

**ANNA UNIVERSITY, CHENNAI**  
**UNIVERSITY DEPARTMENTS**  
**B.E. PRODUCTION ENGINEERING**  
**REGULATIONS – 2019**  
**CHOICE BASED CREDIT SYSTEM**

**Vision**

To develop educational avenues for the students to emerge as disciplined researchers, technocrats and entrepreneurs making transformative impact on establishing a world class society in the domain of Production Engineering and Automation.

**Mission**

1. To impart students with knowledge on modern manufacturing and automated systems by incorporating critical thinking, leadership qualities, communication with interpersonal skills.
2. To create a conducive environment for exchange of multidisciplinary ideas towards research, creativity, innovation and entrepreneurship to meet the societal needs with optimal solutions.
3. To follow the values of integrity and honesty through curricular, co-curricular and extracurricular activities.

**Programme Educational Objectives (PEOs)**

1. Graduates will be competent to effectively design, model, and analyze products and processes, incorporating essential skills required for automated production systems.
2. Graduates will emerge with the necessary confidence and expertise in production engineering, positioning them for successful careers in industry, research organizations, or as entrepreneurs.
3. Graduates will incorporate ethical considerations and a keen awareness of societal and environmental responsibilities into their lifelong learning practices.

**Program Outcomes (POs)**

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

**6. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**7. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**10. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**11. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**12. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

### Program Specific Outcomes (PSOs)

1. Graduates will exhibit foundation in production techniques by understanding the behaviour of materials, mechanics and design principles.
2. Graduates will demonstrate management principles, sustainability, quality systems and resource optimization in industry
3. Graduates will apply various production practices to meet industrial, societal and multidisciplinary requirements.

### Mapping of PEOs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
PEO1	3	3	3	2	2	2	2	1	2	1	2	2	3	1	2
PEO2	3	3	3	2	3	2	2	2	3	2	3	3	3	2	2
PEO3	1	1	1	1	1	3	3	3	2	1	1	3	1	1	2

### MAPPING OF COURSE OUTCOMES WITH PROGRAMME OUTCOMES:

#### SEMESTER I

S. No	Course Title	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
<b>Theory</b>																
1	Technical English	-	-	-	-	-	3	3	3	3	3	-	3	-	-	1
2	Engineering Mathematics- I	3	3	3	2	2	-	-	-	-	-	-	2	1	1	-
3	Engineering Physics	3	3	3	2	2	-	-	-	-	-	-	-	2	2	1
4	Engineering Chemistry	3	3	3	2	2	-	-	-	-	-	-	-	2	1	1
5	Engineering Graphics	3	3	3	3	3	3	-	-	1		2	3	3	3	1
<b>Practicals</b>																
6	Basics Sciences Laboratory	3	3	3	3	3	-	-	-	-	-	-	-	3	1	1
7	Workshop Practices Laboratory	3	3	3	3	3	-	-	-	2	-	1	-	3	3	2

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## SEMESTER II

S. No	Course Title	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
<b>Theory</b>																
1	Professional Communication	-	-	-	-	-	1	1	-	3	3	-	3	-	-	1
2	Engineering Mathematics-II	3	3	3	3	3	-	-	-	1	-	-	3	2	2	-
3	Problem Solving and Python Programming	3	3	3	3	3	-	-	-	-	-	3	3	1	1	1
4	Basics of Electrical and Electronics Engineering	3	2	2	1	1	-	-	-	-	1	-	1	2	1	1
5	Engineering Mechanics	3	3	3	2	3	-	-	-	1	-	1	-	3	3	1
6	Materials Science	2	1	-	-	-	-	1	-	1	2	-	1	2	1	1
<b>Practicals</b>																
7	Problem Solving and Python Programming Laboratory	3	3	3	3	3	-	-	-	-	-	3	3	1	1	1
8	Electrical and Electronics Engineering Laboratory	2.6	2.6	2.6	-	2.6	-	-	-	2	2	-	1	1	1	2

## SEMESTER III

S. No	Course Title	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
<b>Theory</b>																
1	Numerical Methods	2	2.6	2	1.6	2.4	-	-	2	2	2	-	1	3	1	-
2	Mechanics of Solids	3	3	2	2	1	2	2	1	2	1	-	2	3	3	3
3	Thermodynamics and Thermal Engineering	2.2	2.2	2.2	1	1	1	1.4	1	1	2.2	-	2	2.8	2.8	2.2
4	Fluid Mechanics and Fluid Machines	3	3	2	2	1	2	2	1	2	1	1	2	3	2	3
<b>Practicals</b>																
7	Computer Aided Drafting and Machining Laboratory	2.0	1.0	1.0	1.0	2.0	-	-	1.0	1.0	2.0	1.0	2.0	1.0	-	2.0
8	Material Testing and Thermal Engineering Laboratory	1	1	1	1	1	-	-	1	1	1	-	-	1	-	1

## SEMESTER IV

S. No	Course Title	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
<b>Theory</b>																
1	Environmental Sciences	2	2.6	2	1.6	2.4	-	-	2	2	2	-	1	3	1	-
2	Foundry and Welding Technology	1	1	1	-	1.6	3	2	-	-	-	-	2	1	1	1
3	Engineering Materials	1	1.6	1	1	1	1	1	-	-	-	-	1	1	1	1
4	Machining Processes and Machine Tools	1	-	1	-	1	-	1	-	-	-	-	-	1	-	1
5	Kinematics and Dynamics of Machines	2	1	1	1	1	-	-	-	1	1	-	-	1	1	1
<b>Practicals</b>																
6	Machining Processes Laboratory	1.2	1	1	3	3	2	-	-	3	2	-	1	1	-	1
7	Foundry, Welding and Metallurgy Laboratory	2.4	-	2	2	-	-	2	-	3	3	1	3	1	-	1

### SEMESTER V

S. No	Course Title	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
<b>Theory</b>																
1	Statistics for Production Management	3	2	1	1.2	1	-	-	-	-	-	-	1	1	1	1.2
2	Constitution of India	-	-	-	-	-	1	-	1	-	1	-	1	-	-	-
3	Engineering Metrology	1	1	1	2	-	1	-	-	-	1	-	1.2	1	1	1
4	Fluid Power Systems	2.2	1.4	1.4	1	1	-	-	-	-	-	-	1	1	-	1.2
5	Machine Components Design	3	3	3	3	-	3	3	3	-	-	-	2	1	1	1
6	Professional Elective I															
<b>Practical</b>																
7	Fluid Power Systems Laboratory	1	2	2	-	1	-	-	-	3	2	1	3	1	-	2
8	Engineering Metrology Laboratory	1.2	1.8	1	2	-	-	-	-	3	3	-	3	1	1	2

### SEMESTER VI

S. No	Course Title	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
<b>Theory</b>																
1	Metal Forming	3	2	1	1	-	-	1	1	1	2	-	1	1	-	1
2	CNC Machines	1	1	1	1	2	2	-	-	-	-	-	1	1	-	1
3	Computer Aided Design and Analysis	1.8	1.6	1	1	1	-	-	-	1	-	1	1	-	2	
4	Professional Elective II															
5	Professional Elective III															
6	Professional Elective IV															
<b>Practical</b>																
7	CNC and Metal Forming Laboratory	1	1	-	-	-	-	-	-	3	3	-	-	1	-	1
8	Modeling and Analysis Laboratory	2	2	1	2	2	-	1	1	1	2	1	2	2	1	2

### SEMESTER VII

S. No	Course Title	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
<b>Theory</b>																
1	Mechatronics for Automation	1.2	1	1	1	1	-	-	-	-	1	-	1	1	-	1
2	Computer Integrated Manufacturing Systems	1	1	-	-	1	-	-	-	-	1	1	1	1	1	1
3	Professional Elective IV															
4	Professional Elective V															
5	Professional Elective VI															
6	Open Elective II															
<b>Practical</b>																
7	Internship/ Certificate Courses (4 Weeks)	3	3	3	3	3	3	1	2	1	1	1	3	3	3	3
8	Project I	3	2	2	2	2	2	2	2	3	3	3	3	2	1	2

### SEMESTER VIII

S. No	Course Title	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
<b>Practical</b>																
1	Project II	3	2	2	2	2	2	2	2	3	3	3	3	2	1	2

## PROFESSIONAL ELECTIVE COURSES (PEC)

S. No	Course Title	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1.	Smart Materials for Manufacturing	1.6	1	-	-	-	1	1	-	-	2	-	1	2	1	2
2.	Corrosion Engineering	1	1	-	-	-	1	-	-	-	1	-	-	1	1	1.4
3.	Disaster Management	1	1				1				1			1	1	1.4
4.	Human Rights	2	-	-	-	-	3	2	2	2	1	-	2	-	1	1
5.	Engineering Ethics and Human Values	-	-	-	-	-	3	3	3	-	-	-	3	-	3	3
6.	Electronic Materials and Processing	1	1	1	1	-	-	1	-	-	1	-		1	-	1
7.	Advances in Operations Research	2	2	1	1	-	-	-	-	-	1	1.2	1	2	2	2
8.	Heat Transfer	2.8	1	2	-	1	-	-	-	-	-	-	1	1	-	-
9.	Elements of Green Manufacturing	1	1	1	-	-	3	3	1	-	-	-	3	1	1	1
10.	Industrial Management	2	2	2	2	3	1	2	1	-	-	2	3	3	3	1
11.	Design of Casting and Weldments	2	2	3	1	-	-	-	-	-	-	-	1	2	1	1
12.	Computer Aided Product Design	1	-	1.7	1	2	2.5	2	2	-	-	-	-	1	2	1
13.	Quantitative Techniques in Management	3	2	1	1.4		1	1	-	-	1	-	1	1	1.4	1
14.	Green Electronics Manufacturing	1.2	-	-	1	-	2.6	2.5	-	-	1	-	2	1	2.8	2
15.	Lean Manufacturing	1	2	2	2.2	3	-	-	-	-	-	1.6	3	-	2	1
16.	Micro Electro Mechanical Systems and Nano Technology	1.6	1	-	-	-	-	-	-	-	2	-	1.5	2.2	1	1.4
17.	Micromachining and Fabrication	1.4	1	-	1	-	-	-	-	-	1	-	2	1	1	1
18.	Modern Concepts in Manufacturing	1	1	1	1	1	2	1	-	-	1	-	2	1	-	2
19.	Non Destructive Testing Methods	2	1	-	1	-	1	-	-	-	1	-	2	1.0	-	1.8
20.	Processing of Plastics and Polymers	1.6	-	-	2	2	3	3	3	-	-	-	3	3	-	3
21.	Processing of Composites	1	-	1	-	-	1	1	-	-	-	-	3	1	-	1
22.	Materials Procurement Management	1	1	1	-	-	-	-	-	-	-	1	1	-	1	1
23.	Selection and Treatment of Materials	1	1	1	1	1	1	1	1	-	-	-	1	1	-	1
24.	Supply Chain Management	-	1	1	1	1	1	-	-	1	-	-	1	-	1	1
25.	Total Quality Management: Principles and Applications	1.4	1	1	2.2	2	1	1	3	1	1.6	1	-	-	1	1
26.	Unconventional Machining Processes	2	1	1	1	-	-	-	-	-	-	-	1	1	-	1
27.	Integrated Product Development	1	1	1	-	-	-	-	-	3	1	-	1	1	1	1
28.	Production of automotive Components	1	1	1	-	-	1	1	-	-	-	-	1	1	1	1
29.	Additive Manufacturing	3	1.2	1	1	2	-	2	-	-	2	-	3	1.6	2	1.2
30.	Process Planning and Cost Estimation	3	3	2	1.8	2	1	1	1	1	-	1	1	2	2	1.4
31.	Robotic Technology	1.2	1	1	1	1	1	-	-	-	1	1	1	1	-	1.4
32.	Finite Element Analysis in Application	3	3	1	2	2	-	-	1	-	1	-	1	1	-	2
33.	Theory of Metal Cutting	2	2	-	1	-	-	-	-	-	1	1	1	1	1	1
34.	Tool Design	1.4	1	1	-	-	-	-	-	-	-	-	-	1	1	1

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B.E. PRODUCTION ENGINEERING  
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**CURRICULA AND SYLLABI FOR I TO VIII SEMESTERS**

**SEMESTER I**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
<b>THEORY</b>								
1.	HS5151	Technical English	HSMC	3	0	0	3	3
2.	MA5158	Engineering Mathematics-I	BSC	3	1	0	4	4
3.	PH5151	Engineering Physics	BSC	3	0	0	3	3
4.	CY5151	Engineering Chemistry	BSC	3	0	0	3	3
5.	GE5151	Engineering Graphics	ESC	1	0	4	5	3
6.	GE5154	தமிழர் மரபு/ Heritage of Tamils	HSMC	1	0	0	1	1
<b>PRACTICALS</b>								
7.	BS5161	Basic Sciences Laboratory	BSC	0	0	4	4	2
8.	GE5162	Workshop Practices Laboratory	ESC	0	0	4	4	2
9.	GE5163	English Laboratory <sup>§</sup>	EEC	0	0	2	2	1
<b>TOTAL</b>				<b>14</b>	<b>1</b>	<b>14</b>	<b>29</b>	<b>22</b>

<sup>§</sup> Skill Based Course

**SEMESTER II**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
<b>THEORY</b>								
1.	HS5251	Professional Communication	HSMC	2	0	0	2	2
2.	MA5252	Engineering Mathematics - II	BSC	3	1	0	4	4
3.	GE5153	Problem Solving and Python Programming	ESC	3	0	0	3	3
4.	EE5251	Basics of Electrical and Electronics Engineering	ESC	3	0	0	3	3
5.	GE5152	Engineering Mechanics	ESC	3	1	0	4	4
6.	PH5251	Materials Science	BSC	3	0	0	3	3
7.	GE5252	தமிழரும் தொழில்நுட்பம் Tamils and Technology	HSMC	1	0	0	1	1
<b>PRACTICALS</b>								
8.	GE5161	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
9.	EE5261	Electrical and Electronics Engineering Laboratory	ESC	0	0	4	4	2
10.	GE5262	Communication Laboratory / Foreign Language <sup>§</sup>	EEC	0	0	4	4	2
<b>TOTAL</b>				<b>18</b>	<b>2</b>	<b>12</b>	<b>32</b>	<b>26</b>

<sup>§</sup> Skill Based Course

*Attested*

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**SEMESTER III**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
<b>THEORY</b>								
1		Elective – Humanities I	HSMC	3	0	0	3	3
2	MA5353	Numerical Methods	BSC	3	1	0	4	4
3	AU5352	Mechanics of Solids	PCC	3	0	0	3	3
4	AU5351	Thermodynamics and Thermal Engineering	PCC	3	1	0	4	4
5	AE5351	Fluid Mechanics and Fluid Machines	PCC	3	0	0	3	3
<b>PRACTICALS</b>								
6.	PR5311	Computer Aided Drafting and Machining Laboratory	PCC	0	0	4	4	2
7.	PR5312	Material Testing and Thermal Engineering Laboratory	PCC	0	0	4	4	2
8.	GE5361	Professional Development <sup>§</sup>	EEC	0	0	2	2	1
<b>TOTAL</b>				<b>15</b>	<b>2</b>	<b>10</b>	<b>27</b>	<b>22</b>

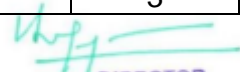
**SEMESTER IV**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
<b>THEORY</b>								
1.		Elective – Humanities II	HSMC	3	0	0	3	3
2.	GE5251	Environmental Sciences	BSC	3	0	0	3	3
3.	PR5401	Foundry and Welding Technology	PCC	3	0	0	3	3
4.	PR5402	Engineering Materials	PCC	3	0	0	3	3
5.	PR5403	Machining Processes and Machine Tools	PCC	3	0	0	3	3
6.	PR5451	Kinematics and Dynamics of Machines	PCC	3	1	0	4	4
7.		Audit Course – I*	AC	3	0	0	3	0
<b>PRACTICALS</b>								
8.	PR5411	Machining Processes Laboratory	PCC	0	0	4	4	2
9.	PR5412	Foundry, Welding and Metallurgy Laboratory	PCC	0	0	4	4	2
<b>TOTAL</b>				<b>21</b>	<b>1</b>	<b>8</b>	<b>30</b>	<b>23</b>

\*Audit Course is optional.

**SEMESTER V**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
<b>THEORY</b>								
1.	GE5551	Statistics for Production Management	HSMC	3	0	0	3	3
2.	PR5501	Engineering Metrology	PCC	3	0	0	3	3

  
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3.	PR5502	Fluid Power Systems	PCC	3	0	0	3	3
4.	PR5503	Machine Components Design	PCC	3	1	0	4	4
5.		Professional Elective I	PEC	3	0	0	3	3
6.		Audit Course – II*	AC	3	0	0	3	0
<b>PRACTICALS</b>								
7.	PR5511	Fluid Power Systems Laboratory	PCC	0	0	4	4	2
8.	PR5512	Engineering Metrology Laboratory	PCC	0	0	4	4	2
<b>TOTAL</b>				<b>18</b>	<b>1</b>	<b>8</b>	<b>27</b>	<b>20</b>

\*Audit course is optional.

### SEMESTER VI

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
<b>THEORY</b>								
1.	PR5601	Metal Forming	PCC	3	0	0	3	3
2.	PR5602	CNC Machines	PCC	3	0	0	3	3
3.	PR5603	Computer Aided Design and Analysis	PCC	3	0	0	3	3
4.		Professional Elective II	PEC	3	0	0	3	3
5.		Professional Elective III	PEC	3	0	0	3	3
6.		Professional Elective IV	PEC	3	0	0	3	3
7.		Open Elective I	OEC	3	0	0	3	3
<b>PRACTICALS</b>								
8.	PR5611	CNC and Metal Forming Laboratory	PCC	0	0	4	4	2
9.	PR5612	Modeling and Analysis Laboratory	PCC	0	0	4	4	2
<b>TOTAL</b>				<b>18</b>	<b>0</b>	<b>8</b>	<b>26</b>	<b>25</b>

### SEMESTER VII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
<b>THEORY</b>								
1.	PR5701	Mechatronics for Automation	PCC	3	0	2	5	4
2.	PR5702	Computer Integrated Manufacturing Systems	PCC	3	0	0	3	3
3.		Professional Elective V	PEC	3	0	0	3	3
4.		Professional Elective VI	PEC	3	0	0	3	3
5.		Professional Elective VII	PEC	3	0	0	3	3
6.		Open Elective II	OEC	3	0	0	3	3
<b>PRACTICALS</b>								
7.	PR5711	Internship/ Certificate Courses (4 Weeks)	EEC	0	0	4	4	2
8.	PR5712	Project I	EEC	0	0	6	6	3
<b>TOTAL</b>				<b>18</b>	<b>0</b>	<b>12</b>	<b>30</b>	<b>24</b>

\* the students will undergo industrial training / Internship during previous vacation

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**SEMESTER VIII**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
<b>PRACTICALS</b>								
1.	PR5811	Project II	EEC	0	0	16	16	8
<b>TOTAL</b>				<b>3</b>	<b>0</b>	<b>16</b>	<b>19</b>	<b>11</b>

**TOTAL CREDITS: 170**

**HUMANITIES AND SOCIAL SCIENCES (HSMC) – MANAGEMENT AND OTHERS**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	C
				L	T	P		
1.	HS5151	Technical English	HSMC	3	0	0	3	3
2.	GE5154	தமிழர் மரபு /Heritage of Tamils	HSMC	1	0	0	1	1
3.	GE5252	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology.	HSMC	1	0	0	1	1
4.	HS5251	Professional Communication	HSMC	3	0	0	3	3
5.	GE5551	Statistics for Production Management	HSMC	3	0	0	3	3

**HSMC- ELECTIVES – HUMANITIES I (ODD SEMESTER)**

Sl. No	Course Code	Course Title	Periods per week			Credits
			Lecture	Tutorial	Practical	
1.	HU5171	Language and Communication	3	0	0	3
2.	HU5172	Values and Ethics	3	0	0	3
3.	HU5173	Human Relations at Work	3	0	0	3
4.	HU5174	Psychological Processes	3	0	0	3
5.	HU5175	Education, Technology and Society	3	0	0	3
6.	HU5176	Philosophy	3	0	0	3
7.	HU5177	Applications of Psychology in Everyday Life	3	0	0	3

**HSMC- ELECTIVES – HUMANITIES II (EVEN SEMESTER)**

Sl. No	Course Code	Course Title	Periods per week			Credits
			Lecture	Tutorial	Practical	
1.	HU5271	Gender Culture and Development	3	0	0	3
2.	HU5272	Ethics and Holistic Life	3	0	0	3
3.	HU5273	Law and Engineering	3	0	0	3

  
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4.	HU5274	Film Appreciation	3	0	0	3
5.	HU5275	Fundamentals of Language and Linguistics	3	0	0	3
6.	HU5276	Understanding Society and Culture through Literature	3	0	0	3

### BASIC SCIENCES COURSES (BSC)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	C
				L	T	P		
1.	MA5158	Engineering Mathematics - I	BSC	3	1	0	4	4
2.	PH5151	Engineering Physics	BSC	3	0	0	3	3
3.	CY5151	Engineering Chemistry	BSC	3	0	0	3	3
4.	BS5161	Basic Sciences Laboratory	BSC	0	0	4	4	2
5.	MA5252	Engineering Mathematics-II	BSC	3	1	0	4	4
6.	PH5251	Materials Science	BSC	3	0	0	3	3
7.	MA5353	Numerical Methods	BSC	3	1	0	4	4
8.	GE5251	Environmental Sciences	BSC	3	0	0	3	3

### ENGINEERING SCIENCES COURSES (ESC)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	TOTAL CONTACT PERIODS	C
1.	GE5151	Engineering Graphics	ESC	1	0	4	5	5
2.	GE5162	Workshop Practices Laboratory	ESC	0	0	4	4	2
3.	GE5161	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
4.	GE5153	Problem Solving and Python Programming	ESC	3	0	0	3	3
5.	GE5152	Engineering Mechanics	ESC	3	1	0	4	4
6.	EE5251	Basics of Electrical and Electronics Engineering	ESC	3	0	0	3	3
7.	EE5261	Electrical and Electronics Engineering Laboratory	ESC	0	0	4	4	2

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**PROFESSIONAL CORE COURSES (PCC)**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	C
				L	T	P		
1.	AU5352	Mechanics of Solids	PCC	3	0	0	3	3
2.	AU5351	Thermodynamics and Thermal Engineering	PCC	3	1	0	4	4
3.	AE5351	Fluid Mechanics and Fluid Machines	PCC	3	0	0	3	3
4.	PR5402	Engineering Materials	PCC	3	0	0	3	3
5.	PR5403	Materials Science for Production Engineers	PCC	3	0	0	3	3
6.	PR5401	Foundry and Welding Technology	PCC	3	0	0	3	3
7.	PR5403	Machining Processes and Machine Tools	PCC	3	0	0	3	3
8.	PR5451	Kinematics and Dynamics of Machines	PCC	3	1	0	4	4
9.	PR5501	Engineering Metrology	PCC	3	0	0	3	3
10.	PR5502	Fluid Power Systems	PCC	3	0	0	3	3
11.	PR5503	Machine Components Design	PCC	3	1	0	4	4
12.	PR5602	CNC Machines	PCC	3	0	0	3	3
13.	PR5603	Computer Aided Design and Analysis	PCC	3	0	0	3	3
14.	PR5701	Mechatronics for Automation	PCC	3	0	2	5	4
15.	PR5702	Computer Integrated Manufacturing Systems	PCC	3	0	0	3	3
16.	PR5601	Metal forming	PCC	3	0	2	5	4
17.	PR5311	Computer Aided Drafting and Machining Laboratory	PCC	0	0	4	4	2
18.	PR5312	Material Testing and Thermal Engineering Laboratory	PCC	0	0	4	4	2
19.	PR5411	Machining Processes Laboratory	PCC	0	0	4	4	2
20.	PR5412	Foundry, Welding and Metallurgy Laboratory	PCC	0	0	4	4	2
21.	PR5511	Fluid Power Systems Laboratory	PCC	0	0	4	4	2
22.	PR5512	Engineering Metrology Laboratory	PCC	0	0	4	4	2
23.	PR5611	CNC and Metal Forming Laboratory	PCC	0	0	4	4	2
24.	PR5612	Modeling and Analysis Laboratory	PCC	0	0	4	4	2

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## AUDIT COURSES (AC)

Registration for any of these courses is optional to students

Sl. No	Course Code	Course Title	Periods per week			Total Contact Periods	Credits
			L	T	P		
1.	AD5091	Constitution of India	3	0	0	3	0
2.	AD5092	Value Education	3	0	0	3	0
3.	AD5093	Pedagogy Studies	3	0	0	3	0
4.	AD5094	Stress Management by Yoga	3	0	0	3	0
5.	AD5095	Personality Development Through Life Enlightenment Skills	3	0	0	3	0
6.	AD5096	Unnat Bharat Abhiyan	3	0	0	3	0
7.	AD5097	Essence of Indian Knowledge Tradition	3	0	0	3	0
8.	AD5098	Sanga Tamil Literature Appreciation	3	0	0	3	0

## PROFESSIONAL ELECTIVE COURSES

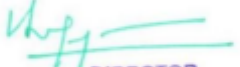
### Semester V, Elective I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	Periods per Week			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	PR5001	Micromachining and Fabrication	PEC	3	0	0	3	3
2.	PR5002	Modern Concepts in Manufacturing	PEC	3	0	0	3	3
3.	MF5652	Additive Manufacturing	PEC	3	0	0	3	3
4.	PR5003	Tool Design	PEC	3	0	0	3	3
5.	PR5004	Unconventional Machining Processes	PEC	3	0	0	3	3

### Semester VI, Elective II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	Periods per Week			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	PR5074	Materials Procurement Management	PEC	3	0	0	3	3
2.	PR5005	Selection and Treatment of Materials	PEC	3	0	0	3	3
3.	IE5751	Supply Chain Management	PEC	3	0	0	3	3
4.	PR5006	Theory of Metal Cutting	PEC	3	0	0	3	3
5.	GE5001	Industrial Management	PEC	3	0	0	3	3

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**Semester VI, Elective III**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	Periods per Week			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	PR5007	Elements of Green Manufacturing	PEC	3	0	0	3	3
2	PR5008	Design of Casting and Weldments	PEC	3	0	0	3	3
3	PR5009	Computer Aided Product Design	PEC	3	0	0	3	3
4	PR5010	Green Electronics Manufacturing	PEC	3	0	0	3	3
5	PR5072	Production of automotive Components	PEC	3	0	0	3	3

**Semester VI, Elective IV**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	Periods per Week			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	ME5081	Process Planning and Cost Estimation	PEC	3	0	0	3	3
2.	PR5073	Robotic Technology	PEC	3	0	0	3	3
3.	PR5011	Finite Element Analysis in Application	PEC	3	0	0	3	3
4.	GE5002	Quantitative Techniques in Management	PEC	3	0	0	3	3

**Semester VII, Elective V**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	Periods per Week			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	PR5012	Advances in Operations Research	PEC	3	0	0	3	3
2.	PR5013	Heat Transfer	PEC	3	0	0	3	3
3.	PR5014	Lean Manufacturing	PEC	3	0	0	3	3
4.	PR5015	Non - Destructive Testing Methods	PEC	3	0	0	3	3
5.	PR5071	Processing of Plastics and Polymers	PEC	3	0	0	3	3

**Semester VII, Elective VI**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	Periods per Week			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	PR5016	Processing of Composites	PEC	3	0	0	3	3
2.	PR5017	Smart Materials for Manufacturing	PEC	3	0	0	3	3
3.	PR5018	Corrosion Engineering	PEC	3	0	0	3	3
4.	GE5071	Disaster Management	PEC	3	0	0	3	3
5.	GE5077	Engineering Ethics and Human Values	PEC	3	0	0	3	3

**Semester VII, Elective VII**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	Periods per Week			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	GE5072	Human Rights	PEC	3	0	0	3	3
2.	PR5019	Electronic Materials and Processing	PEC	3	0	0	3	3
3.	PR5020	Micro Electro Mechanical Systems and Nano Technology	PEC	3	0	0	3	3
4.	PR5021	Total Quality Management: Principles and Applications	PEC	3	0	0	3	3
5.	PR5022	Integrated Product Development	PEC	3	0	0	3	3

**EMPLOYABILITY ENHANCEMENT COURSES (EEC)**

SL. No.	Course Code	Course Title	Category	Periods per week			Total contact periods	Credits
				L	T	P		
1.	GE5163	English Laboratory <sup>s</sup>	EEC	0	0	2	2	1
2.	GE5262	Communication Laboratory / Foreign Language <sup>s</sup>	EEC	0	0	4	4	2
3.	GE5361	Professional Development <sup>s</sup>	EEC	0	0	2	2	1
4.	PR5712	Project I	EEC	0	0	6	6	3
5.	PR5811	Project II	EEC	0	0	16	16	8

PROGRESS THROUGH KNOWLEDGE

UG : Production Engineering										
	Subject Area	Credit per semester								Credit Total
		I	II	III	IV	V	VI	VII	VIII	
1.	HSMC	04	03	03	03	03	-	-	-	16
2.	BSC	12	07	04	03	-	-	-	-	26
3.	ESC	05	14		-	-	-	-	-	19
4.	PCC	-	-	14	17	14	13	07	-	65
5.	PEC	-	-	-	-	03	06	09	03	21
6.	OEC	-	-	-	-	-	03	03	-	06
7.	EEC	1	2	1	-	-	-	05	08	17
8.	AC	-	-	-	-	-	-	-	-	00
		22	26	22	23	20	22	24	11	170

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**OBJECTIVES**

- To build lexical competency and accuracy that will help learners to use language effectively.
- To learn various reading strategies that will enable learners to comprehend the different modes of reading materials of varied levels of complexity.
- To comprehend the linguistic aspects of various rhetorical structures and functions of Technical English and use them effectively in writing.

**UNIT I INTRODUCING ONESELF 9****Theory:**

Reading: Descriptive passages (From Newspapers / Magazines) – Writing: Writing a coherent paragraph (Native Place, School Life) – Grammar: Simple present tense, Present continuous tense – Vocabulary development: One word substitution.

**UNIT II DIALOGUE WRITING 9****Theory:**

Reading: Reading a print interview (Comprehension and inference questions) - Writing: Writing a checklist - Dialogue writing – Grammar: Simple past tense – Question formation (Wh-Questions, 'Yes' or 'No' Questions, Tag Questions) – Vocabulary Development: Lexical items relevant to the theme of the given unit.

**UNIT III FORMAL LETTER WRITING 9****Theory:**

Reading: Reading motivational essays on famous Engineers and Technologists (Answering Open – Ended and Closed Questions) – Writing: Writing formal letters/ emails – Grammar: Future tenses, Subject and verb agreement - Vocabulary Development: Collocations – Fixed expressions.

**UNIT IV WRITING LETTERS OF COMPLAINT 9****Theory:**

Reading: Reading Problem – Solution Articles/Essays Drawn From Various Sources – Writing: Making Recommendations – Writing a complaint Letter – Letter / email to the Editor – Note Making – Grammar: Use of modal verbs – Phrasal verbs – Cause-and-effect sentences – Vocabulary Development: Connectives, Use Of cohesive devices in writing, Technical vocabulary.

**UNIT V WRITING DEFINITIONS AND PRODUCT DESCRIPTION 9****Theory:**

Reading: Reading graphical material for comparison (Advertisements & Infographics) – Writing: Writing Definitions - One-line & extended definition – Compare-and-contrast paragraphs - Grammar: Adjectives – Degrees of comparison – Compound nouns – Compound words - Vocabulary Development: Use of Discourse Markers – Suffixes (Adjectival endings).

**TOTAL : 45 PERIODS****LEARNING OUTCOMES:**

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

CO1: Exposure to basic aspects of technical English.

CO2: The confidence to communicate effectively in various academic situations.

CO3: Learnt the use of basic features of Technical English.

CO4: Small group discussions and note making

CO5: Listening to a product description, reading and writing

**Assessment Pattern**

- Two written internal assessments to test learner's progress in grammar, vocabulary, reading and writing skills.
- End Semester exam to be tested in two parts: Theory exam for three hours and listening and speaking skills for two hours.

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

MA5158

ENGINEERING MATHEMATICS – I

L T P C

(Common to all branches of B.E. / B.Tech. Programmes in I Semester) 3 1 0 4

**COURSE OBJECTIVES:**

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

**UNIT I MATRICES**

12

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

**UNIT II DIFFERENTIAL CALCULUS**

12

Limit of function – One sided limit – Limit Laws – Continuity – left and right continuity – types of discontinuities – Intermediate Value Theorem – Derivatives of a function - Differentiation rules – Chain rule – Implicit differentiation – logarithmic differentiation – Maxima and minima – Mean value theorem – (Optional: Polar coordinate system – Differentiation in polar coordinates).

**UNIT III FUNCTIONS OF SEVERAL VARIABLES**

12

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

**UNIT IV INTEGRAL CALCULUS**

12

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

**UNIT V MULTIPLE INTEGRALS**

12

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

**TOTAL :60 PERIODS**

*Attested*

**COURSE OUTCOMES:**

At the end of the course the students will be able to

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- Use the matrix algebra methods for solving practical problems.
- Apply differential calculus tools in solving various application problems.
- Able to use differential calculus ideas on several variable functions.
- Apply different methods of integration in solving practical problems.
- Apply multiple integral ideas in solving areas, volumes and other practical problems.

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

#### TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 44<sup>th</sup> Edition, New Delhi, 2017.
2. James Stewart, "Calculus with Early Transcendental Functions", Cengage Learning, 6<sup>th</sup> Edition, New Delhi, 2013.
3. Joel Hass, Christopher Heil and Maurice D.Weir, "Thomas' Calculus", Pearson, 14<sup>th</sup> Edition, New Delhi, 2018.
4. Narayanan S. and Manicavachagom Pillai T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.

#### REFERENCES:

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), 7<sup>th</sup> Edition, New Delhi, 2009.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10<sup>th</sup> Edition, New Delhi, 2015.
3. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education 2<sup>nd</sup> Edition, 5<sup>th</sup> Reprint, Delhi, 2009.
4. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, 5<sup>th</sup> Edition, New Delhi, 2017.
5. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7<sup>th</sup> Edition, New Delhi, 2012.
6. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., 11<sup>th</sup> Reprint, New Delhi, 2010.

PH5151

### ENGINEERING PHYSICS

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

L T P C  
3 0 0 3

#### COURSE OBJECTIVES:

- To make the students in understanding the importance of mechanics.
- To equip the students on the knowledge of electromagnetic waves.
- To introduce the basics of oscillations, optics and lasers.
- To enable the students in understanding the importance of quantum physics.
- To elucidate the application of quantum mechanics towards the formation of energy bands in crystalline materials.

UNIT I

MECHANICS

Attested 9

  
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Moment of inertia (M.I) - Radius of gyration - Theorems of M .I - M.I of circular disc, solid cylinder , hollow cylinder , solid sphere and hollow sphere - K.E of a rotating body – M.I of a diatomic molecule – Rotational energy state of a rigid diatomic molecule - centre of mass – conservation of linear momentum – Relation between Torque and angular momentum - Torsional pendulum.

**UNIT II ELECTROMAGNETIC WAVES 9**

Gauss’s law – Faraday’s law - Ampere’s law - The Maxwell’s equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

**UNIT III OSCILLATIONS, OPTICS AND LASERS 9**

Simple harmonic motion - resonance - waves on a string - standing waves - traveling waves - Energy transfer of a wave - sound waves - Doppler effect - reflection and refraction of light waves - total internal reflection - interference - interferometers - air wedge experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein’s coefficients - population inversion - Nd-YAG laser, CO<sub>2</sub> laser, semiconductor laser - applications.

**UNIT IV BASIC QUANTUM MECHANICS 9**

Photons and light waves - Electrons and matter waves - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization - Particle in a infinite potential well - Normalization, probabilities and the correspondence principle.

**UNIT V APPLIED QUANTUM MECHANICS 9**

The harmonic oscillator - Barrier penetration and quantum tunneling - Tunneling microscope - Resonant diode - Finite potential wells - particle in a three dimensional box - Bloch’s theorem for particles in a periodic potential, Kronig-Penney model and origin of energy bands.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES**

After completion of this course, the students should able to

- Understanding the importance of mechanics.
- Express the knowledge of electromagnetic waves.
- Know the basics of oscillations, optics and lasers.
- Understanding the importance of quantum physics.
- Apply quantum mechanical principles towards the formation of energy bands in crystalline materials.

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

**TEXT BOOKS**

1. D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education, 2017.
2. D.Halliday, R.Resnick and J.Walker. Principles of Physics. John Wiley & Sons, 2015.
3. N.Garcia, A.Damask and S.Schwarz. Physics for Computer Science Students. Springer-Verlag, 2012.

## REFERENCES

1. R.Wolfson. Essential University Physics. Volume 1 & 2. Pearson, 2016.
2. D.J.Griffiths. Introduction to Electrodynamics. Pearson Education, 2015
3. K.Thyagarajan and A.Ghatak. Lasers: Fundamentals and Applications. Springer, 2012.

CY5151

## ENGINEERING CHEMISTRY (COMMON TO ALL BRANCHES)

L T P C  
3 0 0 3

### COURSE OBJECTIVES:

- To introduce the basic concepts of polymers, their properties and some of the important applications.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To facilitate the understanding of the laws of photochemistry, photo processes and instrumentation & applications of spectroscopic techniques.
- To familiarize the operating principles and applications of energy conversion, its processes and storage devices.
- To inculcate sound understanding of water quality parameters and water treatment techniques.

### UNIT I POLYMER CHEMISTRY

9

Introduction: Functionality-degree of polymerization. Classification of polymers- natural and synthetic, thermoplastic and thermosetting. Types and mechanism of polymerization: addition (free radical, cationic, anionic and living); condensation and copolymerization. Properties of polymers: T<sub>g</sub>, tacticity, molecular weight-weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension. Structure, Properties and uses of: PE, PVC, PC, PTFE, PP, Nylon 6, Nylon 66, Bakelite, Epoxy; Conducting polymers – polyaniline and polypyrrole.

### UNIT II NANO CHEMISTRY

9

Basics-distinction between molecules, nanomaterials and bulk materials; size-dependent properties. Types –nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Characterization - Scanning Electron Microscope and Transmission Electron Microscope - Principle and instrumentation (block diagram). Properties (optical, electrical, mechanical and magnetic) and Applications of nanomaterials - medicine, agriculture, electronics and catalysis.

### UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY

9

Photochemistry: Laws of photochemistry - Grothuss-Draper law, Stark-Einstein law and Lambert-Beer Law (derivation and problems). Photo physical processes – Jablonski diagram. Chemiluminescence, photo-sensitization and photoquenching – mechanism and examples. Spectroscopy: Electromagnetic spectrum - absorption of radiation - electronic, vibrational and rotational transitions. Width and intensities of spectral lines. Atomic absorption spectroscopy, UV-Vis and IR spectroscopy- principles, instrumentation (Block diagram) and applications.

### UNIT IV ENERGY CONVERSIONS AND STORAGE

9

Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant – fast breeder reactor. Solar energy conversion - solar cells. Wind energy. Batteries - types of batteries – primary battery (dry cell), secondary battery (lead acid, nickel-cadmium and lithium-ion-battery). Fuel cells – H<sub>2</sub>-O<sub>2</sub> and microbial fuel cell. Explosives – classification, examples: TNT, RDX, Dynamite; Rocket fuels and propellants – definition and uses.

### UNIT V WATER TECHNOLOGY

9

Water – sources and impurities – water quality parameters: colour, odour, pH, hardness, alkalinity, TDS, COD and BOD. Boiler feed water – requirement – troubles (scale & sludge, caustic embrittlement, boiler corrosion and priming & foaming. Internal conditioning – phosphate, calgon

and carbonate treatment. External conditioning - zeolite (permutit) and ion exchange demineralization. Municipal water treatment process – primary (screening, sedimentation and coagulation), secondary (activated sludge process and trickling filter process) and tertiary (ozonolysis, UV treatment, chlorination, reverse osmosis).

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

At the end of the course the students will be able to

- To recognize and apply basic knowledge on different types of polymeric materials, their general preparation methods and applications to futuristic material fabrication needs.
- To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
- To identify and apply suitable spectroscopic technique for material analysis and study different forms of photochemical reactions.
- To recognize different forms of energy resources and apply them for suitable applications in energy sectors.
- To demonstrate the knowledge of water and their quality in using at different industries.

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

**TEXT BOOKS:**

1. Jain P. C. & Monica Jain., “Engineering Chemistry”, 16<sup>th</sup> Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2015.
2. Sivasankar B., “Engineering Chemistry”, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
3. S.S.Dara, “A text book of Engineering Chemistry”, Chand Publications, 2014.

**REFERENCES:**

1. Schdeva M V, “Basics of Nano Chemistry”, Anmol Publications Pvt Ltd
2. B.Sivasankar, “Instrumental Methods of Analysis”, Oxford University Press. 2012.
3. Friedrich Emich, “Engineering Chemistry”, Scientific International Ltd.
4. V. R. Gowariker, N V Viswanathan and Jayadev Sreedhar, “Polymer Science” New AGE International Publishers, 2009.

**GE5151**

**ENGINEERING GRAPHICS**

**L T P C**  
**1 0 4 3**

**COURSE OBJECTIVES:**

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

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

*Attested*

*[Signature]*  
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Anna University, Chennai-600 025

**CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION)****1**

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

**UNIT I PLANE CURVES AND FREE HANDSKETCHING****14**

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

**UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES****15**

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

**UNIT III PROJECTION OF SOLIDS****15**

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

**UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES****15**

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

**UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS****12**

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

**COMPUTER AIDED DRAFTING (DEMONSTRATION ONLY)****3**

Introduction to drafting packages and demonstration of their use

**TOTAL (L: 15 + P: 60)=75 PERIODS****COURSE OUTCOMES:**

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

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

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

**TEXT BOOKS:**

1. Bhatt, N. D., Panchal V M and Pramod R. Ingle, "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2014.
2. Parthasarathy, N. S. and Vela Murali, "Engineering Drawing", Oxford University Press, 2015

**REFERENCES:**

1. Agrawal, B. and Agrawal C.M., "Engineering Drawing", Tata McGraw, N.Delhi, 2008.
2. Gopalakrishna, K. R., "Engineering Drawing", Subhas Stores, Bangalore, 2007.
3. Natarajan, K. V., "A text book of Engineering Graphics", 28<sup>th</sup>Ed., Dhanalakshmi Publishers, Chennai, 2015.
4. Shah, M. B., and Rana, B. C., "Engineering Drawing", Pearson, 2<sup>nd</sup> Ed., 2009.
5. Venugopal, K. and Prabhu Raja, V., "Engineering Graphics", New Age, 2008.

**Publication of Bureau of Indian Standards:**

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

**Special points applicable to University Examinations on Engineering Graphics:**

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

**GE5154****தமிழர் மரபு****L T P C**  
**1 0 0 1****அலகு I மொழி மற்றும் இலக்கியம்:****3**

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் புகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமணப் பெளத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

**அலகு II மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை:****3**

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள் – பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளூர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

*Attested*  
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Anna University, Chennai-600 025

**அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்: 3**

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஓயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

**அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள்: 3**

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறை முகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

**அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு: 3**

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்ச வரலாறு.

**TOTAL : 15 PERIODS**

**TEXT-CUM-REFERENCE BOOKS**

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.)
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies.)
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

**GE5154**

**HERITAGE OF TAMILS**

**L T P C**  
**1 0 0 1**

**UNIT I LANGUAGE AND LITERATURE**

**3**

Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism

in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

**UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 3**

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

**UNIT III FOLK AND MARTIAL ARTS 3**

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

**UNIT IV THINAI CONCEPT OF TAMILS 3**

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

**UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3**

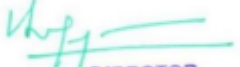
Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

**TOTAL : 15 PERIODS**

**TEXT-CUM-REFERENCE BOOKS**

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

*Attested*

  
**DIRECTOR**  
Centre for Academic Courses  
Anna University, Chennai-600 025



**PHYSICS LABORATORY: (Any Seven Experiments)**

**COURSE OBJECTIVES:**

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

**LIST OF EXPERIMENTS:**

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of disc
2. Non-uniform bending - Determination of Young's modulus
3. Uniform bending – Determination of Young's modulus
4. Lee's disc Determination of thermal conductivity of a bad conductor
5. Potentiometer-Determination of thermo e.m.f of a thermocouple
6. Laser- Determination of the wave length of the laser using grating
7. Air wedge - Determination of thickness of a thin sheet/wire
8. a) Optical fibre -Determination of Numerical Aperture and acceptance angle  
b) Compact disc- Determination of width of the groove using laser.
9. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
10. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
11. Post office box -Determination of Band gap of a semiconductor.
12. Spectrometer- Determination of wavelength using gating.
13. Photoelectric effect
14. Michelson Interferometer.
15. Estimation of laser parameters.
16. Melde's string experiment

**TOTAL: 30 PERIODS**

**COURSE OUTCOMES:**

Upon completion of the course, the students will be able

CO1: To determine various moduli of elasticity.

CO2: To determine the velocity of ultrasonic waves, band gap determination

CO3: To determine various thermal and optical properties of materials.

CO4: To determine the viscosity of liquids

CO5: To determine the estimation of laser parameters

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

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

**COURSE OBJECTIVES:**

- To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.

*Attested*

*[Signature]*  
**DIRECTOR**  
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- To induce the students to familiarize with electroanalytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and polymers by spectroscopy and viscometry methods.

#### LIST OF EXPERIMENTS:

1. Estimation of HCl using  $\text{Na}_2\text{CO}_3$  as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
11. Determination of molecular weight of polyvinylalcohol using Ostwald viscometer.
12. Pseudo first order kinetics-ester hydrolysis.
13. Corrosion experiment-weight loss method.
14. Phase change in a solid.

**TOTAL: 30 PERIODS**

#### COURSE OUTCOMES:

At the end of the course the students will be able

- To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.
- To determine the amount of metal ions through volumetric and spectroscopic techniques
- To determine the molecular weight of polymers by viscometric method.
- To quantitatively analyse the impurities in solution by electroanalytical techniques
- To design and analyse the kinetics of reactions and corrosion of metals

#### TEXT BOOKS:

1. Laboratory Manual- Department of Chemistry, CEGC, Anna University (2014).
2. Vogel's Textbook of Quantitative Chemical Analysis (8<sup>th</sup> edition, 2014).



**GE5162**

**WORKSHOP PRACTICES LABORATORY**  
(Common to all Branches of B.E. / B.Tech. Programmes)

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

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

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

*Attested*

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## GROUP – A (CIVIL & ELECTRICAL)

### PART I CIVIL ENGINEERING PRACTICES

15

#### PLUMBING WORK:

- Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
- Preparing plumbing line sketches.
- Laying pipe connection to the suction side of a pump
- Laying pipe connection to the delivery side of a pump.
- Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

#### WOOD WORK:

- Sawing,
- Planing
- Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.

#### Wood Work Study:

- Studying joints in door panels and wooden furniture
- Studying common industrial trusses using models.

### PART II ELECTRICAL ENGINEERING PRACTICES

15

#### WIRING WORK:

- Wiring Switches, Fuse, Indicator and Lamp etc. such as in basic household,
- Wiring Stair case light.
- Wiring tube – light.
- Preparing wiring diagrams for a given situation.

#### Wiring Study:

- Studying an Iron-Box wiring.
- Studying a Fan Regulator wiring.
- Studying an Emergency Lamp wiring.

## GROUP – B (MECHANICAL AND ELECTRONICS)

### PART III MECHANICAL ENGINEERING PRACTICES

15

#### WELDING WORK:

- Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
- Practicing gas welding.

#### BASIC MACHINING WORK:

- (simple)Turning.
- (simple)Drilling.
- (simple)Tapping.

#### ASSEMBLY WORK:

- Assembling a centrifugal pump.
- Assembling a household mixer.
- Assembling an air conditioner.

#### SHEET METAL WORK:

- Making of a square tray

#### FOUNDRY WORK:

- Demonstrating basic foundry operations.

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**SOLDERING WORK:**

- a) Soldering simple electronic circuits and checking continuity.

**ELECTRONIC ASSEMBLY AND TESTING WORK:**

- a) Assembling and testing electronic components on a small PCB.

**ELECTRONIC EQUIPMENT STUDY:**

- a) Studying a FM radio.  
b) Studying an electronic telephone.

**TOTAL (P: 60) = 60 PERIODS**

**COURSE OUTCOMES:**

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

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

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

PROGRESS THROUGH KNOWLEDGE

GE5163

ENGLISH LABORATORY

L T P C  
0 0 2 1

**OBJECTIVES :**

- To improve the communicative competence of learners
- To help learners use language effectively in academic /work contexts
- To develop various listening strategies to comprehend various types of audio materials like lectures, discussions, videos etc.
- To build on students' English language skills by engaging them in listening, speaking and grammar learning activities that are relevant to authentic contexts.
- To use language efficiently in expressing their opinions via various media.

**UNIT I INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION**

6

Listening for general information-specific details- conversation: Introduction to classmates - Audio / video (formal & informal); Telephone conversation; Listening to voicemail & messages; Listening and filling a form. Speaking - making telephone calls-Self Introduction; Introducing a friend; - politeness strategies- making polite requests, making polite offers, replying to polite requests and offers- understanding basic instructions (filling out a bank application for example).

**UNIT II NARRATION AND SUMMATION 6**

Listening - Listening to podcasts, anecdotes / stories / event narration; documentaries and interviews with celebrities. Speaking - Narrating personal experiences / events-Talking about current and temporary situations & permanent and regular situations\* - describing experiences and feelings- engaging in small talk- describing requirements and abilities.

**UNIT III DESCRIPTION OF A PROCESS / PRODUCT 6**

Listening - Listen to product and process descriptions; a classroom lecture; and advertisements about products. Speaking – Picture description- describing locations in workplaces- Giving instruction to use the product- explaining uses and purposes- Presenting a product- describing shapes and sizes and weights- talking about quantities(large & small)-talking about precautions.

**UNIT IV CLASSIFICATION AND RECOMMENDATIONS 6**

Listening – Listening to TED Talks; Listening to lectures - and educational videos. Speaking – Small Talk; discussing and making plans-talking about tasks-talking about progress- talking about positions and directions of movement-talking about travel preparations- talking about transportation-

**UNIT V EXPRESSION 6**

Listening – Listening to debates/ discussions; different viewpoints on an issue; and panel discussions. Speaking –making predictions- talking about a given topic-giving opinions-understanding a website-describing processes

**TOTAL : 30 PERIODS**

**LEARNING OUTCOMES:**

At the end of the course, learners will be able

- To listen and comprehend complex academic texts
- To speak fluently and accurately in formal and informal communicative contexts
- To express their opinions effectively in both oral and written medium of communication

**ASSESSMENT PATTERN**

- One online / app based assessment to test listening /speaking
- End Semester **ONLY** listening and speaking will be conducted online.
- Proficiency certification is given on successful completion of listening and speaking internal test and end semester exam.

**HS5251**

**PROFESSIONAL COMMUNICATION**

**L T P C  
2 0 0 2**

**OBJECTIVES**

- To comprehend various reading materials relevant to technical context and understand the main and supporting ideas of the reading materials.
- To write effective job applications along with detailed CV for internship or placements.
- To explore definitions, essay and report writing techniques and practice them in order to develop associated skills.

**UNIT I TECHNICAL COMMUNICATION 6**

Theory:

Reading: Reading the Interview of an Achiever and Completing Exercises (Skimming, Scanning and Predicting) – Writing: Writing a Short Biography of an Achiever Based on Given Hints – Grammar: Asking and Answering Questions, Punctuation in Writing, Prepositional Phrases

**UNIT II SUMMARY WRITING 6**

Theory:

Reading: Reading Technical Essays/ Articles and Answering Comprehension Questions – Writing: Summary Writing – Grammar: Participle Forms, Relative Clauses

**UNIT III PROCESS DESCRIPTION 6**

Theory:

Reading: Reading Instruction Manuals – Writing: Writing Process Descriptions – Writing Instructions – Grammar: Use of Imperatives, Active and Passive Voice, Sequence Words

**UNIT IV REPORT WRITING 6**

Theory:

Reading: Reading and Interpreting Charts/Tables and Diagrams – Writing: Interpreting Charts/Tables and Diagrams, Writing a Report – Grammar: Direct into Indirect Speech, Use of Phrases

**UNIT V WRITING JOB APPLICATIONS 6**

Theory:

Reading: Reading a Job Interview, SOP, Company Profile and Completing Comprehension Exercises – Writing: Job Applications and Resumes And Sops-Grammar: Present Perfect and Continuous Tenses.

**TOTAL : 30 PERIODS****LEARNING OUTCOMES**

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

- Read and comprehend technical texts effortlessly.
- Write technical reports and job application for internship or placement.
- Learn to use language effectively in a professional context.

**Assessment Pattern**

- Two written internal assessments to test learner's progress in grammar, reading and writing skills.
- End Semester exam to be tested in two parts: Theory exam for three hours and listening and speaking skills along with vocabulary for two hours.

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	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	-	-	-	1	1	-	3	3	-	3	-	-	1
2	-	-	-	-	-	1	1	-	3	3	-	3	-	-	1
3	-	-	-	-	-	1	1	-	3	3	-	3	-	-	1
Avg.	-	-	-	-	-	1	1	-	3	3	-	3	-	-	1

PROGRESS THROUGH KNOWLEDGE

**MA5252 ENGINEERING MATHEMATICS – II** L T P C  
 (Common to all branches of B.E. / B.Tech. Programmes in II Semester) 3 1 0 4

**COURSE OBJECTIVES:**

- To acquaint the students with the concepts of vector calculus which naturally arises in many engineering problems.
- To develop an understanding of the standard techniques of complex variable theory in particular analytic function and its mapping property.
- To familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals.
- To acquaint the students with Differential Equations which are significantly used in engineering problems.
- To make the students appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

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**UNIT I VECTOR CALCULUS 12**

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

**UNIT II ANALYTIC FUNCTION 12**

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

**UNIT III COMPLEX INTEGRATION 12**

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

**UNIT IV DIFFERENTIAL EQUATIONS 12**

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

**UNIT V LAPLACE TRANSFORMS 12**

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems – Transforms of derivatives and integrals – Initial and Final Value Theorems – Inverse Transforms – Convolution Theorem – Transform of periodic functions – Application to solution of linear ordinary differential equations with constant coefficients.

**TOTAL : 60 PERIODS****COURSE OUTCOMES:**

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

- Calculate grad, div and curl and use Gauss, Stokes and Greens theorems to simplify calculations of integrals.
- Construct analytic functions and use their conformal mapping property in application problems.
- Evaluate real and complex integrals using the Cauchy's integral formula and residue theorem.
- Apply various methods of solving differential equation which arise in many application problems.
- Apply Laplace transform methods for solving linear differential equations.

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	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	3	-	-	-	1	-	-	3	2	2	-
2	3	3	3	3	3	-	-	-	1	-	-	3	2	2	-
3	3	3	3	3	3	-	-	-	1	-	-	3	2	2	-
4	3	3	3	3	3	-	-	-	1	-	-	3	2	2	-
5	3	3	3	3	3	-	-	-	1	-	-	3	2	2	-
Avg.	3	3	3	3	3	-	-	-	1	-	-	3	2	2	-

**TEXT BOOKS:**

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10<sup>th</sup> Edition, New Delhi, 2015.
2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 44<sup>th</sup> Edition, New Delhi, 2017.

**REFERENCES:***Attested*

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), 7<sup>th</sup> Edition, New Delhi, 2009.
2. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, 4<sup>th</sup> Edition, New Delhi, 2011.
3. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, 5<sup>th</sup> Edition, New Delhi, 2017.
4. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7<sup>th</sup> Edition, New Delhi, 2012.
5. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., 11<sup>th</sup> Reprint, New Delhi, 2010.

GE5153

PROBLEM SOLVING AND PYTHON PROGRAMMING

L T P C  
3 0 0 3

**COURSE OBJECTIVES:**

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

**UNIT I INTRODUCTION TO COMPUTING AND PROBLEM SOLVING 9**

Fundamentals of Computing – Computing Devices – Identification of Computational Problems – Pseudocodes and Flowcharts – Instructions – Algorithms – Building Blocks of Algorithms – Introduction to Python Programming – Python Interpreter and Interactive Mode – Variables and Identifiers – Arithmetic Operators– Values and Types – Statements.

**SUGGESTED ACTIVITIES:**

- Developing Pseudocodes and flowcharts for real life activities such as railway ticket booking using IRCTC, admission process to undergraduate course, academic schedules during a semester etc.
- Developing algorithms for basic mathematical expressions using arithmetic operations.
- Installing Python.
- Simple programs on print statements, arithmetic operations.

**SUGGESTED EVALUATION METHODS:**

- Assignments on pseudocodes and flowcharts.
- Tutorials on Python programs.

**UNIT II CONDITIONALS AND FUNCTIONS 9**

Operators – Boolean Values – Operator Precedence – Expression – Conditionals: If-Else Constructs – Loop Structures/Iterative Statements – While Loop – For Loop – Break Statement – Function Call and Returning Values – Parameter Passing – Local and Global Scope – Recursive Functions.

**SUGGESTED ACTIVITIES:**

- Simple Python program implementation using Operators, Conditionals, Iterative Constructs and Functions.
- Implementation of a simple calculator.
- Developing simple applications like calendar, phone directory, to-do lists etc.
- Flow charts for GCD, Exponent Functions, Fibonacci Series using conditionals and iterative statements.
- External learning - Recursion vs. Iteration.

**SUGGESTED EVALUATION METHODS:**

- Tutorials on the above activities.
- Group discussion on external learning.

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### **UNIT III SIMPLE DATA STRUCTURES IN PYTHON**

**10**

Introduction to Data Structures – List – Adding Items to a List – Finding and Updating an Item – Nested Lists – Cloning Lists – Looping Through a List – Sorting a List – List Concatenation – List Slices – List Methods – List Loop – Mutability – Aliasing – Tuples: Creation, Accessing, Updating, Deleting Elements in a Tuple, Tuple Assignment, Tuple as Return Value, Nested Tuples, Basic Tuple Operations – Sets.

#### **SUGGESTED ACTIVITIES:**

- Implementing python program using lists, tuples, sets for the following scenario:  
Simple sorting techniques  
Student Examination Report  
Billing Scheme during shopping.
- External learning - List vs. Tuple vs. Set – Implementing any application using all the three data structures.

#### **SUGGESTED EVALUATION METHODS:**

- Tutorials on the above activities.
- Group Discussion on external learning component.

### **UNIT IV STRINGS, DICTIONARIES, MODULES**

**10**

Strings: Introduction, Indexing, Traversing, Concatenating, Appending, Multiplying, Formatting, Slicing, Comparing, Iterating – Basic Built-In String Functions – Dictionary: Creating, Accessing, Adding Items, Modifying, Deleting, Sorting, Looping, Nested Dictionaries Built-in Dictionary Function – Finding Key and Value in a Dictionary – Modules – Module Loading and Execution – Packages – Python Standard Libraries.

#### **SUGGESTED ACTIVITIES:**

- Implementing Python program by importing Time module, Math package etc.
- Creation of any package (student's choice) and importing into the application.

#### **SUGGESTED EVALUATION METHODS:**

- Tutorials on the above activities.

### **UNIT V FILE HANDLING AND EXCEPTION HANDLING**

**7**

Introduction to Files – File Path – Opening and Closing Files – Reading and Writing Files – File Position – Exception: Errors and Exceptions, Exception Handling, Multiple Exceptions.

#### **SUGGESTED ACTIVITIES:**

- Developing modules using Python to handle files and apply various operations on files.
- Usage of exceptions, multiple except blocks - for applications that use delimiters like age, range of numerals etc.
- Implementing Python program to open a non-existent file using exceptions.

#### **SUGGESTED EVALUATION METHODS:**

- Tutorials on the above activities.
- Case Studies.

**TOTAL: 45 PERIODS**

#### **COURSE OUTCOMES:**

**On completion of the course, students will be able to:**

1. Develop algorithmic solutions to simple computational problems.
2. Develop and execute simple Python programs.
3. Write simple Python programs for solving problems.
4. Decompose a Python program into functions.
5. Represent compound data using Python lists, tuples, dictionaries etc.
6. Read and write data from/to files in Python programs.

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	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
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2	3	3	3	3	3	-	-	-	-	-	3	3	1	1	1
3	3	3	3	3	3	-	-	-	-	-	3	3	1	1	1
4	3	3	3	3	3	-	-	-	-	-	3	3	1	1	1
5	3	3	3	3	3	-	-	-	-	-	3	3	1	1	1
Avg.	3	3	3	3	3	-	-	-	-	-	3	3	1	1	1

#### TEXT BOOKS:

1. Reema Thareja, "Python Programming: Using Problem Solving Approach", Oxford University Press, 2017.
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", Second Edition, Shroff/O'Reilly Publishers, 2016.  
(<http://greenteapress.com/wp/thinkpython/>).

#### REFERENCES:

1. Guido van Rossum, Fred L. Drake Jr., "An Introduction to Python – Revised and Updated for Python 3.2", Network Theory Ltd., 2011.
2. John V Guttag, "Introduction to Computation and Programming Using Python", Revised and Expanded Edition, MIT Press, 2013
3. Charles Dierbach, "Introduction to Computer Science using Python", Wiley India Edition, 2016.
4. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015.
5. Kenneth A. Lambert, "Fundamentals of Python: First Programs", Cengage Learning, 2012.

EE5251

**BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING**

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

#### COURSE OBJECTIVES:

- To understand the basic concepts of electric circuits, magnetic circuits and wiring.
- To understand the operation of AC and DC machines.
- To understand the working principle of electronic devices and circuits.

#### UNIT I

#### **BASIC CIRCUITS AND DOMESTIC WIRING**

**9**

Electrical circuit elements (R, L and C)-Dependent and independent sources – Ohm's Law- Kirchhoff's laws - mesh current and node voltage methods (Analysis with only independent source) - Phasors – RMS-Average values-sinusoidal steady state response of simple RLC circuits. Types of wiring- Domestic wiring - Specification of Wires-Earthing-Methods-Protective devices.

#### UNIT II

#### **THREE PHASE CIRCUITS AND MAGNETIC CIRCUITS**

**9**

Three phase supply – Star connection – Delta connection –Balanced and Unbalanced Loads-Power in three-phase systems – Comparison of star and delta connections – Advantages-Magnetic circuits-Definitions-MMF, Flux, Reluctance, Magnetic field intensity, Flux density, Fringing, self and mutual inductances-simple problems.

#### UNIT III

#### **ELECTRICAL MACHINES**

**9**

Working principle of DC generator, motor-EMF and Torque equation-Types –Shunt, Series and Compound-Applications. Working principle of transformer-EMF equation-Operating principles of three phase and single phase induction motor-Applications. Working principles of alternator-EMF equation-Operating principles of Synchronous motor, stepper motor-Applications.

**UNIT IV BASICS OF ELECTRONICS****9**

Intrinsic semiconductors, Extrinsic semiconductors – P-type and N-type, P-N junction, VI Characteristics of PN junction diode, Zener effect, Zener diode, Zener diode Characteristics- Rectifier circuits-Wave shaping.

**UNIT V CURRENT CONTROLLED AND VOLTAGE CONTROLLED DEVICES****9**

Working principle and characteristics - BJT, SCR, JFET, MOSFET.

**TOTAL: 45 PERIODS****COURSE OUTCOMES:**

1. To be able to understand the concepts related with electrical circuits and wiring.
2. To be able to study the different three phase connections and the concepts of magnetic circuits.
3. Capable of understanding the operating principle of AC and DC machines.
4. To be able to understand the working principle of electronic devices such as diode and zener diode.
5. To be able to understand the characteristics and working of current controlled and voltage controlled devices.

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	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	1	1	-	-	-	-	1	-	1	2	1	1
2	3	2	2	1	1	-	-	-	-	1	-	1	2	1	1
3	3	2	2	1	1	-	-	-	-	1	-	1	2	1	1
4	3	2	2	1	1	-	-	-	-	1	-	1	2	1	1
5	3	-	2	1	1	-	-	-	-	1	-	1	2	1	1
Avg.	3	2	2	1	1	-	-	-	-	1	-	1	2	1	1

**TEXT BOOKS:**

1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", McGraw Hill Education, 2014
2. Del Toro, "Electrical Engineering Fundamentals", Second edition, Pearson Education, New Delhi, 1989.
3. John Bird, "Electrical Circuit theory and technology", Routledge; 5<sup>th</sup> edition, 2013

**REFERENCES:**

1. Thomas L. Floyd, 'Electronic Devices', 10<sup>th</sup> Edition, Pearson Education, 2018.
2. Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education; 7<sup>th</sup> edition, 2017
3. Kothari DP and I.J Nagrath, "Basic Electrical Engineering", McGraw Hill, 2010.
4. Muhammad H.Rashid, "Spice for Circuits and electronics", 4<sup>th</sup> ed., Cengage India, 2019.

**GE5152****ENGINEERING MECHANICS****L T P C  
3 1 0 4****COURSE OBJECTIVES:**

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

- Applying the various methods to determine the resultant forces and its equilibrium acting on a particle in 2D and 3D.
- Applying the concept of reaction forces (non-concurrent coplanar and noncoplanar forces) and moment of various support systems with rigid bodies in 2D and 3D in equilibrium.

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5. Apply the various methods of evaluating kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

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1	3	3	3	2	3	-	-	-	1	-	1	-	3	3	1
2	3	3	3	2	3	-	-	-	1	-	1	-	3	3	1
3	3	3	3	2	3	-	-	-	1	-	1	-	3	3	1
4	3	3	3	2	3	-	-	-	1	-	1	-	3	3	1
5	3	3	3	2	3	-	-	-	1	-	1	-	3	3	1
Avg.	3	3	3	2	3	-	-	-	1	-	1	-	3	3	1

#### TEXT BOOKS:

- Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 11<sup>th</sup> Edition, 2017.
- Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.

#### REFERENCES:

- Boresi P and Schmidt J, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.
- Hibbeler, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13<sup>th</sup> edition, Prentice Hall, 2013.
- Irving H. Shames, Krishna Mohana Rao G, Engineering Mechanics – Statics and Dynamics, 4<sup>th</sup> Edition, Pearson Education Asia Pvt. Ltd., 2005.
- Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, 7<sup>th</sup> edition, Wiley student edition, 2013.
- Timoshenko S, Young D H, Rao J V and Sukumar Pati, Engineering Mechanics, 5<sup>th</sup> Edition, McGraw Hill Higher Education, 2013.

PH5251

#### MATERIALS SCIENCE

L T P C

(Common to Mechanical, Manufacturing, Industrial, Mining,

3 0 0 3

Aeronautical, Automobile and Production Engineering & Rubber and Plastics Technology)

#### COURSE OBJECTIVES:

- To make the students to understand the basics of crystallography and crystal imperfections.
- To introduce various strengthening methods of materials, and also various mechanical properties and their measurement.
- To impart knowledge on the basics of phase diagrams and their applications.
- To learn about iron-carbon system, and about various ferrous and non-ferrous alloys.
- To introduce the preparation, properties and applications of ceramics, composites and nanomaterials.

#### UNIT I CRYSTALLOGRAPHY

9

Crystallographic directions and planes – metallic crystal structures: BCC, FCC and HCP – linear and planar densities – crystal imperfections- edge and screw dislocations, Burgers vector and elastic strain energy- surface imperfections – grain and twin boundaries – Polymorphism – phase changes – nucleation and growth – homogeneous and heterogeneous nucleation.

#### UNIT II MECHANICAL PROPERTIES

9

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Tensile test - plastic deformation by slip – slip systems – mechanisms of strengthening in metals: strain hardening, grain size reduction, solid solution strengthening, precipitation hardening – Creep: creep curves, stress and temperature effects, mechanisms of creep, creep-resistant materials – Fracture: ductile and brittle fractures - the Griffith criterion – fracture toughness - Fatigue failure: the S-N curve – factors that affect fatigue life – Hardness: Rockwell and Brinell hardness tests, Knoop and Vickers microhardness tests.

### UNIT III PHASE DIAGRAMS

9

Basic concepts - Gibbs phase rule – Unary phase diagram (iron) - Binary phase diagrams: isomorphous systems (Cu-Ni) – determination of phase composition and phase amounts – tie line and lever rule - binary eutectic diagram with no solid solution and limited solid solution (Pb-Sn) – eutectoid and peritectic reactions - other invariant reactions – micro structural development during the slow cooling: eutectic, hypereutectic and hypoeutectic compositions.

### UNIT IV FERROUS AND NONFERROUS ALLOYS

9

The Fe-Fe<sub>3</sub>C phase diagram: phases, invariant reactions, development of microstructure in eutectoid, hypoeutectoid and hypereutectoid alloys – influence of other alloying elements in the Fe-C system - phase transformations – isothermal transformation diagram for eutectoid iron-carbon alloy – microstructures: pearlite, bainite, spheroidite and martensite – steels, stainless steels and cast irons – copper alloys – aluminum alloys – titanium alloys.

### UNIT V CERAMICS, COMPOSITES AND NANO MATERIALS

9

Ceramics – types and applications- refractories, abrasives and cements – Composites: classification, role of matrix and reinforcement - Fiber reinforced composites – carbon-carbon composites – Nanomaterials: types, physical, chemical and mechanical properties - carbon nanotubes: properties and applications - synthesis of nanomaterials: sonochemical, molecular epitaxy, physical vapor deposition (PVD) and chemical vapor deposition (CVD). Characterization: Transmission electron microscopy - scanning electron microscopy - Atomic force microscopy - X-ray powder diffraction - Nanoparticle size calculation.

**TOTAL: 45 PERIODS**

### COURSE OUTCOMES:

**Upon completion of this course, the students will**

1. Understand the basics of crystallography and its importance in materials properties
2. Understand the significance of dislocations, strengthening mechanisms, and tensile, creep, hardness and fracture behavior of materials
3. Gain knowledge on binary phase diagrams, and also will be able to determine the phase composition and phase amount.
4. Understand about the Fe-C system and various microstructures in it, and also about various ferrous and non-ferrous alloys
5. Get adequate understanding on the preparation, properties and applications of ceramics, composites and nanomaterials.

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

### REFERENCES

1. W.D.Callitser and D.G.Rethwish. Materials Science and Engineering. John Wiley & Sons, 2014.

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2. V.Raghavan. Materials Science and Engineering: A First Course. PHI Learning, 2015.
3. M.F.Ashby, P.J.Ferreira and D.L.Schodek. Nanomaterials, Nanotechnologies and Design: An Introduction for Engineers, 2011.
4. J.F.Shackelford. Introduction to Materials Science for Engineers. Pearson, 2015.
5. D.R. Askeland and W.J.Wright. Essentials of Materials Science and Engineering, Cengage Learning, 2013.
6. W.F.Smith, J.Hashemi and R.Prakash. Materials Science and Engineering. McGraw Hill Education, 2017.

GE5252

**தமிழரும் தொழில்நுட்பமும்**

**L T P C**  
**1 0 0 1**

**அலகு I நெசவு மற்றும் பானைத் தொழில்நுட்பம்:**

**3**

சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்.

**அலகு II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்:**

**3**

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரம் சிற்பங்களும், கோவில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் - நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை.

**அலகு III உற்பத்தித் தொழில் நுட்பம்:**

**3**

கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருக்குதல், எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத்துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

**அலகு IV வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்:**

**3**

அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக் குழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.

**அலகு V அறிவியல் தமிழ் மற்றும் கணித்தமிழ்:**

**3**

அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.

**TOTAL : 15 PERIODS**

**TEXT-CUM-REFERENCE BOOKS**

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருளை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL - (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by:

- International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
  9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
  10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
  11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
  12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

**GE5252**

**TAMILS AND TECHNOLOGY**

**L T P C**

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**UNIT I WEAVING AND CERAMIC TECHNOLOGY 3**

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

**UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3**

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

**UNIT III MANUFACTURING TECHNOLOGY 3**

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beads - Archeological evidences - Gem stone types described in Silappathikaram.

**UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3**

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

**UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING 3**

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

**TOTAL : 15 PERIODS**

**TEXT-CUM-REFERENCE BOOKS**

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருளை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.)
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies.)
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)



11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)  
 12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

**GE5161 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY L T P C  
 0 0 4 2**

**COURSE OBJECTIVES:**

- To understand the problem solving approaches.
- To learn the basic programming constructs in Python.
- To articulate where computing strategies support in providing Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

**EXPERIMENTS:**

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same.
2. Python programming using simple statements and expressions.
3. Scientific problems using Conditionals and Iterative loops.
4. Implementing real-time/technical applications using Lists, Tuples.
5. Implementing real-time/technical applications using Sets, Dictionaries.
6. Implementing programs using Functions.
7. Implementing programs using Strings.
8. Implementing programs using written modules and Python Standard Libraries.
9. Implementing real-time/technical applications using File handling.
10. Implementing real-time/technical applications using Exception handling.
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

**TOTAL: 60 PERIODS**

**COURSE OUTCOMES:**

**On completion of the course, students will be able to:**

1. Develop algorithmic solutions to simple computational problems
2. Develop and execute simple Python programs.
3. Structure simple Python programs for solving problems.
4. Decompose a Python program into functions.
5. Represent compound data using Python data structures.
6. Apply Python features in developing software applications.

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	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	3	-	-	-	-	-	3	3	1	1	1
2	3	3	3	3	3	-	-	-	-	-	3	3	1	1	1
3	3	3	3	3	3	-	-	-	-	-	3	3	1	1	1
4	3	3	3	3	3	-	-	-	-	-	3	3	1	1	1
5	3	3	3	3	3	-	-	-	-	-	3	3	1	1	1
6	3	3	3	3	3						3	3	1	1	1
Avg.	3	3	3	3	3	-	-	-	-	-	3	3	1	1	1

*Attested*

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**COURSE OBJECTIVES**

- To impart hands on experience in verification of circuit laws and measurement of circuit parameters
- To train the students in performing various tests on electrical motors.
- It also gives practical exposure to the usage of CRO, power sources & function generators

**LIST OF EXPERIMENTS**

1. Verification of Kirchoff's Law.
2. Steady state response of AC and DC circuits (Mesh, Node Analysis)
3. Frequency response of RLC circuits.
4. Measurement power in three phase circuits by two-watt meter method.
5. Regulation of single phase transformer.
6. Performance characteristics of DC shunt generator.
7. Performance characteristics of single phase induction motor.
8. Characteristics of PN diode and Zener diode
9. Characteristics of Zener diode
10. Half wave and full wave Rectifiers
11. Application of Zener diode as shunt regulator.
12. Characteristics of BJT and JFET

**TOTAL: 60 PERIODS**

**COURSE OUTCOMES:**

1. To become familiar with the basic circuit components and know how to connect them to make a real electrical circuit;
2. Ability to perform speed characteristic of different electrical machines
3. Ability to use logic gates and Flip flops

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	-	3	-	-	-	2	2	-	1	1	1	2
2	2	2	2	-	2	-	-	-	2	2	-	1	1	1	2
3	3	3	3	-	3	-	-	-	2	2	-	1	1	1	2
Avg.	2.6	2.6	2.6	-	2.6	-	-	-	2	2	-	1	1	1	2



GE5262

**COMMUNICATION LABORATORY**

L T P C  
0 0 4 2

**OBJECTIVES**

- To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.
- To be able to communicate effectively through writing.

**UNIT I**

**12**

Speaking-Role Play Exercises Based on Workplace Contexts, - talking about competition-discussing progress toward goals-talking about experiences- talking about events in life-discussing past events-Writing: writing emails (formal & semi-formal).

**UNIT II**

**12**

Speaking: discussing news stories-talking about frequency-talking about travel problems-discussing travel procedures- talking about travel problems- making arrangements-describing arrangements-discussing plans and decisions- discussing purposes and reasons- understanding common technology terms-Writing: - writing different types of emails.

*Attested*

**UNIT III** **12**  
Speaking: discussing predictions-describing the climate-discussing forecasts and scenarios-talking about purchasing-discussing advantages and disadvantages- making comparisons-discussing likes and dislikes- discussing feelings about experiences-discussing imaginary scenarios Writing: short essays and reports-formal/semi-formal letters.

**UNIT IV** **12**  
Speaking: discussing the natural environment-describing systems-describing position and movement- explaining rules-(example- discussing rental arrangements)- understanding technical instructions-Writing: writing instructions-writing a short article.

**UNIT V** **12**  
Speaking: describing things relatively-describing clothing-discussing safety issues (making recommendations) talking about electrical devices-describing controlling actions- Writing: job application (Cover letter + Curriculum vitae)-writing recommendations.

**TOTAL: 60 PERIODS**

**LEARNING OUTCOMES**

1. Speak effectively in group discussions held in a formal/semi formal contexts.
2. Write emails and effective job applications.

**Assessment Pattern**

- One online / app based assessment to test speaking and writing skills
- Proficiency certification is given on successful completion of speaking and writing.

**MA5353**

**NUMERICAL METHODS**

**L T P C**  
**3 1 0 4**

**COURSE OBJECTIVES:**

- To provide the mathematical foundations of numerical techniques for solving Eigen value problems and linear system of equations.
- To apply the techniques of interpolation for equal and unequal intervals for the given data.
- To understand and to apply the techniques of numerical integration and differentiation for solving and ODE in applying day today life.
- To familiar in solving initial value problems and ODE for given initial and boundary conditions.
- To demonstrate the utility of Numerical techniques for solving Partial Differential Equations in Heat and Fluid problems.

**UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS** **12**  
Solution of algebraic and transcendental equations - Fixed point iteration method – Newton-Raphson method- Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss-Jordan methods – Iterative methods of Gauss-Jacobi and Gauss-Seidel - Matrix Inversion by Gauss-Jordan method – Eigen values of a matrix by Power method and by Jacobi’s method.

**UNIT II INTERPOLATION AND APPROXIMATION** **12**  
Interpolation with unequal intervals - Lagrange interpolation – Newton’s divided difference interpolation – Cubic Splines - Interpolation with equal intervals - Newton’s forward and backward difference formulae – Least square method - Linear curve fitting.

**UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION** **12**  
Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson’s 1/3 and Simpson’s 3/8 rules – Romberg’s method - Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson’s rules.

**UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS****12**

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

**UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS****12**

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

**TOTAL: 60 PERIODS****COURSE OUTCOMES:**

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

1. Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to the algebraic and transcendental equations.
2. Apply numerical methods to obtain approximate solutions to mathematical problems using interpolation.
3. Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
4. Analyse and evaluate the accuracy of common numerical methods in solving ODE of First and Second order equations.
5. Understand various numerical techniques for solving PDE, for given conditions in Heat flow and Wave problems.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
<b>1</b>	2	2	2	2	3	-	-	2	2	2	-	1	3	1	-
<b>2</b>	2		2	1	2	-	-	2	2	2	-	1	3	1	-
<b>3</b>	2	3	2	2	2	-	-	2	2	2	-	1	3	1	-
<b>4</b>	2	3	2	1	2	-	-	2	2	2	-	1	3	1	-
<b>5</b>	2	3	2	2	3	-	-	2	2	2	-	1	3	1	-
<b>Avg.</b>	2	2.6	2	1.6	2.4	-	-	2	2	2	-	1	3	1	-

**TEXT BOOKS:**

1. Grewal, B.S. and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10<sup>th</sup> Edition, New Delhi, 2014.
2. Sankara Rao, K, "Numerical Methods for Scientists and Engineers", PHI Learning Pvt Ltd., New Delhi, 2007.

**AU5352****MECHANICS OF SOLIDS****L T P C  
3 0 0 3****COURSE OBJECTIVES:**

The objective of this course is

- To know about how a solid (materials, structures) behaves when it is exposed to forces and deformations.
- To apply the fundamental concepts of principle of superposition, equilibrium, compatibility, force deformation, and stress-strain relationships to the solid and structural mechanics problems
- To analyze determinate and indeterminate bars, beams, to determine axial forces, torques, shear forces, and bending moments
- To have physical insight into distribution of stresses and strains in shafts and springs
- To identify the biaxial stresses in acting in a body or an element.

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**UNIT I STRESS - STRAIN, AXIAL LOADING 9**

Stress and strain, elastic limit, Hooke's law, factor of safety, shear stress, shear strain, relationship between elastic constants. Stresses in stepped bars, uniformly varying sections, composite bars due to axial force. Lateral strain, Poisson's ratio, volumetric strain, changes in dimensions and volume. Thermal stresses and impact loading.

**UNIT II STRESSES IN BEAMS 9**

Beam – Definition, types of end supports, types of beam, types of loading. Shear force diagram and bending moment diagram for cantilever, simply supported and overhanging beams under point load, UDL, UVL and moments. Euler beam theory - Bending equation, section modulus, Bending stress in beams – Shear stress in beams.

**UNIT III DEFLECTION OF BEAMS AND COLUMNS 9**

Governing differential equation - Problems on Double integration method -Macaulay's Method – Moment area method. Concepts of Conjugate Beam method and Method of superposition. Columns – different end conditions – buckling load – Euler's theory – Rankine's formula.

**UNIT IV TORSION AND SPRINGS 9**

Theory of torsion and assumptions - torsion equation, polar modulus, stresses in solid and hollow circular shafts, power transmitted by a shaft, shafts in series and parallel, deflection in shafts fixed at the both ends. Springs – types, Deflection expression for closed coiled helical spring – Stress in springs - design of springs.

**UNIT V BIAXIAL STRESS 9**

Principal stresses, normal and tangential stresses, maximum shear stress - analytical and graphical method. Stresses in combined loading. Thin walled cylinder under internal pressure – changes in dimensions – volume. spherical shells subjected to internal pressure – deformation in spherical shells – Lamé's theory.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

At the end of the course, the students are expected to

1. Know about how a solid (materials, structures) behaves when it is exposed to forces and deformations
2. Apply the fundamental concepts of principle of superposition, equilibrium, compatibility, force-deformation, and stress strain relationships to the solid and structural mechanics problems
3. Analyze determinate and indeterminate bars, beams, to determine axial forces, torques, shear forces, and bending moments
4. Have physical insight into distribution of stresses and strains in shafts and springs
5. Identify the biaxial stresses in acting in a body or an element

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

**TEXT BOOKS:**

1. James M Gere, Barry J Goodno, "Mechanics of Materials, SI Edition", Ninth Edition, Cengage Learning, 2018
2. Russell C. Hibbeler, "Mechanics of Materials", Tenth Edition, Pearson education, 2017
3. Stephen Timoshenko, 'Strength of Materials', Vol I & II, CBS Publishers and Distributors, 3rd edition, 2004.

## REFERENCES:

1. Clive L. Dym , Irving H. Shames, "Solid Mechanics : A Variational Approach, Augmented Edition", Springer publishers, 2013
2. Roy R Craig, "Mechanics of Materials", Third Edition, John Wiley & Sons, 2011
3. R.K.Rajput, 'Strength of Materials', S Chand; 4th Rev. Edition 2007.
4. Timothy A. Philpot, "Mechanics of Materials: An Integrated Learning System," 3rd Edition, Wiley, 2012.
5. William A. Nash, Merle C. Potter, "Schaum's Outline of Strength of Materials", 6th Edition, McGraw Hill Education, 2014

**AU5351**

**THERMODYNAMICS AND THERMAL ENGINEERING**

**L T P C**  
**3 1 0 4**

## COURSE OBJECTIVES:

- To impart knowledge of basic principles of thermodynamics via real world engineering examples
- To analyze and evaluate cardinal air standard cycles
- To analyze and evaluate cardinal Steam power cycles
- Summarize the governing concepts of Refrigeration and Air conditioning
- To introduce various modes of heat transfer, related to real time scenarios of thermodynamics applied in engineering practice

### **UNIT I BASIC THERMODYNAMICS**

**12**

Systems, closed, open and isolated. Property, state, path and process, quasi-static process, Zeroth law, First law. Steady flow energy equation. Engineering Applications of Steady flow energy equation Heat and work transfer in flow and non-flow processes. Second law, Kelvin-Planck statement – Clausius statement - Concept of Entropy, Clausius inequality, Entropy change in non-flow processes. Availability and Un Availability. Properties of gases and vapours

### **UNIT II AIR STANDARD CYCLES AND COMPRESSORS**

**12**

Cycle, Carnot cycle, Otto, Diesel, Dual combustion and Brayton cycles. Air standard efficiency. Mean effective pressure. Comparison of cycles, Efficiency versus compression ratio, For the same compression ratio and the same heat input Compressors, Classifications of compressors, Single stage and multi stage, Effect of intercooler in multi stage compressor, Perfect and imperfect intercooler, work done by the compressor, Reciprocating, Rotary, Axial, Vane compressors.

### **UNIT III STEAM AND JET PROPULSION**

**12**

Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. p-v-T surface

Properties of steam, Dryness fraction, Quality of steam by steam tables and Mollier chart – Rankine cycle, Work done, Steam rate – Steam Nozzles, Types of nozzles, Friction in nozzles - Simple jet propulsion system – Thrust rocket motor – Specific impulse.

### **UNIT IV REFRIGERATION AND AIR-CONDITIONING**

**12**

Principles of refrigeration, Vapour compression – Types of VCR system with respect to condition of vapour, Problems, Vapour absorption types, comparison - Co-efficient of performance (COP), Properties of refrigerants – Basic Principle, Summer, winter and Year round Air conditioning.

### **UNIT V HEAT AND MASS TRANSFER**

**12**

Modes of heat transfer, Heat conduction in parallel, radial and composite wall – Heat conduction through hollow and composite cylinders, spheres. Basics of Convective heat transfer. Fundamentals of Radiative heat transfer – Flow through heat- exchangers, Logarithmic Mean Temperature Difference (LMTD) for parallel flow and Arithmetic Mean Temperature Difference (AMTD) counter flow heat exchangers.

**TOTAL: 45 PERIODS**

(Use of standard Steam tables with mollier chart and Refrigerant tables are permitted)

## COURSE OUTCOMES:

At the end of the course the students will be able to

1. Will demonstrate understanding of the nature of the thermodynamic processes for pure substances of ideal gases
2. Will interpret First Law of Thermodynamics and its application to systems and control volumes
3. Will solve any flow specific problem in an engineering approach based on basic concepts and logic sequences
4. Will compare and contrast between various types of refrigeration cycles
5. Will get exposed to the basics and modes of heat transfer

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	1	1	1	2	1	1	3	-	2	3	3	3
2	2	3	2	1	1	1	2	1	1	2	-	2	3	3	2
3	2	2	2	1	1	1	1	1	1	2	-	2	2	3	2
4	2	2	2	1	1	1	1	1	1	2	-	2	3	2	2
5	2	2	2	1	1	1	1	1	1	2	-	2	3	3	2
Avg.	2.2	2.2	2.2	1	1	1	1.4	1	1	2.2	-	2	2.8	2.8	2.2

## TEXT BOOKS:

1. Chattopadhyay. P Engineering Thermodynamics”, oxford University Press, New Delhi, 2010.
2. Nag.P.K., “Engineering Thermodynamics”, Tata McGraw-Hill, New Delhi, 2007.
3. Rathakrishnan E., “Fundamentals of Engineering Thermodynamics” Prentice-Hall India, 2005.

## REFERENCES:

1. Arora C.P, “Thermodynamics”, Tata McGraw-Hill, New Delhi, 2003.
2. Holman.J.P., “Thermodynamics”, 3rd Ed. McGraw-Hill, 2007.
3. Mathur & Sharma Steam Tables, Jain Publishers, New Delhi.
4. Merala C, Pother, Craig W, Somerton, “Thermodynamics for Engineers”, Schaum Outline Series, Tata McGraw-Hill, New Delhi, 2004.
5. Ramalingam K.K. “Thermodynamics”, Sci-Tech Publications, 2006

AE5351

FLUID MECHANICS AND FLUID MACHINES

L T P C  
3 0 0 3

**COURSE OBJECTIVES:** Of this course are

- To learn about the basic properties of fluids.
- To introduce the concept of incompressible and viscous flows.
- To have a thorough knowledge on dimensional analysis and model studies.
- To study the applications of conservation laws to flow through pipes and hydraulic machines.
- To learn the basics of water turbines, their classification and working principles

## UNIT I BASIC EQUATIONS

9

Definition of fluid, Newton’s law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Control volume- application of continuity equation and momentum equation, Incompressible flow, Bernoulli’s equation and its applications.

## UNIT II INCOMPRESSIBLE VISCOUS FLOW

9

Exact flow solutions in channels and ducts, Couette and Poiseuille flow, laminar flow through circular conduits and circular annuli- concept of boundary layer – measures of boundary layer





conventional machining tasks.

- To Analyze and break down the process of determining machining times for individual operations through the application of time study techniques.
- To Evaluate and assess, judge the process of creating process planning sheets, while determining the most optimal sequence for machining operations.
- To Create and construct proficiency in utilizing 2D modeling software to design mechanical components for various purposes.

## LIST OF EXPERIMENTS

### Machining Exercises

1. Preparation of part drawing to machine a raw material in a lathe – (involving facing, turning, stepped turning, knurling, taper turning, thread cutting and parting)
2. Preparation of part drawing to machine a blank material in a shaper – (involving horizontal, vertical surface machining, V-shape, dove-tail end)
3. Preparation of part drawing to machine the given part in drilling machine – (involving single hole, multi hole, equidistant, equi-pitch, reaming, boring, counter boring, counter sinking).
4. Preparation of part drawing to mill the groove part in a milling machine – (involving key way, slot, spur gear, patched milling, spline, gang milling).
5. Preparation of part drawing to grind the part in a grinding machine-(involving flat surface, cylindrical surface).
6. Preparation of part drawing to machine a part in combination of machine-( Lathe and Milling, Lathe and Grinding, Shaper and Grinding).

### Drafting Exercises

1. Any CAD software with 2D modeling to used by students for drafting exercises
2. Practice on Drafting Software using Measuring commands; Basic Draw Commands; Display Commands GRID, SNAP, CIRCLE, LINE, ARC LIMITS, ZOOM, PAN.
3. Practice on using Editing commands; Creating layers: CHANGE, ERASE, EXTEND, TRIM, GRIPS. Construction Commands; ARRAY, COPY, MIRROR, MOVE, OFFSET, FILLET, CHAMFER, OSNAP.
4. Placing lettering on a drawing; Crosshatching a drawing TEXT BHATCH.
5. 2D drafting of automobile components like engine crank shaft , connecting rod etc.,
6. 2D drafting of machine components.
7. 2D drafting of machine shop drawing.
8. 2D drafting of pin joints, cotter joints and bearings.

The drafting exercise include process planning sheet where student shall fill up the data for producing the product as per drawing. As per the process planning sheet the machining operations are to be conducted.

1. Step turning, Taper Turning/ Threading and Knurling operations in Lathe.
2. Eccentric turning in a Lathe
3. Multi start Threading/ Burnishing operations in a Turret Lathe.
4. Machining to make a cube/ V-Block using shaper.
5. Counter sinking, Counter Boring and Tapping operation in a drilling machine.
6. Surfacing/Pocket Milling in a vertical milling machine.
7. Polygonal shape milling in a horizontal milling machine.
8. Flat surface grinding and cylindrical grinding operations.

**TOTAL: 60 PERIODS**

### COURSE OUTCOMES:

**At the end of the course the students will be able to**

1. The student will be capable of assessing and selecting the most appropriate machining process for intricate engineering components.
2. The student will be capable of employing skills to produce part drawings corresponding to a range of manufacturing operations.

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3. The student will be capable of breaking down tasks to compute machining durations across various manufacturing operations.
4. The student will be capable of generating process planning sheets tailored to different manufacturing operations.
5. The student will be capable of crafting orthographic and isometric models utilizing 2D modeling software for diverse mechanical components.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	1	1	2	-	-	1	1	2	1	2	1	-	2
2	2	1	1	1	2	-	-	1	1	2	1	2	1	-	2
3	2	1	1	1	2	-	-	1	1	2	1	2	1	-	2
4	2	1	1	1	2	-	-	1	1	2	1	2	1	-	2
5	2	1	1	1	2	-	-	1	1	2	1	2	1	-	2
<b>Avg.</b>	2.0	1.0	1.0	1.0	2.0	-	-	1.0	1.0	2.0	1.0	2.0	1.0	-	2.0

**PR5312 MATERIAL TESTING AND THERMAL ENGINEERING LABORATORY**

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

**COURSE OBJECTIVES:**

- To study the mechanical properties of materials when subjected to different types of loading.
- To study the performance characteristics of various engines
- To understand the working principle of IC engines
- To understand the modes of heat transfer
- To enable the students to apply the heat transfer knowledge to real applications.

**MATERIAL TESTING**

1. Tension test on mild steel rod
2. Torsion test on mild steel rod
3. Hardness test on metal beam ( Rockwell, Vicker's and Brinell Hardness Tests)
4. Compression test on helical spring
5. Deflection test on carriage spring
6. Impact Test (Izod and Charpy)

**THERMAL ENGINEERING LAB**

1. Valve timing diagram
2. Port timing diagram
3. Performance test on four stroke diesel engine
4. Performance test on air compressor
5. Composite wall apparatus
6. Determination of convective heat transfer coefficient
7. Determination of thermal conductivity for pipe application.
8. Emissivity apparatus
9. Stefan Boltzmann apparatus
10. Pin fin apparatus

**TOTAL:60 PERIODS**

**COURSE OUTCOMES:**

**At the end of the course, students will be able to**

1. Perform Tension, Torsion, Hardness, Compression, and Deformation test on Solid materials.
2. Perform Tension, Torsion, Hardness, compression, and deformation test on Solid materials.
3. Understand the importance of valve timing, and overlap on performance
4. Analyze the performance characteristics of the given engine.

5. Distinguish different modes of heat transfer.

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

GE5361

PROFESSIONAL DEVELOPMENT

L T P C  
0 0 2 1

**OBJECTIVES:**

- To be proficient in important Microsoft Office tools: MS WORD, EXCEL, POWERPOINT.
- To be proficient in using MS WORD to create quality technical documents, by using standard templates, widely acceptable styles and formats, variety of features to enhance the presentability and overall utility value of content.
- To be proficient in using MS EXCEL for all data manipulation tasks including the common statistical, logical, mathematical etc., operations, conversion, analytics, search and explore, visualize, interlink, and utilizing many more critical features offered
- To be able to create and share quality presentations by using the features of MS PowerPoint, including: organization of content, presentability, aesthetics, using media elements and enhance the overall quality of presentations.

**MS WORD:**

Create and format a document  
Working with tables  
Working with Bullets and Lists  
Working with styles, shapes, smart art, charts  
Inserting objects, charts and importing objects from other office tools  
Creating and Using document templates  
Inserting equations, symbols and special characters  
Working with Table of contents and References, citations  
Insert and review comments  
Create bookmarks, hyperlinks, endnotes footnote  
Viewing document in different modes  
Working with document protection and security  
Inspect document for accessibility

10 Hours

**MS EXCEL:**

Create worksheets, insert and format data  
Work with different types of data: text, currency, date, numeric etc.  
Split, validate, consolidate, Convert data  
Sort and filter data  
Perform calculations and use functions: (Statistical, Logical, Mathematical, date, Time etc.)  
Work with Lookup and reference formulae  
Create and Work with different types of charts  
Use pivot tables to summarize and analyse data  
Perform data analysis using own formulae and functions  
Combine data from multiple worksheets using own formulae and built-in functions to generate results

10 Hours

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Export data and sheets to other file formats  
Working with macros  
Protecting data and Securing the workbook

**MS POWERPOINT:**

**10 Hours**

Select slide templates, layout and themes  
Formatting slide content and using bullets and numbering  
Insert and format images, smart art, tables, charts  
Using Slide master, notes and handout master  
Working with animation and transitions  
Organize and Group slides  
Import or create and use media objects: audio, video, animation  
Perform slideshow recording and Record narration and create presentable videos

**TOTAL: 30 PERIODS**

**OUTCOMES:**

On successful completion the students will be able to

1. Use MS Word to create quality documents, by structuring and organizing content for their day to day technical and academic requirements
2. Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding
3. Use MS PowerPoint to create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects.

**GE5251**

**ENVIRONMENTAL SCIENCES**

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

**COURSE OBJECTIVES:**

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation and measures to preserve them.
- To familiarize the influence of societal use of resources on the environment and introduce the legal provisions, National and International laws and conventions for environmental protection.
- To inculcate the effect of population dynamics on human and environmental health and inform about human right, value education and role of technology in monitoring human and environmental issues.

**UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY**

**14**

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

**UNIT II ENVIRONMENTAL POLLUTION**

**8**

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – soil

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waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

### UNIT III NATURAL RESOURCES

10

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

### UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT

7

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

### UNIT V HUMAN POPULATION AND THE ENVIRONMENT

6

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

**TOTAL: 45 PERIODS**

### COURSE OUTCOMES:

At the end of the course the students will be able to

1. To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation
2. To identify the causes, effects and environmental pollution and natural disasters and contribute to the preventive measures in the immediate society.
3. To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations
4. To recognize different forms of energy and apply them for suitable applications in for technological advancement and societal development.
5. To demonstrate the knowledge of societal activity on the long and short term environmental issues and abide by the legal provisions, National and International laws and conventions in professional and personal activities and to identify and analyze effect of population dynamics on human value education, consumerism and role of technology in environmental issues

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	3	-	-	2	2	2	-	1	3	1	-
2	2		2	1	2	-	-	2	2	2	-	1	3	1	-
3	2	3	2	2	2	-	-	2	2	2	-	1	3	1	-
4	2	3	2	1	2	-	-	2	2	2	-	1	3	1	-
5	2	3	2	2	3	-	-	2	2	2	-	1	3	1	-
Avg.	2	2.6	2	1.6	2.4	-	-	2	2	2	-	1	3	1	-

**TEXT BOOKS:**

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6<sup>th</sup> Edition, New Age International Publishers (2018).
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2016).
3. Gilbert M. Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education (2004).

**REFERENCES:**

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press (2005).
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. (2013).

**PR5401****FOUNDRY AND WELDING TECHNOLOGY****L T P C****3 0 0 3****COURSE OBJECTIVES:**

- To enhance the knowledge about principles/methods of casting with detail design of gating/riser system needed for casting, defects in cast objects and requirements for achieving better casting.
- To impart the basic principle, procedure and applications of various Foundry and Welding methods.
- To knowledge the principle, thermal and metallurgical aspects during solidification of metal and alloys
- To discuss SMAW, GMAW, GTAW, Oxy-acetylene welding and resistance spot welding processes
- To have a improve knowledge to design a casting and welding process and metallurgical and weldability aspects of different common engineering materials.

**UNIT I CASTING PROCESSES****9**

Introduction to casting – pattern – materials allowances – coding – types – moulds – mould making, sand – properties, types and testing of sands – core making – type of cores – single box, two box and three box moulding processes, runner, riser and gate and chills chaplets.

**UNIT II SPECIAL CASTING PROCESSES****9**

Pressure die casting – Centrifugal – continuous – investment – shell moulding – squeeze – electro slag casting – CO<sub>2</sub> moulding – Plaster Mould castings – Antioch process – Slush casting- Counter gravity low pressure casting - electro-magnetic casting.

**UNIT III METAL JOINING PROCESSES****9**

Introduction to soldering, brazing and welding Types of joints – plane of welding – edge preparation – filler material – flux – shielding gases – fusion welding – gas welding – flame types – Manual arc welding – arc theory – power supply – braze welding – Thermit welding – Resistance welding – spot, seam, projection, percussion and flash- Shielded Metal Arc welding, Gas Metal Arc Welding-Gas Tungsten Arc Welding.

**UNIT IV SPECIAL WELDING PROCESSES****9**

Submerged arc welding – Flux Cored Arc Welding – Electro slag welding – friction welding – explosive welding – Underwater welding – Diffusion bonding – EBW – LBW – PAW – Stud welding – welding of dissimilar materials – Friction stir welding – High frequency induction welding.

**UNIT V TESTING OF CASTINGS AND WELDMENTS****9**

Causes and remedies for casting defects – welding defects – Destructive testing – Non Destructive Testing (NDT) methods– Testing: Dye penetrant – magnetic particle – X-ray - Radiography - ultrasonic - Case studies in testing of welded joints and castings.

**TOTAL: 45 PERIODS****COURSE OUTCOMES:****At the end of the course, students will be able to:**

1. Explain the key concepts and terminology related to pattern making, moulding, and core making in casting processes.
2. Evaluate and select appropriate special most suitable casting method for a given application.
3. Recall the fundamental concepts, terminologies, and classifications of joints and welding methods.
4. Compare the behavior of common and emerging welding techniques, considering their advantages and limitations.
5. Summarize and categorize various casting and welding defects using destructive and non-destructive testing methods

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	1	-	1	3	2	-	-	-	-	2	1	-	1
2	1	1	1	-	2	3	-	-	-	-	-	2	1	-	1
3	1	1	1	-	1	3	2	-	-	-	-	2	1	-	1
4	1	1	1	-	2	3	-	-	-	-	-	2	1	-	1
5	1	1	1	-	2	3	2	-	-	-	-	2	1	1	1
Avg.	1	1	1	-	1.6	3	2	-	-	-	-	2	1	1	1

**TEXT BOOKS:**

1. Jain .P.L., “Principle of Foundry Technology”, Tata McGraw Hill ,4th edition, 2004.
2. Parmer .R.S ,“Welding Engineering and Technology”, Khanna Publishers , 2004.

**REFERENCES:**

1. Curry .B.,“Modern Welding Technology” , Prentice Hall ,2008.
2. Heime, Looper and Rosenthal, “Principle of metal casting” , Tata McGraw Hill ,2nd edition 2002.
3. Little, “Welding Technology”, Tata McGraw Hill, 2008.
4. Taylor HF Fleming, “Foundry Engineering” , M.C. and Wiley Eastern Ltd., 2003.
5. Ramana Rao, T. V., Metal Casting – Principles and Practice, New Age International Pvt. Ltd. (2003).

**PR5402****ENGINEERING MATERIALS****L T P C  
3 0 0 3****COURSE OBJECTIVES:**

- To impart knowledge on the various microstructural features of metallic materials, also study the effect of alloying addition in the steel with their structural change.
- To illustrate the role of heat treatment on microstructure and properties, also study the case
- To desire the various non-ferrous alloys and their applications with properties.
- To introduce the concepts of mechanical behaviour of the materials, also study the various strengthening mechanism.
- To describe the properties and applications of various polymers and ceramics.

**UNIT I MICROSTRUCTURAL DEVELOPMENT AND METALLOGRAPHY** *Attested 9*

Basics of Metallographic microscopy -sample preparation – resolution – contrast – Metallographic microscope - quantitative techniques - Homogenous and Heterogeneous nucleation - grain

growth- directional solidification- cast and weld microstructure- ingot and continuous casting - microstructures of Steels and Cast irons - spinodal decomposition - Pearlitic, bainitic and martensitic transformations - Effect of alloying elements on steel ( Mn, Si, Cr, Ni, Mo, V, Ti and W) – Specification and Standards, Properties and application -stainless and tool steels – HSLA steels – TRIP steel- maraging steels – Gray, white, malleable, spheroidal / graphite, alloy cast irons

**UNIT II HEAT TREATMENT AND KINETICS 9**

Diffusion in solids - Fick's law - - Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram CCR - Types and stages of annealing, stress relief, recrystallisation and spheroidizing – normalizing, Hardenability, Jominy end quench test - hardening and tempering of steel –Cryotreatment, Austempering, martempering – case hardening, carburizing, nitriding cyaniding, carbonitriding – Flame, Induction Laser and Electron beam and plasma phase hardening, Special and Duplex surface hardening processes.

**UNIT III NON FERROUS METALS 9**

Specification, Properties and application: Copper and Copper alloys, Brass, Bronze and Cupronickel – Aluminium alloys and Al-Cu –precipitation strengthening treatment – Bearing alloys, Alloys of Titanium, Zinc, Magnesium and Nickel –Intermetallics - Ni, Ti Aluminides – Refractory alloys- Superalloys- Shape memory alloys- high entropy alloys- Bulk Metallic glasses.

**UNIT IV DEFORMATION AND FAILURE OF METALS 9**

Elastic, anelastic and viscoelastic behaviour - Dislocation in FCC,BCC,HCP – stress field - interaction between dislocations -Strengthening mechanism- effect of temperature- deformation mechanism maps - cyclic loading - Types of Fracture – Fracture mechanics - fracture toughness ductile-brittle transition - types of wear - corrosion - Basics of Scanning electron microscope (SEM)- Energy Dispersive Spectroscopy (EDS)- Failure analysis

**UNIT V NON METALLIC MATERIALS 9**

Polymers- Thermo, Thermoset Polymers, Co and mixed Polymers- Commodity Polymers, PE, PS,PVS PMMA, PC, PET, ABS- Engineering Polymers, PA, PPS, PI, PFE- Natural and Synthetic rubbers, Elastomers- Adhesives- Ceramics- Natural and Synthetic Ceramic- Feldspar, Corundum, Garnet- WC, TC,TiC, Si3N4,Al2O3, CBN, PCD, Uses of abrasives and cutting tools.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

1. Identify the microstructural features of ferrous materials, also understand the structural properties correlations.
2. Understand the various heat treatment concept, also identify the suitable heat treatment process for the require applications.
3. Understand the properties and uses of non-ferrous alloys, also justify the selection for the various applications.
4. Correlate the mechanical behaviour with the mechanisms of strengthening, also understand the different types of fracture with exact reason.
5. Suggest suitable polymer and ceramic for a given application

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	1	1	-	1	1	-	-	-	-	1	1	-	1
2	1	2	1	1	1	1	1	-	-	-	-	1	1	-	1
3	1	2	1	-	-	-	-	-	-	-	-	1	1	-	1
4	1	2	1	-	-	-	-	-	-	-	-	1	1	1	1
5	1	1	1	-	-	1	1	-	-	-	-	1	1	1	1
Avg.	1	1.6	1	1	1	1	1	-	-	-	-	1	1	1	1



**TEXT BOOKS:**

1. Balasubramanian.R, Callister's 'Materials Science and Engineering', 7th Edition, Wiley India Pvt. Limited, 2010.
2. Kenneth G.Budinski and Michael K.Budinski , "Engineering Materials", 9th Indian Reprint, Prentice-Hall of India Private Limited, 2011.

**REFERENCES:**

1. Callisers's Jr. W.D, Rethuish, D.G, Materials Science and Engineering, 9th Edition, Wiley, 2014.
2. Donald R. Askeland, Pradeep P. Fulay and Wendelin J. Wright, "The Science and Engineering of Materials", 7 th Edition, Cengage Learning, Inc. 2017.
3. Raghavan V., "Materials Science and Engg: A first Course", 6th Edition, Prentice Hall of India Pvt Ltd., 5th edition, 2004.
4. Sidney H. Avner, "Introduction to Physical Metallurgy", McGraw Hill Book Company, 2<sup>nd</sup>Edition, 2008.
5. Yang Leng, "Materials Characterization: Introduction to Microscopic and Spectroscopic Methods", John Wiley and Sons, 2<sup>nd</sup>edition, 2013.

**PR5403****MACHINING PROCESSES AND MACHINE TOOLS****L T P C  
3 0 0 3****COURSE OBJECTIVES:**

- To provide students with fundamental knowledge and principles in material removal processes.
- To understand the fundamentals aspects of metal cutting principles by studying various machining processes.
- To study the constructional features and various operations related to milling, drilling and grinding.
- To know the factors influencing the processes and their applications.
- To recommend appropriate manufacturing process when provided a set of functional requirements and constraints.

**UNIT I LATHE****9**

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

**UNIT II SHAPER, PLANER and SLOTTER****9**

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

**UNIT III DRILLING****9**

Purpose of drilling – block diagram and function – types of drilling machines – portable drilling – bench type – sensitive drilling – radial arm drilling – functions of parts – purpose and operation – gang drilling, multiple drill head, upright drilling, relative operations – reaming, boring, tapping, counter boring, courses sinking, trepanning and spot facing (with simple sketch, purpose and

application). Work holding devices – specification torque calculation – speed, feed and depth of cut.

#### UNIT IV MILLING

9

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

#### UNIT V GRINDING

9

Purpose – classification – surface finish – applications – grinding wheel – types – specifications – selection – surface grinding machine – block diagram – functions of each part – cylindrical grinding – Centre less grinding – Comparison – in-feed, end feed and through feed. Balancing, dressing, loading and Truing of wheel – special grinding machines – specification of machine – cutting condition.

**TOTAL: 45 PERIODS**

#### COURSE OUTCOMES:

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

1. Explain the features and applications of lathe, milling, drilling and grinding machines
2. Discuss the features and applications of reciprocating machine tools and like shaper, planer and slotting machine
3. Explain the machine tool structures
4. Explain the working principles of various machines used in manufacturing
5. Identify the appropriate production process and machines.

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

#### TEXT BOOKS:

1. HMT Bangalore, "Production Technology", Tata Mc-Graw Hill Publishing Company Limited, New Delhi, 2008.
2. Sharma.P.C., "A Text Book of Production Technology", S.Chand and Company, 11th edition. 2010.

#### REFERENCES:

1. HajraChoudharyetal, "Elements of Production Technology –Vol.II", Asia Publishing House, 2010.
2. Jain.R.K., "Production Technology", Khanna Publishers, New Delhi, 17th edition.
3. Kalpakjain, "Manufacturing Process for Engineering Material", Addison –WesleyPublication, 2000.
4. Kumar B., "Manufacturing Technology", Khanna Publishers, New Delhi 2000.
5. Radhakrishnan P., "Manufacturing Technology, Vol.I", Scitech Publications, edition-1, 2002

*Attested*

*[Signature]*  
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**COURSE OBJECTIVES:**

- To identify and enumerate different link based mechanisms with basic understanding of motion and analyze the various velocity and acceleration diagrams for various mechanisms
- To understand the effects of friction in motion in transmission and machine components.
- To familiarize higher pairs like cams, gears and gear trains their nomenclature and their profiles.
- To study the basics of vibrations their effects on rotation and reciprocating members
- To study the undesirable effects of unbalances and instability resulting from prescribed motions in mechanisms, governors and gyroscopes

**UNIT I MECHANISMS****9+3**

Definition – Machine and Structure – Kinematic link, pair and chain – classification of Kinematic pairs – Constraint and motion – Degrees of freedom - Slider crank – single and double – Crank rocker mechanisms – Inversions, applications – Introduction to Kinematic analysis and synthesis of simple mechanisms – Determination of velocity and acceleration of simple mechanisms.

**UNIT II FRICTION****9+3**

Types of friction – friction in screw and nut – screw jack – pivot, collar and thrust bearings – plate and cone clutch – belt (Flat and V) and rope drives – creep in belts – open and crossed belt drives – Ratio of tensions – Effect of centrifugal and initial tensions – condition for maximum power transmission.

**UNIT III GEARS AND CAMS****9+3**

Gear – Types and profile – nomenclature of spur and helical gears – laws of gearing – interference – requirement of minimum number of teeth in gears – gear trains – simple, compound and reverted gear trains – determination of speed and torque in epicyclic gear trains – cams different types of followers – Cam – Types of cams and followers – Cam design for different follower motions.

**UNIT IV VIBRATION****9+3**

Free, forced and damped vibrations of single degree of freedom systems – force transmitted to supports – vibration Isolation – vibration absorption – torsional vibration of shafts – single and multi-rotor systems – geared shafts – critical speed of shafts.

**UNIT V BALANCING****9+3**

Static and dynamic balancing – single and several masses in different planes – primary and secondary balancing of reciprocating masses – Balancing of single and multi-cylinder engines – Governors and Gyroscopic effects.

**TOTAL:60 PERIODS****COURSE OUTCOMES:**

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

1. Able to analyze the velocity and accelerations in mechanisms, and to utilize their inversions of mechanism.
2. Able to acquire the knowledge on different type screw jack, bearings, brakes and clutches.
3. Able to design a cam and gear and to select suitable gears and gear trains for effective power transmission
4. Able to solve problems in vibration due to unbalance in rotating members
5. Able to analyze the effects of unbalancing in machines, controlling force and instability in governors and gyroscopes

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

4	2	1	1	1	-	-	-	-	-	1	-	-	1	1	1
5	2	1	1	1	-	-	-	-	-	1	-	-	1	1	1
Avg.	2	1	1	1	1	-	-	-	1	1	-	-	1	1	1

**TEXT BOOKS:**

1. Bansal R.K., "Theory of Machines", Laxmi Publications Pvt Ltd., New Delhi, 20th edition 2009.
2. Rattan S.S., "Theory of machines", Tata McGraw Hill publishing Co., New Delhi, 2nd edition 2011.

**REFERENCES:**

1. Gosh A and Mallick A.K., "Theory of Machines and Mechanisms", Affiliated East West press, 2009.
2. Malhotra D.R. and Gupta H.C , "The Theory of machines", Satya Prakasam, Tech. India Publications, 2008.
3. Rao J.S. and Dukkupati R.V., "Mechanism and Machine Theory", Second Edition, Wiley Eastern Limited, 2006.
4. Shigley J.E. and Uicker J.J., "Theory of Machines and Mechanisms", McGraw Hill, 2006.
5. Ambekar A.G., "Mechanism and Machine Theory", PHI India Pvt Ltd, 2007

PR5411

**MACHINING PROCESSES LABORATORY**

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

**COURSE OBJECTIVES:**

- To demonstrate the various machining operations in conventional lathe and shaping machine.
- To demonstrate the various machining operations in conventional milling machine.
- To demonstrate the grinding and gear cutting process.
- To educate the measurement and analyze of cutting forces.
- To provide the knowledge on the fundamentals of part program.

**LIST OF EXPERIMENTS**

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

**TOTAL: 60 PERIODS**

**COURSE OUTCOMES:**

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

1. To machine the given workpiece in the conventional lathe and shaping machine to get the required geometry
2. To machine the given workpiece in the conventional milling machine to get the required profile
3. To produce the gear with the given workpiece.
4. Calculate the values of various forces involved in the machining operations.
5. Develop a CNC program for the given part

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CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	1	3	3	2	-	-	3	2	-	1	1	-	1
2	1	1	1	3	3	2	-	-	3	2	-	1	1	-	1
3	1	1	1	3	3	2	-	-	3	2	-	1	1	-	1
4	2	1	1	3	3	2	-	-	3	2	-	1	1	-	1
5	1	1	1	3	3	2	-	-	3	2	-	1	1	-	1
Avg.	1.2	1	1	3	3	2	-	-	3	2	-	1	1	-	1

PR5412

FOUNDRY, WELDING AND METALLURGY LABORATORY

L T P C

0 0 4 2

**COURSE OBJECTIVES:**

- To train the students in the area of non-ferrous metal casting with the simple shapes.
- To study the basic requirements of given moulding sand by standard tests.
- To train the students to make the simple joints by various welding techniques.
- To study the solidification of metals and alloys also find the various microstructure of given specimens.
- To train the students for various heat treatment processes and their applications

**LIST OF EXPERIMENTS:**

**FOUNDRY**

1. Green and Dry Strength of Moulding sand.
2. Permeability testing.
3. Determining the clay content.
4. Sieve analysis of dry silica sand.
5. Determining the moisture content.
6. Melting any non-ferrous metal and making simple castings – Demonstration.

**WELDING**

1. Welding of basic joints using gas and arc welding.
2. Welding of pipes in different positions.
3. GTAW / GMAW of ferrous and non - ferrous metals.
4. Spot welding of plates.
5. Brazing practice – Dissimilar metals.
6. Welding of standard grill structures.

**METALLURGY**

1. Cooling curve- Pure metal and alloy (Pb-Sn).
2. Specimen preparation for macro – examination.
3. Specimen preparation for micro examination (steel/cast iron/non-ferrous alloys).
4. Quantitative metallography – Estimation of volume fraction, particle size, shape and distribution.
5. Heat treatments of Steel-Micro structural study: Annealing/ Normalising / Quench
6. Hardening/ Tempering.
7. Jominy End Quench Test.

**TOTAL: 60 PERIODS**

**COURSE OUTCOMES:**

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

1. Utilize testing methods and equipment to assess the quality of moulding sand.
2. Demonstrate the basic casting procedure for different materials and shapes.

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3. Demonstrate the practical ability to create simple welded joints using appropriate welding techniques.
4. Analyze phase diagrams to predict the microstructural evolution of materials during heat treatment.
5. Explain the mechanisms behind various heat treatment processes and describe their applications.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	-	2	2	-	-	2	-	3	3	1	3	1	-	1
2	2	-	2	2	-	-	2	-	3	3	1	3	1	-	1
3	2	-	2	2	-	-	2	-	3	3	1	3	1	-	1
4	2	-	2	2	-	-	2	-	3	3	1	3	1	-	1
5	3	-	2	2	-	-	2	-	3	3	1	3	1	-	1
Avg.	2.4	-	2	2	-	-	2	-	3	3	1	3	1	-	1

GE5551

**STATISTICS FOR PRODUCTION MANAGEMENT**

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

**COURSE OBJECTIVES:**

- To train the students so that students will be able to design experimental designs and use these concepts for research design.
- To make use of the concept of probability for industrial applications.
- To stress upon the importance of the sampling theory and its usefulness in industrial quality control.
- To make students familiarize with the concepts of estimation theory and its applications.
- To help students understand the usefulness of tests of significance and its applications in industry and research.

**UNIT I PROBABILITY THEORY**

**12**

Random variables – Discrete and continuous random variable- Probability mass and density functions- Joint density and mass functions-Moment about mean and origin- Moment generating and characteristic functions – Binomial, Poisson, Normal distributions and their applications- to manufacturing problems.

**UNIT II SAMPLING THEORY**

**12**

Sampling with and without replacement- Random sample- Sampling distributions of means, proportions, difference of means and proportions-Student 't' distribution- Chi square distribution- Fisher's distribution and their applications to production problems.

**UNIT III ESTIMATION THEORY**

**6**

Point and Interval estimation- Confidence limits for mean, proportions, difference of means, proportions- Confidence limits using student 't' distribution, Chi square and F distribution- applications.

**UNIT IV TESTING OF HYPOTHESIS**

**10**

Procedure for testing hypothesis and significance- Level of Significance of large samples for means, proportions, difference of means and difference of proportions- Tests based on student t distribution, chi square distribution and F distribution – Applications to manufacturing.

**UNIT V ANOVA**

**5**

One factor experiments – Mathematical model for one factor experiments- Two factor experiments-Mathematical model for two factor experiments- Applications to production problems.

**TOTAL: 45 PERIODS**

## COURSE OUTCOMES:

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

1. Interpret the concept of probability and statistics for industrial applications
2. Estimate the quality of the sample using sampling theory in industrial quality control
3. Estimate the life of the sample using estimation theory in industrial reliability analysis
4. Formulate hypothesis and conduct Design of experiments
5. Utilize appropriate decision making tools in production management

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	-	-	-	-	-	-	-	1	1	1	1
2	3	2	1	1	-	-	-	-	-	-	-	1	1	1	1
3	3	2	1	1	-	-	-	-	-	-	-	1	1	1	1
4	3	2	1	1	-	-	-	-	-	-	-	1	1	1	1
5	3	2	1	2	1	-	-	-	-	-	-	1	1	1	2
Avg.	3	2	1	1.2	1	-	-	-	-	-	-	1	1	1	1.2

## TEXT BOOKS:

1. Richard I. Levin and David S. Rubin, "Statistics for Management", Pearson India, 2018.
2. Richard Barrett Clements, "Handbook of Statistical Methods in Manufacturing", PH, 1991.

## REFERENCES:

1. Gupta. S.C. and Kapoor. V.K, "Fundamentals of Mathematical Statistics", Sultanchand, 2017.
2. Hooda. R.P., "Statistics for business and economics", Vikas Publications, 2010.
3. Morris. H. Degroot, Mark J. Schervish, Probability and Statistics, Pearson Education, 2018.
4. Vijay K. Rohatgi, Ehsanes Saleh A.K Md, "An Introduction to Probability and Statistics", Wiley, 2008.
5. Rukmangadachari. E, Probability and Statistics, Pearson, 2012.

PR5501

ENGINEERING METROLOGY

L T P C  
3 0 0 3

## COURSE OBJECTIVES:

- To define the various aspects of measurement and its applications in industry
- To explain the working principles of various measuring systems
- To apply the principles of metrology and measurements in manufacturing industries.
- To evaluate the various measurable parameters of the given component using suitable measuring equipment
- To compare the advances in measurement with the traditional measuring methods.

### UNIT I FUNDAMENTALS OF MEASUREMENT

9

Fundamentals of Engineering metrology – Line, end and wave length standards of measurement – Accuracy, Precision and Calibration of instruments - Errors in measurements – Limits, fits, tolerance and gauge design – Inter changeability and selective assembly – Uncertainties in measurements.

### UNIT II LINEAR AND ANGULAR MEASURING SYSTEMS

9

Linear and Angular measuring systems. Vernier calipers, micrometers, Slip gauges, dial gauges and surface plates – Concept of comparators - mechanical, electrical, optical and pneumatic comparators – Angular measuring systems – angle gauges – Sine bar – Precision spirit level, Auto collimators – Angle dekkor – Clinometers.

**UNIT III MEASUREMENT OF SURFACE TEXTURE AND MEASURING INSTRUMENTS****9**

Surface texture – Definitions – types of surface texture – surface texture measurement methods Comparison – Profilometer – Surface texture measuring instruments – Straightness and flatness measurement using precision level and auto collimators-Measurement of roundness and camming– Tool makers microscope – Optical and Laser Alignment telescope – Geometric Dimensioning and Tolerancing

**UNIT IV METROLOGY OF SCREW THREADS AND GEARS****9**

Metrology of screw threads and gears Internal and external screw threads – terminology - measurement of various elements of screw threads – thread micrometer two wire and three wire - methods, gear terminology measurement of various elements of gears pitch circle method, constant chord method, base tangent method – plug method – Rolling gear tester.

**UNIT V LASER METROLOGY AND COMPUTER AIDED METROLOGY****9**

Laser micrometer - Laser interferometer – non contact and in-process inspection using laser – Co-ordinate measuring machines – Probe sensors – Errors – Environmental factors – vision systems – Atomic force microscope - Scanning tunneling microscope - 3D Computed Tomography.

**TOTAL: 45 PERIODS****COURSE OUTCOMES:****At the end of the course, students will be able to:**

1. Identify the various errors in measurement and calculate the uncertainties in measurements
2. Utilize measuring instruments for analyzing the linear and angular components
3. Select appropriate and analyze the various parameters of surface texture
4. Identify and calculate the various parameters of screw thread and gear tooth
5. Apply measurements for quality control in manufacturing Industries.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	1	2	-	-	-	-	-	1	-	1	1	1	1
2	1	1	1	2	-	-	-	-	-	1	-	1	1	1	1
3	1	1	1	2	-	1	-	-	-	1	-	1	1	1	1
4	1	1	1	3	-	-	-	-	-	1	-	1	1	1	1
5	1	1	1	1	-	-	-	-	-	1	-	2	1	1	1
Avg.	1	1	1	2	-	1	-	-	-	1	-	1.2	1	1	1

**TEXT BOOKS:**

1. Jain.R.K., “Engineering Metrology”, Khanna Publishers, 20<sup>th</sup> edition, 2009.
2. Gupta.I.C., “A text book of Engineering Metrology”, Dhanpat Rai and Sons, 7<sup>th</sup> edition 2012.

**REFERENCES:**

1. “ASTE Hand book of Industrial Metrology”, Prentice Hall of India Limited 2002.
2. Gayler G.N. and ShotboltC.R., “Metrology for Engineers”, ELBS 2000.
3. Rajput R.K., “Engineering Metrology and Instrumentation”, Kataria and Sons Publishers, 2013.
4. Raghavendra and L.Krishnamurthy, “Engineering Metrology and Measurements”OUP India, 2013.
5. Francis T. Farago and Mark A.Curtis, “Handbook of Dimensional Measurements”, Industrial Press Inc, 3 rd Edition, 1994.

*Attested*

*[Signature]*  
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**COURSE OBJECTIVES:**

- To understand the basic fluid power
- To classify the different properties of hydraulic fluids and its effects
- To explain the working principle of various control elements
- To illustrate the working principle of hydraulic and pneumatic circuits for different applications
- To design electro pneumatic and PLC circuits for industrial application

**UNIT I BASICS OF FLUID POWER****9**

Introduction to fluid power controls – Hydraulics and pneumatics – Selection criteria, Application of Fluid power, Application of Pascal's Law, Transmission and multiplication of force – Pressure Losses – Fluids, selection and properties – Gas laws- properties of air with pressure and temperature - ISO symbols.

**UNIT II FLUID POWER SOURCES****9**

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

**UNIT III FLUID POWER ACTUATORS AND ELEMENTS****9**

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

**UNIT IV HYDRAULIC AND PNEUMATIC CIRCUITS DESIGN****9**

Regenerative, speed control, synchronizing circuits -Design of Hydraulic and pneumatic circuits for automation, selection and specification of circuit components, sequencing circuits, cascade, and Karnaugh – Veitch map method – Circuits for industrial application - grinding, milling, shaping, press and material handling- Case studies.

**UNIT V ELECTRO PNEUMATICS AND PLC CIRCUITS****9**

Fluidics -Moving part logic circuits - Use of electrical timers, switches, solenoid, relays, proximity sensors - electro pneumatics sequencing Ladder diagram – PLC – elements, functions and selection – PLC programming– Ladder and different programming methods - Sequencing circuits.

**TOTAL: 45 PERIODS**

PROGRESS THROUGH KNOWLEDGE

**COURSE OUTCOMES:**

The students will be able to

1. Recall and list the fundamental principles of fluid power systems related to hydraulic and pneumatic systems.
2. Describe the working principles of pumps, actuators and control elements in fluid power systems.
3. Explain the construction and operation of various control elements with their characteristics and applications.
4. Develop fluid power circuits for specific applications that meet industry requirements.
5. Create programmable logic controller (PLC) circuits for fluid power systems for various applications.

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

<b>4</b>	3	2	2	1	-	-	-	-	-	-	-	1	1	-	1
<b>5</b>	3	2	2	1	1	-	-	-	-	-	-	1	1	-	2
<b>Avg.</b>	2.2	1.4	1.4	1	1	-	-	-	-	-	-	1	1	-	1.2

#### TEXT BOOKS:

1. Anthony Esposito, "Fluid power with applications", Pearson education, 7<sup>th</sup> edition, 2014.
2. Srinivasan R, "Hydraulics and Pneumatic Controls", Vijay Nicole Imprints, 2<sup>nd</sup> edition, 2008.

#### REFERENCES:

1. Andrew Parr, "Hydraulics and Pneumatics", Jaico Publishing House, 3<sup>rd</sup> edition, 2011.
2. Jagadeesha T, "Pneumatics: Concepts, Design and Applications", University Press, 2015.
3. Majumdar, "Oil hydraulics: Principles and Maintenance", Tata McGraw Hill, 13<sup>th</sup> edition, 2006.
4. Majumdar, "Pneumatic system: Principles and Maintenance", Tata McGraw Hill, 7<sup>th</sup> edition 2008.
5. Peter Rohner, "Fluid Power Logic circuit Design", Macmillan Press Ltd., 2000.

**PR5503**

**MACHINE COMPONENTS DESIGN**

**L T P C**  
**3 1 0 4**

#### COURSE OBJECTIVES:

- To introduce the variety of mechanical components available and emphasize the need to continue learning.
- To initiate the exploration of bolt and joint design, as well as the process of selecting keys
- To educate students on the practical application of mechanical engineering design principles in recognizing and measuring machine components
- To instruct students in the utilization of design principles and/or the process of selecting machine components for efficient power transmission.
- To provide information regarding diverse cushioning elements.

#### UNIT I INTRODUCTION

**9+3**

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

#### UNIT II JOINTS

**9+3**

Design of Bolts under Static Load, Design of Bolt with tightening / Initial Stress, Design of Bolts subjected to Fatigue – Keys -Types, Selection of Square and Flat Keys-Design of Riveted Joints and Welded Joints.

#### UNIT III SHAFTS AND COUPLINGS

**9+3**

Design of Shaft –Static and Varying Loads, Strength and Rigidity- Design of Coupling-Types, Flange, Muff and Flexible Rubber Bushed Coupling

#### UNIT IV GEARS AND BELT DRIVES

**9+3**

Design of Spur, Helical, Bevel and Worm Gear drives- Design of Belt drives- Flat , V Belts and Timer Belts

#### UNIT V SPRINGS AND BEARINGS

**9+3**

Design of Helical Spring-Types, Materials, Static and Variable Loads- Design of Leaf Spring-Design of Journal Bearing -Antifriction Bearing-Types, Life of Bearing, Reliability Consideration, Selection of Ball and Roller Bearings.

**TOTAL:60 PERIODS**

## COURSE OUTCOMES:

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

1. Grasp the essentials of engineering design, theories of failure, and effectively solve fundamental mechanical challenges.
2. Translate their concepts into practical bolt and joint designs, while also introducing them to the process of key selection.
3. Acquire understanding in the design of a range of springs and bearings.
4. Cultivate a profound understanding of designing diverse varieties of gears and belt drives.
5. Know the design of different springs and bearings.

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

## TEXTBOOKS:

1. Prabhu. T.J., "Design of Machine Elements", Kasthuri Publications, Chennai, 2003.
2. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, 2015.

## REFERENCES:

1. Bhandari. V.B., "Design of Machine Elements", Tata McGraw-Hill Publishing Company Limited, 3<sup>rd</sup> edition, 2010.
2. Jalaludeen. S.Md., "Machine Design Vol - I & Vol - II", Anuradha publications, 2006.
3. Joseph Edward Shigley, Charles R. Mischke, "Mechanical Engineering Design", McGraw Hill, International Edition, 4<sup>th</sup> edition 2011.
4. "P.S.G.Design Data Hand Book", PSG College of Tech Coimbatore.
5. Robert L.Norton, "Machine Design – An Integrated Approach", Prentice Hall International Edition, 5<sup>th</sup> edition, 2013.

PR 5511

PROGRESS THROUGH KNOWLEDGE  
FLUID POWER SYSTEMS LABORATORY

L T P C  
0 0 4 2

## COURSE OBJECTIVES:

- To study the functional aspects of different pneumatic Components and its use in circuits design
- To study the functional aspects of different hydraulic components and its use in circuits
- To train the student in designing different pneumatics for different applications
- To train the student in designing different hydraulic circuits for different applications
- To train the student in designing of PLC circuits using hydraulic circuit applications

## LIST OF EXPERIMENTS

1. Study and use of pneumatic and hydraulic elements.
2. Basic hydraulic and Basic Electro hydraulic circuits.
3. Single and double acting cylinder circuits using different directional control valves.
4. Basic Electro-pneumatic circuits.
5. Logic pneumatic circuits.
6. Speed control circuits in a pneumatic trainer kit.
7. Pneumatic sequencing circuits.
8. Electro pneumatic sequencing circuits.

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9. PLC based electro hydraulic sequencing circuits.
10. PLC based electro pneumatic sequencing circuits.
11. Simulation of pneumatic, Electro pneumatic and electro hydraulic sequencing circuits using software.

**TOTAL: 60 PERIODS**

**COURSE OUTCOMES:**

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

1. Demonstrate the ability to identify and assemble various components of pneumatic systems for their practical applications.
2. Operate and interact with hydraulic system components to execute tasks in hydraulic systems.
3. Analyze practical requirements and translate them into pneumatic circuit designs for its applications
4. Design electro-pneumatic circuits that integrate sensors, actuators, and logic elements to achieve specific operational sequences.
5. Create logical and sequential programmable logic controller (PLC) circuits for specific practical applications.

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

PR5512

**ENGINEERING METROLOGY LABORATORY**

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

**COURSE OBJECTIVES:**

- Learn the main principle on which different instruments operate and provide hands on experience on them.
- Generate knowledge and skill in use of precision instruments.
- Learn a basic understanding of various instruments used in linear and angular
- Get familiarize with usage of tool makers microscope.
- To utilize the advanced instruments such as machine vision system and CMM

**LIST OF EXPERIMENTS**

1. Measurement of angle using Sine bar/bevel protractor.
2. Measurement of external taper angle.
3. Measurement of internal taper angle
4. Measurement of Bore Diameter.
5. Calibration of a Dial gauge.
6. Measurement of Roundness.
7. Inspection of screw thread parameters using three wire method.
8. Measurement of gear tooth thickness
9. Measurements using Tool makers microscope.
10. Measurements using profile projector.
11. Measurements using Autocollimator
12. Measurements using Vision Measuring System.
13. Measurements using CMM.
14. Contact and Non-contact surface roughness measurements.

**TOTAL: 60 PERIODS**

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

1. Develop quality standards of engineering products in industries.
2. Demonstrate the use of instruments for measuring linear (internal and external) and angular dimensions.
3. Analyze the measurement of the surface roughness and perform alignment tests.
4. Utilize the optical measurement devices for various applications
5. Demonstrate working of CMM and Machine vision for any given component.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	1	2	-	-	-	-	3	3	-	3	1	1	2
2	1	2	1	2	-	-	-	-	3	3	-	3	1	1	2
3	1	2	1	2	-	-	-	-	3	3	-	3	1	1	2
4	1	2	1	2	-	-	-	-	3	3	-	3	1	1	2
5	2	2	1	2	-	-	-	-	3	3	-	3	1	1	2
Avg.	1.2	1.8	1	2	-	-	-	-	3	3	-	3	1	1	2

**PR5601****METAL FORMING****L T P C  
3 0 0 3****COURSE OBJECTIVES:**

- Students will comprehend the mechanics underlying plastic deformation and the methods of representing associated parameters.
- Students will interpret and grasp the functioning of diverse bulk forming processes, including recent technological advancements.
- Students will memorize and recall various sheet metal forming processes.
- Students will examine and evaluate powder metallurgy techniques as well as specialized metal forming processes.
- Students will apply their understanding to recognize the importance of heat treatment according to specific applications.

**UNIT I FUNDAMENTALS OF METAL FORMING****9**

State of stress – Components of stress, symmetry of stress tensor, principle stresses – Stress deviator – Von-Mises, Tresca yield criteria – Octahedral shear stress and shear strain theory – Flow stress determination – Temperature in metal forming – Hot, cold and warm working – strain rate effects – metallurgical structures – residual stresses – Spring back.

**UNIT II FORGING AND ROLLING****9**

Principle – classification – equipment – tooling – processes parameters and calculation of forces during forging and rolling processes – Ring compression test – Post forming heat treatment – defects causes and remedies – applications – Roll forming.

**UNIT III EXTRUSION AND DRAWING PROCESSES****9**

Classification of extrusion processes – tool, equipment and principle of these processes – influence of friction – extrusion force calculation – defects, causes and remedies – Rod / Wire drawing – tool, equipment and principle – defects – Tube drawing and sinking processes – Mannesmann process of seamless pipe manufacturing – Tube bending.

**UNIT IV SHEET METAL FORMING PROCESSES****9**

Classification – conventional and High Energy Rate Forming processes – presses – types and selection of presses – formability studies – Formability Limit Diagram, Limiting Draw ratio – processes: Deep drawing, spinning, stretch forming, plate bending, Rubber pad forming, bulging

and press brake forming – Explosive forming, electro hydraulic forming, Magnetic pulse forming and Super plastic forming.

**UNIT V POWDER FORGING AND RECENT ADVANCES**

**9**

Metal Powder and fabrication procedures, Applications, Preparation of powders, Compaction and sintering, Yield criteria and flow rules, Hot and cold pressing – Electro forming – fine blanking – Hydro forming – Peen forming – Laser Forming – Micro forming – Isothermal forging – high speed for forging and extrusion near net shape forming – Ultra fine grained materials by severe plastic deformation CAD and CAM in forming.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

**At the end of the course, students will be able to**

1. Students will analyze and depict the state of stress within a metal forming process.
2. Students will evaluate and discriminate between different bulk forming processes, aligning their choices with specific applications.
3. Students will comprehend the traditional sheet metal forming procedures and discern the importance of diverse high-energy-rate forming techniques.
4. Students will critically analyze and deeply comprehend the intricacies of the powder metallurgy technique.
5. Students will apply their knowledge to choose an appropriate surface heat treatment technique in accordance with particular applications.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	-	-	1	1	1	2	-	1	1	-	1
2	3	2	1	1	-	-	1	1	1	2	-	1	1	-	1
3	3	2	1	1	-	-	1	1	1	2	-	1	1	-	1
4	3	2	1	1	-	-	1	1	1	2	-	1	1	-	1
5	3	2	1	1	-	-	1	1	1	2	-	1	1	-	1
<b>Avg.</b>	3.0	2.0	1.0	1.0	-	-	1.0	1.0	1.0	2.0	-	1.0	1.0	-	1.0

**TEXT BOOKS:**

1. Dieter G.E., “Mechanical Metallurgy”, McGraw Hill, Co., S.I. 5<sup>th</sup> Edition, 2012.
2. Nagpal G.R. ,”Metal forming processes”, Khanna Publishers, New Delhi, 2<sup>nd</sup> edition 2009.

**REFERENCES:**

1. Edward M. Mielink, “Metal working science engineering”, McGraw Hill, Inc, 2007
2. Metal Hand book Vol 14, “Forming and Forging”, Metal Park, Ohio, USA, 2006
3. Rao, P.N., “Manufacturing Technology”, TMH Ltd., 3<sup>rd</sup> edition, 2014.
4. SeropeKalpakjian, Steven R Schmid, “Manufacturing Process for Engineering Materials”, Pearson Education, 7<sup>th</sup> Edition, 2007.
5. Taylan Atlan and A. ErmanTekkaya ,” Sheet Metal Forming Fundamentals”, ASM International, 1<sup>st</sup> Edition, 2012.

**PR5602**

**CNC MACHINES**

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

**COURSE OBJECTIVES:**

- To provide knowledge on the fundamentals of CNC machines.
- To educate the different components and functions of CNC machines.
- To teach the control systems, advantages and disadvantages of CNC machining centers.
- To discuss and develop the CNC program.
- To explain the different cutting tool materials and work holding devices.

**UNIT I INTRODUCTION**

**9**

Evolution Of CNC Technology, Principles, Features, Advantages, Applications, CNC And DNC Concept, Classification Of CNC Machines – Turning Centre, Machining Centre, Grinding Machine,

EDM, Types Of Control Systems, CNC Controllers, Characteristics, Interpolators– Computer Aided Inspection- Economics Of CNC.

**UNIT II STRUCTURE OF CNC MACHINE 9**

CNC Machine Building, Structural Details, Configuration And Design, Guide Ways – Friction, Anti Friction And Other Types Of Guide Ways, Elements Used To Convert The Rotary Motion To A Linear Motion – Screw And Nut, Recirculating Ball Screw, Planetary Roller Screw, Recirculating Roller Screw, Rack And Pinion, Spindle Assembly, Torque Transmission Elements – Gears, Timing Belts, Flexible Couplings, Bearings- Maintenance Of CNC Machines.

**UNIT III CNC MACHINING 9**

Coordinates, Axes, and Motion - CNC Systems - CNC Controls - Operating a CNC Machine – CNC Milling – Types, Machines axes, Machining centers, CNC Turning – Types, Number of axes, Axes designation -Advantages and Disadvantages of CNC Technology - Applications .

**UNIT IV CNC PROGRAMMING 9**

Coordinate Systems and Reference Points -The Ten Steps of CNC Programming - Structure Of A Part Program, G Codes and M Codes, Tool Length Compensation, Cutter Radius And Tool Nose Radius Compensation, Do Loops, Subroutines, Canned Cycles, Mirror Image, Parametric Programming, Machining Cycles, Programming For Machining Centre And Turning Centre For Well Known Controllers, Generation of CNC Codes From CAM Packages.

**UNIT V TOOLING AND WORK HOLDING DEVICES 9**

Introduction To Cutting Tool Materials – Carbides, Ceramics, CBN, PCD–Inserts Classification- PMK, NSH, Qualified, Semi Qualified And Preset Tooling, Tooling System For Machining Centre And Turning Centre, Work Holding Devices For Rotating And Fixed Work Parts.

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES:**

**At the end of the course, students will be able to**

1. To describe the fundamentals of CNC machines.
2. To discuss the different components and functions of CNC machines.
3. To illustrate the control systems, advantages and disadvantages of CNC machining centers.
4. To recall and develop the CNC program.
5. To identify the appropriate cutting tool and work holding devices.

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

**TEXT BOOKS :**

1. HMT, “Mechatronics”, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005.
2. Warren S.Seamers, “Computer Numeric Control”, Fourth Edition, Thomson Delmar, 2002.

**REFERENCES :**

1. Rao P.N., “CAD/CAM” ,Third Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi,2010.
2. Michael Fitzpatrick “ Machining and CNC Technology” McGraw-Hill Higher Education (2013)
3. Graham T. Smith “ CNC Machining Technology, Volume II Cutting, Fluids and Work holding Technologies” Springer-Verlag London (1993)
4. Daniel Kandray ,” Programmable automation technologies - an introduction to CNC, Robotics and PLCs” Industrial Press (2010).

5. Radhakrishnan P, " Computer Numerical Control (CNC) Machines" , New Age International Publishers, 2018.

**PR5603**

**COMPUTER AIDED DESIGN AND ANALYSIS**

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

**COURSE OBJECTIVES:**

- To impart basic knowledge on geometric modeling, product design and finite element analysis
- To understand and apply the concepts in 2D, 3D modeling and finite element analysis
- To apply the knowledge of modeling and analysis through assembly modeling and analysis in product design
- To analyze the assembly and reduce the failures through DFM, DFA, FMEA, DOE and FEA
- To interpret and evaluate the model through FEA, bench marking and design for environment

**UNIT I COMPUTER GRAPHICS AND GEOMETRIC MODELING 9**

Introduction to Engineering Design Computer graphics – applications – principals of interactive computer graphics – 2D 3D transformations – projections – curves – Bezier, B-Spline and NURBS – Concepts- Geometric Modeling – types – Wire frame surface and solid modeling – Boundary Representation, constructive solid geometry – Graphics standards – assembly modeling – use of software packages.

**UNIT II PRODUCT DESIGN CONCEPTS 9**

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

**UNIT III ELEMENTS OF FINITE ELEMENT ANALYSIS 9**

General field problems in engineering-Discrete and continuous models-Characteristics-the relevance and place of finite element method- The method of weighted residuals-Rayleigh-Ritz and Galerkin methods - Solution of large system of equations- Gaussian elimination procedures - Discretization of Domain selection of interpolation polynomials-Convergence requirements - Formulation of element characteristics matrices and load vectors – Assembly of element characteristics matrices-Solution of finite element equations-Post processing of results.

**UNIT IV FINITE ELEMENT ANALYSIS OF ONE DIMENSIONAL AND TWO DIMENSIONAL PROBLEMS 9**

One dimensional finite element analysis - Beam element - Frame elements - One dimensional heat transfer - Two dimensional finite element analysis approximation of geometry and field variables - triangular and rectangular element- - Natural coordinates and coordinate transformation – Numerical integration - Incorporation of boundary conditions. Dynamic analysis - Equations of motion using Lagrange's approach-Consistent and Lumped mass matrices-Formulation of FE equations for vibration problems- Solution of Eigen value problems - Transient vibration analysis-Thermal transients- Isoparametric elements.

**UNIT V APPLICATION OF FINITE ELEMENT ANALYSIS 9**

Finite element analysis of Machine elements - Axisymmetric FEA of a pressure vessel-Application of FEM in various metal forming processes – Solid formulation and flow formulation – FEA simulation of Metal cutting, Solidification of castings and Weldments.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

**At the end of the course, students will be able to**

1. Able to gain basic knowledge on geometric modeling, product design and finite element analysis

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2. Able to understand and apply the concepts in 2D, 3D modeling and finite element analysis
3. Able to apply the knowledge of modeling and analysis through assembly modeling and analysis in product design
4. Able to analyses the assembly and reduce the failures through DFM, DFA, FMEA, DOE and FEA
5. Able to interpret and evaluate the model through FEA, bench marking and design for environment

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	-	1	1	1	-	-	-	-	1	-	1	1	-	2
2	2	-	1	1	1	-	-	-	-	1	-	1	1	-	2
3	2	2	1	1	1	-	-	-	-	1	-	1	1	-	2
4	2	2	1	1	1	-	-	-	-	1	-	1	1	-	2
5	2	1		1	1	-	-	-	-	1	-	1	1	-	2
Avg.	1.8	1.6	1	1	1	-	-	-	-	1	-	1	1	-	2

#### TEXT BOOKS:

1. Ibrahim Zeid, "CAD/CAM theory and Practice", Tata McGraw Hill, 2nd edition, 2008
2. Reddy. J.N., "An Introduction to Finite Element Method", McGraw Hill, Third Edition, 2005.

#### REFERENCES:

1. Chandraputla T.R., and Belegundu A.D., "Introduction of Finite Element in Engineering", Prentice Hall of India, Fourth Edition, 2012.
2. David F.Rogers.J, Alan Adams, "Mathematical Elements for Computer Graphics", McGraw Hill, 2nd edition, 2009.
3. Kevin Otto, Kristin Wood, "Product Design", Pearson Education, 7th Reprint , 2011.
4. Seshu.P., "Text Book of Finite Element Analysis", Prentice Hall of India, tenth print, 2010.
5. Segarland. L.J., "Applied Finite Element Analysis", John Wiley and Sons, second edition, 1984.

PR5611

CNC AND METAL FORMING LABORATORY

L T P C  
0 0 4 2

#### COURSE OBJECTIVES:

- To explain the different CNC turning operations.
- To discuss the different CNC milling operations.
- To impart knowledge in making profile complex cutting.
- To educate the basic concepts on metal forming
- To teach the material behavior by various metal forming operations.

#### LIST OF EXPERIMENTS

##### CNC LAB

1. Programming and machining of step turning and taper turning operation in CNC Lathe.
2. Programming and machining of thread cutting and grooving operation in CNC Lathe.
3. Programming and simulation for canned cycle in CNC lathe.
  - (i) Stock removing in facing cycle.
  - (ii) Stock removing in turning cycle.
  - (iii) Grooving cycle.
  - (iv) Thread cutting cycle.
4. Programming for milling operations in a CNC milling simulation.
5. Programming for mirroring / scaling function / Pocket milling and drilling cycle in a CNC milling.

6. Programming for spur gear cutting operation and Programming for hexagonal cutting operation.
7. Programming and Simulation of profile cutting in CNC Router.
8. Programming for cross drilling in a four axis CNC machining center.
9. 3D Profile cutting in CNC machining center.

#### METAL FORMING LABORATORY

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

**TOTAL: 60 PERIODS**

#### COURSE OUTCOMES:

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

1. Program and perform various turning operation
2. Program and perform various milling operation
3. Write program to perform the machining of complex profiles.
4. Demonstrate the fundamental concepts of metal forming
5. Analyze the formability of given materials.

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

**PR5612**

**MODELING AND ANALYSIS LABORATORY**

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

#### COURSE OBJECTIVES:

- The course aims to ensure students can recall fundamental concepts of Modelling and Analysis techniques.
- Students will comprehend the fundamental concepts underlying Modelling and Analysis software usage.
- Through practical exercises, students will apply various approaches required for assembly modelling.
- Students will analyse different types of analysis and apply core principles to determine stress and other relevant parameters of bars and beams subjected to varying loading conditions.
- Students will apply their knowledge to conduct dynamic analysis in order to determine the natural frequency of different types of beams.

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**LIST OF EXPERIMENTS**  
**MODELLING EXPERIMENTS**

1. 3-D Assembly of Bolt and Nut
2. 3-D Assembly if Protected Type Flange Coupling
3. 3-D Assembly of Universal Coupling
4. 3-D Assembly of Plummer Block
5. 3-D Assembly if Swivel Bearing

**ANALYSIS EXPERIMENTS**

1. One Dimensional FEA Problem.
  - a. Truss structure analysis.
  - b. Cantilever beam analysis.
  - c. Temperature distribution problem.
2. Two Dimensional FEA Problems.
  - a. Plane stress analysis.
  - b. Axisymmetric analysis.
  - c. Vibration Analysis.
3. Three Dimensional FEA Problems.
  - a. 3D Shell Analysis.
  - b. 3D Contact Analysis.
4. FEA Application in metal forming, Metal cutting, Casting process etc.

**TOTAL: 60 PERIODS**

**COURSE OUTCOMES:**

**At the end of the course, students will be able to**

1. Students will apply their skills to conduct finite element modeling within the context of manufacturing applications and analysis software.
2. Students will operate and utilize a variety of available analysis packages.
3. By the end of the course, students will be capable of analyzing and conducting finite element modeling for solid mechanics, heat transfer, vibration, shell, and contact problems in both 2D and 3D simulations.
4. Students will evaluate and perform dynamic analysis, determining natural frequencies across different boundary conditions while also considering external forcing functions.
5. Equipped with modern tools, students will generate problem formulations, develop geometries, discretize models, and apply boundary conditions to solve problems related to bars, trusses, beams, and plates. This process will enable them to determine stress under various loading conditions.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	1	2	2	-	1	1	1	2	1	2	2	1	2
2	2	2	1	2	2	-	1	1	1	2	1	2	2	1	2
3	2	2	1	2	2	-	1	1	1	2	1	2	2	1	2
4	2	2	1	2	2	-	1	1	1	2	1	2	2	1	2
5	2	2	1	2	2	-	1	1	1	2	1	2	2	1	2
<b>Avg.</b>	2	2	1	2	2	-	1	1	1	2	1	2	2	1	2

**PR5701**

**MECHATRONICS FOR AUTOMATION**

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

**COURSE OBJECTIVES:**

- To acquire overview of multi-domain engineering integration and make the students get acquainted with the sensors and transducers and its interfacing.
- To understand and apply the various types of actuators and its drives for interfacing

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- To apply modeling of basic mechanical system elements and cognize the need of control systems.
- To impart knowledge about the fundamentals of microcontroller to realize the interfacing and control.
- To render exposure in the design and development of mechatronics systems.

**UNIT I MECHATRONICS SYSTEMS AND SENSORS 9**

Introduction to Mechatronics Systems, Key Elements, Ways of Integration – Hardware and Software. Sensors – Characteristics – Static and Dynamic, Types - Linear, Rotational, Velocity Acceleration, Force, Torque, Flow, Temperature, Proximity, Optical, Micro and Nano Sensors, Selection of Sensors. Analog and Digital Signals - Signal Condition Module – Amplifiers - Inverting Amplifier, Non-Inverting Amplifier, Instrumentation Amplifier, Filters, A/D and D/A Converter.

**UNIT II ACTUATORS 9**

Electrical Actuators and Its Characteristics – DC Motors, AC Motors - Servo Motor and Stepper Motor. AC Drives - H-Bridge Circuits and Stepper Motor Driving Circuits - Switching Devices – Mechanical, Solenoids, Relays - Overview of Fluid Power Actuators and Control - Types and Characteristics of Micro and Nano Actuators.

**UNIT III SYSTEM MODELING AND CONTROL 9**

Transfer Function - Mechanical System Modeling – Characterization of System Time Response – Stable and Unstable System - Open Loop and Closed Loop Control Systems. Controllers - P, PD, PI, PID Controllers - Comparison of Control Realization in Hardware – Microprocessor – Microcontroller – PLC.

**UNIT IV MICROCONTROLLERS 9**

8051 Microcontrollers – Architecture, Address Modes, Instruction Sets, Programming Exercises - Memories – Different Types – Different I/O Devices, Stepper and Servo Motor Interface. Overview of Advanced Microcontrollers - Typical Applications.

**UNIT V MECHATRONICS SYSTEM DESIGN AND APPLICATIONS 9**

Stages in Designing Mechatronics Systems – Traditional and Mechatronic Design – Mechatronics System Elements and Architecture of CNC Machine, Serial Manipulator, Engine Management System, Car Production and its Assembly Line Automation.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

1. Recognize the working principles of sensors, controller and actuator and mathematical models to develop mechatronics systems.
2. Apprise the features of sensor, controller and actuators.
3. Select appropriate sensors, actuators and controllers to develop mechatronics systems.
4. Develop the mathematical model of the system to study on its control.
5. Apply and analyze the selected sensor, controller and actuator for the integrated application requirement.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	-	-	-	-	-	-	-	-	1	-	-	1	-	1
2	1	-	-	-	-	-	-	-	-	1	-	-	1	-	1
3	-	1	-	1	-	-	-	-	-	-	-	1	1	-	1
4	2	1	1	-	-	-	-	-	-	-	-	-	1	-	1
5	1	1	1	1	1	-	-	-	-	1	-	-	1	-	1
Avg.	1.2	1	1	1	1	-	-	-	-	1	-	1	1	-	1

**TEXT BOOKS:**

1. Bolton .W.,“Mechatronics” ,Pearson Education Limited, 5<sup>th</sup> Edition, 2011.
2. Devadas Shetty, Richard A. Kolk, “Mechatronics System Design”, CENGAGE Learning

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## REFERENCES:

1. Mazidi. M.A and Mazidi .M.J., MCKinlay.R.D, "The 8051 Microcontroller and Embedded Systems Using Assembly and C", Pearson India, 2<sup>nd</sup> Edition, 2008.
2. Patranabis D., "Sensor and Actuators", Prentice Hall of India Pvt Ltd., 2<sup>nd</sup> edition 2005.
3. Vijayaraghavan G.K., Balasundaram M.S , Ramachandran K.P. , Mechatronics: Integrated Mechanical Electronic Systems, Wiley, 2008.
4. John P. Bentley., "Principle of Measurement systems", Pearson Prentice Hall, Fourth edition, 2005.
5. K. Ogata, "Modern Controls Engineering", Prentice Hall of India Pvt. Ltd., New Delhi, 2005.

## MECHATRONICS FOR AUTOMATION LABORATORY

### LIST OF EXPERIMENTS:

1. Experimentation on Characterization and Application of Optical Sensors.
2. Experimentation on Characterization of Temperature Transducers.
3. Experiments on LVDT and Ultrasonic Transducer for Displacement Measurements.
4. Experiments on Resistive Transducers for Force and Torque Measurements
5. 8 bit and 16 bit Arithmetic Operation in 8051 Microcontroller.
6. I/O Port Programming of 8051 Microcontroller for Sensor and Motor Interfacing.
7. Modeling and Simulation of Mechanisms using Simulation Software.
8. Kinematic Analysis and Verification of 2 DOF RR Configuration Robot.
9. Position, Speed and Direction Measurement and Control of Servomotor.
10. Robot Control with Stepper Motor Interfacing.

**TOTAL: 30 PERIODS**

**PR5702**

**COMPUTER INTEGRATED MANUFACTURING SYSTEMS**

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

### COURSE OBJECTIVES:

- To understand fundamentals and application of computer Technology in the manufacturing activities
- To familiarize the types, working principle of various materials handling and automated data collection systems.
- To impart knowledge on group technology and its components.
- To gain knowledge to analyze existing system and implement cellular manufacturing and FMS.
- To acquire overview about different automation systems used in manufacturing activities.

### **UNIT I INTRODUCTION TO AUTOMATED PRODUCTION SYSTEMS 9**

Product design – General Design Process – Elements of CAD, CAM and CIM – Functions of CIM – Benefits of CIM - Three step process for implementation of CIM – Types of Automation - Automation strategies – USA Principle – Ten strategies for automation – Automation Migration Strategy - Automated Production Lines – System Configurations – Work part Transfer Mechanisms – Storage Buffers- Industry 4.0-Digital Manufacturing.

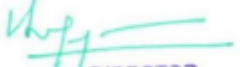
### **UNIT II MATERIAL HANDLING AND STORAGE SYSTEM 9**

Factors influencing material handling system – Ten principles of Material handling —Types of Material Transport Equipments; Industrial Trucks – conveyors - cranes and Hoists – Automated guided vehicle system – Mono-rails and other rail-guided vehicles – Types - Automated Storage and Retrieval systems – carousel storage systems.

### **UNIT III CELLULAR MANUFACTURING**

Group Technology - Part families – Parts classification and coding – Production flow analysis – Types of Process Planning - Cellular Manufacturing – Composite part concept – Machine cell

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design – Key machine concept - quantitative analysis in cellular manufacturing using Holier Method.

**UNIT IV FLEXIBLE MANUFACTURING SYSTEM 9**

Flexible Manufacturing System - Types – FMS components – Workstations, Material Handling and storage system – types of FMS Layouts - computer control system- Human resource – Dead lock in FMS – FMS application and benefits – FMS planning and implementation issues.

**UNIT V AUTOMATED ASSEMBLY AND AUTOMATED DATA COLLECTION 9**

Automated assembly – Fundamentals – system configurations - Parts delivery at work stations - Applications - Shop floor control – Three phases – Factory data collection system – manual data input techniques – Automated and semi-automated data collection (ADC) systems – Bar code technologies and other ADC Technologies.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

1. Describe the principle and concept of CIM, Group technology and various automated manufacturing techniques.
2. Describe the working principle and types of material handling and automated data collection system.
3. Compare the advantage and disadvantage of computer integrated manufacturing system over manual system.
4. Identify and select suitable material handling and automated data collection system for given task.
5. Analyze conventional system and implement cellular manufacturing, FMS.

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

**TEXT BOOKS:**

1. Kant Vajpayee.S, “Principles of Computer-Integrated Manufacturing”, Prentice Hall of India Private Limited, 1<sup>st</sup> edition, 2006.
2. MikellP.Groover, “Automation, Production Systems and Computer-integrated Manufacturing”, Prentice Hall of India Private Limited, 4<sup>th</sup> edition 2014.

**REFERENCES:**

1. Radhakrishnan.P, Subramanyan.S and Raju.V, “CAD/CAM/CIM”, New Age International Publishers, 2<sup>nd</sup> edition 2008.
2. James A.Reitg and Henry W. Kraebher, “Computer Integrated Manufacturing”, Pearson Education, Asia, 2001.
3. Viswanathan.N and Narahari.Y, “Performance modelling of automated manufacturing system”, Prentice Hall of India Private Limited, 1st edition, 2008.
4. Alavudeen.A and Venkateshwaran.N, “Computer Integrated Manufacturing”, PHI Learning Private Limited, 2010.
5. A.W.Scheer, “Computer Integrated Manufacturing”, Springer-Verlag, 2<sup>nd</sup> edition, 1991.

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**COURSE OBJECTIVES**

- To provide industrial exposure, work pattern and hands-on experience
- To gain practical experience and apply academic knowledge in a real word setting
- To expand professional network and refine transferable skills for future career opportunities

**CERTIFICATE COURSES MUST BE STATED**

1. Industry profile.
2. Organization structure.
3. Plant layout.
4. Process/ Machines/ Equipment/ Devices details.
5. Labor welfare schemes.
6. Training schedule.
7. Project work carried out.
8. Learning points.

The assessment will be based equally on the report in the prescribed format and Viva Voce examination by a committee nominated by the Head of the Department.

**COURSE OUTCOMES:**

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

1. Learn the application of engineering basics to solve complex industrial problems
2. Foresee group dynamics and engage in life-long learning
3. Gain knowledge on computational and design tools for sustainable product development

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	3	3	1	1	1	1	1		3	3	3
2	3	3	3	3	3	3	1	2	1	1	1	3	3	3	3
3	3	3	3	3	3	3	1	3	1	1	1	3	3	3	3
<b>Avg.</b>	3	3	3	3	3	3	1	2	1	1	1	3	3	3	3

**COURSE OBJECTIVES:**

- Stimulate creativity in themselves and learn the impact of innovation creation.
- Understand several innovation concepts/ methodologies.
- Apply creative and design thinking to real-world business situations.

**EVALUATION:**

- A project topic may be selected based on the literature survey and the creative ideas of the students themselves in consultation with their project supervisor.

**COURSE OUTCOMES:**

The students would be able to:

1. To understand and analyze the problem which needs engineering solution
2. To design and simulate the creative solution for the required applications.
3. To fabricate, analyze and evaluate the developed solution for the suitability of desired applications

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

PR5811

PROJECT II

L T P C  
0 0 16 8

### COURSE OBJECTIVES:

- Develop problem-solving skills: The objective of the project work is to provide students with an opportunity to apply the principles and concepts learned in the course to real-world problems. By working on a project, students will develop their problem-solving skills and learn how to analyze and address complex engineering challenges.
- Enhance interdisciplinary knowledge: The project work allows students to explore interdisciplinary topics and gain a deeper understanding of the interconnected nature of engineering fields. By selecting a project in consultation with faculty members, students can work on projects that involve multiple disciplines, fostering a broader perspective and knowledge base.
- Foster collaboration and project management skills: The project work involves working in teams and collaborating with faculty members as guides. This objective aims to enhance students' collaboration and project management skills, including effective communication, teamwork, time management, and task allocation.

### EVALUATION:

A project area must be selected by the students in consultation with the faculty members who act as a guide. The objective of the project work is to deepen comprehension of principles by applying them to a problem which may be; design and fabrication of a device / a research project with a focus on the application needed by the industry; a software oriented project involving design and analysis; a management project to apply the latest technique for an industrial problem; material characterization (or) any inter-disciplinary topic of due weightage / continued work of internship in a company etc.,

The progress of this project is evaluated based on a minimum of three reviews. The review

committee will be constituted by the Head of the Department. A project report is to be submitted at the end of the project. The final end semester exam will be evaluated jointly by external and internal examiners based on oral presentation and the demonstration of the project work.

### COURSE OUTCOMES:

The students would be able to:

1. Application of engineering principles: Through the project work, students will demonstrate the application of engineering principles to solve real-world problems. They will be able to identify appropriate engineering methodologies, tools, and techniques and apply them effectively to achieve project goals
2. Proficiency in project execution: Students will gain proficiency in executing a project from inception to completion. They will demonstrate their ability to plan, organize, and manage project tasks, allocate resources, and meet project milestones and deadlines
3. Effective communication and presentation skills: The project work will enhance students' communication and presentation skills. They will learn to articulate their ideas, methodologies, and project outcomes through written reports, oral presentations, and project demonstrations. Students will also develop the ability to effectively communicate technical concepts to both technical and non-technical audiences



CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
<b>1</b>	3	2	2	2	2	2	2	2	3	3	3	3	2	1	2
<b>2</b>	3	2	2	2	2	2	2	2	3	3	3	3	2	1	2
<b>3</b>	3	2	2	2	2	2	2	2	3	3	3	3	2	1	2
<b>Avg.</b>	3	2	2	2	2	2	2	2	3	3	3	3	2	1	2

PR5001

**MICROMACHINING AND FABRICATION**

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

**COURSE OBJECTIVES:**

- To introduce to various methods of micro/nano material removal as well as material build up with use unconventional processes
- To understand the mechanism of micro/nano material removal with use of abrasive flow, electro-discharge, electrochemical, laser, ultrasonic and high energy beams as well as micro/nano structure build up with use of vapour deposition, etching and electrodeposition.
- To identify process parameters of micromachining/microfabrication and their effect on the rate, finish and accuracy of material removal/build up.
- To understand the concepts of hybrid machining for high material removal and surface finish.
- To compare and analyze the various methods of micromachining/microfabrication for selection of process applicable for specific application.

**UNIT I INTRODUCTION**

**9**

Introduction to micromachining process – Classification of micromachining and nanomachining processes – Molecular dynamics (MD), principle of molecular dynamics simulation potential energy function – Boundary condition – MD simulation procedure.

**UNIT II MICROFABRICATION METHODS**

**9**

Methods of microfabrication — Electro deposition, Chemical vapour deposition, physical vapour deposition – Electro Chemical spark deposition – LIGA (Lithographie, Galvanoformung, Abformung) process- Stereolithography- MicroMoulding

**UNIT III MECHANICAL MICROMACHINING**

**9**

Ultrasonic machining – Abrasive jet machining – Abrasive water jet machining, water jet machining – Beam energy micromachining – Electron beam machining, Electro discharge machining, Ion beam machining, Focused ion beam machining.

**UNIT IV MICROMACHINING AND NANO FUNCTIONING WITH ABRASIVE FLOW**

**9**

Process principle and description – Process Technology Selection of machine Effect of process parameter on performance – Mechanism of materials removal Magneto Rheological Nano functioning Process. Nano functioning – Smart Rheological fluids – Magneto Rheological polishing fluid – Rheological characteristics of MR fluid – MR Abrasive Flow Finishing Process – MR Jet Finishing technology .

**UNIT V HYBRID MICRO MACHINING**

**9**

Surface Integrity of Machined surface-Chemical Mechanical polishing – Electro chemical spark micro machining – Electro discharge grinding – Electrolytic in process dressing – Laser and Ultrasonic aided Machining – High/Low temperature aided Machining -Application.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

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1. Ability to list and match a process of micro/nano material removal as well as material build up to broad kind of micromachining/microfabrication techniques
2. To illustrate the mechanism of micro/nano material removal as well as micro/nano structure build up
3. To analyze the effect of process parameters on the performance of micromachining/microfabrication
4. To interpret the concepts of hybrid machining for high material removal and surface finish.
5. To evaluate the various methods of micromachining/microfabrication for selection of process applicable for specific application.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	-	-	-	-	-	1	-	2	1	-	1
2	1	-	-	-	-	-	-	-	-	1	-	2	1	-	1
3	1	-	-	1	-	-	-	-	-	1	-	2	1	1	1
4	2	1	-	1	-	-	-	-	-	1	-	2	1	1	1
5	1	-	-	-	-	-	-	-	-	1	-	2	1	1	1
Avg.	1.4	1	-	1	-	-	-	-	-	1	-	2	1	1	1

#### TEXT BOOKS:

1. Jain.V.K., "Introduction to Micromachining", Narrosa Publishing house, 2<sup>nd</sup> edition Reprint 2018.
2. Marc Madou, "Fundamentals of Microfabrication", 3<sup>rd</sup> Edition, CRC Press, 2011

#### REFERENCES:

1. Jain V.K., "Advanced machining process", Allied Publisher, Delhi, 2002.
2. Mohammed Gad-el-Hat, "The MEMS Hand book", CRC Press, 2<sup>nd</sup> edition, 2006.
3. Sami Franssito, "Introduction to Micro fabrication", John Wiley and sons, 2<sup>nd</sup> edition 2010.
4. MojtabaKahrizi, "Micromachining Techniques for Fabrication of Micro and Nano Structures", InTech, Chapters published, 2012.
5. Ja Mc Geogh, "Micro Machining of Engineering Materials", CRC Press, 2001.

PR5002

MODERN CONCEPTS IN MANUFACTURING  
PROGRESS THROUGH KNOWLEDGE

L T P C  
3 0 0 3

#### COURSE OBJECTIVES:

- To remember the different categories of manufacturing Techniques
- To apply the advanced manufacturing techniques to increase the productivity in industries
- To introduce students the basics of additive manufacturing/rapid prototyping and its applications in various fields, reverse engineering techniques
- To incorporate knowledge about the environmental based improvements towards lean manufacturing systems
- To understand the smart manufacturing concepts

#### UNIT I LEAN MANUFACTURING

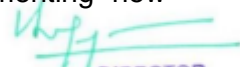
9

Objectives of lean manufacturing-key principles and implications of lean manufacturing -traditional Vs lean manufacturing- flow-continuous improvement/Kaizen –worker involvement- 5S principles-elements of JIT - uniform production rate - Kanban system - Lean implementation, Reconciling lean with other systems - lean six sigma- lean and ERP - lean with ISO 9001:2000.

#### UNIT II AGILE MANUFACTURING

The Agile Production Paradigm – Agile Manufacturing Vs Mass Manufacturing - Agile Practices - Agile practice for product development - Manufacturing agile practices - Implementing new

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technology - A checklist, technology applications that enhance agility - agile technology make or buy decisions. - Costing for Agile Manufacturing practices - Creating the learning factory: Imperative for success, factory becoming a learning factory, building a road map for becoming a learning factory

**UNIT III GREEN MANUFACTURING 9**

Introduction to Green Manufacturing- impact of manufacturing in environmental ecology - green manufacturing strategies - Principles of green manufacturing and its efficiency – System model architecture and module- design and planning- control or tools for green manufacturing.(Qualitative Analysis, Consumption Analysis, Life Cycle Analysis, Efficiency, Sustainability tools). - Enabling techniques for assuring green manufacturing - Carbon footprint analysis and management of manufacturing processes

**UNIT IV ADDITIVE MANUFACTURING 9**

Overview- Additive Manufacturing Technology in product Development - CAD and Reverse Engineering - Data Processing for Additive Manufacturing Technology: CAD model preparation – Stereo lithography – Stereo lithography Apparatus (SLA)- Principle, process, advantages and applications - Powder Based Additive Manufacturing Systems - Selective Laser Sintering – Principles of SLS process - Process, advantages and applications.

**UNIT V INTELLIGENT MANUFACTURING 9**

Goals of AI in manufacturing- Methods for production equipment selection and layout, Heuristic scheduling of multiple resources, Fuzzy multiple attribute decision making methods- Application of neural networks and fuzzy sets to machining and metal forming.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

1. Remember the various manufacturing techniques
2. Discuss the concepts of JIT, Lean Manufacturing, and Agile Manufacturing methodologies
3. Analyzing the environmental impact of manufacturing, green strategies, efficiency principles, and enabling techniques for sustainable production, including carbon footprint management.
4. Apply knowledge on process of transforming a concept into the final product in AM technology.
5. Apply artificial intelligence (AI) and data mining (DM) techniques to improve the efficiency of manufacturing systems

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

**TEXT BOOKS:**

1. Badiru A.B., “Expert Systems Applications in Engineering and Manufacturing”, Prentice-Hall, New Jersey, 1st edition, 1992.
2. Kusiak, Andrew, “Intelligent Manufacturing Systems”, Prentice Hall, 1st edition, 1990.

**REFERENCES:**

1. Black .J.T. and Kohser R.A, “DeGarmo’s Materials and Processes in Manufacturing”, Published by Wiley, 11th edition, 2011.
2. Chowdiah.M.P., “Agile Manufacturing”, IK International Publishing House Pvt Ltd,
3. Christian N. Madu, “Handbook of environmentally conscious manufacturing”, Springer US Publishers, 1st edition, 2001.
5. John Schey, “Introduction to Manufacturing Processes”, Tata McGraw-Hill Education ,3<sup>rd</sup>

edition,1999 .

- Rao R. V, "Advanced Modeling and Optimization of Manufacturing Processes", 2nd edition, 2006.
- Ronald G. Askin and Jeffrey B. Goldberg, "Design and Analysis of Lean Production Systems", John Wiley and Sons, 2003.

**MF5652**

**ADDITIVE MANUFACTURING**

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

**COURSE OBJECTIVES:**

- To introduce the development of Additive Manufacturing (AM), various business opportunities and applications
- To familiarize various software tools, processes and techniques to create physical objects that satisfy product development / prototyping requirements, using AM.
- To be acquainted with vat polymerization and material extrusion processes.
- To be familiar with powder bed fusion and direct energy deposition.
- To gain knowledge on applications of binder jetting, material jetting and laminated object manufacturing processes

**UNIT I INTRODUCTION**

**9**

Overview – Need - Development of Additive Manufacturing (AM) Technology: Rapid Prototyping- Rapid Tooling – Rapid Manufacturing – Additive Manufacturing. AM Process Chain- Classification – Benefits. Applications: Building Printing-Bio Printing- Food Printing-Printing Electronics. Business Opportunities and Future Directions - Intellectual Property.

**UNIT II DESIGN FOR ADDITIVE MANUFACTURING (DFAM)**

**9**

Concepts and Objectives- AM Unique Capabilities: Part Consolidation-Topology Optimization-Light weight Structure - DFAM for Part Quality Improvement. Data Processing - CAD Model Preparation -Part Orientation and Support Structure Generation -Model Slicing - Tool Path Generation-Customized Design and Fabrication for Medical Applications- Case Studies.

**UNIT III VAT POLYMERIZATION AND MATERIAL EXTRUSION**

**9**

Photo polymerization: Stereolithography Apparatus (SLA)- Materials -Process -Advantages-Limitations- Applications. Digital Light Processing (DLP) - Materials – Process - Advantages - Applications. Extrusion Based System: Fused Deposition Modeling (FDM)- Process-Materials - Applications and Limitations.

**UNIT IV POWDER BED FUSION AND DIRECT ENERGY DEPOSITION**

**9**

Powder Bed Fusion: Selective Laser Sintering (SLS): Process – Powder Fusion Mechanism – Process Parameters – Typical Materials and Application. Selective Laser Melting (SLM) and Electron Beam Melting (EBM): Materials – Process - Advantages and Applications. Beam Deposition Process: Laser Engineered Net Shaping (LENS)- Process -Material Delivery - Process Parameters -Materials -Benefits -Applications.

**UNIT V OTHER ADDITIVE MANUFACTURING PROCESSES**

**9**

Binder Jetting: Three Dimensional Printing - Materials -Process - Benefits and Limitations. Material Jetting: Multijet Modeling- Materials - Process - Benefits. Sheet Lamination Process: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding – Thermal Bonding- Materials-Application and Limitation.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

At the end of this course students shall be able to:

- Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities
- Acquire knowledge on process of transforming a concept into the final product in AM technology.
- Elaborate the vat polymerization and material extrusion processes and its applications.

4. Acquire knowledge on process and applications of powder bed fusion and direct energy deposition
5. Evaluate the advantages, limitations, applications of binder jetting, material jetting and laminated object manufacturing Processes.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	-	-	-	-	-	1	3	-	2	-	3	1	1	1
2	3	2	1	1	2		3	2	-	2	-	3	1	3	2
3	3	1	-	-	-	-	2	-	-	2	-	3	2	2	1
4	3	1	-	-	-	-	2	-	-	2	-	3	2	2	1
5	3	1	-	-	-	-	2	-	-	2	-	3	2	2	1
<b>Avg.</b>	3	1.2	1	1	2	-	2	-	-	2	-	3	1.6	2	1.2

#### TEXT BOOKS:

1. Andreas Gebhardt and Jan-Steffen Hötter “Additive Manufacturing: 3D Printing for Prototyping and Manufacturing”, Hanser publications, United States, 2015, ISBN: 978-1-56990-582-1.
2. Ian Gibson, David W. Rosen and Brent Stucker “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, 2<sup>nd</sup> edition, Springer., United States, 2015, ISBN-13: 978-1493921126.

#### REFERENCES:

1. Amit Bandyopadhyay and Susmita Bose, “Additive Manufacturing”, 1<sup>st</sup> Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590.
2. Andreas Gebhardt, “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing”, Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN :9783446425521.
3. Kamrani A.K. and Nasr E.A., “Rapid Prototyping: Theory and practice”, Springer., United States ,2006, ISBN: 978-1-4614-9842-1.
4. Liou, L.W. and Liou, F.W., “Rapid Prototyping and Engineering applications: A tool box for prototype development”, CRC Press., United States, 2011, ISBN: 9780849334092.
5. Milan Brandt, “Laser Additive Manufacturing: Materials, Design, Technologies, and Applications”, Woodhead Publishing., United Kingdom, 2016, ISBN: 9780081004333.



PR5003

**TOOL DESIGN**

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

#### COURSE OBJECTIVES:

- To introduce the fundamental concepts in tool design, materials, jigs and fixtures.
- To explain the design of jigs and fixtures.
- To educate the different dies and its components.
- To teach the design of dies.
- To discuss the case studies pertain to the dies, jigs and fixtures.

#### UNIT I TOOL DESIGN

9

Tool design process – Material used for tooling – Cutting tool design – Work holding concepts – Computer applications in tool design – geometric dimensions and tolerancing- Principles of Jigs and Fixture – Design concepts – Different types of locating devices – different types of clamps – Drill bushes – types – Elements of fixtures – Analysis of clamping forces, tolerances and error analysis – safety factors while designing of jigs and fixtures.

#### UNIT II DESIGN OF JIGS AND FIXTURES

9

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Design concepts of Template Jig, Plate Jig, Sandwich Jig, Vice Jaw Jig, Latch Jig, Turnover Jig, Box Jig – Design of Jigs, Fixtures for Milling, Grinding, Turning, Welding, and Assembly – Modular fixtures.

**UNIT III CONCEPTS OF DIES AND ITS ELEMENTS 9**

Design concepts of the following elements of progressive, compound and Combination dies – Die block – Die shoe – Bolster plate – punch – punch plate – punch holder – guide pins and guide bushes – strippers – knockouts – stops - pilots – selection of standard die sets – strip layout and development.

**UNIT IV DESIGN OF DIES 9**

Die design – fourteen steps to design a die - Design of Blanking, Piercing, lancing, notching and bending dies, Design features of dies for drawing, extrusion, wire drawing and forging, Design of Progressive die – compound die –combination die- Bending and drawing dies

**UNIT V CASE STUDIES IN JIGS, FIXTURES AND DIES 9**

Design of jigs, fixtures and dies for industrial components.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

1. Categorize and justify the requirements of tools, Jigs and Fixtures for Manufacturing, Testing and Assembly
2. Analyze problems related to Jigs and fixtures in Manufacturing, Testing and Assembly.
3. To explain the different dies and its components.
4. Apply the design procedure to develop the dies.
5. Provide solution for the real time issues in the design and Manufacturing of dies, jigs and fixtures.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	-	-	-	-	-	-	-	-	-	-	-	1	1	1
2	2	1	1	-	-	-	-	-	-	-	-	-	1	1	1
3	1	-	-	-	-	-	-	-	-	-	-	-	1	1	1
4	2	1	1	-	-	-	-	-	-	-	-	-	1	1	1
5	1	1	1	-	-	-	-	-	-	-	-	-	1	1	1
Avg.	1.4	1	1										1	1	1

**TEXT BOOKS:**

1. Venkataraman.K ,”Design of Jigs Fixtures and Press Tools” ,Wiley press, Ane Books, Pvt Ltd, 2015.
2. Edward G. Hoffman, “Jigs and Fixtures Design”,Thomson-Delmar Learning, Singapore,2004

**REFERENCES:**

1. Jones.E.J.H. “Jigs and Tool Design”, Ballou Press, 2009.
2. Paquin.J.R,Crowley.R.E.,”Die Design Fundamentals”, Industrial Press Inc., New York, 1987.
3. Cyril Donaldson,” Tool design”, McGraw-Hill Education, 5<sup>th</sup> edition, 2017.
4. Handbook of die design, McGraw-Hill Education, 2<sup>nd</sup> edition 2006.
5. Joshi P H,”Jigs and Fixtures”, 2<sup>nd</sup> Edition, Tata Mcgraw Hill Publications, 2001.

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**COURSE OBJECTIVES:**

- To impart knowledge on the mechanical energy based unconventional machining process.
- To inculcate the knowledge chemical and electro chemical energy based machining processes.
- To educate the working and influence of process parameter of electric discharge machining.
- To discuss the thermal energy based machining processes.
- To recognize the significance of hybrid machining processes.

**UNIT I MECHANICAL ENERGY BASED PROCESSES 9**

Abrasive Jet Machining (AJM) – Water Jet machining (WJM) - Abrasive Water Jet Machining (AWJM) –Working Principle – equipments used – Process parameters – MRR – Applications - Ultrasonic machining (USM) – Grain throwing and Grain hammering mechanisms.

**UNIT II CHEMICAL AND ELECTRO CHEMICAL ENERGY BASED PROCESSES 9**

Chemical machining - Etchants – maskants - techniques of applying maskants – Process Parameters – MRR – Applications – Chemical blanking – Chemical milling - Electro-Chemical machining (ECM) –Principles of ECM – Equipments – MRR – Electrochemical Grinding (ECG) and Electrochemical Honing (ECH) – Applications- Micro ECM.

**UNIT III ELECTRICAL ENERGY BASED PROCESSES 9**

Electric Discharge Machining (EDM) – working principle – equipments –Process Parameters – MRR – Electrode- Power circuits – Tool Wear – Dielectric – Flushing – Wire cut – EDM – Applications – Micro EDM.

**UNIT IV THERMAL ENERGY BASED PROCESSES 9**

Laser Beam machining (LBM) - Plasma Arc machining (PAM) - Electron Beam Machining (EBM) – Ion Beam Machining (IBM) - Principle – Parameters – Equipment – Types– MRR -Applications.

**UNIT V HYBRID MACHINING 9**

Abrasive based hybrid machining processes - Thermal based hybrid machining processes - Electro based hybrid machining processes – Vibration assisted EDM - Vibration assisted ECM.

**TOTAL: 45 PERIODS****COURSE OUTCOMES:**

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

1. To explain the working and effect of process parameters of mechanical energy based unconventional machining processes.
2. To describe the working and significance of chemical and electro chemical energy based machining processes.
3. To illustrate the working and identify the effect of process parameter of electric discharge machining.
4. To recall the working and analyze process parameter of thermal energy based machining processes.
5. To explain the working of hybrid machining processes.

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

**TEXT BOOKS:**

1. Jain.V.K, "Advanced Machining Processes", Allied Publishers Pvt.Ltd., New Delhi, 2002.
2. Hassan Abdel,Gawad El, Hofy , "Advanced Machining Processes", Tata McGraw Hill, 2005.

**REFERENCES :**

1. Pandey, P.C. and Shan H.S., Modern Machining Processes, Tata McGraw Hill (2004).
2. Mishra, P.K., Non Conventional Machining, Narosa Publications (2006).
3. Hofy, H.E., Advanced Manufacturing Process, B and H Publication (1998).
4. Jain, V.K., Advanced Machining processes, Allied Publishers Private Limited (2004).
5. Ghosh, A. and Mullik, A., Manufacturing Science, East –West private Limited (2010)

**PR5074****MATERIALS PROCUREMENT MANAGEMENT****L T P C  
3 0 0 3****COURSE OBJECTIVES:**

- To understand the objectives and procedures of Purchasing.
- To remember the various aspects of stores management
- To apply the various concepts of inventory management
- To analyze management tools such as MRP, Aggregate planning, JIT concepts.
- To evaluate the usefulness of quantitative techniques in materials management.

**UNIT I PURCHASING MANAGEMENT 9**

Introduction to materials management – objectives – organization — value analysis – make or buy decisions-Purchasing and procedures – Selection of sources of supply – Vendor development – Vendor evaluation and rating – Vendor rating methods- Imports – Buyer and Seller relationship.

**UNIT II STORES MANAGEMENT 9**

Store function – Location – Layout – Stock taking – Materials handling Travel chart method- Transportation- Codification – Inventory pricing- warehousing –Logistics.

**UNIT III BASIC INVENTORY MANAGEMENT 9**

Basic EOQ Models- Assumptions- Quantity discount model- Q system- P system- Reorder level- ABC analysis- Deterministic and Probabilistic models- Finite Production

**UNIT IV ADVANCED INVENTORY MANAGEMENT 9**

Bill of Materials-Market Production Schedule requirements planning– Aggregate planning- Aggregate planning strategies-Costs-Techniques-Tabulation method-Linear Programming Method – JIT- Lot size under constraints.

**UNIT V O.R TECHNIQUES IN MATERIAL MANAGEMENT 9**

Application of O.R. Techniques in Materials Management- Linear Programming – Distribution model- Replacement analysis- Scheduling – Forecasting-Forecasting techniques.

**TOTAL: 45 PERIODS****COURSE OUTCOMES:****At the end of the course, students will be able to:**

1. Identify the objectives and procedures of Purchasing.
2. Design the possible layout, selecting the appropriate equipment for material handling
3. Decide the correct inventory system for the given application
4. Develop suitable inventory management strategies
5. Select a suitable quantitative techniques for the particular situation

**TEXT BOOKS:**

1. Gopalakrishnan. P, "Purchasing and Material Management", Text and cases, Tata McGraw Hill, 1996.
2. Kesavan.R, Elanchezhian.C and VijayaRamnath.B, "Engineering Management", Eswar Press. 2005.



**REFERENCES:**

1. Gupta P.K. and Man Mohan, "Problems in Operations Research", Sultan chand and Sons, 2014.
2. Jhamb L.C," Inventory Management", Everest Publishing House, 2013.
3. Menan K.S and Sarikakulkarni, Purchasing and Inventory Management, Shross, 2011.
4. Stephan.N, Chapmen J.R and Tany Arnold, "Introduction to Materials Management", Pearson , 2017.
5. Nair N.K, "Purchasing and Materials Management", Vikas Publishing, 1990.

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

PR5005

**SELECTION AND TREATMENT OF MATERIALS**

L	T	P	C
3	0	0	3

**COURSE OBJECTIVES:**

- To introduce the role of materials in the evolution of engineering
- To illustrate the various factors to be considered in materials selection
- To indicate the various methods and steps to be adopted in materials selection
- To inform the need and emergence of alternate materials
- To train in performing specific case studies in selection of materials.

**UNIT I MATERIALS AND PROPERTIES****9**

Classes of engineering materials - Evolution of Engineering Materials-Definition of materials properties- Displaying material properties using materials selection charts- Forces for change in materials selection and design, Materials and the environment.

**UNIT II FACTORS IN SELECTION PROCESS****9**

Design process - types of design, design requirements, function, Material attributes. Shape and Manufacturing processes - Materials processing and design processes and their influence on design, Process attributes, Systematic process selection, Process selection diagrams, Process cost, Energy consumption for production, Material costs, availability and recyclability, Environmental consideration

**UNIT III MATERIALS SELECTION PROCESS****9**

Materials selection methods: Screening, Ranking - weighted ranking, Performance indices - Materials selection charts, Deriving property limits and material indices, Structural indices. Shape factors, Efficiency of standard sections, Material limits for shape factors, Material indices which include shape-microscopic or micro structural shape factor, Co-selecting material and shape.

**UNIT IV ALTERNATE MATERIALS****9**

Environmental design, Economics and environmental impact of materials, Hybrid materials: composites, sandwich structure, lattices and segmented structure, applications of hybrid materials, polymer foams.

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**UNIT V CASE STUDIES****9**

Automobile materials (Body panels, Engine Components), Marine structural materials (Hull and Propeller), Aircraft structural materials (Wings and landing gears), Materials for Aero engines and compressor and Gas turbines, Materials for power generation machinery (Boilers and Pressure vessels), Materials for medical applications (Surgical knives and Bone replacements), Chemical and petrochemical industries (Acid storage tanks and Fuel carrying pipes).

**TOTAL: 45 PERIODS****COURSE OUTCOMES:****At the end of the course, the students will be able to:**

1. Understand the relationship between the evolution of materials and the development in engineering.
2. Find out the various factors governing the materials selection.
3. Adopt suitable method and essential steps in materials.
4. Identify suitable alternate materials for various engineering applications
5. Suggest and select appropriate materials in an engineering industry.

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

**TEXT BOOKS:**

1. Ashby. M.F., "Materials Selection in Mechanical Design", Third edition, Butterworth-Heineman, New York, 16<sup>th</sup> edition, 2012.
2. Charles. J. A. and Crane. F. A. A, "Selection and Use of Engineering Materials", second edition, Butterworth-Heinemann Ltd., 3<sup>rd</sup> edition 2005.

**REFERENCES:**

1. "ASM Handbook, Volume 20: Materials Selection and Design", ASM International, 2010.
2. Budinski. K. G., Budinski. M. K., "Engineering Materials: Properties and Selection", 2th edition, Prentice Hall, 9th edition, 2010.
3. Dieter. G. E, "Engineering Design: A Materials and Processing Approach", 5th, Edition, McGraw-Hill, 2007.
4. Mahmoud M.Farag, "Materials and Process Selection for Engineering Design", CRC Press, New York, 2nd edition, 2007.
5. Petroski. H, "Invention by Design", Harvard University Press, 1997.

**IE5751****SUPPLY CHAIN MANAGEMENT****L T P C****3 0 0 3****COURSE OBJECTIVES:**

- Describe the role and drivers of and supply chain management in achieving competitiveness.
- Explain about Supply Chain Network Design.
- Illustrate about the issues related to Logistics in Supply Chain.
- Appraise about Sourcing and Coordination in Supply Chain.
- Application of Information Technology and Emerging Concepts in Supply Chain.

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- UNIT I INTRODUCTION 9**  
 Role of Logistics and Supply chain Management: Scope and Importance - Evolution of Supply Chain – Examples of supply Chains - Decision Phases in Supply Chain - Competitive and Supply chain Strategies – Drivers of Supply Chain Performance and Obstacles.
- UNIT II SUPPLY CHAIN NETWORK DESIGN 9**  
 Role of Distribution in Supply Chain – Factors influencing Distribution network design – Design options for Distribution Network- Distribution Network in Practice - Role of network Design in Supply Chain – Framework for network Decisions.
- UNIT III LOGISTICS IN SUPPLY CHAIN 9**  
 Role of transportation in supply chain – Factors affecting transportations decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation - 3PL- 4PL- Global Logistics - Reverse Logistics; Reasons, Activities and issues.
- UNIT IV SOURCING AND COORDINATION IN SUPPLY CHAIN 9**  
 Role of Sourcing in supply chain - Supplier selection - Contracts - Design Collaboration - Sourcing planning and analysis - Supply chain co-ordination - Bull whip effect – Effect of lack of co-ordination in supply chain and obstacles – Building strategic partnerships and trust within a supply chain.
- UNIT V IT AND EMERGING CONCEPTS IN SUPPLY CHAIN 9**  
 The role IT in supply chain-The supply chain IT framework - Customer Relationship Management – Internal supply chain management – supplier relationship management – future of IT in supply chain – E-Business in supply chain- Introduction to Warehouse Management, Risks in Supply Chain, Lean supply Chains, Sustainable supply Chains.
- TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

After undergoing this course, students will acquire

1. Ability to understand the scope of Supply Chain Management and the Drivers of SC performance
2. Ability to design suitable SC network for a given situation
3. Ability to solve the issues related to Logistics in SCM.
4. Ability to understand Sourcing, Coordination and current issues in SCM.
5. Ability to appraise about the applications of IT in SCM and apply SCM concepts in selected enterprise.

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

**TEXT BOOK:**

1. Sunil Chopra, Peter Meindl and D.V. Kalra, “Supply Chain Management: Strategy, Planning, and Operation”, Pearson Education, 2016.

**REFERENCES:**

1. Ravi Ravindran A, Donald P. Warsing, Jr”, Supply Chain Engineering: Models and Applications, “CRC Press, 2012.
2. Srinivasan G.S, “Quantitative models in Operations and Supply Chain Management”, PHI, 2010.

**COURSE OBJECTIVES:**

- To impart knowledge to students about fundamentals of cutting tool
- To make students understand the mechanics of metal cutting
- To understand thermal aspects of machining and familiarize types of cutting fluids
- To familiarize about the various cutting tool materials and its uses
- To familiarize about the various gear manufacturing methods

**UNIT I TOOL NOMENCLATURE, TOOL WEAR AND TOOL LIFE 9**

Nomenclature of single point cutting tool and nomenclature of multi point cutting tools – Twist Drill – milling cutter – Tool geometry - Mechanisms of tool wear – Abrasion – Adhesion – Diffusion – Types of tool wear – flank wear – crater wear – Tool life – Tool life equations - factors affecting tool life – Illustrative problems – Theory of chatter

**UNIT II MECHANICS OF METAL CUTTING 9**

Types of chips – Continuous chips – Discontinuous chips – continuous chips with BUE – Mechanism of chip formation- Chip thickness ratio - Orthogonal cutting – Oblique cutting - Merchant circle diagram – Force relationships - shear angle - shear stress - shear strain – velocity relationships – Illustrative Problems.

**UNIT III THERMAL ASPECTS AND CUTTING FLUIDS 9**

Sources of heat generation in metal cutting- Experimental determination of tool temperatures – Tool – work piece thermocouple- embedded thermocouple – Infrared photographic technique- Economics of metal cutting - Cutting fluid – properties – types of cutting fluids – Selection of cutting fluids.

**UNIT IV CUTTING TOOL MATERIALS 9**

Types of motions in machining – Desirable properties of tool materials – Characteristics of cutting tool materials – High carbon steel, High speed steel, cast alloys, carbides, ceramics, Diamond and CBN tools- coating of tools – bits and inserts - Need for rational approach to the problem of cutting materials - Machinability

**UNIT V GEAR CUTTING 9**

Methods of gear manufacture – Gear Generation Methods; Gear shaping - gear planning - gear hobbing – kinematics - Bevel gear generation – Gear finishing methods – burnishing - shaving – grinding - lapping and gear honing.

**TOTAL: 45 PERIODS****COURSE OUTCOMES:**

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

1. Describe various types of cutting tools, its nomenclature, composition and applications
2. Explain the mechanism of metal cutting, tool wear, and determine tool life
3. Compute various forces and process parameter involved in metal cutting operation
4. Explain the thermal aspects of metal cutting process and cutting fluids types, properties and application
5. Explain various gear manufacturing processes

**TEXT BOOKS**

1. Juneja B.L., Sekhan G.S. and Nitin Seth, "Fundamentals of metal cutting and machine tools", New Age International Publishers, 2012.
2. Nagpal G.R., "Machine Tool Engineering", Khanna Publishers, 2011.

**REFERENCES**

1. Bhattacharya.A., "Metal Cutting Theory and practice", Central Book Publishers, India, 1984.

- Boothroid D.G. & Knight W.A., "Fundamentals of machining and machine tools", Marcel Dekker, Newyork, 1989.
- Shaw.M.C., "Metal cutting principles", Oxford Clare don press, 1984.
- David A.Stephenson and JognS.Agapiou, "Metal Cutting and Theory Practices", Taylor and Francis, CRC press, 3rd Edition, 2016.
- Geoffrey Boothroyd, Winston A, Knight, "Fundamentals of Machining and Machine Tools", Taylor and Francis, CRC press, 3rd Edition, 2006.

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

GE5001

INDUSTRIAL MANAGEMENT

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**COURSE OBJECTIVES:**

- To familiarize students about the concepts of inventory management.
- To introduce the students about Production Management Techniques such as work study, Plant location, Layout, Materials handling.
- To illustrate to the students the importance of financial management.
- To introduce Profit Planning and management as a concept to plan for profit.
- To familiarize the students, HR and Marketing **concepts and techniques.**

**UNIT I INVENTORY MANAGEMENT 11**

Inventory – Purpose – Economic Order Quantity – Quantity Discount Model – Material Requirement Planning – Q System – P system – Finite Replenishment – ABC Analysis.

**UNIT II PRODUCTION MANAGEMENT 10**

Work Study – Method Study – Steps in method study – Motion economy – Principles – Work measurement – Stop watch – Time study – Work sampling – Plant location decision making – Plant layout – Principles types- Selection – Material handling – Principles – Selection – Plant layout, location techniques- Aggregate Planning

**UNIT III FINANCIAL MANAGEMENT 10**

Financial Accounting- Income statement-Balance sheet- Assets- types- Liabilities- Consumers equity- Sources of finance- Capital budgeting- Working Capital Management- Inventory Pricing.

**UNIT IV PROFIT MANAGEMENT 6**

Break Even Analysis – Profit planning – Angle of incidence – Margin of safety – Multi product break even analysis – Effect of variation in selling price, Fixed cost and Variable cost on break even quantity, angle of incidence and margin of safety.

**UNIT V HUMAN RESOURCE MANAGEMENT AND MARKETING MANAGEMENT 8**

Human resource management – Organization- Recruitment- Selection – Training and Development- Communication – Motivation – Trade union – Industrial relations – Marketing – Organization – Difference between marketing and selling – Sales promotion- Distribution channels- Advertisement – Publicity – Packaging – Market research.

**COURSE OUTCOMES:**

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

1. Design a suitable inventory system for a given situation
2. Interpret work study and its methods to develop layout and materials handling systems
3. Prepare financial statements such as balance sheet, income statements
4. Apply concepts of Break Even Analysis for profit planning
5. Develop marketing and human resource skills.

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

**TEXT BOOKS:**

1. Kesavan. R, Elanchezian.C, and SundarSelwyn. T, "Engineering Management", Eswar Press, Chennai, 2005.
2. Panneerselvam.R, "Production and Operations Management", PHI – 2012.

**REFERENCES:**

1. Aswathappa" Human Resources Management" McGraw Hill (India) - 2018.
2. Chary S.N, "Production and Operation Management", Tata McGraw Hill-2012.
3. Philips Kotler, "Marketing Management" Pearson Education – 2015.
4. Prasanna Chandra,"Financial Management" McGraw Hill (India) - 2018.
5. Martland Telsand, "Industrial Engineering and Production Management". S.Chand. 2006.

PR5007

ELEMENTS OF GREEN MANUFACTURING

L T P C  
3 0 0 3

PROGRESS THROUGH KNOWLEDGE

**COURSE OBJECTIVES:**

- To understand the basics of environmental sustainability and impact assessment methods.
- To incorporate knowledge about the environmental based improvements towards lean manufacturing systems.
- To analyze various machineries with intent to evaluate energy conservation
- To understand the environmental impact on hazardous and solid wastes and subsequently applying knowledge on its minimization or prevention.
- To evaluate and understand the Green-Co rating scores and its benefits.

**UNIT I ENVIRONMENTAL SUSTAINABILITY AND IMPACT ASSESSMENT 9**

Environmental impact assessment objectives – Legislative development – European community directive – Hungarian directive. Strategic environmental assessment and sustainability appraisal. Regional spatial planning and environmental policy.

**UNIT II LEAN MANUFACTURING AND GREEN ENERGY SYSTEM 9**

Conventional Manufacturing versus Lean Manufacturing – Principles of Lean Manufacturing. World energy consumption – Green house effect, Global warming. Energy conservation and measurement principles with their applicability in engineering and process industries.

**UNIT III ENERGY SAVING MACHINERY AND COMPONENTS 9**

Electricity Billing: Components and Costs – kVA – Need and Control – Determination of kVA demand and Consumption. Selection of fans, pumps and Compressors – Performance Evaluation – Cause for inefficient operation – scope for energy conservation.

**UNIT IV HAZARDOUS AND SOLID WASTE MANAGEMENT 9**

Hazardous waste: definition, terminology, classification and Sources – Need for hazardous waste management: Need, Handling, methods of collection, storage and transport with suitable examples. Solid waste management: Need, Waste prevention and Life cycle assessment. Collection, storage, reuse and recycling of solid waste with suitable examples.

**UNIT V GREEN CO-RATING 9**

Ecological Footprint - Need For Green Co-Rating – Green Co-Rating System – Intent – System Approach – Weightage- Assessment Process – Types Of Rating – Green Co-Benefits – Case Studies of Green Co-Rating.

**TOTAL: 45 PERIODS****COURSE OUTCOMES:**

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

1. Understand the Concepts of environmental sustainability and environmental impact assessment tools.
2. Remember suitable schemes towards design of Lean manufacturing requirements
3. Evaluate the energy conservation and accordingly apply on manufacturing processes.
4. Analyze manufacturing processes towards minimization or prevention of hazardous and solid wastes.
5. Apply Knowledge on green co-rating assessment and its benefits

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

**TEXT BOOKS:**

1. Ronald G. Askin and Jeffrey B. Goldberg, "Design and Analysis of Lean Production Systems", John Wiley and Sons, 2003.
2. Stephen Doven, "Environment and Sustainability Policy : Creation, implementation, Evaluation", The Federation Press, 2005.
3. "Green Co Case Study Booklet", CII – Sohrabji Godrej Green Business Centre, 2015

**REFERENCES:**

1. Clive George, Collin.C, Kirkpolarice.H, "Impact Assessment and sustainable development", Edward Elgar Publishing 2007.
2. "Green Manufacturing: Case Studies in Lean and Sustainability, Association for Manufacturing Excellence", CRC press,2007.
3. Chaigier N.A. "Energy Consumption and Environment", McGraw Hill, 2007.
4. Hamies, "Energy Auditing and Conservation, Methods Measurements, management and Case Study", Hemisphere, Washington, 1980.
5. Bhide A.D., Sundaresan B.B., "Solid Waste Management – Collection Processing and Disposal", Mudrashilpa offset printers, Nagpur, 2001.

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**COURSE OBJECTIVES:**

- To expose the students to design for conducting the machining processes
- To impart knowledge to the students about the design principles of casting.
- To impart knowledge to the students about the design principles of welding
- To conduct some of the cleaning and coating processes
- To outline various casting processes, several defects that appear in cast part and corresponding remedial measures, and general recommendations to achieve a good quality casting.

**UNIT I DESIGN FOR MACHINING**

Introduction to machining, Recommended materials for machinability, Design recommendations, Design for turning operation: Process description, Typical characteristics and applications, Suitable materials, Design recommendations, Design for machining round holes: Introduction, Suitable materials, Design recommendations, Recommended tolerances, Parts produced by milling: Process description, Characteristics and applications of parts produced on milling machines, Design recommendations for milling, Dimensional factors and tolerances, Parts produced by planing, shaping and slotting: Process description, Design recommendation planning, Design for broached parts: Process description, Typical characteristics of broached parts, Suitable materials for broaching, Design recommendations.

**UNIT II DESIGN FOR CASTING**

Introduction to sand casting, Typical characteristics of a sand cast part, Design recommendation for sand casting, Investment casting: Introduction, Steps in investment casting, Design consideration of Investment casting, Typical characteristics and applications, Die casting: Introduction to die casting, Advantages of the die casting process, Disadvantages of the die casting process, Applications, Suitable material consideration, General design consideration, Specific design recommendation,

**UNIT III DESIGN FOR WELDING**

Different types of welding processes, Design for welding: Design for recommendation for welding process, Design for solder and brazed assembly: Process, Typical characteristics, Suitable materials, Detail Design recommendations, Design for adhesively bonded assemblies: Introduction, Typical characteristics, Suitable materials, Design recommendations for adhesive joint,

**UNIT IV DESIGN FOR CLEANING**

Introduction to cleaning process, In-process cleaning operations, Cleaning processes and their applications, Design recommendations, Design for polishing and plating: Introduction to Polishing processes, Design recommendations for polishing process, Design for plated surface: Electroplating process, Typical characteristics, Design recommendations for plating, Hot Dip Metallic Coating: Process, Design recommendations for Hot Dip Metallic coating, Thermal sprayed coating: Process, Design recommendations for thermal sprayed coating, Vacuum Metalized surfaces: The process, Typical characteristics and applications, Design recommendations, Design for heat treatment: Introduction to heat treatment, Heat treating process for steel, Applications of heat-treated parts, Design recommendations for heat treatment.

**UNIT V DESIGN FOR ASSEMBLY**

The assembly process, Characteristics and applications, Example of common assembly, Economic significance of assembly, General taxonomies of assembly operation and systems, Limits fits and tolerances - Interchangeability, selective assembly, limits, fit and tolerances, limit gauging, design of limit gauges, Assembling a product, Design for Assembly: Introduction, Design consideration, Design for Fasteners: Introduction, Design recommendation for fasteners.

**TOTAL:45 PERIODS****COURSE OUTCOMES:**

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

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1. Apply design principles and design concepts for machining to ensure successful machining processes.
2. Analyze the design considerations for casting to ensure optimal casting outcomes and minimize defects.
3. Evaluate design principles related to welding and ensure strong and reliable joints.
4. Explain of various cleaning processes to maintain the quality and functionality of components.
5. Apply design principles for assembly to create designs that simplify the assembly process.

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

#### TEXT BOOKS:

1. Parmar, R.S., Welding Processes and Technology, Khanna Publishers, 2006.
2. Jain, P.L., Principles of Foundry Technology, Tata McGraw Hill, 2006.

#### REFERENCES:

1. J. Lesko, (1999) Industrial Design, Materials and Manufacture Guide, John Willy and Sons, Inc
2. George E. Dieter and Linda C. Schmidt (2009), Engineering Design, Fourth edition, McGraw-Hill companies, New York, USA
3. Geoffrey Boothroyd, Peter Dewhurst and Winston Knight (2002) Product Design for Manufacture and Assembly, Second Edition, CRC press, Taylor & Francis, Florida, USA
4. O. Molloy, S. Tilley and E.A. Warman (1998) Design for Manufacturing and assembly, First Edition, Chapman & Hall, London, UK.
5. D. E. Whitney, (2004) Mechanical Assemblies: Their Design, Manufacture, and Role in Product Development, Oxford University Press, New York

PR5009

COMPUTER AIDED PRODUCT DESIGN

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3 0 0 3

#### COURSE OBJECTIVES:

- To construct applicable design challenges, execute experimental or analytical investigations, and analyze outcomes using contemporary mathematical and scientific techniques along with software tools.
- To present the concepts of computer graphics in connection with design principles.
- To initiate an understanding of geometric modeling and the practical applications of Computer-Aided Design (CAD)
- To provide insights into product design and the tools involved in the design process.
- To demonstrate comprehension of product data management and the life cycle of products.

#### UNIT I INTRODUCTION TO COMPUTER AIDED DESIGN

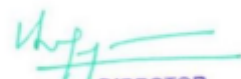
9

Introduction to Engineering Design – Various phases of systematic design – sequential engineering and concurrent engineering – Computer hardware and Peripherals – software packages for design and drafting.

#### UNIT II COMPUTER GRAPHICS FUNDAMENTALS

9

Computer graphics – applications – principals of interactive computer graphics – 2D 3D transformations – projections – curves – Bezier, B-Spline and NURBS – Concepts.

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**UNIT III GEOMETRIC MODELING****9**

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

**UNIT IV PRODUCT DESIGN CONCEPTS****9**

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

**UNIT V PRODUCT DATA MANAGEMENT****9**

Product Data Management – concepts – Collaborative product design and commerce – Information Acquisition – Sourcing factor – manufacturing planning factor – Customization factor – Product life cycle management.

**TOTAL: 45 PERIODS****COURSE OUTCOMES:****At the end of this course students could be able to**

1. Students will have achieved a solid grasp of the fundamental design process and familiarized themselves with the features of cutting-edge design tools.
2. Students will have been introduced to the foundational principles of computer graphics and gained familiarity with its concepts.
3. Students will have gained expertise in geometric modeling and proficiency in utilizing CAD software packages.
4. Students will have developed comprehension of product design and a high level of proficiency in employing process tools in accordance
5. Apply concepts in data management and the management of product life cycles

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	-	2	-	1	-	2	2	-	-	-	-	1	2	1
2	-	-	2	-	2	-	2	2	-	-	-	-	1	2	1
3	-	-	2	1	2	-	-	-	-	-	-	-	1	2	1
4	-	-	1	1	3	3	-	-	-	-	-	-	1	2	1
5	-	-	-	-	2	2	2	2	-	-	-	-	1	2	1
Avg.	1	-	1.7	1	2	2.5	2	2	-	-	-	-	1	2	1

**TEXT BOOKS:**

1. Ibrahim Zeid, “CAD/CAM theory and Practice”, Tata McGraw Hill, 2<sup>nd</sup> edition, 2008
2. Kevin Otto, Kristin Wood, “Product Design”, Pearson Education, 7<sup>th</sup> Reprint, 2011.

**REFERENCES:**

1. Biren Prasad, “Concurrent engineering Fundamentals Vol. II”, Prentice Hall, 1<sup>st</sup> edition, 2007.
2. James G.Bralla , “Handbook of Product Design for Manufacturing”, McGraw Hill, 2<sup>nd</sup> edition, 2004.
3. David F.Rogers.J, Alan Adams, “Mathematical Element for Computer Graphics”, McGraw Hill, 2<sup>nd</sup> edition, 2009.
4. Donald Hearn and Pauline Baker, “Computer Graphics C Version”, Pearson Education, 2004.
5. Michael E Mortenson, “Geometric Modeling”, John Wiley & Sons Inc., 2004.

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**COURSE OBJECTIVES:**

The students will be able to

- To introduce the need for green electronics, regulatory bodies, re-cycling and environmental concern in electronic manufacturing.
- To analyze the environmental pollution in electronic processing.
- To review the counter measures in electronic processing by adaption of new materials, eco-design and recycling.
- To provide overview of life cycle assessment of electronics manufacturing and international standards.
- To appraise the reuse and recycle of electronic products based on case studies on typical products

**UNIT I INTRODUCTION TO GREEN ELECTRONICS 9**

Environmental concerns of the modern society- Overview of electronics industry and their relevant regulations in China, European Union and other key countries- global and regional strategy and policy on green electronics industry. Restriction of Hazardous substances (RoHS) - Waste Electrical and electronic equipment (WEEE - Energy using Product (EuP) and Registration - Evaluation, Authorization and Restriction of Chemical substances (REACH).

**UNIT II GREEN ELECTRONICS MATERIALS AND PRODUCTS 9**

Basics of IC manufacturing and its process – Electronics with Lead (Pb) -free solder pastes, conductive adhesives, Introduction to green electronic materials and products - halogen-free substrates and components. Substitution of non-recyclable thermosetting polymer based composites with recyclable materials X-Ray Fluorescence (XRF) for identifying hazardous substances in electronic products

**UNIT III GREEN ELECTRONICS ASSEMBLY AND RECYCLING 9**

Various processes in assembling electronics components - the life-cycle environmental impacts of the materials used in the processes - substrate interconnects. Components and process equipments used. Technology and management on e-waste recycle system construction, global collaboration, and product disassembles technology.

**UNIT IV PRODUCT DESIGN AND SUSTAINABLE ECO-DESIGN 9**

Stages of product development process in green design: Materials- Manufacturing - Packaging and use - End of Life and disposal - Design for recycling - Life Cycle Assessment (LCA), and Eco-design tools - Environmental management systems, and International standards - Eco-design in electronics industry

**UNIT V CASE STUDIES 9**

Reliability of green electronics systems , Reuse and recycle of End-of-Life(EOL) electrical and electronic equipment for effective waste management – Introduction of Green Supply Chain, and Modeling green products from Supply Chain point of view - A life-cycle assessment for eco-design of Cathode Ray Tube Recycling.

**TOTAL: 45 PERIODS****COURSE OUTCOMES:**

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

1. Spell out the regulatory bodies for re-cycling and end of use of electronic products.
2. Analyze the environmental pollution in electronic processing and reprocessing.
3. Describe the counter measures in electronic processing and recycling by adaption of new materials and eco-design.
4. Summarize of life cycle assessment of electronics manufacturing and international standards.
5. Infer the reuse and recycle of typical electronic products.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	-	-	-	3	-	-	-	1	-	2	1	2	2
2	1	-	-	1	-	-	-	-	-	1	-	2	1	3	2
3	2	-	-	1	-	-	2	-	-	1	-	2	1	3	2
4	1	-	-	1	-	3	3	-	-	1	-	2	1	3	2
5	1	-	-	1	-	2	-	-	-	1	-	2	1	3	2
Avg.	1.2	-	-	1	-	2.6	2.5	-	-	1	-	2	1	2.8	2

#### TEXT BOOKS:

1. Lee H. Goldberg and Wendy Middleton, "Green Electronics/ Green Bottom Line", Newnes Publications, 2000.
2. Sammy G. Shina, "Green Electronics Design and Manufacturing", McGraw Hill., 2008.

#### REFERENCES:

1. David Austen, "Green Electronic Morning", Ingleby Gallery, 2006.
2. John Hu. Mohammed Ismail, "CMOS High Efficiency on – Chip Power Management", Springer Publications 4<sup>th</sup> edition, 2011.
3. SankaGanesan, Michael Pecht, "Lead-free Electronics", John Wiley & Sons, 2006.
4. Yuhang yang and Maode Ma, "Green Communications and Networks", Springer Publication., 2014.
5. Charles A. Harper, "Electronic Materials and Processes Hand book", McGraw-Hill, 2010.

PR5072

### PRODUCTION OF AUTOMOTIVE COMPONENTS

L T P C  
3 0 0 3

#### COURSE OBJECTIVES:

- To impart knowledge on the working of engines, piston and cylinder components and its manufacturing methods.
- To describe the working and manufacturing of engine components.
- To impart the knowledge in working and manufacturing of fuel system and transmission system.
- To educate the working and production of chassis and suspension system
- To learn the recent developments in automobile industries.

#### UNIT I ENGINE

9

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

#### UNIT II ENGINE COMPONENTS

9

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

#### UNIT III FUEL AND TRANSMISSION SYSTEM

9

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

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**UNIT IV CHASSIS AND SUSPENSION SYSTEM****9**

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

**UNIT V RECENT ADVANCEMENTS****9**

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

**TOTAL: 45 PERIODS****COURSE OUTCOMES:**

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

1. To define the working of engines, piston and cylinder components and its manufacturing methods.
2. To explain the working and manufacturing of engine components.
3. To recall the working and manufacturing of fuel system and transmission system.
4. To summarize the working and production of chassis and suspension system
5. To explain the recent development in automobile industries

**TEXT BOOKS:**

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

**REFERENCES:**

1. Brian Cantor, "Automotive Engineering", CRC Press, Taylor and Francis Group, London, 2008.
2. Garrett. T.K., Newton. K., Steeds. W., "The Motor Vehicle ", Butterworth-Heinemann, 13th edition, 2001
3. Kirpal Singh, "Automobile Engineering., Vol. I and II", Standard Publishers, New Delhi, 13<sup>th</sup> edition, 2012.
4. Serope Kalpakjian and Steven R. Schmid, "Manufacturing Processes for Engineering Materials", Fourth Edition – Pearson Education publications, 2003.
5. V Ganesan, "Internal Combustion Engines", Tata Mc GrawHil Publications, 4<sup>th</sup> Edition, 2017.

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

**ME5081****PROCESS PLANNING AND COST ESTIMATION****L T P C****3 0 0 3****COURSE OBJECTIVES:**

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

- Elucidate the steps involved in preparing a process plan for a given Product.
- Provide an overview for cost estimation of a given product.
- Explain the allocation of overhead costs in manufacturing.

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- Elucidate the procedure to estimate the cost of castings and forging products.
- Explain the costs involved in machining and estimate the machining cost.

**UNIT I PROCESS PLANNING 9**

Defining process planning –Drawing interpretation –Material selection process and methods – Selection of Production Processes from Tables – Selection of Process Parameters from Tables– Factors to be considered in selecting: Processes; Process Sequencing; Operation Sequencing; Equipment & Tool Selection; Tool Holding Devices; Measuring Instruments –Computer Aided Process Planning – Retrieval / Variance CAPP and Generative CAPP - Case Study in Process Planning.

**UNIT II FUNDAMENTAL OF ESTIMATING AND ELEMENTS OF COST 9**

Concept and Purpose of Estimating, Functions of Estimating Department, Concept of Costing, Costing versus Estimating, Types of Estimates, Importance of Estimates, Estimating Procedure, Cost Estimators and their Qualifications, Principal Constituents in a Cost Estimate – Elements of Cost – Introduction, Material Cost, Labour Cost, Expenses and Cost of Product (Ladder Cost).

**UNIT III OVERHEADS AND DEPRECIATION 9**

Overhead, Allocation or Distribution of Overhead Cost , Depreciation and Methods to Calculate it, Interest on Capital, Idleness Costs, Repair and Maintenance Cost

**UNIT IV ESTIMATION OF CASTING, FORGING & WELDING COSTS 9**

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

**UNIT V ESTIMATION OF MACHINING TIME AND COST 9**

Estimation of Machining Time and Cost – Lathe operations, Drilling, Milling, Shaping Planing, and Grinding operations.

**TOTAL = 45 PERIODS**

**COURSE OUTCOMES:**

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

1. Create a Process Plan for a given Product
2. Identify Cost elements for a given Product.
3. Allocate Overhead to different departments in manufacturing a product.
4. Estimate cost for Casting and Forging products. Analyze the costs for machining a product
5. Able to calculate the machining cost

**TEXT BOOKS:**

1. Adithan, M, Process Planning and Cost Estimation, New Age International Publishers, 2007.
2. Peter Scallan, Process planning, The Design/Manufacture Interface, Butterworth-Heinemann, 2003.

**REFERENCES:**

1. Chitale A. K., and Gupta R. C., “Product Design and manufacturing”, Prentice Hall of India, New Delhi, 1997.
2. Gideon Halevi, “Process and operation planning”, Kluwer academic publishers (Printed ebook), 2003.
3. Narang G.B.S. & Kumar .V, “Production and Costing”, Khanna Publishers, 2000.
4. Phillip F. Ostwald & Jairo Munoz, “Manufacturing Processes And Systems”, 9th Edition, Wiley student edition, 2002.
5. Robert Creese, Adithan M. & Pabla B. S., “Estimating and Costing for the Metal Manufacturing Industries”, Marcel Dekker, 1992.

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

<b>3</b>	3	3	2	2	-	1	1	1	-	-	1	1	2	2	1
<b>4</b>	3	3	2	2	-	1	1	1	-	-	1	1	2	2	1
<b>5</b>	3	3	2	2	-	1	1	1	-	-	1	1	2	2	1
<b>Avg.</b>	3	3	2	1.8	2	1	1	1	1	-	1	1	2	2	1.4

**PR5073**

**ROBOTIC TECHNOLOGY**

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

**COURSE OBJECTIVES:**

- To understand the general functioning , terminologies and applications in robotics
- To learn to formulate and derive kinematics for any configuration of robot.
- To learn about the different drives and end effectors used in robotics
- To learn about the different types of sensors used in robotics and different methods used for sensing
- To learn about different programming techniques and commands and applications used in robotics.

**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 KINEMATICS**

**9**

Forward kinematics, inverse kinematics and the difference: forward kinematics and inverse Kinematics of Manipulators with two, three degrees of freedom (in 2 dimensional), four degrees of freedom (in 3 dimensional) – derivations and problems. Homogeneous transformation matrices, translation and rotation matrices Denvavit and Hartenberg transformation.

**UNIT III ROBOT DRIVE SYSTEMS AND END EFFECTORS**

**9**

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of All These Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic grippers, vacuum grippers, two fingered and three fingered grippers, internal grippers and external grippers, selection and design considerations of a gripper - gripper force calculation and analysis.

**UNIT IV SENSORS IN ROBOTICS**

**9**

Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors, safety considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and compliance mechanism. Machine vision system - 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 V PROGRAMMING AND APPLICATIONS OF ROBOT**

**9**

Teach pendant programming, lead through programming, robot programming languages – VAL programming – Motion Commands, Sensors commands, End-Effector Commands, and simple programs - Role of robots in inspection, assembly, material handling, underwater, space and medical fields.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

1. Describe the principles, feature and specifications of robot and its kinematics and accessories
2. Summarize the configurational and peripheral features of robot
3. Solve robot kinematics solutions

4. Use mechanical links, and joints, sensors and actuators for robots
5. Demonstrate the robot programming and application of robot for different scenarios.

**TEXT BOOKS:**

1. Ganesh.S.Hedge ,”A textbook of Industrial Robotics”, Lakshmi Publications, 2006. McGraw Hill 2<sup>th</sup> edition 2012.
2. Mikell.P.Groover , “Industrial Robotics – Technology, Programming and applications”,

**REFERENCES:**

1. Fu K.S. Gonalz R.C. and ice C.S.G.”Robotics Control, Sensing, Vision andIntelligence”, McGraw Hill book co. 2007.
2. YoramKoren, “Robotics for Engineers”, McGraw Hill Book, Co., 2002.
3. Janakiraman P.A., “Robotics and Image Processing”, Tata McGraw Hill 2005.
4. John. J.Craig, “Introduction to Robotics: Mechanics and Control” 2<sup>nd</sup> Edition, 2002.
5. Jazar, “Theory of Applied Robotics: Kinematics, Dynamics and Control”, Springer India reprint, 2010.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	-	-	-	1	-	-	-	1	-	1	1	-	1
2	1	1	-	1	-	-	-	-	-	1	-	1	1	-	2
3	2	1	-	1	1	-	-	-	-	-	-	1	1	-	1
4	1	1	1	1	1	-	-	-	-	-	-	1	1	-	1
5	-	-	1	1	1	1	-	-	-	1	1	1	1	-	2
Avg.	1.2	1	1	1	1	1	-	-	-	1	1	1	1	-	1.4

PR5011

**FINITE ELEMENT ANALYSIS IN APPLICATION**

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

**COURSE OBJECTIVES:**

- Introduce the concept of Finite Element Analysis (FEA) and its application within the realm of Manufacturing.
- Enable students to analyze provided problems by employing finite element techniques.
- Impart knowledge about the multitude of factors, pre-processing and post-processing steps, and the integration of computers in FEA implementation.
- Foster understanding in the domain of finite element methods, encompassing their principles and applications.
- Familiarize students with the various applications of FEA within the manufacturing sector.

**UNIT I INTRODUCTION**

**9**

General field problems in engineering-Discrete and continuous models-Characteristics-the relevance and place of finite element method- variational calculus- variational formulation of boundary value problems-The method of weighted residuals-Rayleigh-Ritz and Galerkin methods-Solution of large system of equations- Choleski Decomposition-Gaussian elimination procedures.

**UNIT II GENERAL PROCEDURE OF FEA**

**9**

Discretization of Domain selection of interpolation polynomials-Convergence requirements-Formulation of element characteristics matrices and load vectors – Assembly of element characteristics matrices-Solution of finite element equations-Post processing of results.



**UNIT III FINITE ELEMENT ANALYSIS OF ONE DIMENSIONAL AND TWO DIMENSIONAL PROBLEMS**

**9**

One dimensional finite element analysis-Linear bar element-Quadratic bar element-Beam element-Frame elements-One dimensional heat transfer-Two dimensional finite element analysis approximation of geometry and field variables-Three noded triangular element-Four noded rectangular element-Six noded triangular element-Natural coordinates and coordinate transformation – Numerical integration-Incorporation of boundary conditions

**UNIT IV ISO-PARAMETRIC ELEMENTS**

**9**

Isoparametric elements-Dynamic analysis-Equations of motion using Lagrange’s approach-Consistent and Lumped mass matrices-Formulation of FE equations for vibration problems-Solution of Eigen value problems-Transient vibration analysis-Thermal transients.

**UNIT V APPLICATION OF FINITE ELEMENT ANALYSIS**

**9**

Finite element analysis of Machine elements - Axisymmetric FEA of a pressure vessel-Application of FEM in various metal forming processes – Solid formulation and flow formulation – FEA simulation of Metal cutting, Solidification of castings and Weldments.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

1. Attain understanding of the foundational principles involved in solving Finite Element problems.
2. Apply the process of discretization and solution to one-dimensional solid mechanics and heat transfer problems using Finite Element Analysis.
3. Examine the influence of shape functions and the utilization of higher order formulations in achieving convergence while solving FEA problems.
4. Implement computer-based techniques to solve problems utilizing Finite Element Analysis.
5. Analyze a production process using Finite Element Analysis, considering its parameters and effects on the process.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
<b>1</b>	3	3	1	2	2	-	-	1	-	1	-	1	1	-	2
<b>2</b>	3	3	1	2	2	-	-	1	-	1	-	1	1	-	2
<b>3</b>	3	3	1	2	2	-	-	1	-	1	-	1	1	-	2
<b>4</b>	3	3	1	2	2	-	-	1	-	1	-	1	1	-	2
<b>5</b>	3	3	1	2	2	-	-	1	-	1	-	1	1	-	2
<b>Avg.</b>	3.0	3.0	1.0	2.0	2	-	-	1	-	1.0	-	1.0	1.0	-	2.0

**TEXT BOOKS:**

1. Chandraputla T.R., and Belegundu A.D., “Introduction of Finite Element in Engineering”, Prentice Hall of India, Fourth Edition, 2012.
2. Reddy. J.N., “An Introduction to Finite Element Method”, McGraw Hill, Third Edition, 2005.

**REFERENCES:**

1. Rao.S.S., “The Finite Element Method in Engineering”, Butterworth-Heinemann, fourth edition, 2004.
2. Segarland. L.J., “Applied Finite Element Analysis”, John Wiley and Sons, second edition, 1984.
3. Seshu.P., “Text Book of Finite Element Analysis”, Prentice Hall of India, tenth print, 2010.
4. AngelosP.Markopoulos, “Finite Element Method in Machining Processes”, Springer, 2013.
5. J. Paulo Davim, “Finite Element Method in Manufacturing Processes”, Wiley, 2011.

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**COURSE OBJECTIVES:**

- To familiarize the students with concepts of Linear Programming
- To introduce the replacement models to students
- To enable the students to utilize the queuing models for application to waiting line problems.
- To stress importance of inventory management and their use in industry.
- To familiarize project network and decision tree problems to students so that they can use them in project management.

**UNIT I LINEAR PROGRAMMING 9**

Problem formulation - Graphical method – simplex method- Big M method- Two Phase Method– Dual Simplex method- Special cases of LP– transportation model- assignment model – applications.

**UNIT II REPLACEMENT MODELS AND GAME THEORY 9**

Basic replacement model – individual replacement and group replacement problems – applications – game theory – terminology – decision criteria – solution to a 2 x 2 and 2 x n games – applications of LP in game theory – applications.

**UNIT III QUEUING MODELS AND SIMULATION 9**

Elements of queue – queue discipline – Poisson arrival and exponential service – queue length – waiting time – steady state conditions – applications – concept of simulation – Monte Carlo method – applications.

**UNIT IV FORECASTING, SEQUENCING AND LINE BALANCING 9**

Forecasting – purpose – methods – measures of forecast error; scheduling – priority rules - sequencing – methods of sequencing – Johnson’s rule – Heuristic approach, line balancing – applications.

**UNIT V PROJECT NETWORK ANALYSIS AND DECISION TREE ANALYSIS 9**

Network – CPM/PERT – Project time estimation – critical path – crashing of network, Decision tree analysis – applications

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

**To students will be able to**

1. Use the simplex method to solve problems in industry
2. Identify a suitable replacement model so that replacement of equipment can be done optimally
3. Utilize the knowledge on queuing models and sequencing in production systems
4. Identify inventory model for a specific industry
5. Select a suitable project network technique for project management

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	-	1	-	-	-	-	-	1	-	1	1	1	1
2	3	2	-	1	-	-	-	-	-	1	-	1	1	1	1
3	3	2	-	1	-	-	-	-	-	1	-	1	1	1	1
4	3	2	-	2	-	1	1	-	-	1	-	1	1	2	1
5	3	2	1	2	-	-	-	-	-	1	-	1	1	2	1
Avg.	3	2	1	1.4		1	1	-	-	1	-	1	1	1.4	1

**TEXT BOOKS:**

1. Hamdy A.Taha, “Operations Research – An Introduction”, Prentice Hall of India, 8th edition 2008.

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2. Panneerselvam R., "Operation Research", Prentice Hall of India, 2008.

#### REFERENCES:

1. Gupta.P.K. and Man-Mohan, "Problems in Operations Research", Sultan chand and Sons, 2014.
2. Monks. J.G, "Operations Management theory and Practice", McGraw Hill, 2nd edition 1996.
3. Ravindran, Philips and Sojberg, "Operations Research Principles and Practice", John Wiley and Sons, Singapore, 2nd edition, 2007.
4. Sharma J.K., "Operations Research Theory and Applications", Macmillan India Ltd., 4th edition, 2009.
5. Kothari D P, Awari G K, "Quantitative Techniques in Business, Management and Finance", CRC Press, Taylor and Francis Group, 2016.

PR5012

ADVANCES IN OPERATIONS RESEARCH

L T P C  
3 0 0 3

#### COURSE OBJECTIVES:

- To understand the basics of operation research & its applications
- To remember the concepts and models of operation research
- To apply the knowledge to formulate and find the solution for the managerial problems in industries
- Ability to understand and analyze the managerial problems
- To apply the OR techniques to make effective decisions in real world management problems

#### UNIT I INTRODUCTION

Optimization – Historical Development – Engineering applications of optimization – Statement of an Optimization problem – classification of optimization problems. **8**

#### UNIT II CLASSICAL OPTIMIZATION TECHNIQUES

Linear programming– simplex method – dual simplex method – revised simplex method – duality in LP – Sensitivity Analysis - Parametric Linear programming. **9**

#### UNIT III NON-LINEAR PROGRAMMING

Introduction – Lagrangian Method – Kuhn-Tucker conditions – Quadratic programming – Separable programming – Stochastic programming **10**

#### UNIT IV INTEGER PROGRAMMING AND DYNAMIC PROGRAMMING

Integer Programming- Cutting plane algorithm – Branch and bound technique - Zero-one implicit enumeration; Geometric Programming- Dynamic Programming. **9**

#### UNIT V NETWORK TECHNIQUES

Shortest path model- Minimum spanning tree- Maximal Flow problem **9**

**TOTAL: 45 PERIODS**

#### COURSE OUTCOMES:

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

1. Summarizing optimization's historical development, engineering applications, problem statements, and classifications of problems.
2. Solve linear programming problems and apply the simplex algorithm to find optimal solutions.
3. Apply non-linear programming techniques, including the Lagrangian method and Kuhn-Tucker conditions, to solve optimization problems.
4. Solve operation research problems using algorithms.
5. Analyzing the shortest path, minimum spanning tree, and maximal flow problems.

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CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	1	1	-	-	-	-	-	-	1	-	2	2	2
2	2	2	1	1	-	-	-	-	-	1	1	1	2	2	2
3	2	2	1	1	-	-	-	-	-	1	1	1	2	2	2
4	2	2	1	1	-	-	-	-	-	1	1	1	2	2	2
5	2	2	1	1	-	-	-	-	-	1	2	1	2	2	2
Avg.	2	2	1	1	-	-	-	-	-	1	1.2	1	2	2	2

#### TEXT BOOKS:

1. Panneerselvam. R., "Operations Research", Prentice Hall of India Private Limited, NewDelhi ,2005.
2. Sharma.S.D., "Operations Research: Theory, Methods and Applications", KedarNath Ram Nath publisher, 15<sup>th</sup> edition, 1972.

#### REFERENCES:

1. Gupta. P.K. and Man-Mohan, "Problems in Operations Research", Sultan chand and Sons, 1994.
2. Ravindran, Philips and Solberg, "Operations Research Principles and Practice", John Wiley and Sons, Singapore, 1992.
3. Sharma.J.K., "Operations Research Theory and Applications" – Macmillan India Ltd.,1997.
4. Hamdy A. Taha, "Operations Research – An Introduction", Prentice Hall of India, 1997.
5. Srinivasan G, Operation Research, PHI, 2<sup>nd</sup> Edition, 2010

PR5013

### HEAT TRANSFER

L T P C  
3 0 0 3

#### COURSE OBJECTIVES:

- To learn the principle mechanism of modes of heat transfer to the physical system
- Get familiarize the conduction heat transfer under steady state and transient conditions.
- Learn the fundamental concept and principles in convective heat transfer
- Create the fundamental concept and principles in radiation heat transfer
- Implement the knowledge of heat transfer in the design of heat exchangers

#### UNIT I MODES OF HEAT TRANSFER AND GOVERNING EQUATION

9

Modes of heat transfer - effect of temperature on thermal conductivity of different solids, liquids and gases- derivation of generalized equation in Cartesian ,cylindrical and spherical coordinates and its reduction to specific cases- General laws

#### UNIT II CONDUCTION

9

Fourier's law- One dimensional steady state conduction- heat conduction through plane and composite walls, cylinders and spheres-electrical analogy-critical radius of insulation for cylinder and sphere, overall heat transfer coefficient- Transient heat conduction- lumped heat capacity analysis, time constant, transient heat conduction in solids with finite conduction and convective resistances -Heat transfer from extended surface-Types of fin, heat flow through rectangular fin, infinitely long fin, fin insulated at the tip and fin losing heat at the tip-efficiency and effectiveness of fin-Biot number-Estimation of error in temperature measurement in a thermometer well.

#### UNIT III CONVECTION

9

Newton's law of cooling-Dimensional analysis applied to forced and free convection-dimensionless numbers and their physical significance-empirical correlations for free and forced convection -Continuity, momentum and energy equations-thermal and hydrodynamic boundary layer-Blasius solution for laminar boundary layer- General solution of Von-Karman integral momentum equation

**UNIT IV RADIATION****9**

Absorptivity, reflectivity and transmissivity- black, white and grey body-emissive power and emissivity-laws of radiation – Planck, Stefan-Boltzmann, Wein's displacement, Kirchhoff's law, intensity of radiation and solid angle- Lambert's cosine law Radiation heat exchange between black bodies, shape factor, heat exchange between non-black bodies- infinite parallel planes and infinite long concentric cylinders- radiation shield- heat exchange between two grey surfaces- electrical analogy

**UNIT V HEAT EXCHANGER****9**

Classification- heat exchanger analysis- LMTD for parallel and counter flow exchanger- condenser and evaporator- overall heat transfer coefficient- fouling factor- correction factors for multi pass arrangement- effectiveness and number of transfer unit for parallel and counter flow heat exchanger- introduction of heat pipe and compact heat exchanger.

**TOTAL: 45 PERIODS****COURSE OUTCOMES:**

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

1. Learn the modes of heat transfer for the physical situation
2. Interpret the boundary conditions and analyze problems on conduction heat transfer
3. Apply the concept of free and forced convection heat transfer principles in engineering systems
4. Implement the concept of radiation heat transfer in various systems.
5. Design the heat exchangers and understand the phase change characteristics of fluids.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	2	-	1	-	-	-	-	-	-	1	1	-	-
2	3	1	2	-	1	-	1	-	-	-	-	1	1	-	-
3	3	1	2	-	1	-	1	-	-	-	-	1	1	-	-
4	3	1	2	-	1	-	1	-	-	-	-	1	1	-	-
5	2	1	2	-	1	-	-	-	-	-	-	1	1	-	-
Avg.	2.8	1	2	-	1	-	-	-	-	-	-	1	1	-	-

**TEXT BOOKS:**

1. Nag. P.K., "Heat and Mass Transfer", McGraw Hill, 3<sup>rd</sup> edition, 2011.
2. YunusCengel, "Heat and Mass Transfer: Fundamentals and Application", McGraw Hill, 5<sup>th</sup> edition, 2014.

**REFERENCES:**

1. Dutta, Binay K, "Heat Transfer: Principles and Applications", PHI Publication, 1<sup>st</sup> edition, 2006.
2. Holman. J P, "Heat Transfer", McGraw Hill, 10<sup>th</sup> edition, 2011.
3. Incropera and Dewitt, "Fundamental of Heat and Mass Transfer", Wiley Publication, 7<sup>th</sup> edition.
4. Mills and Ganesan, "Heat Transfer", Pearson Education, 2<sup>nd</sup> edition, 2009.
5. Rajput. R. K, "Heat and Mass Transfer", S.Chand Publication, 2007.

**PR5014****LEAN MANUFACTURING**
**L T P C**  
**3 0 0 3**
**COURSE OBJECTIVES:**

- To understand the basics of lean manufacturing and to identify the industrial waste
- To understand the applications of various tools available in lean manufacturing
- To analyze and apply the tools of lean manufacturing in an organization
- To identify the perfect value creation process and obtain zero waste.
- To Remember and apply the lean manufacturing tools and techniques through case studies.

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**UNIT I INTRODUCTION TO LEAN MANUFACTURING 9**

Conventional Manufacturing versus Lean Manufacturing – Identification and Elimination of wastes in all forms - Principles of Lean Manufacturing – Basic elements of lean manufacturing – Introduction to LM Tools.

**UNIT II CELLULAR MANUFACTURING, JIT AND TPM 9**

Cellular Manufacturing – Types of Layout, Principles of Cell layout, Implementation. JIT – Principles of JIT and Implementation of Kanban. TPM – Pillars of TPM, Principles and implementation of TPM.

**UNIT III SET UP TIME REDUCTION, TQM, 5S AND VSM 9**

Set up time reduction – Definition, philosophies and reduction approaches. TQM – Principles and implementation. 5S Principles and implementation - Value stream mapping - Procedure and principles, EOQ, EPQ.

**UNIT IV SIX SIGMA 9**

Six Sigma – Definition, statistical considerations, variability reduction, design of experiments – Six Sigma implementation

**UNIT V CASE STUDIES 9**

Various case studies of implementation of lean manufacturing at industries.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

1. Understand the need of waste accumulation in various manufacturing process
2. Acquire knowledge about various tools and methods in lean manufacturing
3. Analyze and apply the knowledge of various concepts of TQM, 5S and VSM to reduce manufacturing time.
4. Understand and apply the concepts of Six sigma and Lean Manufacturing
5. Apply the knowledge of Lean manufacturing to case studies in Industries.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	2	2	1	3	-	-	-	-	-	1	3	-	2	1
2	1	2	2	2	3	-	-	-	-	-	2	3	-	2	1
3	1	2	2	3	3	-	-	-	-	-	2	3	-	2	1
4	1	2	2	3	3	-	-	-	-	-	2	3	-	2	1
5	1	2	2	2	3	-	-	-	-	-	1	3	-	2	1
Avg.	1	2	2	2.2	3	-	-	-	-	-	1.6	3	-	2	1

**TEXT BOOKS:**

1. Lonnie Wilson, “How to Implement Lean Manufacturing”, McGraw-Hill Professional; 1 edition, 2009.
2. Ronald G. Askin and Jeffrey B. Goldberg, “Design and Analysis of Lean Production Systems”, John Wiley and Sons, 2003.

**REFERENCES:**

1. Mikell P. Groover, “Automation, Production Systems and Computer-Integrated Manufacturing”, 3<sup>rd</sup> Edition, 2007.
2. Rother M. and Shook J, “Learning to See: Value Stream Mapping to Add Value and Eliminate Muda”, Lean Enterprise Institute, Brookline, MA.1999.
3. William M. Field, “Lean Manufacturing: Tools, Techniques and How to use them”, CRC Press, Taylor and Francis Group, 2000.

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4. Pascal Dennis, Lean Production Simplified- CRC press, 2007.
5. Micheal I George, David Rowlands, Mark Price, John Mazy, Lean Six Sigma, MC-Graw Hill, 2005.

**PR5015**

**NON-DESTRUCTIVE TESTING METHODS**

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

**COURSE OBJECTIVES:**

- Understand principle behind various NDT techniques.
- Learn working procedures of various NDT techniques.
- Understand concepts of NDT in various manufacturing processes.
- Impart knowledge in selection of required NDT for specific applications
- Learn importance of inspection and its techniques.

**UNIT I INTRODUCTION 9**

Introduction to various non-destructive methods – need for inspection – types of inspection systems – quality of inspection – conditions for effective Non-destructive testing – Comparison of Destructive and Non destructive Tests, Visual Inspection, Optical aids used for visual inspection, Applications – benefits of Non-destructive testing.

**UNIT II LIQUID PENETRANT TESTING AND MAGNETIC PARTICLE TESTING 9**

Physical principles, procedure for penetrant testing, Penetrant testing materials, Penetrant testing methods – Applications Principle of MPT, Magnetising technique and procedure used for testing a component, Equipment used for MPT, Applications

**UNIT III EDDY CURRENT TESTING AND ACOUSTIC EMISSION TESTING 9**

Principles, Instrumentation for ECT, Various Techniques – High sensitivity Techniques, Single, Multi and high frequency ECT, Applications Principle of AET, AE signal parameters, Applications.

**UNIT IV ULTRASONIC TESTING 9**

Principle, Ultrasonic transducers, Inspection Methods – Normal incident pulse-echo Inspection, through – transmission testing, angle Beam Pulse-echo testing, Techniques A-Scan, B-Scan , C-Scan – Applications.

**UNIT V RADIOGRAPHY, COMPARISON AND SELECTION OF NDT METHODS 9**

Basic principle, Effect of radiation of Film, Thermography-Radiographic Imaging – Inspection Techniques – Single wall single image, Double wall Penetration and Multiwall Penetration technique – Comparison and selection of various NDT techniques.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

1. Classify different NDT methods based on their applications and distinguish NDT methods and mechanical testing methods.
2. Explain the principles and procedures of liquid penetrant testing and magnetic particle testing and discuss the interpretation of results for both methods
3. Explain the techniques thermography, eddy current testing and discuss their advantages and limitations
4. Summarize ultrasonic testing and the acoustic emission technique, including their principles, parameters, and applications.
5. Discuss radiography principles and imaging techniques and Design the NDT System for specific application

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**TEXT BOOKS:**

1. Baldev Raj, Jeyakumar. T, Thavasimuthu. M., "Practical Non-Destructive Testing", Narosa Publishing house, New Delhi, 3<sup>rd</sup> edition, 2015.
2. Peter J. Shull, "Non Destructive Evaluation: Theory, Techniques and Application",
3. Marcel Dekker, Inc., New York, 2<sup>nd</sup> edition, 2002

**REFERENCES:**

1. Baldev Raj and B.Venkataraman, "Practical Radiology", Narosa Publishing House,2011.
2. Birchan.B, "Non-Destructive Testing", Oxford, London, 1975.
3. Krautkramer.J, "Ultrasonic Testing of Materials", 4<sup>th</sup> Edition, Springer – Verlag Publication, New York, 1996.
4. Prasat.J and Nair C.G.K, " Non Destructive Test and Evaluation of Materials, Tata MacGraw Hill Education, 2<sup>nd</sup> Edition, 2011.
5. Raj.B, Jayakumar.T and Thavasamuthu. M, "Practical Non Destructive Testing", Alpha Science Internationals Limited, 3rd Edition,2002.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	1	-	1	-	-	-	1	-	2	1	-	1
2	2	1	-	1	-	1	-	-	-	1	-	2	1	-	2
3	2	1	-	1	-	1	-	-	-	1	-	2	1	-	2
4	2	1	-	1	-	1	-	-	-	1	-	2	1	-	2
5	2	1	-	1	-	1	-	-	-	1	-	2	1	-	2
Avg.	2	1	-	1	-	1	-	-	-	1	-	2	1.0	-	1.8

PR5071

**PROCESSING OF PLASTICS AND POLYMERS****L T P C  
3 0 0 3****COURSE OBJECTIVES:**

- To remember and understand the various types of plastics and their applications.
- To explore the basics of polymers and their applications
- To impart and apply knowledge about various plastic and polymer processing techniques.
- To enlighten the students about the various polymer mixing and blending techniques.
- To understand the properties of polymers and its testing methods.

**UNIT I INTRODUCTION TO PLASTICS****9**

Plastics – Classification – Structure – Properties of Thermo plastics – Properties of Thermosetting Plastics – Engineering Plastics, Specialty Plastics and High temperature plastics. Properties and application of Epoxy, polyester, PMMA, PEEK, Poly propylene, polyimide, phenolics, polyetherimide – Merits and Disadvantages.

**UNIT II INTRODUCTION TO POLYMERS****9**

Chemistry and Classification of Polymers – Glass transition temperature, thermal expansion and its effects, molecular weight, stress strain behaviour. Types of polymers - plastics and rubbers . Applications of various types of polymers.

**UNIT III PROCESSING OF PLASTICS AND POLYMERS****9**

Extrusion - Injection Moulding –Thermoforming – Compression moulding - Transfer moulding – Blow molding - reaction injection molding - pultrusion – calendaring - rotational molding - Rubber processing in two-roll mill, internal mixer.



**UNIT IV POLYMER MIXING AND BLENDING****9**

Introduction - mechanism of mixing and dispersion - mixing of solid-solid - liquid-liquid and liquids-solids - dispersive mixing distributive mixing - laminar mixing - overview of polymer mixing and blending machinery.

**UNIT V POLYMER TESTING****9**

Mechanical-static and dynamic: tensile, flexural, compressive, abrasion, endurance, fatigue, hardness, tears, resilience, impact, toughness. Conductivity-thermal and electrical, dielectric constant, dissipation factor, power factor, electric resistance, Surface resistivity, volume resistivity, swelling, ageing resistance, environmental stress, Cracking resistance.

**TOTAL: 45 PERIODS****COURSE OUTCOMES:**

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

1. Acquire knowledge of various plastics and their applications.
2. Understand the different types of polymers and their applications.
3. Analyze and apply the knowledge to select the appropriate method to process a plastics or polymers.
4. Remember the impact on properties and accordingly appropriate polymer mixing and blending techniques should be chosen.
5. Evaluate the properties of polymers through suitable testing methods.

**TEXT BOOKS:**

1. Brent Strong. A, "Plastics Materials and Processing", Pearson Prentice Hall, Inc., New Jersey, 3rd Edition, 2005.
2. Jean-Michel Charrier, "Polymer materials and Processing: Plastics, Elastomers, and Composites", Hanser Publishing, Munich Vienna New York, 1990.

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1. Krishan K Chawla, "Composite Material Science and Engineering", Third Edition, Springer, 2013.
2. HoralBelofsky, "Plastics Product design and Process Engineering", Hanser Publications, 2002.
3. Charles A. Harper, "Modern Plastics Handbook", McGraw-Hill, New York, 2000.
4. Anand. J.S, "Applications of Plastics", CIPET, Chennai, 1997.
5. B.R. Gupta, "Polymer Processing Technology", Asian Books Pvt. Ltd, 2008

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	-	-	2	2	3	3	3	-	-	-	3	3	-	3
2	2	-	-	2	2	3	3	3	-	-	-	3	3	-	3
3	1	-	-	2	2	3	3	3	-	-	-	3	3	-	3
4	1	-	-	2	2	3	3	3	-	-	-	3	3	-	3
5	3	-	-	2	2	3	3	3	-	-	-	3	3	-	3
Avg.	1.6	-	-	2	2	3	3	3	-	-	-	3	3	-	3

**PR5016****PROCESSING OF COMPOSITES****L T P C  
3 0 0 3****COURSE OBJECTIVES:**

- To impart the knowledge about the different types of fibres and matrix materials
- To understand the different polymer matrix composites processing methods and their applications for suitable production

- To create knowledge on various metal matrix composite processing methods
- To apply knowledge on selection of appropriate processing technique for ceramic matrix composite component production.
- To introduce the concept of composites and its composites.

**UNIT I COMPOSITES 9**

Definition and fundamentals of composites– need for composites – enhancement of properties - Reinforcement, classification, general characteristics, rule of mixture – Theory of composites – Mechanical behavior – Stress strain relationships. Applications of various types of composites.

**UNIT II FIBRES AND MATRIX MATERIALS 9**

Fibres – Types, Fabrication, Structure, properties and applications – Glass, Boron, carbon, polyethylene, Kevlar, Aramid, Alumina, SiC, Si<sub>3</sub>N<sub>4</sub>, B<sub>4</sub>C, ceramic and metallic fibers whiskers – Matrix materials structure – Polymers – metals and ceramics – Physical and chemical properties.

**UNIT III POLYMER MATRIX COMPOSITES 9**

Open mould process, bag moulding, Hand layup and spray up techniques filament winding, compression and transfer moulding, BMC and SMC– pultrusion – centrifugal casting – injection moulding – structure, properties and application of PMC’s – Carbon Matrix Composites – Interfaces – Properties – recycling of PMC.

**UNIT IV METAL MATRIX COMPOSITES 9**

Processing of MMCs: Types, Important metallic materials, Processing – solid state, Liquid state, deposition, insitu fabrication methods. Interfaces – diffusion bonding – powder metallurgy technique - properties - Applications.

**UNIT V CERAMIC MATRIX COMPOSITES 9**

Ceramic matrix materials – Processing – Hot pressing, liquid infiltration techniques lanxide process, Insitu, solgel, chemical reaction techniques - CVD, CVI process. Interface in CMCs. Thermal shock resistance. Applications. Properties. Surface treatment.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

1. Understand the need of composites for suitable application.
2. Acquire Knowledge about various types of fibres and matrix materials.
3. Have exposure to various polymer matrix composites and their processing methods.
4. Analyze and apply knowledge on selection of suitable processing method of metal matrix composites fabrication among various types.
5. Understand the various ceramic matrix composites processing techniques.

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

**TEXT BOOKS:**

1. Mallick P.K., "Fiber-Reinforced Composites: Materials, Manufacturing, and Design", Third Edition, CRC Press, Taylor & Francis group, 2007.
2. Krishan K Chawla, "Composite materials science and engineering", Third Edition, Springer, 2013.

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1. Chawla K.K. "Composite Materials", Springer Verlag, 2013
2. Kenneth, Budinski G and Michael K. Budinski, "Engineering Materials", Prentice Hall of India pvt ltd., 4th Indian reprint, 2010
3. Mathews F.L. and Rawlings R.D., "Composite materials, Engineering and Science", Chapman. Woodhead Publishing, 1999.
4. Strong. B, "Fundamentals of composite manufacturing", SME, 2008
5. Sharma. S.C, "Composite materials", Narosa publications, 2000
6. Weatherhead R.G. "FRP technology" (Fibre Reinforced Resin System), Applied Science Publishers Limited, London, 2012

PR5017

SMART MATERIALS FOR MANUFACTURING

L T P C

3 0 0 3

## COURSE OBJECTIVES:

- To introduce the basic concepts of smart material for shape memory, counteracting wear and energy generation as well as storage
- To understand the mechanism by which smart materials enhance performance of mechanical/energy transmission
- To outline smart manufacturing system for efficient mechanical and/ or energy transmission
- To analyze and optimize smart manufacturing system.
- To analyze and optimize energy generation and storage.

### UNIT I SHAPE MEMORY ALLOYS

9

Shape Memory Alloys – Introduction, one way memory effect, two way memory effect – Types (copper-aluminium-nickel, and nickel-titanium (Ni-Ti) alloys), manufacturing methods, properties, crystal structures, applications and limitations.

### UNIT II CUTTING FLUIDS

9

Cutting Fluids – definition, types - oil, water, emulsion fluid as coolant and lubricant, selection parameters for cutting fluids, functions of cutting fluid- shear – strength reduction mechanism, applications, Smart Fluids – introduction, applications - Magnetorheological fluids (MR Fluids), preparation of demineralized water (ion exchange method and permanganate method).

### UNIT III ELECTROCHEMICAL ENERGY SYSTEMS

9

Electrochemical cell, definition, types – difference between a galvanic cell and an electrolytic cell – a Daniel cell – electrochemical cell notations – the origin of the electrode potential – measurement of electrode potential – derivation of Nernst equation – applications (EMF measurement) – Electrodes – types – ion selective electrodes – principle and applications – reference electrode – primary and secondary electrodes – Determination of pH of a solution using glass and calomel electrodes – concentration cells – types and applications.

### UNIT IV WEAR MECHANISM

9

Wear – definition, stages of wear (primary, secondary, tertiary), types – adhesive, abrasive, surface fatigue, fretting, erosion wear, measurement – Tribometry (Pin/ball on disc method), control of wear – Lubrication – theory, mechanism, types of lubricants (liquid, semi-solid, solid and gaseous), selection of lubricants.

### UNIT V BATTERY TECHNOLOGY AND ENERGY SOURCES

9

Battery technology: Principle, characteristics – classification – applications – Dry cells, Lead - acid, alkaline, Nickel – cadmium and Lithium batteries, discharging and recharging mechanism. Fuel cells – merits – types – H<sub>2</sub> – O<sub>2</sub> Fuel cells, alkaline fuel cells, PEMFC, MCFC, SOFC. Alternate energy sources – nuclear energy, hydro energy, wind energy, bio energy and solar cells, UPS.

TOTAL: 45 PERIODS

## COURSE OUTCOMES:

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

1. Recall concepts of smart material for shape memory, counteracting wear and energy generation as well as storage
2. Explain the mechanism by which smart materials enhance performance of mechanical/energy transmission
3. Examine smart manufacturing system for efficient mechanical and/ or energy transmission
4. Analyze and optimize smart manufacturing system.
5. Compare and contrast the various energy generation and storage system.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	-	-	-	-	-	2	-	-	2	-	2
2	2	1	-	-	-	-	-	-	-	2	-	1	2	1	2
3	1	1	-	-	-	-	-	-	-	2	-	1	2	1	2
4	2	1	-	-	-	1	-	-	-	2	-	1	2	-	1
5	1	1	-	-	-	-	1	-	-	2	-	1	2	1	3
Avg.	1.6	1	-	-	-	1	1	-	-	2	-	1	2	1	2

#### TEXT BOOKS:

1. Kannan P, Ravikrishnan A, "Engineering Chemistry", Sri Krishna Hitech Publishing Company Pvt. Ltd. Chennai, Revised Edition, 2014.
2. Jain P.C. and Monika Jain., "Engineering Chemistry", Dhanpat Rai Publishing Company Pvt Ltd, New Delhi, Revised Paper Back edition, 2014.

#### REFERENCES:

1. Sivasankar, B., "Engineering Chemistry", Tata McGraw-Hill Publications Co Ltd, New Delhi, 1<sup>st</sup> edition, 2008.
2. Sharma, B. K., "Engineering Chemistry", Krishna Prakasan Media Pvt Ltd., Meerut, 7<sup>th</sup> edition, 2005.
3. Alexander Thaler, Daniel Watzenig, "Automotive Battery Technology", Springer International Publishing 2014.
4. Dara S.S, Umare S.S., "Engineering Chemistry", S. Chand and Company Ltd., New Delhi, 1<sup>st</sup> edition, 2014.
5. Vairam S, Kalyani P and Subaramesh., "Engineering Chemistry", Wiley India PvtLtd., New Delhi, 2011.

PR5018

CORROSION ENGINEERING

L T P C  
3 0 0 3

#### COURSE OBJECTIVES:

- To introduce various types of corrosion and its mechanism
- To provide knowledge about various methods to prevent or control corrosion
- To familiarize about refractories – characterization, classification and properties
- To outline different metallic and non-metallic coating processes its application, advantage and limitation
- To provide fundamental knowledge on working principle and application of different surface characterization techniques.

#### UNIT I CORROSION AND ITS CONTROL

9

Introduction- chemical and electrochemical corrosions- mechanism of electrochemical and galvanic corrosions- concentration cell corrosion- passivity-Pourbaix diagram- soil, pitting, intergranular, water line, stress and microbiological corrosions- galvanic series- factors influencing corrosion - measurement of corrosion rate. Corrosion control – material selection and design - electrochemical protection – sacrificial anodic protection and impressed current cathodic protection.

**UNIT II HOT CORROSION AND REFRACTORIES 9**

Oxidation, sulfidation and carbonization. Ellingham diagram, Hot corrosion— Coatings for combustion; Refractories- characteristics, classification, properties – refractoriness and Refractoriness Under Load (RUL), dimensional stability, thermal spalling, thermal expansion, porosity; acidic refractories – fire clay, silica; basic refractories – magnesite, dolomite; neutral refractories – silicon carbide, zirconia.

**UNIT III METALLIC COATINGS 9**

Definition – methods of metallic coating, hot dipping - galvanizing, tinning, metal cladding, electroplating, electroless plating. Various other metallic coatings – displacement plating- Kanigen process – metal spraying or metallised coating – cementation or diffusion coatings.

**UNIT IV CHEMICAL CONVERSION AND ORGANIC COATINGS 9**

Chemical Conversion coatings- Types- phosphate, chromate, chemical oxide and anodized (Aluminium) coatings -Organic coatings- paint, vehicle or drying oil, thinners, driers- Formulation of paints, failure of paint film- Varnishes, Enamels, Lacquers, Epicoating, Emulsion Paints-types, advantages and disadvantages – Special paint.

**UNIT V SURFACE CHARACTERIZATION 9**

Surface–Interface–Bulk– Principle- instrumentation- block diagram-data analysis and applications of Scanning Electron Microscopy (SEM) and Transmission electron microscopy (TEM) – X-ray diffraction (XRD) -Atomic Force Microscopy (AFM), Surface Analysis by Brunauer–Emmett–Teller (BET) Method – X-Ray Photoelectron Spectroscopy, Surface coating thickness measurements, Surface Profilometry, Contact Angle.

**TOTAL: 45 PERIODS****COURSE OUTCOMES:**

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

1. Describe various types of corrosion and its mechanism
2. Identify and select suitable methods to prevent or control corrosion
3. Describe refractories based on characteristic, types and properties
4. Compare and select different metallic and non-metallic coating processes based on application, advantages and limitations
5. Explain different methods of surface characterization and identify suitable technique based on requirement

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	-	-	-	-	-	-	-	-	1	-	-	1	1	1
2	1	1	-	-	-	1	-	-	-	1	-	1	1	1	2
3	1	-	-	-	-	-	-	-	-	1	-	-	1	1	1
4	1	-	-	-	-	-	-	-	-	1	-	-	1	1	1
5	1	-	-	-	-	1	-	-	-	1	-	-	1	1	2
Avg.	1	1	-	-	-	1	-	-	-	1	-	-	1	1	1.4

**TEXT BOOKS:**

1. Balasubramaniam. R, "Environmental Degradation of Materials", Cengage International, 2010.
2. Denny A. Jones," Principles and Prevention of Corrosion", 2nd Edition, Prentice Hall, 1995.

**REFERENCES:**

1. David Talbot, James Talbot, "Corrosion Science and Technology", CRC Press, 1998.
2. Mars. G. Fontana," Corrosion Engineering", 3rd ed., TMH.2010.

3. Pierre R. Roberge, "Corrosion Basics: An Introduction", 2nd Edition, NACE Press, Book, 2006.
4. Uhlig, H.H. and Revie, W., "Corrosion and Corrosion Control", Wiley, New York, 2007.
5. Jamal Takadoum, "Materials and Surface Engineering in Tribology", Wiley Publications, 2008.

**GE5071**

**DISASTER MANAGEMENT**

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

**COURSE OBJECTIVES:**

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

**UNIT I INTRODUCTION TO DISASTERS 9**

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

**UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9**

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

**UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9**

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

**UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9**

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

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

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

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

1. Differentiate the types of disasters, causes and their impact on environment and society
2. Assess vulnerability and various methods of risk reduction measures as well as mitigation.

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3. Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	-	-	-	-	-	-	-	-	1	-	-	1	1	1
2	1	1	-	-	-	1	-	-	-	1	-	1	1	1	2
3	1	-	-	-	-	-	-	-	-	1	-	-	1	1	1
Avg.	1	1	-	-	-	1	-	-	-	1	-	-	1	1	1.4

#### TEXT BOOKS:

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

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

GE5351

ENGINEERING ETHICS AND HUMAN VALUES

L T P C  
3 0 0 3

#### COURSE OBJECTIVES

- To emphasize into awareness on Engineering Ethics and Human Values.
- To understand social responsibility of an engineer.
- To appreciate ethical dilemma while discharging duties in professional life.
- To understand the various safety measures in industry.
- To understand the various global issues.

#### UNIT I HUMAN VALUES

9

Morals, Values and Ethics – Integrity – Work Ethic – Honesty – Courage –Empathy – Self Confidence – Discrimination- Character.

#### UNIT II ENGINEERING ETHICS

9

Senses of 'Engineering Ethics' - variety of moral issues - types of inquiry - moral dilemmas – moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest –Professional Ideals and Virtues - Issues of ethical theories. Valuing Time – Co-operation – Commitment.

#### UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION

9

Engineering as experimentation - engineers as responsible experimenters - codes of ethics – Importance of Industrial Standards - a balanced outlook on law – anticorruption- occupational crime -the challenger case study.

#### UNIT IV ENGINEER'S RIGHTS AND RESPONSIBILITIES ON SAFETY

9

Collegiality and loyalty – Respect for authority – Collective Bargaining – Confidentiality- Conflict of interest – Occupational Crime – Professional Rights – IPR- Safety and risk - assessment of safety

and risk - risk benefit analysis and reducing risk - the Three Mile Island, Bhopal Gas plant and Chernobyl as case studies.

## UNIT V GLOBAL ISSUES

9

Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors –moral leadership-Sample code of conduct.

**TOTAL: 45 PERIODS**

### COURSE OUTCOMES

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

1. Perform with professionalism in industry
2. Understand the various ethics in industry
3. Understand their rights, legal, ethical issues
4. Understand the responsibilities pertaining to engineering profession
5. Engage in life-long learning with knowledge of contemporary issues

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

### TEXT BOOKS

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York 2005.
2. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Learning, United States, 2000
3. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

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3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford Press , 2000.
5. R.Subramanian , "Professional Ethics ",Oxford University Press ,Reprint ,2015.

**GE5072**

**HUMAN RIGHTS**

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

### COURSE OBJECTIVES

The course aims to

- To make students learn about the concept and regulation of human rights
- To make students aware about the constitutional human rights

## UNIT I INTRODUCTION TO HUMAN RIGHTS

9

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



<b>UNIT II</b>	<b>REGULATIONS IN HUMAN RIGHTS</b>	<b>9</b>
Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.		
<b>UNIT III</b>	<b>MONITORING AGENCIES</b>	<b>9</b>
Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.		
<b>UNIT IV</b>	<b>HUMAN RIGHTS-INDIAN PERSPECTIVE</b>	<b>9</b>
Human Rights in India – Constitutional Provisions / Guarantees.		
<b>UNIT V</b>	<b>IMPLEMENTATION OF HUMAN RIGHTS IN VARIOUS SCENARIO</b>	<b>9</b>
Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.		

**TOTAL : 45 PERIODS**

### OUTCOMES

At the end of the course the students will be able to

1. Gain and apply the knowledge using computers for various manufacturing activities
2. Employ the most suitable material handling equipment to accomplish the given task
3. Employ the principles of cellular manufacturing
4. Gain and apply the knowledge using flexible manufacturing system
5. Evaluate the functions of shop floor control and associated systems.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
<b>1</b>	2	-	-	-	-	3	2	2	2	1	-	2	-	1	1
<b>2</b>	2	-	-	-	-	3	2	2	2	1	-	2	-	1	1
<b>3</b>	2	-	-	-	-	3	2	2	2	1	-	2	-	1	1
<b>4</b>	2	-	-	-	-	3	2	2	2	1	-	2	-	1	1
<b>5</b>	2	-	-	-	-	3	2	2	2	1	-	2	-	1	1
<b>Avg.</b>	2	-	-	-	-	3	2	2	2	1	-	2	-	1	1

### REFERENCES

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

**PR5019**

**ELECTRONIC MATERIALS AND PROCESSING**

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

### COURSE OBJECTIVES:

- Define the standards and legislation of modern electronics and also the concepts in electronics materials, products design and development, assembly and applications.
- Explain the standards, concepts in materials, design, assembly and application.
- Illustrate the standards need to be followed, materials need to be selected and technology for product design and development, assembly, recycling for an application. *Attested*
- Analyze the available standards, select the material, technology, Product design and development for green electronics application.

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- Implement the green electronics concepts by the way of selecting appropriate standards, materials, product design and development for green electronics application.

**UNIT I INTRODUCTION TO ELECTRONIC MATERIALS 9**

Overview of Semiconductors and Other Basic Materials - Plastics, Elastomers, and Composites - Tables with Material Properties, Terms and Definitions, Trade Names, and Material Structure Correlation, Basic Electronic Components and Its Metallurgical Structure. Carrier Generation and Recombination; Junctions; Photovoltaic Materials and Devices

**UNIT II ORGANIC MATERIALS AND PROCESSES 9**

Types and Properties of Organic Materials, Manufacturing Technique – Vacuum Metallization, Vapour Phase Deposition, Thermal Imaging, Digital Lithography, Application Areas.

**UNIT III MEMS MATERIALS AND PROCESS 9**

MEMS Design Process - Methods, Selection of Materials for Process, Optimization Techniques in Design, Overview of Additive Process of Semiconductors, Dielectric Materials, Metals, and Polymer Materials, Piezoelectric Materials, Shape Memory Alloys, Micromachining Techniques, Packaging Methods.

**UNIT IV PACKAGING AND ASSEMBLY OF ELECTRONICS 9**

Solder Technologies for Electronic Packaging and Assembly, Electroplating and Deposited Metallic Coatings, Printed Circuit Board Fabrication, Materials and Processes for Hybrid Microelectronics and Multichip Modules - Adhesives under Fills, and Coatings in Electronics Assemblies.

**UNIT V THERMAL MANAGEMENT OF MATERIALS AND SYSTEMS 9**

Temperature Effects on Circuit Operation and Physical Construction. Laws of Heat Transfer Mechanism and Their Considerations in the Manufacturing Process. Thermal Management in Packaging of Electronic Materials.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

1. Reproduce the standards, concepts of electronics materials, steps in product design and development technology, concepts in assembly for an application.
2. Describe the standards, concepts in materials, design, and assembly for a green electronics application
3. Study the effect of temperature effect based on material, design and packaging
4. Apply the knowledge to select the standards, material selection, product design and development, assembly and recycling for an application.
5. Compare the standards, materials, technology for product design and development, assembly and recycling steps for an application

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

**TEXT BOOKS:**

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

*revised*

## REFERENCES:

1. Hagen Klauk, Organic Electronics, "Materials, Manufacturing and Applications", Wiley - VCH VerlagGmbh and Co, 2006.
2. Merrill L. Minges, "Electronic Materials Handbook", ASM international, 1989.
3. Franky So, "Organic Electronics: Materials, Processing, Devices and Applications", CRC Press, 2009.
4. Eugene A. Irene, "Electronic Material Science and Surfaces, Interfaces, and Thin Films for Microelectronics", Wiley-Blackwell, 2008.
5. James R. Chelikowsk, "Electronic Materials: A New Era in Materials Science", Springer, 1991.

## PR5020 MICRO ELECTRO MECHANICAL SYSTEMS AND NANO TECHNOLOGY

L T P C  
3 0 0 3

### COURSE OBJECTIVES:

- To relate the changes in properties of materials with dimension reduction and introduce to building materials for MEMS.
- To classify and introduce the concepts of the microfabrication processes/ nanomaterial synthesis applicable for MEMS.
- To recall and consider ignored factors in conventional design of micro-sensors, micro-actuators and MEMS devices.
- To understand the principles of typical MEMS sensors, actuators and devices.
- To justify the choice material, microfabrication, packaging and testing of typical MEMS devices.

### UNIT I EFFECT OF MINIATURISATION AND MATERIALS FOR MEMS 9

Definition – historical development – fundamentals – Scaling laws in miniaturization – Rigid Body dynamics, Electrostatic Forces, Electromagnetic properties, Electricity, diffusion property, optical property and Heat Transfer, Materials for MEMS and Microsystems – Si, Si compounds, Si Piezo resistors, GaAs, Quartz, Piezoelectric Crystals and Polymers – Doping of semiconductors – diffusion process.

### UNIT II MICRO-FABRICATION PROCESSES 9

Photolithography – photo resist applications, light sources and post baking – Ion implantation – diffusion process – oxidation – thermal oxidation, silicon dioxide, oxidation rate, oxide thickness by colour – chemical vapour deposition – enhanced CVD – Physical vapour deposition – sputtering – deposition by epitaxy – etching – chemical and plasma etching. Bulk micro manufacturing – wet etching, dry etching and etch stop – surface micromachining – LIGA process – SLIGA process.

### UNIT III MICROSYSTEM – WORKING PRINCIPLE AND PACKAGING 9

Micro sensors – Optical, Pressure, Acoustic wave and Thermal sensors – Micro actuation – thermal forces, shape memory alloys, piezoelectric crystals and Electrostatic Forces – MEMS with micro actuators – Micro gripper, Micro motor, micro valves and micro pumps – Micro accelerometers – Microfluidics – micro mirror array for video projection – Microsystem packaging – die level, device level and system level – Interfaces – Die preparation – surface bonding- wire bonding – sealing – Assembly of Microsystems – selection of packaging materials – signal mapping and transduction – pressure sensors packaging.

### UNIT IV MICROSYSTEMS DESIGN 9

Static bending of thin plates – Mechanical Vibration – thin film mechanics – Design considerations – constraints, selection of materials, selection of Manufacturing processes, selection of signal transduction, electromechanical system and packaging – Process design – Mechanical Design Thermomechanical loading, Thermomechanical stress analysis, Dynamic Analysis and Interfacial fracture Analysis – simulation of Microfabrication process – Design of a Si die for a micro pressure sensor – Fluid resistance in Micro channels – capillary electrophoresis network systems – Design of MEMS cell gripper – Micro Optical Electro Mechanical System – Complementary Metal Oxide Semiconductor.

Attested

**UNIT V NANO TECHNOLOGY****9**

Classification of nano structures – effect of the nanometer length scale effects of nano scale dimensions on various properties – structural, thermal, chemical, mechanical, magnetic, optical and electronic properties –Fabrication methods – Top down processes – bottom up processes – nano positioning systems.

**TOTAL: 45 PERIODS****COURSE OUTCOMES:**

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

1. Understand the changes in properties of materials with reduction of dimensions by Scaling laws and list of materials for building MEMS devices.
2. Explain the various microfabrication/nanomaterial synthesis applicable for MEMS fabrication.
3. Apply conventional design with factors pertaining to micro-sensors, micro-actuators and MEMS devices.
4. Inference on the principles of typical MEMS sensors, actuators and devices.
5. Choose the appropriate material, microfabrication, packaging and testing of typical MEMS devices.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	-	-	-	-	-	-	-	-	2	-		2	-	1
2	2	1	-	-	-	-	-	-	-	2	-	2	2	1	2
3	2	1	-	-	-	-	-	-	-	2	-	1	3	-	1
4	2	1	-	-	-	-	-	-	-	2	-	1	3	1	1
5	1	-	-	-	-	-	-	-	-	2	-	2	1	-	2
Avg.	1.6	1	-	-	-	-	-	-	-	2	-	1.5	2.2	1	1.4

**TEXT BOOKS:**

1. Mahalik N P, MEMS, McGraw Hill (India), 2009
2. Tai– Ran Hsu, “MEMS and Microsystems Design and Manufacture”, Tata-McGraw Hill, New Delhi, 2007.

**REFERENCES:**

1. Ananthasuresh G.K. Vinoy K.J. Gopalakrishnan S. Bhat K.N and Aatre V.K., “Microand smart systems”, Wiley India Pvt. Ltd., New Delhi, 2010
2. Charles P Poole, Frank J Owens, “Introduction to Nano Technology”, John Wiley and Sons, 2003
3. Julian W. Hardner, “Micro Sensors, Principles and Applications”, CRC Press 1993.
4. Marc Madou , Fundamentals of Micro fabrication, CRC Press, New York, 2011.
5. Mark Madou, “Fundamentals of Microfabrication”, CRC Press, New York, 1997.

**PR5021 TOTAL QUALITY MANAGEMENT: PRINCIPLES AND APPLICATIONS L T P C**  
**3 0 0 3**

**COURSE OBJECTIVES:**

- To introduce the basic needs and evaluation of quality in industry
- To understand the quality statements and principles in Total quality management.
- To familiarize about the tools and techniques for quality control.
- To learn and understand the TQM tools for Continuous Process improvement.
- To analyze the importance of Quality systems and ISO in Industries.

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**UNIT I INTRODUCTION****9**

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality - Basic concepts of TQM – TQM Framework - Barriers to TQM Contributions of Quality Gurus —Deming’s 14 point principles – Crosby’s 14 point principles – Juran Trilogy

**UNIT II TQM PRINCIPLES****9**

Quality statements - Customer focus –Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Continuous process improvement – PDCA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

**UNIT III TOOLS & TECHNIQUES I****9**

The seven traditional tools of quality- Histogram – Pareto diagram – Cause and effect diagram – Flow charts –Check sheet – Scatter diagram – Quality control charts – The seven new tools of quality – Why-why analysis - Affinity diagram – Interrelationship digraph - Tree diagram - Prioritization matrix - Process decision program chart - Activity network diagram

**UNIT IV TOOLS & TECHNIQUES II****9**

Quality circles – Quality Function Deployment (QFD) – Taguchi methodology – Total Productive Maintenance –Concepts – Business Process Reengineering - Six-sigma – Concepts – case studies - Bench marking — Failure Mode and Effect Analysis – Stages, Types.

**UNIT V QUALITY SYSTEMS****9**

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing QS 9000 – ISO 14000 – Concepts, Requirements and Benefits –Quality Council – Leadership, Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward.

**TOTAL: 45 PERIODS****COURSE OUTCOMES:**

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

1. Apply basic need for TQM in Industries.
2. Understand about various principles in TQM
3. Acquire knowledge about TQM Tools and techniques.
4. Analyze the importance of TQM tools for Continuous process improvement
5. To Understand and apply the ISO standards.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	1	2	2	-	-	-	1	1	1	-	-	1	1
2	1	1	1	2	2	-	1	3	1	1	1	-	-	1	1
3	2	1	1	2	2	-	1	3	1	1	1	-	-	1	1
4	2	1	1	3	2	-	1	3	1	3	1	-	-	1	1
5	1	1	1	2	2	1	1	3	1	2	1	-	-	1	1
<b>Avg.</b>	1.4	1	1	2.2	2	1	1	3	1	1.6	1	-	-	1	1

**TEXT BOOKS:**

1. Dale H.Besterfield Carol Besterfield-Michna, Glen H.Besterfield, Mary Besterfield- Sacre, Hemant Urdhwareshe, Rashmi Urdhwareshe, “Total Quality Management, Pearson Publications, 3 rd Edition, 2003.
2. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, Third Edition ,2003.

**REFERENCES:**

1. James R. Evans and William M. Lindsay, “The Management and Control of Quality”, (6thEdition), South-Western (Thomson Learning), 2005.
2. Janakiraman,B and Gopal, R.K, “Total Quality Management – Text and Cases”,Prentice Hall (India) Pvt. Ltd., 2006.

3. Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006 .
4. Chapman and Hall, "Total Quality Management", 2<sup>nd</sup> Edition,1995.
5. P.N .Mukherjee, "Total Quality Management", Prentice- Hall iof India Private Limited, 2006.

**PR5022**

**INTEGRATED PRODUCT DEVELOPMENT**

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

**COURSE OBJECTIVES:**

- To introduce international trends and development methodologies pertaining to diverse products and services,
- To formulate, create prototypes, and construct product management plans for novel products, considering the product type and development methodology while integrating hardware, software, controls, electronics, and mechanical systems
- To comprehend requirement engineering principles and acquire the skills to gather, analyze, and translate requirements for new product development into design specifications
- To apply established product development processes and protocols in order to establish conclusive specifications rooted in customer requirements
- To create documentation, formulate test specifications, and collaborate with diverse teams to validate and sustain engineering customer support activities until End of Life (EOL)

**UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT 9**

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

**UNIT II REQUIREMENTS AND SYSTEM DESIGN 9**

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

**UNIT III DESIGN AND TESTING 9**

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – Challenges in Integration of Engineering Disciplines - Concept Screening & Evaluation - Detailed Design - Component Design and Verification – Mechanical, Electronics and Software Subsystems - High Level Design/Low Level Design 98 of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – Prototyping - Introduction to Rapid Prototyping and Rapid Manufacturing - System Integration, Testing, Certification and Documentation

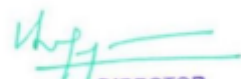
**UNIT IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT 9**

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

**UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9**

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

**TOTAL: 45 PERIODS**

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## COURSE OUTCOMES:

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

1. Students will have to define, shape, and assess challenges associated with developing new products
2. Students will have independently addressed specific challenges or collaborate within a team to find solutions
3. Students will have acquired an understanding of the process of Innovation & Product Development within a business context
4. Students will have demonstrated the ability to function autonomously and collaboratively within teams
5. Students will effectively do a project from its initiation to its completion

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

## TEXT BOOKS:

1. Book specially prepared by NASSCOM as per the MoU.
2. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.

## REFERENCES:

1. Hiriyappa B, "Corporate Strategy – Managing the Business", Author House, 2013.
2. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013
3. Peter F Drucker, "People and Performance", Butterworth – Heinemann [Elsevier], Oxford, 2004.
4. Vinod Kumar Garg and Venkita Krishnan N K, "Enterprise Resource Planning – Concepts", Second Edition, Prentice Hall, 2003.
5. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.

AD5091

CONSTITUTION OF INDIA

L T P C  
3 0 0 0

## COURSE OBJECTIVES:

- Teach history and philosophy of Indian Constitution.
- Describe the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Summarize powers and functions of Indian government.
- Explain emergency rule.
- Explain structure and functions of local administration.

## UNIT I INTRODUCTION

History of Making of the Indian Constitution-Drafting Committee- (Composition & Working) -  
Philosophy of the Indian Constitution-Preamble-Salient Features

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**UNIT II CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES 9**

Fundamental Rights-Right to Equality-Right to Freedom-Right against Exploitation Right to Freedom of Religion-Cultural and Educational Rights-Right to Constitutional Remedies Directive Principles of State Policy-Fundamental Duties

**UNIT III ORGANS OF GOVERNANCE 9**

Parliament-Composition-Qualifications and Disqualifications-Powers and Functions-Executive President-Governor-Council of Ministers-Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions

**UNIT IV EMERGENCY PROVISIONS 9**

Emergency Provisions - National Emergency, President Rule, Financial Emergency

**UNIT V LOCAL ADMINISTRATION 9**

District's Administration head- Role and Importance-Municipalities- Introduction- Mayor and role of Elected Representative-CEO of Municipal Corporation-Pachayati raj- Introduction- PRI- Zila Pachayat-Elected officials and their roles- CEO ZilaPachayat- Position and role-Block level-Organizational Hierarchy (Different departments)-Village level- Role of Elected and Appointed officials-Importance of grass root democracy

**TOTAL: 45 PERIODS****COURSE OUTCOMES:****At the end of the course the students will be able to:**

1. Able to understand history and philosophy of Indian Constitution.
2. Able to understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
3. Able to understand powers and functions of Indian government.
4. Able to understand emergency rule.
5. Able to understand structure and functions of local administration.

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

**TEXTBOOKS:**

1. Basu D D, Introduction to the Constitution of India, Lexis Nexis, 2015.
2. Busi S N, Ambedkar B R framing of Indian Constitution, 1st Edition, 2015.
3. Jain M P, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. The Constitution of India (Bare Act), Government Publication, 1950

**AD5092****VALUE EDUCATION****LT P C  
3 0 0 0****COURSE OBJECTIVES:**

- Develop knowledge of self-development
- Explain the importance of Human values
- Develop the overall personality through value education

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- Overcome the self destructive habits with value education
- Interpret social empowerment with value education

**UNIT I INTRODUCTION TO VALUE EDUCATION 9**

Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation, Standards and principles, Value judgements

**UNIT II IMPORTANCE OF VALUES 9**

Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness. Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline

**UNIT III INFLUENCE OF VALUE EDUCATION 9**

Personality and Behaviour development - Soul and Scientific attitude. Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship Happiness Vs suffering, love for truth.

**UNIT IV REINCARNATION THROUGH VALUE EDUCATION 9**

Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation

**UNIT V VALUE EDUCATION IN SOCIAL EMPOWERMENT 9**

Equality, Non violence, Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

1. Gain knowledge of self-development
2. Learn the importance of Human values
3. Develop the overall personality through value education
4. Overcome the self-destructive habits with value education
5. Interpret social empowerment with value education

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

**REFERENCES:**

1. Chakroborty , S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press ,New Delhi

*Attested*

*[Signature]*  
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**COURSE OBJECTIVES:**

- Understand the methodology of pedagogy.
- Compare pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Infer how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Illustrate the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

**UNIT I INTRODUCTION AND METHODOLOGY:****9**

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

**UNIT II THEMATIC OVERVIEW****9**

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

**UNIT III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES****9**

Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

**UNIT IV PROFESSIONAL DEVELOPMENT****9**

Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

**UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS****9**

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

**TOTAL: 45 PERIODS****COURSE OUTCOMES:**

1. Understand the methodology of pedagogy.
2. Understand Pedagogical practices used by teachers in formal and informal classrooms in developing countries.
3. Find how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
4. Know the factors necessary for professional development.
5. Identify the Research gaps in pedagogy.

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

## REFERENCES:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272-282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

AD5094

STRESS MANAGEMENT BY YOGA

L T P C  
3 0 0 0

### COURSE OBJECTIVES:

- Develop healthy mind in a healthy body thus improving social health also improve efficiency
- Invent Do's and Don't's in life through Yam
- Categorize Do's and Don't's in life through Niyam
- Develop a healthy mind and body through Yog Asans
- Invent breathing techniques through Pranayam

### UNIT I INTRODUCTION TO YOGA

9

Definitions of Eight parts of yog. ( Ashtanga )

### UNIT II YAM

9

Do's and Don't's in life.

Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

### UNIT III NIYAM

9

Do's and Don't's in life.

Ahinsa, satya, astheya, bramhacharya and aparigraha

### UNIT IV ASAN

9

Various yog poses and their benefits for mind & body

### UNIT V PRANAYAM

9

Regularization of breathing techniques and its effects-Types of pranayam

**TOTAL: 45 PERIODS**

### COURSE OUTCOMES:

1. Develop healthy mind in a healthy body thus improving social health also improve efficiency
2. Learn Do's and Don't's in life through Yam
3. Learn Do's and Don't's in life through Niyam
4. Develop a healthy mind and body through Yog Asans
5. Learn breathing techniques through Pranayam

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### REFERENCES:

1. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata
2. 'Yogic Asanas for Group Training-Part-I' : Janardan Swami Yogabhyasi Mandal, Nagpur

**AD5095 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS L T P C  
3 0 0 0**

### COURSE OBJECTIVES:

- Develop basic personality skills holistically
- Develop deep personality skills holistically to achieve happy goals
- Rewrite the responsibilities
- Reframe a person with stable mind, pleasing personality and determination
- Discover wisdom in students

**UNIT I NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - I 9**  
Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue)

**UNIT II NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - II 9**  
Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's)

**UNIT III APPROACH TO DAY TO DAY WORK AND DUTIES 9**  
Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48

**UNIT IV STATEMENTS OF BASIC KNOWLEDGE – I 9**  
Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18

**UNIT V PERSONALITY OF ROLE MODEL - SHRIMAD BHAGWADGEETA 9**  
Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

**TOTAL: 45 PERIODS**

### COURSE OUTCOMES:

1. To develop basic personality skills holistically
2. To develop deep personality skills holistically to achieve happy goals
3. To rewrite the responsibilities
4. To reframe a person with stable mind, pleasing personality and determination
5. To awaken wisdom in students

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## REFERENCES:

1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari's Three Satakam , Niti-sringar-vairagya, New Delhi, 2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016

AD5097

ESSENCE OF INDIAN KNOWLEDGE TRADITION

L T P C

3 0 0 0

## COURSE OBJECTIVES

The course will introduce the students to

- get a knowledge about Indian Culture
- Know Indian Languages and Literature religion and philosophy and the fine arts in India
- Explore the Science and Scientists of Ancient, Medieval and Modern India
- Understand education systems in India

### UNIT I INTRODUCTION TO CULTURE 9

Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India.

### UNIT II INDIAN LANGUAGES AND LITERATURE 9

Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languages and Literature – II: Northern Indian Languages & Literature

### UNIT III RELIGION AND PHILOSOPHY 9

Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only)

### UNIT IV FINE ARTS IN INDIA (ART, TECHNOLOGY & ENGINEERING) 9

Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India

### UNIT V EDUCATION SYSTEM IN INDIA 9

Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India

**TOTAL: 45 PERIODS**

## COURSE OUTCOMES

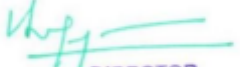
After successful completion of the course the students will be able to

1. Understand philosophy of Indian culture.
2. Distinguish the Indian languages and literature.
3. Learn the philosophy of ancient, medieval and modern India.
4. Acquire the information about the fine arts in India.
5. Know the contribution of scientists of different eras.
6. Understand education systems in India

## REFERENCES:

1. Kapil Kapoor, "Text and Interpretation: The India Tradition", ISBN: 81246033375, 2005

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2. "Science in Samskrit", Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, "Position paper on Arts, Music, Dance and Theatre", ISBN 81-7450 494-X, 200
4. Narain, "Examinations in ancient India", Arya Book Depot, 1993
5. Satya Prakash, "Founders of Sciences in Ancient India", Vijay Kumar Publisher, 1989
6. M. Hiriyanna, "Essentials of Indian Philosophy", Motilal Banarsidass Publishers, ISBN 13: 978- 8120810990, 2014

**AD5098**

**SANGA TAMIL LITERATURE APPRECIATION**

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

**COURSE OBJECTIVES:**

The main learning objective of this course is to make the students an appreciation for:

- Introduction to Sanga Tamil Literature.
- 'Agathinai' and 'Purathinai' in Sanga Tamil Literature.
- 'Attruppadai' in Sanga Tamil Literature.
- 'Puranaanuru' in Sanga Tamil Literature.
- 'Pathitru Paththu' in Sanga Tamil Literature.

**UNIT I SANGA TAMIL LITERATURE AN INTRODUCTION**

**9**

Introduction to Tamil Sangam – History of Tamil Three Sangams – Introduction to Tamil Sangam Literature – Special Branches in Tamil Sangam Literature - Tamil Sangam Literature's Grammar - Tamil Sangam Literature's parables.

**UNIT II 'AGATHINAI' AND 'PURATHINAI'**

**9**

Tholkappiyar's Meaningful Verses – Three literature materials – Agathinai's message - History of Culture from Agathinai – Purathinai – Classification – Message to Society from Purathinai.

**UNIT III 'ATTRUPPADAI'**

**9**

Attruppadai Literature – Attruppadai in 'Puranaanuru' - Attruppadai in 'Pathitru Paththu' – Attruppadai in 'Paththupaattu'.

**UNIT IV 'PURANAANURU'**

**9**

Puranaanuru on Good Administration, Ruler and Subjects – Emotion & its Effect in Puranaanuru.

**UNIT V 'PATHITRUPATHTHU'**

**9**

Pathitru Paththu in 'Ettuthogai' – Pathitru Paththu's Parables – Tamil dynasty: Valor, Administration, Charity in Pathitru Paththu - Message to Society from Pathitru Paththu.

**TOTAL (L: 45) = 45 PERIODS**

**COURSE OUTCOMES:**

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

1. Appreciate and apply the messages in Sanga Tamil Literature in their life.
2. Differentiate 'Agathinai' and 'Purathinai' in their personal and societal life.
3. Appreciate and apply the messages in 'Attruppadai' in their personal and societal life.
4. Appreciate and apply the messages in 'Puranaanuru' in their personal and societal life.
5. Appreciate and apply the messages in 'Pathitru Paththu' in their personal and societal life.

**REFERENCES:**

1. Sivaraja Pillai, The Chronology of the Early Tamils, Sagwan Press, 2018.
2. Hank Heifetz and George L. Hart, The Purananuru, Penguin Books, 2002.
3. Kamil Zvelebil, The Smile of Murugan: On Tamil Literature of South India, Brill Academic Pub, 1997.
4. George L. Hart, Poets of the Tamil Anthologies: Ancient Poems of Love and War, Princeton University Press, 2015.
5. Xavier S. Thani Nayagam, Landscape and poetry: a study of nature in classical Tamil poetry, Asia Pub. House, 1967.

*Attested*

*[Signature]*  
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## HSMC– ELECTIVES – HUMANITIES I (ODD SEMESTER)

HU5171

LANGUAGE AND COMMUNICATION

LT P C  
3 0 0 3

### COURSE DESCRIPTION

This course offers an introduction to language and communication. The primary goal of this course is to familiarize students with key ideas related to communication using language as well as non verbal means. Ideas related to the use of language and the underlying power structures are also examined. The course also examines the role of media in communication and in the dissemination of ideas as well as opinions.

### Objectives

- To familiarize students with the concept of communication using linguistic and non linguistic resources.
- To help students ask critical questions regarding facts and opinions.
- To provide students with the material to discuss issues such as language and power structures.
- To help students think critically about false propaganda and fake news.

### Learning Outcomes

1. Students will be able to use linguistic and non linguistic resources of language in an integrated manner for communication.
2. Students will be able to analyse communication in terms of facts and opinions.
3. Students will be able to discuss, analyse and argue about issues related to language and power.

### UNIT I LINGUISTIC AND NON-LINGUISTIC RESOURCE OF COMMUNICATION: 9

- a) Writing and Speech
- b) Distinction between language structure and language use, form and function, acceptability and grammaticality
- c) Gestures and Body language, pictures and symbols, cultural appropriacy
- d) Communicative Competency, context and situation, combination of linguistic and non-linguistic elements of communication

### UNIT II STRUCTURE OF WRITING/CONVERSATION: 9

- a) Language skills and the communication cycle; speaking and listening, writing and reading
- b) Initiating and closing conversations, intervention, turn taking
- c) Writing for target reader, rhetorical devices and strategies
- d) Coherence and Cohesion in speech and writing

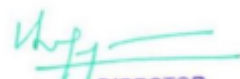
### UNIT III POWER STRUCTURE AND LANGUAGE USE: 9

- a) Gender and language use
- b) Politeness expressions and their use
- c) Ethical dimensions of language use
- d) Language rights as part of human rights

### UNIT IV MEDIA COMMUNICATION: 9

- a) Print media, electronic media, social media

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- b) Power of media
- c) Manufacturing of opinion, fake news and hidden agendas

**UNIT V PERSUASIVE COMMUNICATION AND MISCOMMUNICATION: 9**

- a) Fundamentals of persuasive communication
- b) Persuasive strategies
- c) Communication barriers

**TOTAL : 45 PERIODS**

**TEXT BOOKS:**

1. Austin, 1962, J.L. How to do things with words. Oxford: Clarendon Press. Grice, P.1989. Studies in the way of words. Cambridge, M.A: Harvard University Press.
2. Chomsky, N.1966. Aspects of the theory of syntax, The MIT press, Cambridge. Chomsky, N.2006. Language and Mind, Cambridge University Press.
3. Hymes. D.N. 1972, On communication competence in J.B. Pride and J.Holmes (ed), Sociolinguistics, pp 269-293, London Penguin.
4. Gilbert, H.Harman, 1976. Psychological aspect of the theory of syntax in Journal of Philosophy, page 75-87.
5. Stephen. C. Levenson, 1983, Pragmatics, Cambridge University press.
6. Stangley, J. 2007. Language in Context. Clarendon press, Oxford. 7. Shannon, 1942. A Mathematical Theory of Communication. 8. Searle, J.R. 1969. Speech acts: An essay in the philosophy of language. Cambridge: Cambridge University Press.

**HU5172**

**VALUES AND ETHICS**

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

**OBJECTIVES:**

- Teach definition and classification of values.
- Explain Purusartha.
- Describe Sarvodaya idea.
- Summarize sustenance of life.
- Conclude views of hierarchy of values.

**UNIT I DEFINITION AND CLASSIFICATION OF VALUES 9**

Extrinsic values- Universal and Situational values- Physical- Environmental-Sensuous- Economic-Social-Aesthetic-Moral and Religious values

**UNIT II CONCEPTS RELATED TO VALUES 9**

Purusartha-Virtue- Right- duty- justice- Equality- Love and Good

**UNIT III IDEOLOGY OF SARVODAYA 9**

Egoism- Altruism and universalism- The Ideal of Sarvodaya and Vasudhaiva Kutumbakam

**UNIT IV SUSTENANCE OF LIFE 9**

The Problem of Sustenance of value in the process of Social, Political and Technological Changes

**UNIT V VIEWS ON HIERARCHY OF VALUES 9**

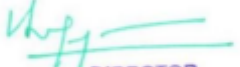
The Problem of hierarchy of values and their choice, The views of Pt. Madan Mohan Malviya and Mahatma Gandhi

**TOTAL: 45 PERIODS**

**OUTCOMES:**

1. Able to understand definition and classification of values.
2. Able to understand purusartha.
3. Able to understand sarvodaya idea.
4. Able to understand sustenance of life.
5. Able to understand views of hierarchy of values.

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Avg.	-	-	-	-	-	-	-	1	1	-	-	1	-	-	-

**TEXT BOOKS:**

1. AwadeshPradhan :MahamanakeVichara. (B.H.U., Vanarasi-2007)
2. Little, William, : An Introduction of Ethics (Allied Publisher, Indian Reprint 1955)
3. William, K Frankena : Ethics (Prentice Hall of India, 1988)

**HU5173**

**HUMAN RELATIONS AT WORK**

**L T P C**

**3 0 0 3**

**OBJECTIVES:**

- Illustrate human relations at work its relationship with self.
- Explain the importance of interacting with people at work to develop teamwork.
- Infer the importance of physical health in maintaining human relations at work.
- Describe the importance of staying psychologically healthy.
- Identify the essential qualities for progressing in career.

**UNIT I UNDERSTANDING AND MANAGING YOURSELF 9**

Human Relations and You: Self-Esteem and Self-Confidence: Self-Motivation and Goal Setting; Emotional Intelligence, Attitudes, and Happiness; Values and Ethics and Problem Solving and Creativity.

**UNIT II DEALING EFFECTIVELY WITH PEOPLE 9**

Communication in the Workplace; Specialized Tactics for Getting Along with Others in the Workplace; Managing Conflict; Becoming an Effective Leader; Motivating Others and Developing Teamwork; Diversity and Cross-Cultural Competence.

**UNIT III STAYING PHYSICALLY HEALTHY 9**

Yoga, Pranayam and Exercise: Aerobic and anaerobic.

**UNIT IV STAYING PSYCHOLOGICALLY HEALTHY 9**

Managing Stress and Personal Problems, Meditation.

**UNIT V DEVELOPING CAREER THRUST 9**

Getting Ahead in Your Career, Learning Strategies, Perception, Life Span Changes, and Developing Good Work Habits.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Students will be able to

1. Understand the importance of self-management.
2. Know how to deal with people to develop teamwork.
3. Know the importance of staying healthy.
4. Know how to manage stress and personal problems.
5. Develop the personal qualities essential for career growth.

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### TEXT BOOK:

1. Dubrien, A. J. (2017). Human Relations for Career and Personal Success: Concepts, Applications, and Skills, 11th Ed. Upper Saddle River, NJ: Pearson.

### REFERENCES:

1. Greenberg, J. S. (2017). Comprehensive stress management (14th edition), New York: McGraw Hill.
2. Udai, Y. (2015). Yogasanaurpranayam. New Delhi: N.S. Publications.

HU5174

PSYCHOLOGICAL PROCESSES

L T P C  
3 0 0 3

### COURSE DESCRIPTION

Psychological Processes course is designed for students to be aware of the basic principles of psychology for the better understanding of people's psyche and behaviour around them. This course enables learners to use the optimal use of different forms of thinking skills and thereby results in effective communication in diverse situations. Every unit of the syllabus highlights the psychological process of people, the most powerful and constructive use of perceptions.

### OBJECTIVES

The major objectives of this course is

- To develop students' awareness – on psychology, learning behavior and usage of perception effectively.
- To learn to use the various kinds of thinking in a formal context.
- To critically evaluate content and comprehend the message on the bases of perception, personality and intelligence.

### UNIT I INTRODUCTION

What is psychology? - Why study psychology? - Psychology as science – Behavior and its role in human communication – socio-cultural bases of behaviour – Biological bases of behavior - Brain and its functions – Principles of Heredity – Cognition and its functions Fields of psychology – Cognitive and Perceptual – Industrial and Organizational.

### UNIT II SENSORY & PERCEPTUAL PROCESSES

Some general properties of Senses: Visual system – the eye, colour vision – Auditory system – Hearing, listening, Sounds - Other senses - Selective attention; physiological correlates of attention; Internal influences on perception learning – set - motivation & emotion - cognitive styles; External influences on perception figure and ground separation – movement – organization – illusion; Internal- external interactions: Constancy - Depth Perception- Binocular & Monocular Perception; Perceptual defense & Perceptual vigilance; Sensory deprivation - Sensory bombardment; ESP - Social Perception.

### **UNIT III COGNITION & AFFECT**

Learning and memory – philosophy of mind – concepts - words – images – semantic features – Association of words – Repetition – Retrieval – Chunking - Schemata - Emotion and motivation – nature and types of motivation – Biological & Psychosocial motivation – nature and types of emotions – physiological & cognitive bases of emotions – expressions of emotions – managing negative emotions - enhancing positive emotions.

### **UNIT IV THINKING, PROBLEM-SOLVING & DECISION MAKING**

Thinking skills – Types of thinking skills – Concrete & Abstract thinking – Convergent & Divergent - Analytical & Creative thinking – Problem & Possibility thinking – Vertical & Lateral thinking – Problem solving skills – stages of problem solving skills – Decision making - intuition and reasoning skills - Thinking and language - The thinking process- concepts, problem solving, decision-making, creative thinking; language communication.

### **UNIT V PERSONALITY & INTELLIGENCE**

Psychological phenomena & Attributes of humans - cognition, motivation, and behavior - thoughts, feelings, perceptions, and actions – personality dimensions, traits, patterns - Specialized knowledge, performance accomplishments, automaticity or ease of functioning, skilled performance under challenge - generative flexibility, and speed of learning or behavior change.

### **REFERENCES**

1. Morgan, C.T. and King, R.A (1994) Introduction to Psychology, Tata McGraw Hill Co Ltd, New Delhi.
2. Robert A. Baron (2002), Psychology, 5th Edition, Prentice Hall, India.
3. Michael W. Passer, Ronald E. Smith (2007), Psychology: The science of mind and Behavior, 3rd Edition Tata McGraw-Hill Edition.
4. Robert S. Feldman (2004) Understanding Psychology 6th Edition Tata McGraw – Hill.
5. Endler, N. S., & Summerfeldt, L. J. (1995). Intelligence, personality, psychopathology, and adjustment. In D. H. Saklofske & M. Zeidner (Eds.). International handbook of personality and intelligence (pp. 249-284). New York: Plenum Press.
6. Ford, M. E. (1994). A living systems approach to the integration of personality and intelligence. In R. J. Sternberg, & P. Ruzgis (Eds.). Personality and intelligence (pp. 188-217). New York: Cambridge University Press.
7. De Bono, E (1990) Lateral Thinking, Harper Perennial, New York.

HU5175

**EDUCATION, TECHNOLOGY AND SOCIETY**

**L T P C**

**PROGRESS THROUGH KNOWLEDGE**

**3 0 0 3**

### **COURSE DESCRIPTION**

This course introduces students to multidisciplinary studies in Education, Technology and Society. Students will get an understanding of the relationship between education, technology and society. They will also learn about the long lasting impact of good education in a technologically advanced society.

### **COURSE OBJECTIVES:**

The course aims

- To help learners understand the basics of different types of technology utilised in the field of education
- To make them realize the impact of education in society
- To make them evolve as responsible citizen in a technologically advanced society

### **LEARNING OUTCOMES**

By the end of the course, learners will be able to

1. Understand the various apps of technology apps and use them to access, generate and present information effectively.
2. Apply technology based resources and other media formats equitably, ethically and legally.

Integrate their technical education for betterment of society as well as their personal life.

### **UNIT I INDIAN EDUCATION SYSTEM**

Gurukul to ICT education – Teacher as facilitator – Macaulay's Minutes – English medium vs Regional medium – Importance of Education in Modern India - Challenges in Education

### **UNIT II LEARNING THEORIES**

Learning Theories – Behaviorism – Cognitivism – Social Constructivism – Humanism Learning Styles – Multiple Intelligences – Emotional Intelligence – Blooms Taxonomy

### **UNIT III TECHNOLOGICAL ADVANCEMENTS**

Web tools – Social media in education – elearning – MOOCs – Mobile assisted learning – Learning Apps – Blended learning - Self-directed learning

### **UNIT IV EDUCATIONAL TECHNOLOGY**

Technological implications on Education – Teaching, Learning & Testing with Technology - Advantages and drawbacks – Critical analysis on the use of technology

### **UNIT V ETHICAL IMPLICATIONS**

Plagiarism – Online Copyright issues – Ethical and value implications of education and technology on individual and society.

**TOTAL:45 PERIODS**

### **TEACHING METHODS**

Teaching modes include guest lectures, discussion groups, presentations, visual media, and a practicum style of learning.

### **EVALUATION**

As this is course is not a content based course, it focuses more on the ethical use of technology in education and society, and so, evaluation can be based on assignments and discussions. So there is no need for an end semester examination. Internals marks can be taken for the total marks.

### **INTERNAL (100 % WEIGHTAGE)**

- (a) Written Test (40 marks)
- (b) Assignment: Write a real time report of the technology use in any school / college (15 marks)
- (c) Presentation: Students choose any one of the technological tools and present its relevance to education and society (15 marks)
- (d) Group discussion: Students discuss in groups on case studies relating to various challenges in education and technology use in society (20 marks)
- (e) Blog entry: Making weekly blog posts in Class Blog on the topics related to the course posted by the instructor and commenting on others' posts. (10 marks)

### **REFERENCES**

- 1) Education and Social order by Bertrand Russel
- 2) Theories of learning by Bower and Hilgard
- 3) Technology and Society by Jan L Harrington

**HU5176**

**PHILOSOPHY**

**LT PC**

**3 0 0 3**

### **OBJECTIVES**

- To create a new understanding by teaching philosophy through a comparison of Indian and Western traditions.
- To Fosters critical thinking and imagination by dealing with inter-related concepts in literature and science.
- To bridge the gap between the sciences and humanities through introspective analyses.
- To nurture an understanding of the self and elucidates ways to progress towards a higher understanding of one's self and others.

**UNIT I KNOWLEDGE****9**

Knowledge (Vidya) Versus Ignorance (Avidya)- Brihadaranyaka Upanishad. Unity and Multiplicity – Isha Upanishad. What is True Knowledge? Ways to True Knowledge. Introduction to Philosophy of Yoga, Socratic Debate, Plato's Views. Asking and Answering Questions to Stimulate Critical Thinking and to Draw Ideas. Argumentative Dialogues. Dialectical Methods to Arrive at Conclusions.

**UNIT II ORIGIN****9**

Origin of Universe And Creation – 'Nasidiya Sukta' in Relation With Big Bang Theory. Greek Concept of Chaos. The Concept of Space – Space as the Final Goal – Udgitha. Relationship Between Teacher And Student – The Knowledge Of Combinations, Body And Speech – Siksha Valli – Taittiriya Upanishad.

**UNIT III WORD****9**

Aum- Speech and Breath as Pair – Chandogya Upanishad and Brihadaryanaka Upanishad. Significance of Chants, Structure of Language and Cosmic Correspondences. The Non-Dual Word – Bhartrihari's Vakyapadiyam. Sphota-Ultimate Reality Expressed Through Language. Intention. Thought 'Sabdanaor' and Speaking.

**UNIT IV KNOWLEDGE AS POWER/OPPRESSION****9**

Power- as Self-Realization in Gita. Krishna's Advice to Arjuna on How to Conquer Mind. Francis Bacon – Four Idols – What Prevents One From Gaining Knowledge? Michel Foucault- Knowledge as Oppression. Panopticon. Rtam (Truth) and Satyam (Eternal Truth).

**UNIT V SELF KNOWLEDGE/BRAHMAN****9**

Knowledge about Self, Transcendental Self. The Different Chakras and the Stages of Sublimation. Philosophy of Yoga and Siva for Union of Mind and Body. Concept of Yin/Yang. Aspects of the Feminine / Masculine.

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

**On completion of the course, the students will be able to:**

1. Think sceptically, ask questions and to arrive at deductions.
2. Connect and relate different branches of thought.
3. Comprehends the relation between language, thought and action.
4. Arrive at a better understanding of self and others and forms a new outlook.

**REFERENCES:**

1. Swami Nikhilananda: The Upanishads, Swami Nikhilananda, Advaita Ashrama, Kolkata.
2. Swamy Tapasyananda: Srimad Bhagavad Gita, The Scripture of Mankind, Sri Ramakrishna Math, Chennai.
3. Subrahmanyam, Korada: Vakyapadiyam of Bhartrhari Brahmakanda, Sri Garib Dass series.
4. Swami Lokeswarananda: Chandogya Upanishad, Swami Lokeswarananda, Ramakrishna Mission Institute of Culture, Kolkata.
5. Brahma, Apuruseya: The Four Vedas: Translated in English.
6. Haich, Elizabeth: Sexual Energy and Yoga.
7. Bacon, Francis: Power as Knowledge
8. Vlastos, Gregory: Socrates Ironist and Moral Philosopher.
9. Plato: The Republic, Penguin.
10. Gutting, Garry: Foucault A Very Short Introduction, Oxford.

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## Learning Outcomes

1. Students will be able to critically read literary and media texts and understand the underlying gender perspectives in them.
2. Students will be able to analyse current social events in the light of gender perspectives.
3. Students will be able to discuss, analyse and argue about issues related to gender and their impact on society, culture and development.

### UNIT I: Introduction to Gender

- Definition of Gender
- Basic Gender Concepts and Terminology
- Exploring Attitudes towards Gender
- Social Construction of Gender

#### Texts:

1. Sukhu and Dukhu (Amar Chitra Katha)
2. The Cat who Became a Queen (Folk tale, J. Hinton Knowles, Folk-Tales of Kashmir. London: Kegan Paul, Trench, Trübner, and Company, 1893, pp. 8-10.)

### UNIT II: Gender Roles and Relations

- Types of Gender Roles
- Gender Roles and Relationships Matrix
- Gender-based Division and Valuation of Labour

#### Texts:

1. Muniyakka (Short Story, Lakshmi Kannan, Nandanvan and Other Stories, Hyderabad: Orient Blackswan, 2011)
2. Video: Witness: Freeing Women From Cleaning Human Waste (2014, HRW, Manual Scavenging, India)

### UNIT III: Gender Development Issues

- Identifying Gender Issues
- Gender Sensitive Language
- Gender, Governance and Sustainable Development
- Gender and Human Rights
- Gender and Mainstreaming

#### Texts:

1. The Many Faces of Gender Inequality (Essay, Amartya Sen, Frontline, Volume 18 - Issue 22, Oct. 27 - Nov. 09, 2001)
2. Tell Us Marx (Poem, Mallika Sengupta, Translated by Sanjukta Dasgupta)

### UNIT IV: Gender-based Violence

- The concept of violence
- Types of Gender-based violence
- The relationship between gender, development and violence
- Gender-based violence from a human rights perspective

#### Texts:

1. Lights Out (Play, Manjula Padmanabhan)
2. Lights Out (Video of play enacted)

### UNIT V: Gender and Culture

- Gender and Film
- Gender, Media and Advertisement

#### Texts:

1. Mahanagar (Movie: Satyajit Ray)
2. Beti Bachao Beti Padhao Advertisements

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**READINGS:** Relevant additional texts for readings will be announced in the class. Classes will consist of a combination of activities: dialogue-based lectures, discussions, collaborative learning activities, group work and in-class assignments.

**ASSESSMENT AND GRADING:**

Discussion & Classroom Participation: 20%

Project/Assignment: 30%

End Term Exam: 50%

**HU5272**

**ETHICS AND HOLISTIC LIFE**

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

**OBJECTIVES:**

- To emphasize the meaning and nature of ethics, human values and holistic life for leading a good, successful and happy life through continuous examination of thoughts and conduct in day to day life.
- To understand the status and responsible role of individual in abatement of value crisis in contemporary world in order to develop a civilized and human society. Understanding the process of ethical decision making through critical assessment of incidents/cases of ethical dilemmas in personal, professional and social life.
- To view the place of Ethics and Human Values in the development of individual and society through identification and cross examination of life values and world view of his/her role models in society.

**UNIT I HUMAN LIFE, ITS AIM AND SIGNIFICANCE**

The concept of a successful life, happy life and a meaningful life, Ethical and decision making capability and its development: Meaning of Ethical dilemma, sharing real life experiences.

**UNIT II CREATIVE AND LEADERSHIP ABILITY AND THEIR DEVELOPMENT**

Intellectual, Emotional, Creative, Ethical - spiritual development, Aesthetic sense, Self-dependency, Activeness, Development of positive attitude.

**UNIT III HARMONY IN PERSONAL AND SOCIAL LIFE:**

Concept of personal and group Ethics; Balance between - rights and duties-welfare of self and welfare of all, Creating a value based work culture in hostel, classroom and other places in the campus and society.

**UNIT IV CHARACTER, RIGHTEOUSNESS AND VIRTUES FOR A MEANINGFUL LIFE**

Egolessness, Humility, Righteousness, Purity, Truthfulness, Integrity, Self-restraint, Self-control, Sense of responsibility, Empathy, Love, Compassion, Maitri / Comradeship, Cooperation, Tolerance.

**UNIT V DILEMMA BETWEEN MATERIALISTIC DEVELOPMENT AND HUMAN WELFARE**

Science, Technology, Consumerism, Relation with Nature and Environment, New dimension of Global Harmony: Democracy, Equality, Social Justice

**TOTAL:45 PERIODS**

**OUTCOMES:**

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

1. Enable students to understand the concept of contemporary ethics at different levels: Individual, local and Global and enable them to cross examine the ethical and social consequences of the decisions of their life-view and world view.
2. Develop the ability of students to create a balance between their individual freedom and social responsibilities and enable them to identify the personal, professional and social values and integrate them in their personality after cross examination.



3. Enable students to cross examine their earlier decisions taken in life and understand the meaning of ethical dilemma to overcome the ethical dilemmas and engage in critical reflection.
4. Develop positive habits of thought and conduct and work cohesively with fellow beings who have variety of strengths, experiences, shortcomings and challenges, hence to enable them to handle diverse type of personalities.
5. Enable students to develop a method for making ethically sound decisions for themselves, within hostels, classrooms, university campus and society.

**HU5273**

**LAW AND ENGINEERING**

**L T P C**

**3 0 0 3**

**UNIT I THE LEGAL SYSTEM: SOURCES OF LAW AND THE COURT STRUCTURE 9**

Enacted law -Acts of Parliament are of primary legislation, Common Law or Case law- Principles taken from decisions of judges constitute binding legal rules. The Court System in India and Foreign Courtiers. (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court) Arbitration: As an alternative to resolving disputes in the normal courts, parties who are in dispute can agree that this will instead be referred to arbitration.

**UNIT II LAWS 9**

Basic principles of contract law, sale of goods law, laws relating to industrial pollution, accident, environmental protection, health and safety at work, patent law, constitutional law: the supreme law of the land, Information technology law and cyber crimes.

**UNIT III BUSINESS ORGANISATIONS 9**

Sole traders (Business has no separate identity from you, all business property belongs to you). Partnerships: Types of Partnerships - Limited Liability Partnership, General Partnership, Limited Partnerships. Companies: The nature of companies, Classification of companies, Formation of companies, Features of a public company, Carrying on business, Directors– Their Powers and Responsibilities/Liabilities.

**UNIT IV LAW AND SOCIETY 9**

Interdisciplinary nature of law, legal ideologies/philosophy/ schools of jurisprudence.

**UNIT V CASE STUDIES 9**

Important legal disputes and judicial litigations

**TOTAL: 45 PERIODS**



**HU5274**

**FILM APPRECIATION**

**L T P C**

**3 0 0 3**

**COURSE DESCRIPTION**

This is an intensive course designed to promote comprehensive understanding and insights into the nature of cinema and other related forms and practices. Movies, though at times are used more as escapism, they are also a true art form and expressive tool used by writers, directors and actors. This course will explore the aesthetics of cinema, the concepts behind storytelling and various other elements of a film. It will also explore the impact of movies in our society and in our lives. It also encourages students to use films as a medium to analyse visual texts and read underlying messages.

**OBJECTIVES:**

- To help learners understand the various movie genres and its types.
- To understand various elements that contributes to film making.

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- To make them realize the impact of film in society.
- To analyse the visual media and interpret the underlying messages.

<b>UNIT I</b>	<b>THE COMPONENTS OF FILMS</b>	<b>9</b>
Story, Screenplay & Script – Actors – Director – Crew Members – Mis En Scene – Structure of A Film – Narrative Elements – Linear & Non-Linear – Types of Movie Genres: Mysteries, Romantic Comedies, Horror Etc.		
<b>UNIT II</b>	<b>EVOLUTION OF FILM</b>	<b>9</b>
History of Films – Early Cinema – Silent Movies – Talkies – Film Language, Form, Movement – Film Theories – Realist, Auteurs, Feminist, Psychoanalytic, Ideological Theories.		
<b>UNIT III</b>	<b>FILMS ACROSS THE WORLD</b>	<b>9</b>
European Films – Russian Films – Japanese Films – Korean Films – Hollywood Film – Studio Culture – All Time Great Movies.		
<b>UNIT IV</b>	<b>INDIAN FILMS</b>	<b>9</b>
The Early Era – History Of Indian Cinema – Movies for Social Change – Hindi Movies that Created Impact – Regional Movies – Documentaries – Cultural Identity.		
<b>UNIT V</b>	<b>INTERPRETING FILMS</b>	<b>9</b>
Film Criticism & Appreciation – Censorship in Movies – Cultural Representation in Movies – Television – New Media & Online Media – Films Beyond Entertainment.		
		<b>TOTAL: 45 PERIODS</b>

## OUTCOMES

**On completion of the course, the students will be able to:**

1. Recognize types of films, their impact on society and their roles in our lives.
2. Have an understanding of the concepts of storytelling, Mise en Scene, and other elements of film making.
3. Interpret the underlying messages in the movies.

## Teaching Methods

1. Each unit consists of reading materials, learning activities videos, websites. Students are expected to watch movies sometimes in class and at times at home and discuss in class.

## Evaluation

2. As this is course is critical appreciation course on films, there is no written end semester examination. The course is more on learning how to critically analyse a movie and appreciate its finer elements. Therefore evaluation can be based on assignments and discussions. Internals marks can be taken for the total marks.

## Internal (100 % weightage)

3. Assignment 1: Write a movie review with critical analysis (20 marks).
4. Assignment 2: Write a script for a scene taken from a short story / novella (20 marks).
5. Presentation: Students choose any one topic related to films and present it to the audience. (25 marks)
6. Group discussion: Students discuss in groups on the various aspects of movies and its impact on society. (25 marks)
7. Blog entry: Making weekly blog posts in Class Blog on the topics related to the course posted by the instructor and commenting on others' posts. (10 marks)

## REFERENCES

1. A Biographical Dictionary of Film by David Thomson, Secker & Warburg, 1975
2. Signs and Meaning in the Cinema by Peter Wollen, Secker & Warburg, 1969
3. The World Viewed by Stanley Cavell 1971
4. Film Style and Technology: History and Analysis by Barry Salt, Starword, 1983
5. The Encyclopedia of Indian Cinema Edited by Ashish Rajadhyaksha and Paul Willemen, BFI, 1994.

*Attested*

**OBJECTIVES**

- To broadly introduce students to the formal and theoretical aspects of linguistics.
- To enable learners to understand the various practical applications of language and recent findings in the field of applied linguistics.

**CONTENTS: -****UNIT I LANGUAGE AND LINGUISTICS: AN OVERVIEW****9**

Language and Linguistics-Linguistic Knowledge-Knowledge of Sound Systems & Words – Creativity of Language – Relationship of form and meaning. Grammar – descriptive, prescriptive, universal-Human Language – Animal Language – Sign Language- Computers and Language.

**UNIT II MORPHOLOGY - WORDS OF LANGUAGE****9**

Content and function words – morphemes -free & bound –prefixes – suffixes – roots and stems – inflectional and derivational morphology-compound words and their formation – malapropisms – slips of the tongue.

**UNIT III SYNTAX- THE SENTENCE PATTERNS OF LANGUAGE AND SEMANTICS-THE MEANING OF LANGUAGE****9**

Syntax : Rules of Syntax- Sentence Structure-Structural Ambiguity-Syntactic Categories. Semantics: Lexical Semantics – Anomaly-Metaphors- Idioms- Synonyms – Antonyms – Homonyms -Pragmatics– Speech Acts

**UNIT IV PHONETICS – THE SOUNDS OF LANGUAGE****9**

Speech sounds- Introduction to branches of Phonetics- The Phonetic Alphabet – IPA – Consonants - Vowels – Diphthongs- Tone and Intonation.

**UNIT V APPLIED LINGUISTICS - THE PRACTICAL APPLICATIONS OF LANGUAGE****9**

Language learning and teaching (ELT)- lexicography-translation studies-computational linguistics-neurolinguistics (speech pathology and language disorders)- forensic linguistics – sociolinguistics.

PROGRESS THROUGH KNOWLEDGE

**TOTAL : 45 PERIODS****Teaching Methods:**

Lectures, discussion.

**Evaluation Internal and External:**

Internal: 2 written tests + assignments, seminars, project (50+15+15+20).

External: A 3 hour written exam (50 marks)

**REFERENCES:**

1. Victoria Fromkin, Robert Rodman, Nina Hyams.2019. An Introduction to Language.USA.CENGAGE.11<sup>th</sup> edition
2. Cook. G,2003. Applied linguistics.UK: Oxford University Press.

**HU5276 UNDERSTANDING SOCIETY AND CULTURE THROUGH LITERATURE****L T P C  
3 0 0 3****OBJECTIVES**

- To internalize the importance of language by understanding its role in the transformation of man.
- To look at language, literature and culture as locus of identity and change.

- To extract meaning from existing literatures and cultures.
- To identify meanings in modern life by reconnecting with lost cultures.

### **UNIT I INTRODUCTION**

Why study literature? Tracing the origin – pictures. Tokens as precursors of writing. Movement from three dimensions to two dimensions- Pictography. From visual to oral -Logography. Reading out literature to young children- Edmund J Farrell.

### **UNIT II READING CULTURE**

Reading culture through language, signs and consumables- Roland Barthes. Culture through poems- Nissim Ezekiel's 'The night of the Scorpion' . 'Nothing's Changed'- Tatamkhulu Afrika- Apartheid. Ruskin Bond- 'Night train at Deoli'- How real life is different from movies.

### **UNIT III IDENTIFYING MEANING**

Searching and locating meaning through literature. Looking for order in a chaotic world. The Myth of Sisyphus (Albert Camus) and Adi Shankar's 'Jagat Mithya'- the world as an illusion. The Indian version as 'meaningless meaning'.

### **UNIT IV POST MODERNISM**

'If on a winter's night a traveler'- Italo Calvino. The book about the reader- the experience of reading as reading. Metafiction. Selfie Culture. Visual Culture as purpose of modern life.

### **UNIT V RETURNING TO PICTURES**

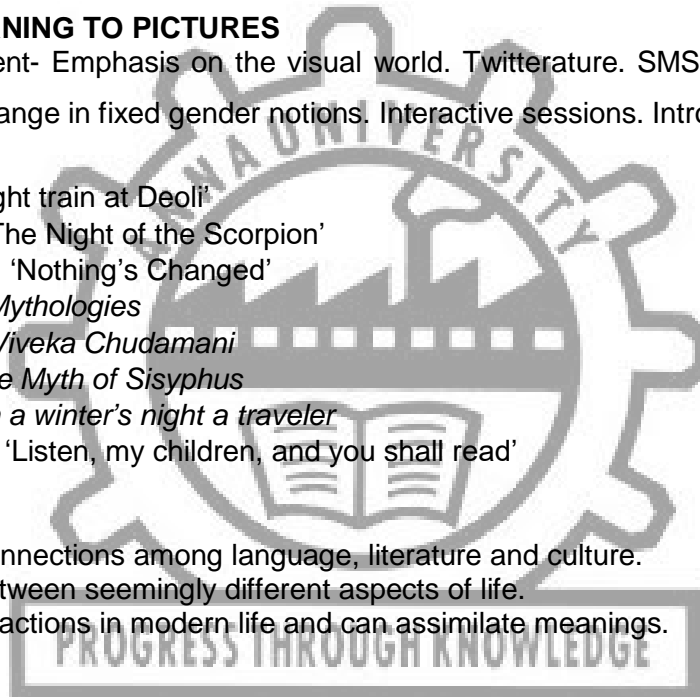
Literature of the present- Emphasis on the visual world. Twitterature. SMS. Whatsapp language. Consumer culture. Change in fixed gender notions. Interactive sessions. Introspection.

#### **Reading list**

1. Bond, Ruskin: 'Night train at Deoli'
2. Ezekiel, Nissim: 'The Night of the Scorpion'
3. Afrika, Tatamkhulu: 'Nothing's Changed'
4. Barthes, Roland: *Mythologies*
5. Shankaracharya: *Viveka Chudamani*
6. Camus, Albert- *The Myth of Sisyphus*
7. Calvino, Italo: *If on a winter's night a traveler*
8. Farrell, Edmund J: 'Listen, my children, and you shall read'

#### **OUTCOMES:**

1. Can identify the connections among language, literature and culture.
2. Is able to relate between seemingly different aspects of life.
3. Understands the fractions in modern life and can assimilate meanings.



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