AS9100 – Concept, Requirements and Benefits- Case studies

Total:L: 45

TEXT BOOKS:

S.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Dale H. Besterfiled	Total Quality Management	Pearson Education Inc, New Delhi	2003
2.	James R. Evans and William M. Lidsay,	The Management and Control of Quality	South-Western	2002

REFERENCE BOOKS:

S.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	N. Gupta and B. Valarmathi,	Total Quality Management	Tata McGraw-Hill Publishing Company Pvt Ltd., New Delhi	2009
2	Dr S. Kumar	Total Quality Management,	Laxmi Publications Ltd., New Delhi	2006
3	P. N. Muherjee	Total Quality Management	Prentice Hall of India, New Delhi	2006
4	James R. Evans and William M. Lindsay	The Management and Control of Quality	8th Edition, First Indian Edition, Cengage Learning	2012
5	Suganthi.L and Anand Samuel	Total Quality Management	Prentice Hall (India) Pvt. Ltd	2006

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16MED24 PRINCIPLES OF MANAGEMENT **L T P C**
3 0 0 3

OBJECTIVES

- To analyze the historic development of Management thoughts
- To learn the nature and purpose of planning, forecasting and decision making
- To expose the knowledge on concepts of organizing
- To analyze the concepts of delegation of authority and Organization culture.
- To familarise the students to the basic concepts of management in order to aid in understanding how an organization functions, and in understanding the complexity and wide variety of issues managers face in today's business firms.

COURSE OUTCOMES:

16MED24.CO1 Understand the management, types of business organization and role of managers in a business entity

16MED24.CO2 Know the planning strategy, setting an objective oriented planning, tools and techniques applied for planning

16MED24.CO3 Discuss the organization structure, recruitment process, training and development.

16MED24.CO4 Identify the importance of directing workforce, essentials of communication between entities of business.

16MED24.CO5 Demonstrate and generate budget controls and control framework for achieving the above objectives.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MED24.CO1	X	-	-	-	-	X	X	X	X	X	-	X	-	X	-
16MED24.CO2	X	-	-	-	-	X	X	X	X	X	-	X	-	X	-
16MED24.CO3	X	X	X	X	-	X	X	X	X	X	-	X	-	X	-
16MED24.CO4	X	X	X	X	-	X	X	X	X	X	-	X	-	X	-
16MED24.CO5	X	X	-	-	X	X	X	X	X	X	X	X	-	X	-

UNIT I : INTRODUCTION TO MANAGEMENT **9**

Organization- Management- Role of managers- Evolution of management thought- Organization and the environmental factors- Managing globally- Strategies for International business.

UNIT II: PLANNING **9**

Nature and purpose of planning- Planning process- Types of plans- OBJECTIVES- Managing by Objective (MBO) strategies- Types of strategies – Policies – Decision Making- Types of decision making process- Rational decision making process- Decision making under different conditions.

UNIT III: ORGANISING **9**

Nature and purpose of organizing- Organization structure- Formal and informal groups/ organization- Line and staff authority- Departmentation- Span of control- Centralization and decentralization- Delegation of authority- Staffing- Selection and Recruitment- Orientation- Career development- Career stages- Training- Performance appraisal

UNIT IV: DIRECTING **9**

Managing people- Communication- Hurdles to effective communication- Organization culture Elements and types of culture- Managing cultural diversity.

UNIT V: CONTROLLING **9**

Process of controlling- Types of control- Budgetary and non-budgetary control techniquesManaging productivity- Cost control- Purchase control- Maintenance control- Quality control Planning operations.

TOTAL: L: 45 = 45

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1	Harold Koontz and Heinz Weihrich	Essentials of management: An International & Leadership Perspective	Tata McGraw-Hill Education	2015
2	Charles W.L Hill and Steven L McShane	Principles of Management	McGraw Hill Education	2013

REFERENCES BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Samuel C. Certo and Tervis Certo	Modern management: concepts and skills	Pearson education	2014
2.	Heinz Weihrich, Mark V Cannice and Harold Koontz,	Management a global entrepreneurial perspective	Tata McGraw Hill	2013
3.	Stephen P. Robbins, David A.De Cenzo and Mary Coulter	Fundamentals of management	Prentice Hall of India	2012
4.	Don Hellriegel, Susan E. Jackson and John W. Slocum,	Management a competency based approach	Thompson South Western	2008
5.	Joseph L.Massie	Essentials of Management	Pearson Education	2003

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2. www.slideshare.net/HashmatUllah1/chap-1-introduction-to-management
3. www.youtube.com/results?search_query=principles+of+management
4. www.swlearning.com/pdfs/chapter/0324117922_1.PDF
5. www.en.wikiversity.org/wiki/Principles_of_Management

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16MED25 COMPUTER INTEGRATED MANUFACTURING SYSTEM

L T P C
3 0 0 3

COURSE OBJECTIVES

- To familiarize the basic components of CIM and its hardware and software
- To familiarize CAD/CAM and its integration with CIM
- To familiarize FMS and its applications
- To familiarize Principles of computer aided process planning, JIT and GT
- To familiarize Computer Aided Quality Control and FIS

COURSE OUTCOMES

16MED25.CO1 Describe the basic concepts of Automation, Production systems and Computer integrated manufacturing systems.

16MED25.CO2 Ability to recall the methodology of Production planning control and computerised process planning.

16MED25.CO3 Demonstrate the concepts of Cellurlar Manufacturing

16MED25.CO4 Describe the information of Flexibile Manufacturing Systems and Automated Guided Vehicle

16MED25.CO5 Illustrate the features of Industrial Robotics

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MED25.CO1	X	-	X	-	-	X	X	-	-	-	X	-	-	X	-
16MED25.CO2	X	-	X	X	-	X	X	-	-	-	X	-	-	X	-
16MED25.CO3	X	-	X	X	-	X	X	-	-	-	X	-	-	X	-
16MED25.CO4	X	-	X	-	X	X	X	-	-	-	X	-	-	X	-
16MED25.CO5	X	-	X	-	X	X	X	-	-	-	X	-	-	X	-

UNIT I: INTRODUCTION 9

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

UNIT II: PRODUCTION PLANNING AND CONTROL AND COMPUTERISED PROCESS PLANNING 9

Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control-Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) - Simple Problems.

UNIT III: CELLULAR MANUFACTURING 9

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

UNIT IV: GUIDED VEHICLE SYSTEM (AGVS) 9

Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety.

UNIT V: INDUSTRIAL ROBOTICS 9

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

TOTAL :L: 45=45

TEXT BOOKS:

S. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Mikell.P.Groover	Automation, Production Systems and Computer Integrated Manufacturing	Pearson Education, Limited	2015
2.	Radhakrishnan P, Subramanyan S.and Raju V	CAD/CAM/CIM	2nd Edition, New Age,International (P) Ltd, New Delhi	2004

REFERENCE BOOKS:

S. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Kant Vajpayee S	Principles of Computer Integrated Manufacturing	Prentice Hall India	2003
2	Gideon Halevi and Roland Weill	Principles of Process Planning	A Logical Approach" Chapman & Hall, London	2012
3	Rao. P, N Tewari &T.K. Kundra	Computer Aided Manufacturing	Tata McGraw Hill Publishing Company	2012
4	M. M. M . Sarcar	Computer Aided Design and Manufacturing	Prentice Hall of India, New Delhi	2008
5	Mikell P. Groover, Mitchell Weiss and Roger N. Nagel G Odrey	Industrial Robotics	Tata McGraw Hill Publishing Company Pvt Ltd. New Delhi	2007

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1. www.youtube.com/watch?v=BBC2oswnrt0
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3. www.youtube.com/watch?v=l26qHi48MKs
4. www.youtube.com/watch?v=_OaBMsUgqgQ
5. www.youtube.com/watch?v=pXsFcnKpid4

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PROFESSIONAL ELECTIVES

(PE)

For

Mechanical Engineering

16MEE01 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS

L T P C
3 2 0 4

(Use of PSG Design Data Book is permitted in the University examination)

COURSE OBJECTIVES

- To understand about the tool design, functions of jigs and fixtures, principles of location and clamping, tolerances and materials used.
- To impart knowledge on different types of jigs such as post, turnover, channel, latch, box, pot, angular post jigs and fixtures.
- To understand the press working terminologies, and design of various elements of dies, design of simple blanking, piercing, compound and progressive dies.
- To impart knowledge on the structure various operations such as bulging, swaging, embossing, coining, curling, whole flanging, shaving and sizing.
- To gain proficiency in the development of required views of the final design.

COURSE OUTCOMES:

16MEE01.CO1 Select the appropriate locating and clamping devices
16MEE01.CO2 Develop jigs and fixtures for the engineering applications
16MEE01.CO3 Build suitable press tools for the Machine Processing
16MEE01.CO4 Demonstrate the design procedure of various bending and drawing dies
16MEE01.CO5 Explain the working principles of recent forming tools and techniques.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEE01.CO1	X	X	X	-	-	-	-	-	-	-	-	-	X	-	-
16MEE01.CO2	X	X	X	-	-	-	-	-	-	-	-	-	X	-	-
16MEE01.CO3	X	X	X	-	-	-	-	-	-	-	-	-	X	-	-
16MEE01.CO4	X	X	X	-	-	-	-	-	-	-	-	-	X	-	-
16MEE01.CO5	X	-	-	-	X	-	-	-	-	-	-	-	-	X	-

UNIT I: LOCATING AND CLAMPING PRINCIPLES 9

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

UNIT II: JIGS AND FIXTURES 9

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

UNIT III: PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES 9

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

UNIT IV: BENDING AND DRAWING DIES 9

Difference between bending and drawing – Blank development for above operations – Types of Bending dies – Press capacity – Spring back – knockouts – direct and indirect – pressure pads – Ejectors – Variables affecting Metal flow in drawing operations – draw die inserts – draw beads ironing – Design and development of bending, forming, drawing, reverse redrawing and combination dies – Blank development for axisymmetric, rectangular and elliptic parts – Single and double action dies.

UNIT V: OTHER FORMING TECHNIQUES 9

Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine Blanking dies – recent trends in tool design- computer Aids for sheet metal forming Analysis – basic introduction - tooling for numerically controlled machines- setup reduction for work holding – Single minute exchange of dies – Poka Yoke.

TOTAL: L: 45+T:30=75

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Joshi P.H	Press tools - Design and Construction	wheels publishing	1996
2.	Joshi P.H	Jigs and Fixtures	Tata McGraw Hill Publishing Co., Ltd., New Delhi	2004

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Venkataraman. K	Design of Jigs Fixtures & Press Tools	McGraw Hill Book Company	1994
2.	Donaldson, Lecain and Goold	Tool Design	3rd Edition, Tata McGraw Hill	2000
3.	Hoffman	Jigs and Fixture Design	Thomson Delmar Learning, Singapore	2004
4.	David Spitler, Jeff Lantrip	Fundamentals of Tool Design	Society of Manufacturing Engineers	2003
5.	Hiram E Grant	Jigs and Fixture	Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi	2003

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2. www.youtube.com/watch?v=7yzvno4AvKw
3. www.youtube.com/watch?v=SP9SQWJOzIs
4. www.youtube.com/watch?v=rXesccuotZE
5. *www.youtube.com/watch?v=0G6M0pQNfC4*

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16MEE02 REFRIGERATION AND AIR CONDITIONING **L T P C**
3 2 0 4

OBJECTIVES:

- To understand the underlying principles of operations in different Refrigeration & Air conditioning systems and components.
- To provide knowledge on design aspects of Refrigeration & Air conditioning systems
- To know about different types of refrigeration system
- To make use of psychrometric chart.
- To know different load calculations in different type of air conditioning systems.

OUTCOMES:

16MEE02.CO1	Upon completion of this course, the students can able to demonstrate the operations in refrigeration system
16MEE02.CO2	Understanding the concets and implementing in different Refrigeration system
16MEE02.CO3	Applying different concepts to different refrigeration system and implementing to calculations
16MEE02.CO4	Solving problems in air conditioning systems
16MEE02.CO5	Load estimation and plant design in real time application of air conditioning system.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEE02.CO1	X	-	-	-	-	-	-	-	-	-	-	-	X	-	-
16MEE02.CO2	X	X	X	-	-	-	-	-	-	-	-	-	X	-	-
16MEE02.CO3	X	X	X	-	-	-	-	-	-	-	-	-	X	-	-
16MEE02.CO4	X	X	X	-	-	-	-	-	-	-	-	-	X	-	-
16MEE02.CO5	-	-	-	-	X	-	-	-	-	-	-	-	-	X	-

UNIT I: INTRODUCTION **9**

Introduction to Refrigeration - Unit of Refrigeration and C.O.P.– Ideal cycles- Refrigerants Desirableproperties – Classification - Nomenclature - ODP & GWP.

UNIT II: VAPOUR COMPRESSION REFRIGERATION SYSTEM **9**

Vapor compression cycle : p-h and T-s diagrams - deviations from theoretical cycle – sub cooling and heating- effects of condenser and evaporator pressure on COP- multipressure system – low temperature refrigeration - Cascade systems – problems. Equipments: Type of Compressors, Condensers, Expansion devices, Evaporators.

UNIT III: OTHER REFRIGERATION SYSTEMS **9**

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

UNIT IV: PSYCHROMETRIC PROPERTIES AND PROCESSES **9**

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

UNIT V: AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION 9

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

TOTAL: L: 45+T:30=75

TEXT BOOKS:

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Arora, C.P	Refrigeration and Air Conditioning	McGraw Hill	2010.
2.	W.P. Jones	Air-Conditioning Engineering	Elsevier	2007

REFERENCE BOOKS:

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Roy J. Dossat,	Principles of Refrigeration	Pearson Education	2009
2	Stoecker, W.F. and Jones J. W.,	Refrigeration and Air Conditioning	McGraw Hill	1986
3	Jones W.P	Air conditioning engineering	Elsevier	2001
4.	R.S.Khurmi	Textbook of Refrigeration and Air-conditioning	S.Chand	2006
5.	G F Hundy, A. R. Trott, T C Welch	Refrigeration and Air-Conditioning	Elsevier	2008

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3. www.youtube.com/watch?v=BiGxJGu42hw
4. www.youtube.com/watch?v=rsWy68JwfQM
5. www.youtube.com/watch?v=dsjJmHDSyoM

16MEE03 ADVANCED I.C ENGINES **LT PC**
3 2 0 4

COURSE OBJECTIVES:

- To understand the underlying principles of operation of different Spark ignition Engines and components.
- To understand the underlying principles of operation of different CI Engines and components.
- To provide knowledge on pollutant formation & control.
- To realize the recent trends in automobiles
- To interpret the hybrid vehicle.

COURSE OUTCOMES

16MEE03.CO1	Understand the phenomenon of combustion in IC engines
16MEE03.CO2	Analyze the combustion phenomena in SI engines
16MEE03.CO3	Analyze the combustion phenomena in CI engines
16MEE03.CO4	Understand the emission standards for SI and CI engines.
16MEE03.CO5	Familiarize about alternative fuels.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEE03.CO1	X	X	X	X	-	-	X	-	-	X	-	X	-	-	-
16MEE03.CO2	X	X	X	X	-	-	X	X	-	X	-	X	X	-	-
16MEE03.CO3	X	X	X	X	-	-	X	-	-	X	-	X	X	-	-
16MEE03.CO4	X	X	X	X	-	-	X	-	-	X	-	X	X	-	-
16MEE03.CO5	X	X	X	X	-	X	X	-	-	X	-	X	-	-	-

UNIT I: SPARK IGNITION ENGINES **9**

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

UNIT II: COMPRESSION IGNITION ENGINES **9**

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

UNIT III POLLUTANT FORMATION AND CONTROL **9**

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

.

UNIT IV ALTERNATIVE FUELS **9**

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

UNIT V RECENT TRENDS **9**

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

TOTAL: L: 45+T:30=75

TEXT BOOKS:

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	John B. Heywood	Internal Combustion Engine Fundamentals	Tata McGraw Hill New Delhi	2002
2.	Ganesan.V	Internal Combustion Engines	Tata McGraw Hill	2003

REFERENCES:

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Chris McMahon and Jimmie Browne	Internal Combustion Engines	Dhanpat Rai & Sons	2007
2.	Obert, E. F.,	Internal Combustion Engine and Air Pollution	International Text Book Publishers	2001
3.	Mathur, M. L, and Sharma. R. P	A COURSE in Internal Combustion Engines	Dhanpat Rai-Publications New Delhi	2000
4.	Duffy Smith	Auto Fuel Systems	The Good Heart Willcox Company, Inc.,	1987
5.	Cohen, H, Rogers, G. E. C, and Saravanamuttoo, H. I. H.,	Gas Turbine Theory	Longman	2004

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2. www.youtube.com/watch?v=zhhurGxjY-c
3. www.google.co.in/#q=website+url+for+advanced+ic+engines
4. www.google.co.in/#q=website+url+for+advanced+ic+engines
5. www.slideshare.net/ravirajan1257/advanced-ic-engines-unit-4

16MEE04 COMPUTATIONAL FLUID DYNAMICS L T P C
3 2 0 4

COURSE OBJECTIVES:

- To introduce Governing Equations of viscous fluid flows
- To introduce numerical modeling and its role in the field of fluid flow and heat transfer
- To enable the students to understand the various discretization methods, solution procedures and turbulence modeling.
- To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers
- To solve heat transfer problems

COURSE OUT COMES :

16MEE04.CO1 Creating numerical modeling and its role in the field of fluid flow and heat transfer calculations

16MEE04.CO2 Using the various discretization methods, solution procedures and turbulence modeling ,in one dimensional

16MEE04.CO3 Create discretization methods, numerical methods

16MEE04.CO4 Introducing numerical modeling and its role in the field of fluid flow and heat transfer

16MEE04.CO5 Creating confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers , and ANSYS analysis also.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEE04.CO1	X	X	X	-	-	X	X	X	-	X	-	X	X	-	-
16MEE04.CO2	X	X	X	X	-	-	X	X	-	X	-	X	X	-	-
16MEE04.CO3	X	X	X	X	-	-	X	X	-	X	-	X	X	-	-
16MEE04.CO4	X	X	X	X	-	-	X	X	-	X	-	X	X	-	-
16MEE04.CO5	X	X	X	X	-	-	X	X	-	X	-	X	X	-	-

UNIT I : GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 8

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

UNIT II : FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION 9

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

UNIT III : FINITE VOLUME METHOD FOR CONVECTION DIFFUSION 10

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

UNIT IV : FLOW FIELD ANALYSIS 9

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

UNIT V : TURBULENCE MODELS AND MESH GENERATION 9

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

TOTAL: L: 45+T:30=75

TEXT BOOKS:

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Versteeg, H.K	An Introduction to Computational Fluid Dynamics: The finite volume Method	Pearson Education Ltd.2nd Edition	2007.
2.	Ghoshdastidar, P.S	Computer Simulation of flow and heat transfer	Tata McGraw Hill Publishing Company Ltd.,	1998

REFERENCE BOOKS:

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Muralidhar, K	Computational Fluid Flow and Heat Transfer	Narosa Publishing House, New Delhi,	1995.
2	Patankar, S.V	Numerical Heat Transfer and Fluid Flow	Hemisphere Publishing Corporation,	2004.
3	Ghoshdastidar P.S	Heat Transfer	Oxford University Press	2005
4.	ProdipNiyogi	Introduction to Computational Fluid Dynamics	Pearson Education	2005
5.	Anil W. Date	Introduction to Computational Fluid Dynamics	Cambridge University Press,	2005.

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3. www.youtube.com/watch?v=tII-QIo4_U4
4. www.youtube.com/watch?v=Z7Ya5BL8L-c
5. www.youtube.com/watch?v=Yf2iVABc8cg

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16MEE05 THERMAL TURBO MACHINES **L T P C**
3 2 0 4

COURSE OBJECTIVES

- To know about fluid machinery and working
- Understanding the principle of centrifugal compressors
- Basic knowledge about axial flow compressors and calculations
- Knowledge about Turbines and different types of turbine
- Calculations related to turbo machinary

COURSE OUTCOMES

16MEE05.CO1 Know about velocity triangles of compressor and turbine
16MEE05.CO2 Know about blowers and fans
16MEE05.CO3 Calculations related to centrifugal compressor
16MEE05.CO4 Calculations related to Axial flow compressor and calculations
16MEE05.CO5 Geometrical and analytical calculations can be calculated.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEE05.CO1	X	X	X	X	-	X	X	-	X	-	-	X	X	-	-
16MEE05.CO2	X	X	X	X	X	X	X	-	X	-	-	X	X	X	-
16MEE05.CO3	X	X	X	X	-	-	X	-	X	X	-	X	X	X	X
16MEE05.CO4	X	X	X	X	X	X	X	-	X	-	-	X	X	-	X
16MEE05.CO5	X	X	X	X	X	X	X	-	X	-	X	X	X	-	X

UNIT I: PRINCIPLES 9

Energy transfer between fluid and rotor, classification of fluid machinery, dimensionless parameters, specific speed, applications, stage velocity triangles, work and efficiency for compressors and turbines.

UNIT II: CENTRIFUGAL FANS AND BLOWERS 9

Types, stage and design parameters, flow analysis in impeller blades, volute and diffusers, losses, characteristics curves and selection, fan drives and fan noise.

UNIT III: CENTRIFUGAL COMPRESSOR 9

Construction details, types, impeller flow losses, slip factor, diffuser analysis, losses and performance curves.

UNIT IV: AXIAL FLOW COMPRESSOR 9

Stage velocity triangles, enthalpy-entropy diagrams, stage losses and efficiency, workdone factor, simple stage design problems and performance characteristics.

UNIT V: AXIAL AND RADIAL FLOW TURBINES 9

Stage velocity diagrams, reaction stages, losses and coefficients blade design principles, testing and performance characteristics.

TOTAL: L: 45+T:30=75

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Yahya, S.H.	Turbines, Compressor and Fans	Tata Mc Graw Hill Publishing Company	2016
2.	Earl Logan, Jr	Hand book of Turbo machinery	Marcel Dekker Inc	2003

REFERENCE BOOKS:

1.	Bruneck	Fans	Pergamum Press	2016.
2.	Dixon, S.I	Fluid Mechanics and Thermodynamics of Turbomachinery	Pergamom Press	2014
3.	Shepherd, D.G	Principles of Turbomachinery	Macmillan	2016
4	Stepanff, A.J.	Blowers and Pumps	John Wiley and Sons Inc	2014
5	Ganesan .V	Gas Turbines	Tata Mcgraw Hill Pub. Co	2010

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16MEE06 VIBRATION AND NOISE CONTROL **L T P C**
3 2 0 4

COURSE OBJECTIVES

- To understand the basics of Vibration
- To understand the basics of Noise.
- To understand the Automotive Noise Sources.
- To impart clear knowledge about Control Techniques
- To understand the Source of Noise and control.

COURSE OUTCOMES

16MEE06.CO1 Understanding causes, source and types of vibration in machineries.
16MEE06.CO2 Gaining knowledge in sources and measurement standard of noise.
16MEE06.CO3 Ability to design and develop vibrations and Noise control systems.
16MEE06.CO4 Learn the applications IC Engines and Shock Absorbers.
16MEE06.CO5 Understand the Source of Noise and control methods.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEE06.CO1	X	-	-	-	-	X	X	-	-	-	-	X	-	-	-
16MEE06.CO2	X	X	X	-	-	X	X	-	-	-	-	X	-	-	-
16MEE06.CO3	X	-	X	-	X	-	X	X	-	-	-	X	-	-	-
16MEE06.CO4	X	-	-	-	-	X	-	X	-	-	-	X	-	-	-
16MEE06.CO5	X	X	-	-	-	X	X	-	-	-	-	X	-	-	-

UNIT I: Basics of Vibration 9

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

UNIT II: Basics of Noise 9

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

UNIT III: Automotive Noise Sources 9

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

UNIT IV: Control Techniques 9

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

UNIT V: Source of Noise and Control 9

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

TOTAL: L: 45+T:30=75

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Singiresu S.Rao	Mechanical Vibrations	Pearson Education,ISBM-81-297-0179-0	2004
2	Kewal Pujara	Vibrations and Noise for Engineers	Dhanpat Rai & Sons	1992

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1	Bernard Challen and Rodica Baranescu	Diesel Engine Reference Book	SAE International-ISBN 0-7680-0403-9	1999
2	Julian Happian-Smith	An Introduction to ModernVehicle Design	Butterworth-Heinemann ISBN 0750-5044-3	2004
3	John Fenton	Handbook of Automotive body Construction and Design Analysis	Professional Engineering Publishing, ISBN 1-86058-073	1998
4	K. J. Bathe and F. I. Wilson	Numerical Methods in Finite Element Analysis	Prentice Hall of India, New Delhi	1978
5	J. P. Den Harto	Mechanical Vibrations	Crastre pres	2007

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16MEE07 DESIGN OF PRESSURE VESSEL AND PIPING **L T P C**
3 2 0 4

(Usage of Pressure Vessels, Design Hand Book is allowed for the students for examination)

COURSE OBJECTIVES

- To obtain an understanding of the fundamental methods and Terminology and its application.
- To understand the membrane stress analysis and industrial related problems in vessels.
- To design principles for pressure vessels and enhance the understanding of reinforcement.
- To obtain the buckling of pressure vessels and tubes, cylinders etc.
- To design procedure of pressure vessel and Design of piping layout.

COURSE OUTCOMES

16MEE07.CO1 Develop the stresses and terminology, efficiency and its applications.
16MEE07.CO2 Analysis the vessels shells components such as cylindrical, spherical, conical and Thermal.
16MEE07.CO3 Design the pressure vessels and ASME vessels codes.
16MEE07.CO4 Estimate the design procedure of pressure vessel and Design of piping layout.
16MEE07.CO5 Design and analysis the pipe stress.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEE07.CO1	X	X	X	-	-	-	-	-	-	-	-	-	X	-	-
16MEE07.CO2	X	X	X	-	-	-	-	-	-	-	-	-	X	-	-
16MEE07.CO3	X	X	X	-	-	-	-	-	-	-	-	-	X	-	-
16MEE07.CO4	X	X	X	-	-	-	-	-	-	-	-	-	X	-	-
16MEE07.CO5	X	-	-	-	X	-	-	-	-	-	-	-	-	X	-

UNIT I: INTRODUCTION 9

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

UNIT II: STRESS IN PRESSURE VESSELS 9

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

UNIT III: DESIGN OF VESSELS 9

Design of Tall cylindrical self supporting process columns –Supports for short, vertical and horizontal vessels – stress concentration – at a variable Thickness transition section in a cylindrical vessel, about a circular Hole, elliptical openings. Theory of Reinforcement – pressure vessel Design. Introduction to ASME pressure vessel codes.

UNIT IV: BUCKLING OF VESSELS 9

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

UNIT V: PIPING 9

Introduction – Flow diagram – piping layout and piping stress Analysis

TOTAL: L: 45+T:30=75

TEXT BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	John F. Harvey	Theory and Design of Pressure Vessels	CBS Publishers and Distributors	2001
2.	Donatello Annaratone	Pressure Vessel Design	Springer	2007

REFERENCE BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Henry H. Bedner	Pressure Vessels, Design Hand Book	CBS publishers and Distributors	2001
2	Stanley, M. Wales	Chemical process equipment, selection and Design	Buterworths series in Chemical Engineering	1988
3	John F. Harvey	Pressure Vessel Design: Nuclear and Chemical Applications	Priceton Inc.	1963
4	William. J., Bees	Approximate Methods in the Design and Analysis of Pressure Vessels and Piping	Pre ASME Pressure Vessels and Piping Conference	1997
5	Sam Kannapan	Introduction to Pipe Stress Analysis	John Wiley and Sons	1985

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4. www.mgu.ac.in/files/MMEMD%20105-1%20Design%20of%20Pr%20Vessels.doc
5. www.journals.elsevier.com/international-journal-of-pressure-vessels-and-piping

16MEE08 QUALITY CONTROL AND RELIABILITY ENGINEERING

L T P C
3 2 0 4

(Note: Use of approved statistical table permitted in the examination.)

COURSE OBJECTIVES:

- To introduce the concept of SQC
- To understand process control techniques
- To understand acceptance sampling procedure and their application
- To learn the concept of reliability and life testing
- To implement quality through improvement in reliability

COURSE OUTCOMES:

16MEE08.CO1 Understand the fundamentals of SQC
16MEE08.CO2 Construct various control charts for attributes
16MEE08.CO3 Illustrate and model acceptance sampling plan
16MEE08.CO4 Explain and apply life testing methods
16MEE08.CO5 Comprehend the relation between reliability & quality and explain design for reliability

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEE08.CO1	X	X	-	-	-	X	X	X	X	X	-	X	-	X	-
16MEE08.CO2	X	-	X	X	X	X	X	X	X	X	X	-	-	X	-
16MEE08.CO3	X	X	X	-	-	X	X	X	X	X	X	X	X	X	X
16MEE08.CO4	-	-	X	X	X	X	X	X	X	X	X	-	X	X	X
16MEE08.CO5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

UNIT I :INTRODUCTION AND PROCESS CONTROL FOR VARIABLES 9

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality control: Quality cost-Variation in process causes of variation –Theory of control chart- uses of control chart – Control chart for chart -process capability – processσvariables – X chart, R chart and capability studies and simple problems. Six sigma concepts

UNIT II: PROCESS CONTROL FOR ATTRIBUTES 9

Control chart for attributes –control chart for non conformings– p chart and np chart – control chart for nonconformities– C and U charts, State of control and process out of control identification in charts, pattern study.

UNIT III: ACCEPTANCE SAMPLING 9

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

UNIT IV: LIFE TESTING – RELIABILITY 9

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

UNIT V QUALITY AND RELIABLITY 9

Reliability improvements – techniques- use of Pareto analysis – design for reliability – redundancy unit and standby redundancy – Optimization in reliability – Product design – Product analysis – Product development – Product life cycles.

TOTAL: L: 45+T:30=75

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Douglas.C. Montgomery	Introduction to Statistical quality control	4th edition, John Wiley	2001.
2	Srinath. L.S	Reliability Engineering	Affiliated East west press,	1991

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	John.S. Oakland	Statistical process control	5th edition, Elsevier	2005
2	Connor, P.D.T.O	Practical Reliability Engineering	John Wiley	1993
3	Grant, Eugene .L	Statistical Quality Control	McGraw-Hill,	1996
4	Besterfield D.H,	Quality Control	Prentice Hall,	1993
5	Danny Samson	Manufacturing & Operations Strategy	Prentice Hall	1991

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16MEE09 UNCONVENTIONAL MACHINING PROCESSES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To study the advanced machining processes.
- To understand the traditional machining processes.
- To understand the unconventional machining processes
- To know the principles and working of various nontraditional processes based on mechanical, and thermal energy.
- To know the principles and working of various nontraditional processes based on electrical and electrochemical energy

COURSE OUTCOMES

16MEE09.CO1 Suggest the advanced machining processes for the various engineering applications.
16MEE09.CO2 Select the suitable mechanical energy-based machine tool and its parameters for the engineering applications.
16MEE09.CO3 Select the suitable Electro discharge machining process and its parameters for the engineering applications.
16MEE09.CO4 Select the suitable chemical and electro-chemical machining process and its parameters for the engineering applications.
16MEE09.CO5 Select the suitable Thermal energy-based advanced machine tools and its parameters for the engineering applications.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEE09.CO1	X	-	-	-	X	X	-	-	-	-	-	X	-	X	-
16MEE09.CO2	X	-	-	-	X	X	-	-	-	-	-	X	-	X	-
16MEE09.CO3	X	-	-	-	X	X	-	-	-	-	-	X	-	X	-
16MEE09.CO4	X	-	-	-	X	X	-	-	-	-	-	X	-	X	-
16MEE09.CO5	X	-	-	-	X	X	-	-	-	-	-	X	-	X	-

UNIT I: INTRODUCTION 9

Unconventional Machining Process – Introduction, Need – Classification – Comparison of conventional and unconventional machining process - Energies employed in the processes– Brief overview of various techniques.

UNIT II: MECHANICAL ENERGY BASED PROCESSES 9

Abrasive Jet Machining – Water Jet Machining – Ultrasonic Machining.. Working Principles – equipment used – Process parameters – Material removal rate-Variation in techniques used – Applications.

UNIT III: ELECTRICAL ENERGY BASED PROCESSES 9

Electric Discharge Machining- working Principles-equipments-Process Parameters- Material removal rate - electrode / Tool – Power Circuits-Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications-Recent developments in Electro discharge machining

UNIT IV: CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES 9

Process principles of Chemical machining and Electro-Chemical machining -Etchants-maskants-techniques-Process Parameters – Material removal rate -Applications-equipments-Electrical circuit-Process Parameters-Electro chemical grinding, Electro chemical honing and Electro chemical deburring Applications.

UNIT V: THERMAL ENERGY BASED PROCESSES 9

Laser Beam machining, Plasma Arc Machining - Principles – Equipment - Electron Beam Machining. Principles – Equipment - Types-Beam control techniques- Material removal rate - Applications.

TOTAL: L:45=45

TEXT BOOK(S):

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	P. K. Mishra	Non Conventional Machining	Narosa Publishing House, New Delhi	2007
2	P. C. Pandey and H.S.Shan	Modern Machining Processes	Tata McGraw Hill Publishing Company Pvt Ltd.,New Delhi	2008

REFERENCE BOOK(S):

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	G. F. Benedict	Nontraditional Manufacturing Processes	Marcel Dekker Inc., New York	1987
2	Ronald.A.Kohser	Material and Processes in Manufacturing	Prentice Hall of India Pvt. Ltd., New Delhi	2007
3	Paul De Garmo, J.T.Black and Ronald.A.Kohser	Material and Processes in Manufacturing	Prentice Hall of India Pvt. Ltd., New Delhi	2007
4	Vijaya Kumar Jain	Advanced Machining Processes	Allied Publishers Pvt. Ltd., New Delhi	2005
5	Mc Geough	Advanced Methods of Machining	Chapman and Hall, London	1998

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16MEE10 MAINTENANCE ENGINEERING

L T P C
3 0 0 3

COURSE OBJECTIVES

- To know the basic principle of maintenance and practices the maintenance in organization and economics.
- To practice the various maintenance policies and the various preventive maintenances.
- To understand the various aspects of condition monitoring.
- To practice various repairs and able to predict the faulty locations
- To familiarize various methods of repairing material handling equipments.

COURSE OUTCOMES

16MEE10.CO1 Know the basic principle of maintenance and practices the maintenance in organization and economics.
16MEE10.CO2 Practice the various maintenance policies and the various preventive maintenances.
16MEE10.CO3 Understand the various aspects of condition monitoring.
16MEE10.CO4 Practice various repairs and able to predict the faulty locations
16MEE10.CO5 Familiarize various methods of repairing material handling equipments.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEE10.CO1	X	X	-	-	-	X	X	X	X	X	-	X	-	X	-
16MEE10.CO2	X	-	X	X	X	X	X	X	X	X	X	-	-	X	-
16MEE10.CO3	X	X	X	-	-	X	X	X	X	X	X	X	X	X	X
16MEE10.CO4	-	-	X	X	X	X	X	X	X	X	X	-	X	X	X
16MEE10.CO5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

UNIT I: PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING 9

Basic Principles of maintenance planning – OBJECTIVES and principles of planned maintenance activity – Importance and benefits of sound Maintenance systems – Reliability and machine availability – MTBF, MTTR and MWT – Factors of availability – Maintenance organization – Maintenance economics.

UNIT II: MAINTENANCE POLICIES – PREVENTIVE MAINTENANCE 9

Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, repairs cycle - Principles and methods of lubrication – TPM.

UNIT III: CONDITION MONITORING 9

Condition Monitoring – Cost comparison with and without CM – On-load testing and off-load testing – Methods and instruments for CM – Temperature sensitive tapes – Pistol thermometers – wear-debris analysis.

UNIT IV: REPAIR METHODS FOR BASIC MACHINE ELEMENTS 9

Repair methods for beds, slide ways, spindles, gears, lead screws and bearings – Failure analysis – Failures and their development – Logical fault location methods – Sequential fault location.

UNIT V: REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT 9

Repair methods for Material handling equipment - Equipment records – Job order systems –Use of computers in maintenance.

TOTAL: L:45=45

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Srivastava S.K	Industrial Maintenance Management	S. Chand and Co	2006
2.	Bhattacharya S.N	Installation, Servicing and Maintenance	S. Chand and Co	1995

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	White E.N.	Maintenance Planning	I Documentation, Gower Press	1979
2.	Mishra R.C. and Pathak K	Maintenance Engineering and Management	Prentice Hall of India Pvt. Ltd	2007
3.	Garg M.R.	Industrial Maintenance	S. Chand & Co	1986
4.	Higgins L.R	Maintenance Engineering Hand book	McGraw Hill, 5th Edition	1988
5.	B.S. Dhillon	Engineering Maintenance: A Modern Approach	CRC Press	2002

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4. www.readorrefer.in/article/Repair-Methods-For-Basic-Machine-Elements_5211/
5. www.readorrefer.in/article/Repair-methods-for-material-handling-equipment_5225/

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16MEE11 PROCESS PLANNING AND COST ESTIMATION

L T P C
3 0 0 3

OBJECTIVE:

- To introduce the process planning concepts to make cost estimation for various products after process planning
- To make cost estimation for various products after process planning
- To know the importance of machining time for various operations
- Able to understand the importance of costing.
- Be familiar with the elements of cost and its importance in costing process.

OUTCOMES:

16MEE11.CO1 The graduates will become equipped with the knowledge and skills necessary for entry-level

16MEE11.CO2 Placement in both Mechanical Engineering as well as IT companies.

16MEE11.CO3 The graduates will have sound foundation for entering into higher education programmes.

16MEE11.CO4 The graduates are expected to have knowledge of contemporary issues and modern practices.

16MEE11.CO5 Able to understand the different types of production process and its application.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEE11.CO1	X	X	-	-	-	X	X	X	-	X	-	X	-	X	-
16MEE11.CO2	X	-	-	-	-	X	X	X	-	X	-	-	-	X	-
16MEE11.CO3	X	X	-	-	-	X	X	X	-	X	-	X	-	X	-
16MEE11.CO4	-	-	-	-	-	X	X	X	-	X	-	-	-	X	-
16MEE11.CO5	X	X	-	-	-	X	X	X	-	X	-	X	-	X	-

UNIT I: INTRODUCTION TO PROCESS PLANNING 9

Introduction- methods of process planning-Drawing interpretation-Material evaluation – steps in process selection-.Production equipment and tooling selection

UNIT II: PROCESS PLANNING ACTIVITIES 9

Process parameters calculation for various production processes-Selection jigs and fixtures selection of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies

UNIT III: INTRODUCTION TO COST ESTIMATION 9

Importance of costing and estimation –methods of costing-elements of cost estimation –Types of estimates – Estimating procedure- Estimation labor cost, material cost- allocation of over head charges- Calculation of depreciation cost

UNIT IV: PRODUCTION COST ESTIMATION 9

Estimation of Different Types of Jobs - Estimation of Forging Shop , Estimation of Welding Shop, Estimation of Foundry Shop

UNIT V: MACHINING TIME CALCULATION 9

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

TOTAL: L: 45 = 45

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	R. Kesavan, E Elanchezhian and B Vijaya Ramnath	Estimating and Costing	New Age International	2008
2.	B. P. Sinha	Mechanical Estimating and Costing	Tata McGraw Hill	2001

REFERENCES BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Ostwalal P.F. and Munez J	Manufacturing Processes and systems	John Wiley	1998
2.	Russell R.S and Tailor B.W	Operations Management	PHI	2003
3.	Chitale A.V. and Gupta R.C.	Product Design and Manufacturing	PHI	2002
4.	S. K.Mukhopadhyay	Production Planning and Control-Text and cases	PHI	2007
5.	T. R. Russel Banga & S. C. Sharma	Mechanical Estimating and Costing	Khanna Publishers	2007

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16MEE12 FLEXIBLE MANUFACTURING SYSTEMS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the planning, scheduling and control of FMS.
- To familiarize the FMS software.
- To understand the simulation and data base of FMS.
- To understand the concepts and applications of FMS.
- To familiarize the factory of the future.

COURSE OUTCOMES

16MEE12.CO1 Ability to perform the planning, scheduling and control of FMS.
16MEE12.CO2 Examine different types of FMS software specifications.
16MEE12.CO3 Perform the simulation software and data base of FMS.
16MEE12.CO4 Understand the concepts and applications of FMS.
16MEE12.CO5 Explain the factory of the future.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEE12.CO1	X	X	X	-	-	X	X	-	-	X	-	X	-	X	-
16MEE12.CO2	X	-	X	-	-	X	X	-	-	X	-	-	-	X	-
16MEE12.CO3	X	X	X	-	-	X	X	-	-	X	-	X	-	X	-
16MEE12.CO4	-	-	X	-	-	X	X	-	-	X	-	-	-	X	-
16MEE12.CO5	X	X	X	-	-	X	X	-	-	X	-	X	-	X	-

UNIT I: PLANNING, SCHEDULING AND CONTROL OF FLEXIBLE MANUFACTURING SYSTEMS 9

Introduction to FMS– development of manufacturing systems – benefits – major elements – 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: L:45 = 45

TEXT BOOKS:

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Jha, N.K.	Handbook of Flexible Manufacturing Systems	Academic Press Inc.,	1991
2.	William W Luggen	Flexible Manufacturing Cells And Systems	Prentice Hall, New Jersey	1991

REFERENCE BOOKS:

Sl. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Radhakrishnan P. and Subramanyan S	CAD/CAM/CIM	Wiley Eastern Ltd., New Age International Ltd.	1994
2.	Groover M.P.	Automation, Production Systems and Computer Integrated Manufacturing	Prentice Hall of India Pvt., New Delhi	1996
3.	Raouf, A. and Ben-Daya	Flexible manufacturing systems: recent development	Elsevier Science	1995
4.	Kalpakjian	Manufacturing Engineering and Technology	Addison-Wesley Publishing Co.	1995
5.	Taiichi Ohno	Toyota Production System: Beyond large-scale Production	Productivity Press (India) Pvt. Ltd.	1992

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2. www.ideas.repec.org/a/pcz/alspcz/v6y2012i1p25-32.html
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16MEE13 **COMPOSITE MATERIALS** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the fundamentals of composite material strength and its mechanical behavior
- To introduce the polymer matrix composites for different applications with different orientations
- To study Characteristics of metal matrix composites in manufacturing sectors
- To study the need of ceramic composites in society and industry.
- To understand the concepts of modern composite materials; and To study residual stresses in laminates during processing

COURSE OUTCOMES

16MEE13.CO1 Understand and explain the fundamentals of composite materials
16MEE13.CO2 Illustrate various orientation of polymer matrix composites and its properties
16MEE13.CO3 Demonstrate the need and production of metal matrix composites
16MEE13.CO4 Summarize the ceramic matrix composites productions
16MEE13.CO5 Comprehend the lamina construction and mechanics of composites

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEE13.CO1	X	-	X	-	X	-	-	-	-	-	-	X	-	-	-
16MEE13.CO2	X	-	-	-	X	-	-	-	-	-	-	X	X	-	-
16MEE13.CO3	X	-	X	-	X	-	-	-	-	-	-	X	-	-	X
16MEE13.CO4	X	-	X	-	-	-	-	-	-	-	-	X	-	-	X
16MEE13.CO5	X	-	X	-	-	-	-	-	-	-	-	X	-	-	-

UNIT I: INTRODUCTION TO COMPOSITE MATERIALS 9

Fundamentals of composites – need for composites – enhancement of properties – classification of composites – Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC) – Reinforcement – particle reinforced composites, Fibre reinforced composites. Applications of various types of composites. Fiber production techniques for glass, carbon and ceramic fibers

UNIT II : POLYMER MATRIX COMPOSITES 9

Polymer resins – thermosetting resins, thermoplastic resins – reinforcement fibres – rovings – woven fabrics – non woven random mats – various types of fibres. PMC processes – hand lay up processes – spray up processes – compression moulding – reinforced reaction injection moulding – resin transfer moulding – Pultrusion – Filament winding – Injection moulding. Fibre reinforced plastics (FRP), Glass Fibre Reinforced Plastics (GFRP). Applications of PMC in aerospace, automotive industries

UNIT III : METAL MATRIX COMPOSITES 9

Characteristics of MMC, various types of metal matrix composites alloy vs. MMC, advantages of MMC, limitations of MMC, Reinforcements – particles – fibres. Effect of reinforcement – volume fraction – rule of mixtures. Processing of MMC – powder metallurgy process – diffusion bonding – stir casting – squeeze casting, a spray process. Applications of MMC in aerospace, automotive industries.

UNIT IV CERAMIC MATRIX COMPOSITES 9

Engineering ceramic materials – properties – advantages – limitations – monolithic ceramics – need for CMC – ceramic matrix - various types of ceramic matrix composites- oxide ceramics – non oxide ceramics – aluminium oxide – silicon nitride – reinforcements – particles- fibres- whiskers. Sintering - Hot pressing – Cold isostatic pressing (CIPing) – Hot isostatic pressing (HIPing). applications of CMC in aerospace, automotive industries

UNIT V: MECHANICS OF COMPOSITES 9

Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Qij), Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Definitions – Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates.

Total: L: 45= 45

TEXT BOOKS:

S.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Mathews F	Composite Materials: Engineering and Science	1st Edition, Chapman and Hall, London, England	1994
2	Chawla K. K	Composite materials	Second Edition, Springer – Verlag	1998

REFERENCE BOOKS:

S.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Clyne, T. W. and Withers, P. J	Introduction to Metal Matrix Composites	Cambridge University Press	1993
2	Mallick, P.K., Fiber,	Reinforced Composites: Materials, Manufacturing and Design	Maneel Dekker Inc	1993
3	Strong, A.B	Fundamentals of Composite Manufacturing	SME,Co	1989
4	Sharma, S.C	Composite materials	Narosa Publications	2000
5	Mallick, P.K. and Newman, S.,	Composite Materials Technology: Processes and Properties	Hansen Publisher, Munish	1990

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5. www-eng.lbl.gov/~ecanderssen/Composite_Design/Laminate_Design.pdf

16MEE14 **INDUSTRIAL ROBOTICS** **L T P C**
3 0 0 3

COURSE OBJECTIVES

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

COURSE OUTCOMES:

16MEE14.CO1 Explain the fundamentals of robot
16MEE14.CO2 Know the working of various robot drive systems and end effectors
16MEE14.CO3 Discuss the working principle of various sensors
16MEE14.CO4 Know about Robot programming
16MEE14.CO5 Understand the implementation of robotics in industries.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEE14.CO1	X	X	X	X	X	X	X	-	-	X	X	X	X	X	X
16MEE14.CO2	X	X	X	X	-	X	X	X	-	X	X	X	X	X	X
16MEE14.CO3	X	X	X	X	X	-	X	X	-	X	X	X	X	X	X
16MEE14.CO4	X	X	X	X	X	-	X	X	-	X	X	X	X	X	X
16MEE14.CO5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

UNIT I: FUNDAMENTALS OF ROBOT 9

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

UNIT II: ROBOT DRIVE SYSTEMS AND END EFFECTORS 9

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

UNIT III: SENSORS AND MACHINE VISION 9

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

UNIT IV: ROBOT KINEMATICS AND ROBOT PROGRAMMING 9

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

UNIT V: IMPLEMENTATION AND ROBOT ECONOMICS 9

RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

TOTAL: L: 45 = 45

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Klafter R.D, Chmielewski T.A and Negin M	Robotic Engineering - An Integrated Approach	Prentice Hall	2003
2.	Groover M.P	Industrial Robotics - Technology Programming and Applications	McGraw Hill	2001

REFERENCES BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Craig J.J.	Introduction to Robotics Mechanics and Control	Pearson Education	2008
2.	Deb S.R.	Robotics Technology and Flexible Automation	Tata McGraw Hill Book Co	1994
3.	Rajput R.K.	Robotics and Industrial Automation	S.Chand and Company	2008
4.	Koren Y	Robotics for Engineers	Mc Graw Hill Book Co	1992
5.	Janakiraman P.A.	Robotics and Image Processing	Tata McGraw Hill	1995

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2. www.robotbasics.com/robot-drive-system
3. www.en.wikipedia.org/wiki/Machine_vision
4. www.et.byu.edu/~ered/ME537/Notes/Ch3-537.pdf
5. www.readorrefer.in/article/Economic-Analysis-of-Robot_5181/

16MEE15 MICRO ELECTRO MECHANICAL SYSTEMS **L T P C**

3 0 0 3

OBJECTIVE:

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

OUTCOMES:

16MEE15.CO1	Describe new applications and directions of modern engineering
16MEE15.CO2	Ability to understand the sensors and actuators-I.
16MEE15.CO3	Ability to understand the sensors and actuators-II.
16MEE15.CO4	Critically analyze Microsystems and Micromachining technology for technical feasibility as well as practicality.
16MEE15.CO5	Ability to understand the Polymers and Optical MEMS

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEE15.CO1	X	X	X	X	X	-	-	-	X	X	-	X	-	X	-
16MEE15.CO2	X	X	X	X	X	-	-	-	X	X	-	X	-	X	-
16MEE15.CO3	X	X	X	X	X	-	-	-	X	X	-	X	-	X	-
16MEE15.CO4	X	X	X	X	X	-	-	-	X	X	-	X	-	X	-
16MEE15.CO5	X	X	X	X	X	-	-	-	X	X	-	X	-	X	-

UNIT I: INTRODUCTION TO PROCESS PLANNING **9**

Intrinsic Characteristics of MEMS-Energy Domains and Transducers-Sensors and Actuators-Introduction to Micro fabrication-Silicon based MEMS processes-New Materials-Review of Electrical and Mechanical Concepts of MEMS-Semiconductor devices-Stress and Strain analysis-Flexural beam bending-Torsional deflection

UNIT II: SENSORS AND ACTUATORS-I **9**

Electrostatic sensors-Parallel plate capacitors-Applications-Interdigitated Finger capacitor-Comb drive devices-Micro Grippers-Micro Motors-Themal Sensing and actuation- Thermal expansion-Thermal couples-Thermal resistors-Thermal Bimorph-Applications-Magnetic Actuators-Micromagnetic components

UNIT III: SENSORS AND ACTUATORS-II **9**

Piezoresistive sensors-Piezoresistive sensor materials-Stress analysis mechanical elements-Applications to inertia,Pressure,Tactile and Flow sensors-Piezoelectric sensors and actuators-piezoelectric effects-piezoelectric materials-Application to inertia,Acoustic,Tactile and Flow sensors

UNIT IV: MICROMACHINING **9**

Silicon Anisotropic Etching-Anisotrophic Wet Etching-Dry Etching of Silicon-Plasma Etching-Deep Reaction Ion Etching(DRIE)-Isotropic Wet Etching-Gas Phase Etchants-Case studies-Basic surface micro machining processes-Structural and Sacrificial Materials-Acceleration of Sacrificial Etch-Assembly of 3D MEMS-Foundary process

UNIT V: POLYMER AND OPTICAL MEMS 9

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

TOTAL: L: 45 = 45

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Chang Liu	Foundations of MEMS	Pearson Education	2006
2.	Stephen D Senturia	Microsystem Design	Springer Publication	2000

REFERENCES BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Nadim Maluf	An Introduction to Micro Electro Mechanical System Design	Artech House	2000
2.	Mohamed Gad-el-Hal	The MEMS Handbook	CRC press Baco Raton	2000
3	Tai Ran Hsu	MEMS&Micro systems Design and Manufacture	Tata McGraw Hill	2002
4	E. H. Tay, Francis and W. O. Choong	, Micrfluids and Bio MEMS applications	Springer	2002
5	Gardner, W. Julian, K. Varadan Vijay and O. Awadelkarim, Osama	Micro sensors MEMS and Smart Devices	Jhon Wiley & Sons Ltd	2001

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3. www.engr.uvic.ca/~mech466/MECH466-Lecture-12.pdf
4. www.mecheng.iisc.ernet.in/~suresh/memsCOURSE/MicromachiningWord.pdf
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16MEE16 ADVANCED MANUFACTURING SYSTEMS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the surface treatment techniques.
- To understand the non-traditional machining
- To familiarize the laser beam machining and electron beam machining.
- To understand the manufacturing processes of ceramic composites.
- To understand the various Processing of Composites.

COURSE OUTCOMES

16MEE16.CO1 Understand the fundamentals of Surface treatment.
16MEE16.CO2 Illustrate the concepts of non-traditional machining processes
16MEE16.CO3 Explain the working principle of laser beam machining and electron beam machining
16MEE16.CO4 Summarize the fabrication techniques of microelectronic devices.
16MEE16.CO5 Comprehend the fabrication and processing of ceramic composites

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEE16.CO1	X	X	X	-	-	X	-	-	-	-	-	X	-	-	X
16MEE16.CO2	X	X	-	X	X	X	-	-	-	-	-	X	-	-	X
16MEE16.CO3	X	-	X	X	X	-	-	-	-	-	-	X	-	-	X
16MEE16.CO4	X	X	-	-	-	-	-	-	-	-	-	X	-	-	X
16MEE16.CO5	X	X	-	-	-	-	-	-	-	-	-	X	-	-	X

UNIT I: SURFACE TREATMENT **9**

Scope, Cleaners, Methods of cleaning, Surface coating types, and ceramic and organic methods of coating, economics of coating. Electro forming, Chemical vapour deposition, thermal spraying, Ion implantation, diffusion coating, Diamond coating and cladding.

UNIT II: NON-TRADITIONAL MACHINING **9**

Introduction, need, AJM, Parametric Analysis, Process capabilities, USM –Mechanics of cutting, models, Parametric Analysis, WJM –principle, equipment ,process characteristics , performance, EDM – principles, equipment, generators, analysis of R-C circuits, MRR , Surface finish, WEDM.

UNIT III: BEAM, ARC AND CHEMICAL MACHINING **9**

Laser beam, electron beam, plasma arc & electro chemical machining-Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications.

UNIT IV: FABRICATION OF MICROELECTRONIC DEVICES **9**

Crystal growth and wafer preparation, Film Deposition oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuit boards, computer aided design in micro electronics, surface mount technology, Integrated circuit economics. E-Manufacturing, nanotechnology

UNIT V: PROCESSING OF CERAMICS AND COMPOSITES **9**

Applications, characteristics, classification .Processing of particulate ceramics, Powder preparations, consolidation, Drying , sintering, Hot compaction, Area of application , finishing of ceramics. Composite Layers, Particulate and fiber reinforced composites, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.

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TOTAL: L: 45 = 45

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	V. K. Jain	Advanced Machining Processes	Allied Publishers	2009
2	J. A. McGeough	Advanced Methods of Machining	Springer	2011

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Kalpakijian	"Manufacturing Engineering and Technology"	Adisson Wesley	2010
2	R. A. Lindburg	"Process and Materials of Manufacturing"	PHI	2003
3	Chang Liu	Foundation of MEMS	Pearson	2012
4	Hassan El-Hofy,	Advanced Machining Processes: Nontraditional and Hybrid Machining Processes	McGraw-Hill	2005
5	V. K. Jain	Introduction to Micromachining	Alpha Science International Limited	2010

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3. www.nptel.ac.in/COURSEs/112105127/pdf/LM-40.pdf.
4. www.nptel.ac.in/COURSEs/112108092/module2/lec07.pdf.
5. www.ce.mu.edu.tr/Icerik/metalurji.mu.edu.tr/Sayfa/Composite_Materials_5.pdf.

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16MEE17 ADDITIVE MANUFACTURING TECHNIQUES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To provide an exhaustive knowledge of various rapid prototyping techniques
- To educate the emerging trends and applications of Additive Manufacturing (AM) technology.
- To educate fundamental and advanced knowledge in the field of the associated aerospace, architecture, art, medical and industrial applications.
- To make familiar in reverse engineering and cad modeling
- To make familiar about materials and process parameters in prototype development.

COURSE OUTCOMES

16MEE17.CO1 Understand the basics of additive manufacturing processes
16MEE17.CO2 Describe various liquid based and solid based rapid prototyping systems
16MEE17.CO3 Illustrate various power based and special rapid prototyping systems
16MEE17.CO4 Describe reverse engineering in rapid prototyping.
16MEE17.CO5 Describe the properties of various materials used in prototyping

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEE17.CO1	X	X	X	-	-	X	-	-	-	-	-	X	-	-	X
16MEE17.CO2	X	X	-	X	X	X	-	-	-	-	-	X	-	-	X
16MEE17.CO3	X	-	X	X	X	-	-	-	-	-	-	X	-	-	X
16MEE17.CO4	X	X	-	-	-	-	-	-	-	-	-	X	-	-	X
16MEE17.CO5	X	X	-	-	-	-	-	-	-	-	-	X	-	-	X

UNIT I: INTRODUCTION **9**

Need - Development of AM systems - AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling - RP to AM -Classification of AM processes – Benefits- Applications.

UNIT II: LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS **9**

Stereo lithography Apparatus SLA Principle, Part building processes, Photo polymerization of SL resins, Part quality, Recoating issues, Materials. Solid Ground Curing, Fused Deposition Modeling and Laminated Object Manufacturing Working Principle - Process parameters and Materials.

UNIT III: POWDER BASED AND OTHER RAPID PROTOTYPING SYSTEMS **9**

Selective Laser Sintering Principle, Process Variables, Indirect and direct SLS - Powder structures, Materials, Post processing, Surface deviation and Accuracy - Three dimensional Printing Principle, Physics of 3DP, Types, Process capabilities, Solid, Liquid and Powder based 3DP systems.

UNIT IV: REVERSE ENGINEERING AND CAD MODELING **9**

Basic concept - Digitization techniques - Model reconstruction - Data Processing for Rapid Prototyping - CAD model preparation, Data requirements - Geometric modeling techniques - Wire frame, surface and solid modeling - data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation-Software for AM- Case studies.

UNIT V: MATERIALS PROPERTIES **9**

Role of materials - Viscous flow - Photo polymerization - Sintering - Infiltration - Materials for AM Processes - Mechanical Properties of AM Parts - Material properties, Colour, Dimensional accuracy, Stability, Surface finish, Machinability, Environmental resistance, Operational properties of products developed Direct Metal Deposition, Ballistic Particle Manufacturing, Electron Beam Melting and Laser Engineered Net Shaping Working Principle.

TOTAL: L:45 = 45

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Ian Gibson, DavidW.Rosen	Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing	Springer	2015
2	Amit Bandyopadhyay, Susmita Bose	Additive Manufacturing	Taylor &Francis Group	2016

REFERENCE BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Liou, L.W. and Liou, F.W	Rapid Prototyping and Engineering applications: A tool box for prototype development"	CRC Press	2011
2	Rafiq I. Noorani	Rapid Prototyping: Principles and Applications	John Wiley & Sons	2008
3	Ian Gibson, David Rosen & Brent Stucker	Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing	Springer	2016
4	Kamrani, A.K. and Nasr, E.A	Rapid Prototyping: Theory and practice	Springer	2006
5	Chua, C.K., Leong K.F. and Lim C.S	Rapid prototyping: Principles and applications	World Scientific Publishers	2010

WEB URLs

1. www.nptel.ac.in/COURSEs/112107143/1
2. www.public.iastate.edu/courses.html
3. www.books.google.co.in/books/about/Rapid_Prototyping
4. www.youtube.com/watch?v=PDLOmoQj4H0
5. www.youtube.com/watch?v=i6Px6RSL9Ac

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16MEE18 **LEAN MANUFACTURING** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To acquire the general knowledge to deliver consistently high quality and value added products and services to the customer in a lean environment
- To understand the terminology relating to lean operations in both service and manufacturing organizations
- To understand various controlling and manufacturing techniques that effect lean manufacturing
- To comprehend the implementation process of lean manufacturing.
- To familiarize with the lean accounting system

COURSE OUTCOMES

16MEE18.CO1 Understand and apply the concept of lean thinking to the processes
16MEE18.CO2 Understand the work place organization process
16MEE18.CO3 Comprehend the various work flow and control techniques.
16MEE18.CO4 Illustrate various lean manufacturing techniques
16MEE18.CO5 Understand and analyze the manufacturing time and implementation of lean manufacturing

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEE18.CO1	X	X	X	-	-	X	-	-	-	-	-	X	-	-	X
16MEE18.CO2	X	X	-	X	X	X	-	-	-	-	-	X	-	-	X
16MEE18.CO3	X	-	X	X	X	-	-	-	-	-	-	X	-	-	X
16MEE18.CO4	X	X	-	-	-	-	-	-	-	-	-	X	-	-	X
16MEE18.CO5	X	X	-	-	-	-	-	-	-	-	-	X	-	-	X

UNIT I: INTRODUCTION 9

History – Evolution - Toyota production system - Lean manufacturing overview.

UNIT II: ORGANIZATION OF WORK PLACE 9

Work place organization - Visual controls - Pull production and cellular manufacturing - Value flow pull - Value and perfection lean

UNIT III: WORK FLOW AND CONTROL TECHNIQUES 9

Mapping the present – Mapping the future - Product and process development – Value stream analysis - Over production - Waiting - Work In Progress - Transportation - Inappropriate processing - Excess motion or ergonomic problems - Defected products - Underutilization of employees.

UNIT IV: LEAN MANUFACTURING TECHNIQUES 9

Just In Time - Kanban tooling - Total Productive Maintenance – 5S - Single Minute Die Exchange - Lean six sigma.

UNIT V: IMPLEMENTATION OF LEAN MANUFACTURING 9

Flow charting - Identifying and eliminating unnecessary steps - Setup time - reduction approaches - Steps in implementing lean strategy – Lean accounting system.

TOTAL: L:45 = 45

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Dennis P Hobbs	Lean Manufacturing Implementation	J. Ross Publications	2009
2	Jay Arthur	Lean Six-Sigma Demystified	Tata McGraw-Hill Company, New Delhi	2009

REFERENCE BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Jeffrey K Liker	The Toyota Way-14 Management Principles	Tata McGraw-Hill Company, New Delhi	2015
2	Pascal Dennis	Lean Production Simplified,	Productivity Press, USA	2002
3	James P Womack, Daniel T. Jones	Lean Thinking: Banish waste and create wealth in your corporatio	Simon & Schuster UK Limited, Free Press	2003
4	Richard J Schonberger	World Class Manufacturing	Sp Free Press	2003
5	Carreira B	Lean Manufacturing that Works	PHI	2007

WEB URLs

1. www.leanmanufacturingtools.org/
2. www.en.wikipedia.org/wiki/Lean_manufacturing
3. www.leanproduction.com
4. www.leanproduction.com/top-25-lean-tools.html
5. www.losyco.com/lean

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OPEN ELECTIVES

(OE)

For

Mechanical Engineering

16ITD21 INTERNET OF THINGS

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the fundamentals of Internet of Things
- To learn about the basics of IOT protocols
- To build a small low cost embedded system using Raspberry Pi.
- To Deploy an IoT application and connect to the cloud.
- To apply the concept of Internet of Things in the real world scenario.

COURSE OUTCOMES:

16ITD21.CO1 Understand the fundamental concepts of IOT
16ITD21.CO2 Draw the architecture IOT
16ITD21.CO3 Design a web page using IOT
16ITD21.CO4 Develop the secure real time application using IOT
16ITD21.CO5 Create a applications using IOT

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16ITD21.CO1	-	-	-	-	-	X	-	-	-	X	X	-	-	-	-
16ITD21.CO2	-	X	X	X	X	-	-	-	-	X	-	-	X	X	X
16ITD21.CO3	-	X	X	X	X	-	-	-	-	X	-	-	X	X	-
16ITD21.CO4	-	X	X	X	X	-	-	X	X	X	X	X	X	X	X
16ITD21.CO5	-	X	X	X	-	-	-	X	X	-	-	X	X	X	X

UNIT I INTRODUCTION TO IoT 9

Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology

UNIT II IoT ARCHITECTURE 9

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture.

UNIT III IoT PROTOCOLS 9

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP - Security.

UNIT IV BUILDING IoT WITH RASPBERRY PI & ARDUINO 9

Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.

UNIT V CASE STUDIES AND REAL-WORLD APPLICATIONS 9

Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT.

TOTAL :45 **PERIODS**

REFERENCE BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Arshdeep Bahga, Vijay Madisetti	Internet of Things A hands-on approach	Universities Press	2015
2	Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds),	Architecting the Internet of Things	Springer	2011
3	Honbo Zhou	The Internet of Things in the Cloud: A Middleware Perspective	CRC Press	2012
4	Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle	From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence	Elsevier	2014
5	Olivier Hersent, David Boswarthick, Omar Elloumi	The Internet of Things – Key applications and Protocols	Wiley	2012

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16ECE04 BIOMEDICAL ENGINEERING

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To explain Human physiology and components of biomedical system
- To discuss the electro physiological parameter measurements
- To describe the non - electro physiological parameter measurements
- To operate of medical imaging and biotelemetry systems
- To explain the principles of operation of Therapeutic equipments

COURSE OUTCOMES:

16ECE04.CO1 Explain Human physiology and components of biomedical system
16ECE04.CO2 Discuss the electro physiological parameter measurements
16ECE04.CO3 Describe the non - electro physiological parameter measurements
16ECE04.CO4 Operate of medical imaging and biotelemetry systems
16ECE04.CO5 Explain the principles of operation of Therapeutic equipments

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16ECE04.CO1	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-
16ECE04.CO2	-	1	2	3	3	-	-	-	-	2	-	-	2	3	3
16ECE04.CO3	-	1	3	3	2	-	-	-	-	1	-	-	2	2	-
16ECE04.CO4	-	2	3	3	3	-	-	-	1	2	3	1	1	3	1
16ECE04.CO5	-	3	2	3	-	-	-	-	1	-	-	1	1	3	2

UNIT I PHYSIOLOGY AND TRANSDUCERS 9

Cell and its structure - Resting and Acton Potential - Nervous system: Functional organization of the nervous system. Structure of nervous system, neurons-synapse - transmitters and neural communication- Cardiovascular system - respiratory system , Basic components of a biomedical system. Transducers - selection criteria – Piezo electric, ultrasonic transducer temperature measurements, Fibre optic temperature sensors.

UNIT II ELECTRO - PHYSIOLOGICAL MEASUREMENTS 9

Electrodes - Limb electrodes floating electrodes -pregelled disposable electrodes -micro-needle and surface electrodes - Amplifiers: Preamplifiers- differential amplifies- chopper amplifiers Isolation amplifier. Physiological measurements - ECG. EEG, EMG. ERG.-Lead systems and recording methods: Typical waveforms, Electrical safety in medial environment shock hazards leakage current.

UNIT III NON ELECTRICAL PARAMETER MEASUREMENTS 9

Measurement of blood pressure Cardiac output -Heart rate-Heart sounds - Pulmonary function measurements - spirometer-Photo Plethysmograpy- Body Plethysmograpy -Blood Gas analyzers -pH of blood measurement of blood. pCO2, pO2, fingertip oxymeter- ESR, GSR measurements

UNIT IV MEDICAL IMAGING AND BIOTELEMETRY 9

Radio graphic and fluoroscopic techniques Computer tomography-Magnetic Resonance Imaging - Ultrasonography-A mode, B mode, M mode. Endoscopy-Thermography- Different types of biotelemetry systems and patient monitoring - Wireless Telemetry. Single channel, multi channel, multi patient and implantable telemetry systems.

UNIT V ASSISTING AND THERAPEUTIC EQUIPMENTS 9

Pacemaker - External and steal pacemaker: Defibrillators-DC Defibrillators, implantable Defibrillators - Ventilators - Nerve and muscle simulators -TENS - Surgical diathermy machine, safety aspects in electro surgical units- Heat Lung machine- Audiometer: Dialysers-Lithotripsy

Total : 45 Hours

TEXT BOOKS

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	R S Khandpur	Hand Book of Bio Medical and Instrumentation	Tata McGraw Hill Publishing Limited	2004

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16CEE09 INDUSTRIAL WASTE MANAGEMENT

L T P C
3 0 0 3

COURSE OBJECTIVES

- To impart the concepts of sources and effects of industrial wastes.
- To recognize about the cleaner production in waste management.
- To knowledge about various pollution arising from the major industries.
- To understand the concept of various treatment technologies for industrial waste.
- To learn about hazardous waste management.

COURSE OUTCOMES

16CEE09.CO1 Discuss the different types of industrial wastes and their effects.
16CEE09.CO2 Summarize the waste management approach
16CEE09.CO3 Appraise the sources and characteristics of various pollutions from different industries.
16CEE09.CO4 Compare and contrast the different waste treatment technologies.
16CEE09.CO5 Reiterate the principles of hazardous waste management.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16CEE09.CO1	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-
16CEE09.CO2	-	X	X	X	X	-	-	-	-	X	-	-	X	X	X
16CEE09.CO3	-	X	X	X	X	-	-	-	-	X	-	-	X	X	-
16CEE09.CO4	-	X	X	X	X	-	-	-	X	X	X	X	X	X	X
16CEE09.CO5	-	X	X	X	-	-	-	-	X	-	-	X	X	X	X

Unit-I : Introduction 9

Types of industries and industrial pollution - characteristics of industrial wastes - population equivalent -bio-assay studies - effects of industrial effluents on streams, sewer, land, effluent treatment plants and human health - environmental legislations related to prevention and control of industrial effluents and hazardous wastes.

Unit-II : Cleaner Production 9

Waste management approach - waste audit – ISO 14000 volume and strength reduction - material and process modifications - recycle, reuse and byproduct recovery - applications.

Unit-III : Pollution from Major Industries 9

Sources, characteristics, waste treatment flow sheets for selected industries - textiles, tanneries, pharmaceuticals, electroplating industries, dairy, sugar, paper, distilleries, steel plants, refineries, fertilizer and thermal power plants - wastewater reclamation concepts.

Unit-IV : Treatment Technologies 9

Equalization -neutralization - removal of suspended and dissolved organic solids - chemical oxidation - adsorption - removal of dissolved inorganic - combined treatment of industrial and municipal wastes - residue management - dewatering – disposal.

Unit-V : Hazardous Waste Management 9

Hazardous wastes - physic - chemical treatment - solidification - incineration - secured landfills.

Total : 45 Hours

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Text Books:

S.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Rao.M.N and Dutta.AK	Wastewater Treatment	Oxford - IBH Publication	2017
2.	Eckenfelder Jr.W.W	Industrial Water Pollution Control	McGraw-Hill Book Company, New Delhi	2014
3.	Freeman .H.M	Industrial Pollution Prevention Hand Book	McGraw-Hill Inc., New Delhi	2008

Reference Books:

S.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Dr. Jagbir Singh	Solid Waste Management	I.K. International	2010
2.	Shen T.T	Industrial Pollution Prevention	Springer	2013
3.	Stephenson R.L. and Blackburn, Jr. J.B	Industrial Wastewater Systems Hand book	Lewis Publisher, New York	2016

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EMPLOYABILITY ENHANCEMENT COURSES

(EEC)

For

Mechanical Engineering

16MEF07 **PROJECT WORK PHASE -I** **L T P C**

0 0 6 3

COURSE OBJECTIVES

- To achieve integrated mechanical design of a product through parts design, assembly and preparation of manufacturing drawings

COURSE OUTCOMES

16MEF07.CO1 Work as a team towards engineering solution for given problem.
16MEF07.CO2 Apply engineering knowledge to convert real time problem into engineering problem.
16MEF07.CO3 Analyse the existing literature study.
16MEF07.CO4 Formulate a solution methodology for engineering problems.
16MEF07.CO5 Summarize and document their findings.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEF07.CO1	X	-	X	X	X	-	-	-	X	X	X	X	X	X	X
16MEF07.CO2	X	-	X	-	-	-	-	-	X	X	X	-	X	X	X
16MEF07.CO3	X	-	-	X	X	X	-	-	X	X	X	-	X	X	X
16MEF07.CO4	-	-	-	-	X	-	-	-	X	X	X	-	X	-	-
16MEF07.CO5	X	-	-	-	-	-	-	-	X	X	X	-	X	-	-

Students are asked to form a team which consists of 4 members, maximum. Each team has to work under a project supervisor. Based on the current industrial scenario, any relevant problem should be selected for the project with the consultation of the supervisor. Literature review should be done related to the problem considered. The working methodology of the project work for the phase II should be decided. These activities should be registered in a report and submitted by the student which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report, jointly by external and internal examiners.

TOTAL: P:90 = 90

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16MEF02 **PROJECT WORK PHASE -II** **L T P C**
0 0 30 15

COURSE OBJECTIVES

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

COURSE OUTCOMES

16MEF02.CO1 Apply sound technical knowledge in core and multi-disciplinary area
16MEF02.CO2 Simplify project planning activities that forecast project costs, timelines and quality
16MEF02.CO3 Experiment with to interpret data pertaining to problem identified
16MEF02.CO4 Prepare documentation and presentation for engineering activities for society
16MEF02.CO5 Solve industrial problems with teamwork and multidisciplinary approach

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEF02.CO1	X	X	X	X	X	-	-	-	X	X	X	X	X	X	X
16MEF02.CO2	-	X	X	-	-	X	-	-	X	X	X	-	X	X	X
16MEF02.CO3	-	-	-	X	X	X	-	-	X	X	X	-	X	X	X
16MEF02.CO4	-	-	-	-	X	-	-	-	X	X	X	-	X	-	-
16MEF02.CO5	-	-	-	-	-	-	-	-	X	X	X	-	X	-	-

Based on the work methodology decided in the Phase I, the project is further developed. Necessary modeling and analysis is done using required software. The project is fabricated. The analytical results and the experimental results are validated. Three reviews will be conducted priodically by a committee constituted by the Head of the Department. A project report to be prepared by the students along with which the project has to be submitted for the final viva voce examination

TOTAL: P: 450 = 450

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16MEF03 **COMPREHENSION** **L T P C**
0 0 2 1

COURSE OBJECTIVES

- To encourage the students to comprehend the knowledge acquired from the first Semester to Sixth Semester of B.E Degree COURSE through periodic exercise.
- To gain ability to understand and comprehend any given problem related to mechanical engineering Field.

COURSE OUTCOMES

16MEF03.CO1 Recall the basic principles of previous semester courses.
16MEF03.CO2 Comprehend and analyze problems associated with mechanical engineering

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEF03.CO1	X	X	X	X	X	-	-	-	X	X	X	X	X	X	X
16MEF03.CO2	-	X	X	-	-	X	-	-	X	X	X	X	X	X	X

The students have to recall the principles and fundamental of the courses studied in their previous semesters. Weekly examination will be conducted and evaluated. The question papers will contain objective and descriptive questions which will be asked from the previous semester Courses. The average of the marks obtained in the tests will be considered for the end semester evaluation.

TOTAL: P:30 = 30

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16MEF04 **DESIGN AND FABRICATION PROJECT** **L T P C**
0 0 4 2

COURSE OBJECTIVES

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

COURSE OUTCOMES

16MEF04.CO1 Use of design principles and develop conceptual and engineering design of any components.

16MEF04.CO2 Ability to fabricate any components using different manufacturing tools.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MEF04.CO1	X	-	X	X	X	-	-	-	X	X	X	X	X	X	X
16MEF04.CO2	X	-	X	-	-	-	-	-	X	X	X	-	X	X	X

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

TOTAL: P: 60 = 60