ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

REGULATIONS - 2019

CHOICE BASED CREDIT SYSTEM

B.E. MATERIALS SCIENCE AND ENGINEERING

THE VISION OF THE DEPARTMENT OF MECHANICAL ENGINEERING

We, at the Department of Mechanical Engineering, Anna University shall strive hard to impart knowledge and state-of-the-art training to our students and expose them to broad areas of Mechanical Engineering, namely Design, Manufacturing, Energy, Thermal Sciences and currently related interdisciplinary areas, so that they can later practice their profession at home or abroad keeping in mind the needs and concern of the society they represent, safeguarding values, ethics and be instrumental in bringing about an overall technological development.

THE MISSION OF THE DEPARTMENT OF MECHANICAL ENGINEERING

1. To deliver knowledge in Mechanical Engineering and Materials Science and Engineering with high educational standards so that the outgoing students are employable and globally competitive.
2. To produce graduate and post graduate engineers with core competency as well as relevant software skills and social responsibility.
3. To be dynamic in imparting knowledge to students depending upon the changing national and International needs.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

Bachelor of Materials Science and Engineering curriculum is designed

1. To prepare students to excel in research and to succeed in the areas of materials science and metallurgical engineering.
2. To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve materials science and metallurgical engineering problems
3. To train students to have sound knowledge on the production, processing, characterization, structural properties correlation and application of all different engineering materials.
4. To inculcate students with professional and ethical attitude, effective communication skills, teamwork skills and multidisciplinary approach.
5. To develop student with an academic excellence, leadership qualities, leading to life-long learning for a successful professional career

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PROGRAMME OUTCOMES (POs):

On successful completion of the Materials Science and Engineering Degree programme, the Graduates shall exhibit the following:

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

PROGRAM SPECIFIC OUTCOMES (PSOs):

On successful completion of the Materials Science and Engineering Degree programme, the Graduates shall exhibit the following:

1. Graduates will have an ability to identify, analyse and provide solution to the problems related to Materials and metallurgical engineering
2. Graduates will have the ability to implement/use appropriate characterisation techniques, analytical skills, and latest/recent development in materials technology to solve engineering problems related to materials selection and design.
3. Graduates will be able to design and develop materials and processing techniques to meet the industry needs within the realistic constraints economic, environmental, social, ethical, health and safety, manufacturability and sustainability

PEO / PO Mapping:

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

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MAPPING OF COURSE OUTCOME AND PROGRAMME OUTCOME

	Course Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010	P011	PO12
Semester 1	Technical English												
	Engineering Mathematics -I												
	Engineering Physics												
	Engineering Chemistry												
	Engineering Graphics	✓		✓		✓					✓		✓
	Basic Sciences Laboratory												
	Workshop practices Laboratory	✓	✓	✓	✓								
Semester 2	Electrical and Electronic Properties of Materials												
	Engineering Mathematics - II												
	Problem Solving and Python programming	✓	✓	✓	✓	✓			✓	✓			✓
	Basics of Electrical and Electronics Engineering	✓	✓	✓	✓	✓							
	Physical Metallurgy												
	Reaction Kinetics and Dynamics												
	Electrical and Electronics Engineering Laboratory	✓	✓	✓	✓					✓		✓	
	Problem Solving and Python Programming Laboratory	✓	✓	✓	✓	✓			✓	✓			✓
Semester3	Transform Techniques and Partial Differential Equations	✓	✓			✓							
	Polymer Science and Engineering	✓	✓	✓	✓	✓				✓			
	Metallurgical Thermodynamics	✓	✓	✓	✓	✓				✓			
	Mechanics of Materials	✓	✓	✓	✓	✓				✓			
	Microstructural Analysis Laboratory			✓	✓	✓				✓			
	Materials testing Laboratory						✓	✓		✓	✓		
Semester 4	Experimental Techniques and Methods	✓	✓	✓	✓								
	Iron and Steel Making	✓	✓	✓	✓								✓
	Mechanical Behaviour of Materials	✓	✓	✓	✓								✓
	Heat Treatment of Metals and alloys	✓	✓	✓	✓								✓
	Powder metallurgy	✓	✓	✓	✓								✓

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	Powder Metallurgy Laboratory	✓	✓	✓	✓								✓
	Heat Treatment Laboratory	✓					✓					✓	
Semester5	Total Quality Management						✓			✓			
	Theory and Applications of Metal Forming	✓	✓	✓	✓	✓				✓			
	Characterisation of Materials	✓	✓	✓	✓	✓				✓		✓	
	Casting Metallurgy	✓	✓	✓	✓	✓							
	Professional Elective I												
	Metal Forming Laboratory						✓			✓		✓	
	Foundry and Welding Laboratory						✓			✓		✓	
Semester6	Environmental Science						✓	✓		✓		✓	
	Composite Materials	✓	✓	✓	✓								
	Materials Selection and Design	✓	✓	✓	✓								
	Professional Elective II												
	Professional Elective III												
	Open Elective I												
	Materials Characterisation Laboratory	✓	✓			✓				✓			
	Composite Materials Laboratory	✓	✓			✓				✓			
Semester7	Surface Engineering	✓	✓	✓	✓								
	Nonferrous Metallurgy	✓	✓	✓	✓								
	Non-destructive Evaluation of Materials	✓	✓	✓	✓								
	Professional Elective IV												
	Professional Elective V												
	Open Elective II												
	Surface Engineering Laboratory	✓			✓								
	Industrial Training/Internship*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Project I												
Semester8	Professional Elective VI												
	Professional Elective VII												
	Project II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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UNIVERSITY DEPARTMENTS

B.E. MATERIALS SCIENCE AND ENGINEERING

REGULATIONS - 2019

CHOICE BASED CREDIT SYSTEM

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		
THEORY								
1.	HS5151	Technical English	HSMC	4	0	0	4	4
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
PRACTICALS								
6.	BS5161	Basic Sciences Laboratory	BSC	0	0	4	4	2
7.	GE5162	Workshop practices Laboratory	ESC	0	0	4	4	2
			TOTAL	**14**	**1**	**12**	**27**	**21**

SEMESTER – II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	HM5201	Electrical and Electronic Properties of Materials	HSMC	3	0	0	3	3
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.	ML5201	Physical Metallurgy	ESC	3	1	0	4	4
6.	ML5202	Reaction Kinetics and Dynamics	BSC	3	0	0	3	3
PRACTICALS								
7.	EE5261	Electrical and Electronics Engineering Laboratory	ESC	0	0	4	4	2
8.	GE5161	Problem Solving and Python programming Laboratory	ESC	0	0	4	4	2
			TOTAL	**18**	**2**	**8**	**28**	**24**

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SEMESTER – III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.		Elective – Humanities I	HSMC	3	0	0	3	3
2.	MA5355	Transform Techniques and Partial Differential Equations	BSC	3	1	0	4	4
3.	ML5301	Polymer Science and Engineering	ESC	3	0	0	3	3
4.	ML5302	Metallurgical Thermodynamics	PCC	4	0	0	4	4
5.	ML5352	Mechanics of Materials	ESC	3	0	0	3	3
PRACTICALS								
6.	ML5311	Microstructural Analysis Laboratory	PCC	0	0	4	4	2
7.	ML5312	Materials testing Laboratory	PCC	0	0	4	4	2
			TOTAL	**16**	**1**	**8**	**25**	**21**

SEMESTER – IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.		Elective – Humanities II	HSMC	3	0	0	3	3
2.	ML5401	Experimental Techniques and Methods	PCC	3	0	0	3	3
3.	ML5402	Iron and Steel Making	PCC	3	0	0	3	3
4.	ML5403	Mechanical Behaviour of Materials	PCC	3	0	0	3	3
5.	ML5404	Heat Treatment of Metals and Alloys	PCC	3	0	0	3	3
6.	ML5405	Powder Metallurgy	PCC	3	0	0	3	3
PRACTICALS								
7.	ML5411	Powder Metallurgy Laboratory	PCC	0	0	4	4	2
8.	ML5412	Heat Treatment Laboratory	PCC	0	0	4	4	2
			TOTAL	**18**	**0**	**8**	**26**	**22**

SEMESTER – V

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	GE5451	Total Quality Management	HSMC	3	0	0	3	3
2.	ML5501	Theory and Applications of Metal Forming	PCC	3	0	0	3	3
3.	ML5502	Characterisation of Materials	PCC	3	0	0	3	3
4.	ML5503	Casting Metallurgy	PCC	3	0	0	3	3
5.		Professional Elective I	PEC	3	0	0	3	3
6.		Audit Course – I*	AC	3	0	0	3	0
PRACTICALS								
7.	ML5511	Metal Forming Laboratory	PCC	0	0	4	4	2
8.	ML5512	Foundry and Welding Laboratory	PCC	0	0	4	4	2
			TOTAL	**18**	**0**	**8**	**26**	**19**

*Audit Course is optional.

SEMESTER – VI

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	GE5251	Environmental Sciences	BSC	3	0	0	3	3
2.	ML5601	Composite Materials	PCC	3	0	0	3	3
3.	ML5602	Materials Selection and Design	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.		Open Elective I	OEC	3	0	0	3	3
7.		Audit Course – II*	AC	3	0	0	3	0
PRACTICALS								
8.	ML5611	Materials Characterisation Laboratory	PCC	0	0	4	4	2
9.	ML5612	Composite Materials Laboratory	PCC	0	0	4	4	2
			TOTAL	**21**	**0**	**8**	**29**	**22**

*Audit Course is optional.

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SEMESTER – VII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	ML5701	Surface Engineering	PCC	3	0	0	3	3
2.	ML5702	Nonferrous Metallurgy	PCC	3	0	0	3	3
3.	ML5751	Non-destructive Evaluation of Materials	PCC	3	0	0	3	3
4.		Professional Elective IV	PEC	3	0	0	3	3
5.		Professional Elective V	PEC	3	0	0	3	3
6.		Open Elective II	OEC	3	0	0	3	3
PRACTICALS								
7.	ML5711	Surface Engineering Laboratory	PCC	0	0	4	4	2
8.	ML5712	Industrial Training/Internship*	EEC	0	0	4	4	2
9.	ML5713	Project I	EEC	0	0	6	6	3
			TOTAL	**18**	**0**	**14**	**32**	**25**

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

SEMESTER – VIII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.		Professional Elective VI	PEC	3	0	0	3	3
2.		Professional Elective VII	PEC	3	0	0	3	3
PRACTICALS								
3.	ML5811	Project II	EEC	0	0	16	16	8
			TOTAL	**6**	**0**	**16**	**22**	**14**

TOTAL NO. OF CREDITS -168

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HUMANITIES AND SOCIAL SCIENCES (HSMC) – MANAGEMENT AND OTHERS

Sl. No	Course Code	Course Title	Periods per week			Credits	Semester
			Lecture	Tutorial	Practical		
1.	HS5151	Technical English	4	0	0	4	1
2.	HM5201	Electrical and Electronic Properties of Materials	3	0	0	3	2
3.	GE5451	Total Quality Management	3	0	0	3	5

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 Process	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
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

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BASIC SCIENCE COURSE [BSC]

Sl. No	Course Code	Course Title	Periods per week			Credits	Semester
			Lectu	Tutorial	Practical		
1.	MA5158	Engineering Mathematics - I	3	1	0	4	1
2.	PH5151	Engineering Physics	3	0	0	3	1
3.	CY5151	Engineering Chemistry	3	0	0	3	1
4.	BS5161	Basic Sciences Laboratory	0	0	4	2	1
5.	MA5252	Engineering Mathematics -II	3	1	0	4	2
6.	MA5355	Transform Techniques and Partial Differential Equations	3	1	0	4	3
7.	GE5251	Environmental Sciences	3	0	0	3	6

ENGINEERING SCIENCE COURSE [ESC]

Sl. No	Course Code	Course Title	Periods per week			Credits	Semester
			Lecture	Tutorial	Practical		
1.	GE5151	Engineering Graphics	1	0	4	3	1
2.	GE5162	Workshop Practices Laboratory	0	0	4	2	1
3.	GE5153	Problem Solving and Python Programming	3	0	0	3	2
4.	EE5251	Basics of Electrical and Electronics Engineering	3	0	0	3	2
5.	ML5405	Physical Metallurgy	3	1	0	4	2
6.	ML5202	Reaction Kinetics and Dynamics	3	0	0	3	2
7.	EE5261	Electrical and Electronics Engineering Laboratory	0	0	4	2	2
8.	GE5161	Problem Solving and Python Programming Laboratory	0	0	4	2	2
9.	ML5352	Mechanics of Materials	3	0	0	3	3

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AUDIT COURSES (AC)

Registration for any of these courses is optional to students

Sl. No	Course	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 CORE COURSES [PCC]

Sl. No	Course Code	Course Title	Periods per week			Credits	Semester
			Lecture	Tutorial	Practical		
1.	ML5302	Metallurgical Thermodynamics	4	0	0	4	3
2.	ML5311	Microstructural Analysis Laboratory	0	0	4	4	3
3.	ML5312	Materials testing Laboratory	0	0	4	4	3
4.	ML5401	Experimental Techniques and methods	3	0	0	3	4
5.	ML5402	Iron and Steel Making	3	0	0	3	4
6.	ML5403	Mechanical Behaviour of Materials	3	0	0	3	4
7.	ML5404	Heat Treatment of Metals	3	0	0	3	4
8.	ML5405	Powder metallurgy	3	0	0	3	4
9.	ML5411	Powder Metallurgy Laboratory	0	0	4	2	4
10.	ML5412	Heat Treatment	0	0	4	2	4
11.	ML5501	Theory and Applications of Metal Forming	3	0	0	3	5

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12.	ML5502	Characterisation of Materials	3	0	0	3	5
13.	ML5503	Casting Metallurgy	3	0	0	3	5
14.	ML5511	Metal Forming	0	0	4	2	5
15.	ML5512	Foundry and Welding Laboratory	0	0	4	2	5
16.	ML5601	Composite Materials	3	0	0	3	6
17.	ML5602	Materials Selection and Design	3	0	0	3	6
18.	ML5611	Materials Characterisation	0	0	4	2	6
19.	ML5612	Composite Materials	0	0	4	2	6
20.	ML5701	Surface Engineering	3	0	0	3	7
21.	ML5702	Nonferrous Metallurgy	3	0	0	3	7
22.	ML5751	Non-destructive Evaluation of Materials	3	0	0	3	7
23.	ML5711	Surface Engineering Laboratory	0	0	4	2	7

PROFESSIONAL ELECTIVE COURSES [PEC]

Semester – V, Elective – I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	Periods per week			TOTAL CONTACT PERIODS	C
				L	T	P		
1	ML5001	Bio and Smart Materials	PEC	3	0	0	3	3
2	ML5002	Creep and Fatigue Behaviour of Materials	PEC	3	0	0	3	3
3	ML5003	Nanostructured Materials	PEC	3	0	0	3	3
4	ML5004	Fuels, Furnaces and Refractories	PEC	3	0	0	3	3

Semester – VI, Elective – II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	Periods per week			TOTAL CONTACT PERIODS	C
				L	T	P		
1	ML5005	Cryogenic Treatment of Materials	PEC	3	0	0	3	3
2	ML5006	Electron Microscopy and Diffraction Analysis of Materials	PEC	3	0	0	3	3
3	ML5007	Phase Transformations	PEC	3	0	0	3	3
4	ML5008	Making and Metallurgy of Stainless Steels	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	C
				L	T	P		
1	ME5751	Finite Element Analysis	PEC	3	0	0	3	3
2	MF5652	Additive Manufacturing	PEC	3	0	0	3	3
3	ME5084	Surface Engineering Tribology	PEC	3	0	0	3	3
4	ML5009	MEMS and Micro Fabrication	PEC	3	0	0	3	3

Semester – VII, Elective – IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	Periods per week			TOTAL CONTACT PERIODS	C
				L	T	P		
1	ML5010	Computational methods for Materials Engineering	PEC	3	0	0	3	3
2	ML5011	Introduction to Transport Phenomena	PEC	3	0	0	3	3
3	ML5012	Modelling and Simulation in Materials Engineering	PEC	3	0	0	3	3
4	ML5013	Laser Processing of Materials	PEC	3	0	0	3	3
5	GE5075	Engineering Ethics	PEC	3	0	0	3	3

Semester – VII, Elective – V

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	Periods per week			TOTAL CONTACT PERIODS	C
				L	T	P		
1	ME5080	Precision Manufacturing	PEC	3	0	0	3	3
2	ML5014	Materials for Automotive Applications	PEC	3	0	0	3	3
3	ML5015	Metallurgy of Tool Materials	PEC	3	0	0	3	3
4	ML5016	Thin Film Technology	PEC	3	0	0	3	3

Semester – VIII, Elective – VI

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	Periods per week			TOTAL CONTACT PERIODS	C
				L	T	P		
1	ML5017	Energy Storing Devices and Fuel Cells	PEC	3	0	0	3	3
2	ML5018	Fracture Mechanics and Failure Analysis	PEC	3	0	0	3	3
3	ML5019	Materials Science and Engineering of Green Energy	PEC	3	0	0	3	3
4	ML5020	High Temperature Materials	PEC	3	0	0	3	3
5	GE5552	Engineering Management	PEC	3	0	0	3	3

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Semester – VIII, Elective – VII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	Periods per week			TOTAL CONTACT PERIODS	C
				L	T	P		
1	MF5651	Non-traditional Machining Processes	PEC	3	0	0	3	3
2	ML5021	Principles of Metal Cutting	PEC	3	0	0	3	3
3	ME5085	Quality and Reliability Engineering	PEC	3	0	0	3	3
4	ML5022	Welding Metallurgy	PEC	3	0	0	3	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl.No	Course Code	Course Title	Periods per week			Credits	Semester
			Lecture	Tutorial	Practical		
1	ML5712	Industrial Training/Internship*	0	0	4	2	5
2	ML5713	Project I	0	0	6	3	7
3	ML5811	Project II	0	0	16	8	8

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HS5151	TECHNICAL ENGLISH	L	T	P	C
		4	0	0	4

OBJECTIVES:

The first semester English course entitled 'Technical English' aims to,

- Familiarise first year students of engineering and technology with the fundamental aspects of technical English.
- Develop all the four language skills by giving sufficient practice in the use of the skills in real life contexts.
- Enhance the linguistic and communicative competence of first year engineering and technology students.

UNIT I INTRODUCING ONESELF 12

Listening: Listening and filling a form, listening to speeches by specialists from various branches of engineering and completing activities such as answering questions, identifying the main ideas of the listening text, style of the speaker (tone and tenor) – **Speaking**: Introducing oneself –introducing friend/ family - **Reading:** Descriptive passages (from newspapers / magazines)- **Writing**: Writing a paragraph (native place, school life)- **Grammar:** Simple present, present continuous – **Vocabulary Development**: One word substitution

UNIT II DIALOGUE WRITING 12

Listening: Listening to conversations (asking for and giving directions) –**Speaking:** making conversation using (asking for directions, making an enquiry), Role plays-dialogues- **Reading:** Reading a print interview and answering comprehension questions-**Writing**: Writing a checklist, Dialogue writing- **Grammar**: Simple past – question formation (Wh- questions, Yes or No questions, Tag questions)- **Vocabulary Development**: Stress shift, lexical items related to the theme of the given unit.

UNIT III FORMAL LETTER WRITING 12

Listening: Listening to speeches by famous people and identifying the central message of the speech – answering multiple-choice questions)-**Speaking:** Giving short talks on a given topic-**Reading:** Reading motivational essays on famous engineers and technologists (answering open-ended and closed questions)- **Writing:** Writing formal letters/ emails (Complaint letters)-**Grammar**: Future Tense forms of verbs, subject and verb agreement-**Vocabulary Development**: Collocations – Fixed expressions

UNIT IV WRITING COMPLAINT LETTERS 12

Listening: Listening to short talks (5 minutes duration and fill a table, gap-filling exercise) note taking/note making- **Speaking:** Small group discussion, giving recommendations-**Reading:** Reading problem – solution articles/essays drawn from various sources- **Writing:** Making recommendations – Writing a letter/ sending an email to the Editor- note making- **Grammar:** Modals – Phrasal verbs – cause and effect sentences- **Vocabulary Development**: Connectives, use of cohesive devices in writing, technical vocabulary.

UNIT V WRITING DEFINITIONS AND PRODUCT DESCRIPTION 12

Listening: Listening to a product description (labeling and gap filling) exercises- **Speaking:** Describing a product and comparing and contrasting it with other products- **Reading**: Reading graphical material for comparison (advertisements)-**Writing:** Writing Definitions (short and long) – compare and contrast paragraphs- **Grammar:** Adjectives – Degrees of comparison - compound nouns- **Vocabulary Development**: Use of discourse markers – suffixes (adjectival endings).

TOTAL : 60 PERIODS

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LEARNING OUTCOMES

At the end of the course the students will have gained,

- Exposure to basic aspects of technical English.
- The confidence to communicate effectively I various academic situations.
- Learnt the use of basic features of Technical English.

TEXT BOOK:

1. Revised Edition of 'English for Engineers and Technologists' Volume 1 published by Orient Black Swan Limited 2019.

ASSESSMENT PATTERN

- Assessments will assess all the four skills through both pen and paper and computer based tests.
- Assessments can be pen and paper based, quizzes.

MA5158	ENGINEERING MATHEMATICS – I (Common to all branches of B.E. / B.Tech. Programmes in I Semester)	L	T	P	C
		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

COURSE OUTCOMES:

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

- Use the matrix algebra methods for solving practical problems.
- Apply differential calculus tools n 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.

TEXT BOOKS:

1. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, 44th Edition, New Delhi, 2017.
2. James Stewart, "Calculus with Early Transcendental Functions", Cengage Learning, 6th Edition, New Delhi,2013.
3. Joel Hass, Christopher Heil and Maurice D.Weir, "Thomas' Calculus", Pearson, 14th 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.,), 7th Edition, New Delhi, 2009.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2015.
3. Greenberg M.D., “Advanced Engineering Mathematics”, Pearson Education2nd Edition, 5th Reprint, Delhi, 2009.
4. Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”,Narosa Publications, 5th Edition, New Delhi, 2017.
5. Peter V.O’Neil, “Advanced Engineering Mathematics”, Cengage Learning India Pvt., Ltd, 7th Edition, New Delhi , 2012.
6. Ramana B.V., “Higher Engineering Mathematics”, Tata McGraw Hill Co. Ltd., 11th Reprint, New Delhi, 2010.

PH5151 **ENGINEERING PHYSICS** **L T P C**

(Common to all branches of B.E / B.Tech programmes) **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 **9**

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_2 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.

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 L T P C
(COMMON TO ALL BRANCHES) 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, photoprocesses 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: Tg, 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 NANOCHEMISTRY 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 - Grotthuss-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_2-O_2 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:

- 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.

TEXT BOOKS:

1. Jain P. C. & Monica Jain., “Engineering Chemistry”, 16th 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 RGowariker, 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:

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

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.

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", 28thEd., Dhanalakshmi Publishers, Chennai, 2015.
4. Shah, M. B., and Rana, B. C., "Engineering Drawing", Pearson, 2ndEd., 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.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9				0.9					0.6		0.6	0.6	0.9	0.6
2	0.9									0.6		0.6	0.6	0.6	
3	0.9				0.9					0.6		0.6	0.6	0.6	
4	0.9		0.6		0.9					0.6		0.6	0.6	0.6	
5	0.9		0.9		0.9					0.6		0.6	0.6	0.6	

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BS5161	BASIC SCIENCES LABORATORY (Common to all branches of B.E. / B.Tech Programmes)	L T P C 0 0 4 2

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

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

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

COURSE OBJECTIVES:

- To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.
- 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 Na_2CO_3 as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler‟s method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
11. Determination of molecular weight of 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:

- 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^{th} 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:

1. 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.
2. Wiring various electrical joints in common household electrical wire work.
3. 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.
4. Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

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GROUP – A (CIVIL & ELECTRICAL)

PART I CIVIL ENGINEERING PRACTICES 15

PLUMBING WORK:

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

WOOD WORK:

a) Sawing,
b) Planing and
c) Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.

Wood Work Study:

a) Studying joints in door panels and wooden furniture
b) Studying common industrial trusses using models.

PART II ELECTRICAL ENGINEERING PRACTICES 15

WIRING WORK:

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

Wiring Study:

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

GROUP – B (MECHANICAL AND ELECTRONICS)

PART III MECHANICAL ENGINEERING PRACTICES 15

WELDING WORK:

a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
b) Practicing gas welding.

BASIC MACHINING WORK:

a) (simple)Turning.
b) (simple)Drilling.
c) (simple)Tapping.

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ASSEMBLY WORK:

a) Assembling a centrifugal pump.
b) Assembling a household mixer.
c) Assembling an air conditioner.

SHEET METAL WORK:

a) Making of a square tray

FOUNDRY WORK:

a) Demonstrating basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES 15

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 = 60 PERIODS

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

1. 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.
2. Wire various electrical joints in common household electrical wire work.
3. 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.
4. 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	0.6	0.3											0.3	0.3	
2		0.6	0.6											0.6	
3		0.6	0.3										0.6	0.6	
4		0.6	0.6	0.3										0.6	

Attested

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HM5201	ELECTRICAL AND ELECTRONIC PROPERTIES OF MATERIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To equip the students to have knowledge on different types of electron theory, basics of quantum mechanics and about energy bands.
2. To introduce the physics of semiconducting materials and applications of semiconductors in device fabrication.
3. To impart knowledge about the mechanisms of polarization in dielectric materials, and about classification and properties of dielectric materials.
4. To make the students to learn the origin of magnetism in magnetic materials and their classification; to learn the physics of superconductivity and various properties exhibited by superconductors.
5. To make the students familiarize with the optical properties of materials.

UNIT – I ELECTRICAL PROPERTIES OF MATERIALS 9

Classical free electron theory – Expression for electrical conductivity – Thermal conductivity, expression - Wiedemann-Franz law – Success and failures - Quantum free electron theory – Particle in a finite potential well – Tunneling- Particle in a three dimensional box – degenerate states – Fermi- Dirac statistics – Density of energy states – Electron in periodic potential – Energy bands in solids – tight binding approximation – Electron effective mass – concept of hole.

UNIT – II SEMICONDUCTOR PHYSICS 9

Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors – Carrier concentration in N-type & P-type semiconductors – Variation of carrier concentration with temperature – Carrier transport in Semiconductors: Drift, mobility and diffusion – Hall effect and devices – Ohmic contacts – Schottky diode.

UNIT – III DIELECTRICS AND FERROELECTRICS 9

Macroscopic description of the static dielectric constant. The electronic and ionic polarizabilities of molecules - orientational polarization - Measurement of the dielectric constant of a solid. The internal field - Lorentz, Clausius-Mosotti relation. Behaviour of dielectrics in an alternating field, elementary ideas on dipole relaxation, - Piezo, pyro and ferroelectric properties of crystals - classification of ferroelectric crystals - BaTiO3 and KDP.

UNIT – IV MAGNETISM AND SUPERCONDUCTIVITY 9

Atomic magnetic moment – classification of magnetic materials: diamagnetism, paramagnetism, ferromagnetism, antiferromagnetism and ferrimagnetism - Ferromagnetism: saturation magnetization and Curie temperature – exchange interaction - Domain theory – M versus H behavior – soft and hard magnetic materials -. Superconductivity – Zero resistance and the Meissner effect – Type I and Type II superconductors – critical current density - BCS theory of superconductivity - Elements of high temperature superconductivity (basic concepts only).

UNIT – V OPTICAL PROPERTIES OF MATERIALS 9

Light waves in a homogeneous medium - refractive index - dispersion: refractive index-wave-length behaviour - group velocity and group index – NLO materials – phase matching - SHG, sum frequency generation, parametric oscillations – difference frequency generation (qualitative)- applications- - complex refractive index and light absorption - Luminescence, phosphors and white LEDs - polarization - optical anisotropy: uniaxial crystals, birefringence, dichroism – electro-optic effect and amplitude modulators.

TOTAL: 45 PERIODS

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COURSE OUTCOMES:

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

1. Explain the theories of electrical and thermal conduction is solids, basic quantum mechanics, and energy bands.
2. Recognize semiconducting materials based on energy level diagrams, its types, temperature effect.
3. Interpret the mechanisms of various types of polarization and about classification and properties of ferroelectric crystals.
4. Discuss the classification of magnetic materials, theory and applications of ferromagnetic materials and superconductors.
5. Describe the optical properties of materials and their applications.

TEXT BOOKS:

1. Palanisamy, P.K., “Materials Science”, Scitech, 2015.
2. Donald Askeland, “Materials Science and Engineering”, Cengage Learning India Pvt. Ltd, 2011.

REFERENCES:

1. Ajoy Kumar Ghatak and K. Thyagarajan, “Optical electronics”, Cambridge University Press, 2013.
2. Balasubramaniam, R. “Callister's Materials Science and Engineering”, Wiley India Pvt. Ltd., 2014.
3. Kasap, S.O., “Principles of Electronic Materials and Devices”, Tata McGraw-Hill, 2007.
4. Kittel, C., “Introduction to Solid State Physics”, Wiley, 2012.
5. Pillai, S.O. “Solid State Physics”, New Age International, 2014.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	0.9		0.3										0.6		
C02	0.9		0.6										0.6		
C03	0.9	0.9	0.6										0.6		
CO4	0.9		0.6										0.6		
CO5	0.9	0.6	0.9										0.9		

Attested

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

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.

TEXT BOOKS:

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

REFERENCES:

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

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:

CO1: Develop algorithmic solutions to simple computational problems.
CO2: Develop and execute simple Python programs.
CO3: Write simple Python programs for solving problems.
CO4: Decompose a Python program into functions.
CO5: Represent compound data using Python lists, tuples, dictionaries etc.
CO6: Read and write data from/to files in Python programs.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									✓
CO2	✓		✓		✓							✓
CO3	✓	✓	✓									✓
CO4	✓	✓	✓	✓	✓							✓
CO5	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
CO6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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.

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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:

CO1 To be able to understand the concepts related with electrical circuits and wiring.
CO2 To be able to study the different three phase connections and the concepts of magnetic circuits.
CO3 Capable of understanding the operating principle of AC and DC machines.
CO4 To be able to understand the working principle of electronic devices such as diode and zener diode.
CO 5 To be able to understand the characteristics and working of current controlled and voltage controlled devices.

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

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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; 5th edition, 2013

REFERENCES:

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

ML5201	PHYSICAL METALLURGY	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

1. To acquire a sound background in predicting the behavior of a metallic material to a certain application.
2. To inculcate the knowledge of the fundamental principles of Physical Metallurgy
3. To impart knowledge on the interpretation of phase diagrams.
4. To impart knowledge on the thermodynamics aspect of physical metallugy
5. To impart knowledge on the use of physical metallurgy concepts in different alloys

UNIT I STRUCTURE OF SOLIDS & SOLIDIFICATION OF PURE METALS 9

Atomic Bonding & Crystal Structure: Metallic bond, unit cell, atomic packing, interstitial sites, Miller indices, crystal orientation, stereographic projection.

Phase rule, Concept of Free Energy, Entropy, Surface Energy (grain boundary) & under cooling, Nucleation & Growth, homogeneous & heterogeneous nucleation, directional solidification. Mechanisms (slip & twin), critical resolved shear stress, single crystal tensile test (FCC), theoretical strength of ideal crystal.

UNIT II CRYSTAL IMPERFECTIONS AND DIFFUSION 9

Vacancy, interstitial, substitutional, free energy of mixing, dislocation (elementary concepts only), edge / screw dislocation, partial dislocation, stacking fault, dislocation lock, dislocation pile up, Hall Petch relation, grain boundary structure.

Elementary concepts of phenomenological & atomistic approaches in Diffusion

UNIT III SOLIDIFICATION OF BINARY ALLOYS 9

Limits of solubility, isomorphous system, lever rule, constitutional super cooling, effect of non-equilibrium cooling, eutectic, peritectic, eutectoid & peritectoid system, complex phase diagram, ternary diagram, structure of cast metal, segregation & porosity, iron-carbon diagram, steel & cast iron.

Phase Diagrams of common commercial alloys: Cu-Ni, Ni-Cr, Al-Si, Al-Zn, Cu-Zn, Cu-Al, Ti-Al, Ti-V, interpretation of microstructure & properties.

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UNIT IV COLD WORKING, ANNEALING AND PRECIPITATION 9

Recovery, recrystallization & grain growth, phenomenological & mechanistic approaches. Thermodynamics & kinetics of precipitation, precipitation hardening.
Need for Heat treatments. Introduction to various Heat treatment processes.

UNIT V APPLICATIONS OF PHYSICAL METALLURGY 9

Strengthening mechanism, strength vs. toughness (ductility), thermo mechanical processing, micro alloyed steel, ultra high strength steel, superalloy, control of texture.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

The student will be able to

1. To recognize basic nomenclature, basic microstructure, and associate terms with the appropriate structure / phenomena and be able to differentiate between related structure / phenomena.
2. To perform simple calculations to qualify materials properties and microstructural characteristics.
3. To interpret the effect of composition and microstructure on material properties.
4. To perform phase equilibrium calculation and construct phase diagram.
5. To select suitable ferrous and non-ferrous materials for engineering application.

TEXT BOOKS

1. V. Raghavan, “Materials Science and Engineering”, Prentice –Hall of India Pvt. Ltd., 2015
2. William D. Callister, Jr., “Materials Science and Engineering an Introduction”, 9/e Edition,John Wiley & Sons, Inc., 2014.

REFERENCES

1. Donald R. Askeland, Pradeep P. Phule, “The Science and Engineering of Materials”, 7th Edition, Thomson Learning, 2015.
2. F. N. Billmayer, “Test Book of polymer science”, John Wiley & Sons, New York, 1994.
3. Kingery, W. D., Bowen H. K. and Uhlmann, D. R., “Introduction to Ceramics”, 2nd Edition, John Wiley & Sons, New York, 1976.
4. Sidney H. Avner, “Introduction to Physical Metallurgy”, Tata Mc-Graw-Hill Inc,2/e, 1997.
5. Vijendra Singh, “Physical Metallurgy”, Standard Publishers Distributors, New Delhi,2012.
6. William F. Smith, “Structure and Properties of Engineering Alloys”, Mc-Graw-Hill Inc.,U.S.A, 2nd edition, 1993.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0.9											0.6	0.3		
CO2	0.6	0.9		0.3									0.3		
CO3	0.9	0.3		0.6								0.3			
CO4	0.9			0.6									0.3		
CO5	0.9	0.6													0.3

ML5202 REACTION KINETICS AND DYNAMICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To discuss and explain the basics of solid state chemistry.
2. To understand and apply the basic principles of chemical reaction kinetics and dynamics.
3. To explain the theoretical models of molecular collisions, reaction dynamics and microscopic kinetics.
4. To theoretically derive rate law equations and solve simple numerical problems.
5. To describe the experimental methods of preparation of materials in various forms.

UNIT – I SOLID STATE CHEMISTRY **9**

Solids - Types - Crystalline, Amorphous and Polycrystalline properties. Isotropy and anisotropy- interfacial angles - symmetry in crystal systems - elements of symmetry, - space lattice and unit cell, Bravias lattices - seven crystal systems. Bond types - molecular, covalent, metallic and ionic. Born-Haber Cycle, Lattice energy, Imperfections in crystal- Stoichiometric defects - Schottky, Frenkel. Non-stoichiometric defects – Colour Centre, F-Centre.

UNIT – II REACTION KINETICS IN SOLUTIONS **9**

Chemical kinetics – rate equation, order of reaction and rate law determination: Integral, Isolation, half-life and differential methods; comparison of different techniques. Kinetic equations for complex reactions-chain, parallel, opposing and consecutive reactions; Theory of reaction rates; Temperature effect on reaction rates; Rate constant for simple bimolecular reactions; Collision theory; Activated complex theory. Reactions in solutions: Diffusion controlled and activation controlled reactions; Thermodynamic formulation of rate constant: effect of pressure and ionic strength.

UNIT – III REACTION KINETICS ON SURFACES **9**

Adsorption: Physisorption and chemisorptiion – Monolayer and multilayer adsorption - Adsorption of gases on solids - factors influencing adsorption - Langmuir adsorption; Adsorption of solutes from solutions - Freundlich adsorption. Applications - Adsorption Chromatography (Column Chromatography). kinetics of surface catalyzed unimolecular and bimolecular reactions; Applications. Surface characterization techniques – BET equation – XPS, AES, SEM and TEM.

UNIT – IV KINETICS OF SOLID STATE REACTIONS **9**

Sintering, Nucleation; Factors influencing the reactivity of solids; Precursors to solid state reactions; Tammann and Hedvall mechanism; Wagner's diffusion theory, Material transport in solid state reaction-counter diffusion, Kirkendall effect; Huttig's mechanism; Kinetic model-Reaction in powder compact, Atomic theory of diffusion- self diffusion mechanism.

UNIT – V SYNTHETIC METHODS **9**

Thin film - Electrochemical methods, PVD and CVD; Crystal growth- Thermal methods – Bridgman, Stockbarger and Zone refining, High Temperature Ceramic Methods, Particle size reduction, Precursor method, Co-precipitation, Sol-gel, Microwave Synthesis, Combustion Synthesis, High Pressure Methods, preparing single crystals - Czochralski, Molecular beam epitaxy - Flame and plasma fusion, Solution methods, Intercalated compounds.

TOTAL: 45 PERIODS

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COURSE OUTCOMES:

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

1. To remember and explain the basic concepts of solid state chemistry.
2. To understand and apply the basic principles of chemical reaction kinetics and dynamics.
3. To analyse the theoretical models of molecular collisions, reaction dynamics and microscopic kinetics.
4. To derive and evaluate rate law equations and solve simple numerical problems.
5. To develop suitable experimental methods for material preparations.

TEXT BOOKS

1. Laidler, Keith J. Chemical Kinetics, 4th Edn. Pearson Educations, New Delhi, 2007.
2. West, Anthony R. Solid State Chemistry and its Applications, 1st Edn. John Wiley & Sons, Singapore, 2003.

REFERENCES:

1. Leslie E. Smart and Elaine A. Moore “Solid State Chemistry: An Introduction”, 3rd Edn. Taylor & Francis, New York, 2005.
2. Sandra E. Dann, “Reactions and Characterization of Solids”, 1st Edn. The Royal Society of Chemistry, Cambridge, 2000.
3. Pilling M.J. and Seakins P. W., “Reaction Kinetics” 1st Edn. Oxford University Press, London, 1995.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.9	0.6			0.3								0.9	0.3	0.3
CO2	0.9	0.6	0.3		0.3								0.6	0.3	0.3
CO3	0.9	0.6	0.3		0.3								0.6	0.3	0.3
CO4	0.9	0.6	0.3		0.3								0.6	0.3	0.3
CO5	0.9	0.6		0.3	0.6								0.6	0.3	0.9

EE5261 ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY

L	T	P	C
0	0	4	2

COURSE OBJECTIVES

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

LIST OF EXPERIMENTS

1. Verification of Kirchhoff’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.

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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

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:

CO1: Develop algorithmic solutions to simple computational problems
CO2: Develop and execute simple Python programs.
CO3: Structure simple Python programs for solving problems.
CO4: Decompose a Python program into functions.
CO5: Represent compound data using Python data structures.
CO6: Apply Python features in developing software applications.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									✓
CO2	✓		✓		✓							✓
CO3	✓	✓	✓									✓
CO4	✓	✓	✓	✓	✓							✓
CO5	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
CO6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

MA5355 TRANSFORM TECHNIQUES AND PARTIAL DIFFERENTIAL EQUATIONS

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To introduce the effective mathematical tools for the solutions of partial differential equations that model physical processes;
- To introduce Fourier series analysis which is central to many applications in engineering
- To develop the analytic solutions for partial differential equations used in engineering by Fourier series;
- To acquaint the student with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic;
- To develop Z- transform techniques which will perform the same task for discrete time systems as Laplace Transform, a valuable aid in analysis of continuous time systems.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 12

Formation – Solutions of first order equations – Standard types and Equations reducible to standard types – Lagrange's Linear equation – Solution of linear equations of higher order with constant coefficients – Linear non-homogeneous partial differential equations.

UNIT II FOURIER SERIES 12

Dirichlet's conditions – General Fourier series – Odd and even functions – Half-range Sine and cosine series – Complex form of Fourier series – Parseval's identity – Harmonic Analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATION 12

Classification of partial differential equations- Method of separation of variables – Solutions of one dimensional wave equation and one-dimensional heat equation – Steady state solution of two-dimensional heat equation – Fourier series solutions in cartesian coordinates.

UNIT IV FOURIER TRANSFORM 12

Fourier integral theorem – Fourier transform pair - Sine and cosine transforms – Properties – Transform of elementary functions – Convolution theorem – Parseval's identity.

UNIT V Z – TRANSFORM AND DIFFERENCE EQUATIONS 12

Z-transform – Elementary properties – Inverse Z-transform – Convolution theorem – Initial and final value theorems – Formation of difference equation – Solution of difference equation using Z - transform.

TOTAL : 60 PERIODS

COURSE OUTCOMES :

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

- Solve partial differential equations which arise in application problems.
- Analyze the functions as an infinite series involving sine and cosine functions.
- Obtain the solutions of the partial differential equations using Fourier series.
- Obtain Fourier transforms for the functions which are needed for solving application problems.
- Manipulate discrete data sequences using Z transform techniques.

TEXT BOOKS:

1. Erwin kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 10th Edition, New Delhi, 2015.
2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, New Delhi, 2017.

REFERENCES:

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

ML5301	POLYMER SCIENCE AND ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To understand the basics of polymers, its formation and polymerization types.
2. To understand the significance and determine the molecular weights of polymers.
3. To characterize polymers for their thermal behaviour and solution properties.
4. To explain the thermodynamics of polymer dissolution and the factors influencing.
5. To identify suitable polymer processing methods for polymer products.

UNIT – I POLYMERS AND POLYMERIZATION 9

Fundamentals of Polymers – Monomers – Functionality - Classification – Polymerization types and techniques – Structure, property and applications of PE, PP, PVC, PMMA, PTFE, Polyamides, Polyesters, Polycarbonates and polyurethanes – Copolymers - Interfacial polymerization – Crosslinked polymers.

UNIT – II MOLECULAR WEIGHTS OF POLYMERS 9

Number average and weight average molecular weights – Degree of polymerization – Molecular weight distribution – Polydispersity – Molecular weight determination-Methods – Viscometry - Gel Permeation Chromatography.

UNIT – III TRANSITIONS IN POLYMERS 9

First and second order transitions – Glass transition, Tg– multiple transitions in polymers – experimental study – significance of transition temperatures. Crystallinity in polymers – effect of

crystallization – factors affecting crystallization, crystal nucleation and growth – Relationship between Tg and Tm – Structure–Property relationship.

UNIT – IV SOLUTION PROPERTIES OF POLYMERS 9

Size and shape of macromolecules – Solubility parameter – polymer/solvent interaction parameter – temperature – size and molecular weight. Solution properties of polymers. Importance of Rheology – Newtonian and Non-Newtonian flow behaviour – Polymer melts.

UNIT – V POLYMER PROCESSING 9

Overview of Features of Single screw extruder –Tubular blown film process - Coextrusion.- Injection Moulding systems – Compression & Transfer Moulding - Blow Moulding – Rotational Moulding – Thermoforming – Vacuum forming -Calendering process – Fiber Spinning process – Structural Foam Moulding – Sandwich Moulding. - Reaction Injection Moulding & Reinforced Reaction Injection Moulding.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. To understand the basics concepts and fundamental principles of polymers and polymerization.
2. To evaluate and determine the molecular weights of polymers.
3. To characterize and evaluate the thermal and solution properties of polymers.
4. To understand and analyze the thermodynamics of polymer dissolution.
5. To produce tailor-made polymers to suit the demanding applications.

TEXT BOOKS

1. Bahadur and Sastry, “Principles of Polymer Science”, Narosa Publishing House, 2002.
2. Morton Jones D. H., “Polymer Processing”, Chapman & Hall, New York, 1995.

REFERENCES:

1. Billmayer Jr. and Fred. W., “Textbook of Polymer Science”, WileyTappers, 1965
2. Crawford R.J, Plastics Engineering (3rd Ed), Pergamon Press, London (1987)
3. Fried J. R., “Polymer Science and Technology”, Prentice Hall, 1995.
4. Gowarikar, “Polymer Science”, Johan Wiley and Sons, 1986.
5. Griskey G., “Polymer Process Engineering”, Chapman & Hall, New York, 1995.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0.9	0.6			0.3		0.6						0.3	0.3	0.9
CO2	0.9	0.6	0.3		0.3		0.6						0.3	0.6	0.9
CO3	0.9	0.6	0.3		0.3		0.3						0.3	0.6	0.9
CO4	0.9	0.6	0.3		0.3		0.6						0.3	0.6	0.9
CO5	0.9	0.6	0.3	0.3	0.6		0.3						0.3	0.6	0.9

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ML5302	METALLURGICAL THERMODYNAMICS	L	T	P	C
		4	0	0	4

COURSE OBJECTIVES:

1. To give an overview of fundamental concepts in metallurgical thermodynamics
2. To impart knowledge about the state functions such as internal energy, entropy and criteria of equilibrium.
3. To give insight to the auxilliary functions, heat capacities and thermodynamic potentials.
4. To provide essentials of thermodynamic behavior of solutions,.
5. To render exposure to thermodynamics of electrochemical cells, surfaces and defects.

UNIT – I FUNDAMENTAL CONCEPTS 9+3

Definition of thermodynamic terms; concept of states, systems and surroundings, Types of systems, equilibrium. Equation of states, extensive and intensive properties, homogeneous and heterogeneous, micro-macro systems. Phase diagrams and its classification, Internal energy, heat capacity, enthalpy, isothermal, and adiabatic processes.

.

UNIT – II INTERNAL ENERGY AND ENTROPY 9+3

First law of Thermodynamics: Relation between Heat and work, Internal energy and Enthalpy. The Second law of thermodynamics: Spontaneous process, Degree of measure of reversibility and irreversibility, Maximum work, criteria of equilibrium. Combined statement of first and second laws on thermodynamics. Statistical interpretation of entropy: Concept of microstate, most probable microstate, Thermal equilibrium, Boltzman equation, configurational entropy

UNIT – III AUXILLARY FUNCTIONS AND THERMODYNAMIC POTENTIALS 9+3

Auxiliary functions: Helmholtz, Gibbs free energy, Maxwell's equation, Gibbs-Helmholtz equations. Concept of Third law, temperature dependence of entropy, Einstein's and Debye's concepts of heat capacity, relation between Cp and Cv, Nernst heat theorem, Consequences of third law, Hess's law, Le Chatelier's principle and Kirchoff's law. Zeroth law of thermodynamics and its applications. Thermodynamic potentials: Fugacity, Activity and Equilibrium constant. Clausius - Clayperon and Vant Hoff's equations.

UNIT – IV THERMODYNAMICS OF SOLUTIONS 9+3

Solutions, Mole fraction, Dalton's law, partial molar quantities, ideal and non-ideal solutions, Henry's law, Gibbs - Duhem equation, regular solution, quasi-chemical approach to solution, statistical treatment. Change of standard state. Phase relations and phase rule, its applications. Ellingham diagram and its use. Free energy composition diagrams for binary alloy systems, determination of liquidus, solidus and solvus lines. Effect of pressure on phase transformation and phase equilibria.

UNIT – V THERMODYNAMICS OF REACTIONS 9+3

Thermodynamics of electrochemical cells, solid electrolytes. Pourbaix diagrams. Thermodynamics of Surfaces: Adsorption isotherms, Effect of surface energy on pressure and phase transformation temperature. Thermodynamics of Defects in solids: Point defects, vacancies and interstitials in solid metals.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

1. Recognize the nature of the system and properties.
2. Explain the concept of internal energy, entropy and criteria for equilibrium.
3. Realize the importance of auxiliary functions and thermodynamic potentials

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4. Apply the concepts of thermodynamics in the behavior of solutions.
5. Outline the thermodynamic approaches towards electrochemical cells, surfaces and defects.

TEXT BOOKS:

1. David R Gaskell & David E Laughlin, "Introduction to the Thermodynamics of materials", CRC press, Sixth edition, 2017.
2. Subir Kumar Bose & Sanat Kumar Roy, " Principles of Metallurgical Thermodynamics", Universities press, 2014.

REFERENCES:

1. Ahindra Ghosh, Textbook of Materials and Metallurgical Thermodynamics, Prentice hall of India, 2002.
2. Boris.S.Bokstein, Mikhail I. Mendelev, David J. Srolovitz," Thermodynamics and Kinetics in Materials science", Oxford University Press 2005.
3. Prasad, Krishna Kant, Ray, H. S. and Abraham, K. P., "Chemical and Metallurgical Thermodynamics", New Age International, 2012.
4. Shamsuddin M, " Physical Chemistry of Metallurgical process", John Wiley, 2016
5. Upadhyaya, G. S. and Dube, R. K., "Problems in Metallurgical Thermodynamics and Kinetics", Pergamon Press, London, 1977.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0.9	0.6			0.3		0.6						0.3	0.3	0.9
CO2	0.9	0.6	0.3		0.3		0.6						0.3	0.6	0.9
CO3	0.9	0.6	0.3		0.3		0.3						0.3	0.6	0.9
CO4	0.9	0.6	0.3		0.3		0.6						0.3	0.6	0.9
CO5	0.9	0.6	0.3	0.3	0.6		0.3						0.3	0.6	0.9

ML5352 MECHANICS OF MATERIALS L T P C
3 0 0 3

COURSE OBJECTIVES:

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

1. Applying the principle concepts behind stress, strain and deformation of solids for various engineering applications.
2. Analyzing the transverse loading on beams and stresses in beam for various engineering applications.
3. Analyzing the torsion principles on shafts and springs for various engineering applications.
4. Analyzing the deflection of beams for various engineering applications.
5. Analyzing the thin and thick shells and principal stresses in beam for various engineering applications

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic constants – Volumertric strains

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UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM 9

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

UNIT III TORSION 9

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

UNIT IV DEFLECTION OF BEAMS 9

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

UNIT V THICK & THIN SHELLS & PRINCIPAL STRESSES 9

Stresses in thin cylindrical shell due to internal pressure, circumferential and longitudinal stresses and deformation in thin cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lame's theory – Application of theories of failure – Stresses on inclined planes – principal stresses and principal planes – Mohr's circle of stress.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Apply the principle concepts behind stress, strain and deformation of solids for various engineering applications.
2. Analyze the transverse loading on beams and stresses in beam for various engineering applications.
3. Analyze the torsion principles on shafts and springs for various engineering applications.
4. Analyze the deflection of beams for various engineering applications.
5. Analyze the thin and thick shells and principal stresses in beam for various engineering applications.

TEXT BOOKS:

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

REFERENCES:

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.9	0.9	0.9										0.9	0.6	
CO2	0.9	0.9	0.9										0.9	0.6	
CO3	0.9	0.9	0.9										0.9	0.6	
CO4	0.9	0.9	0.9										0.9	0.6	
CO5	0.9	0.9	0.9										0.9	0.6	

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ML5311 MICROSTRUCTURAL ANALYSIS LABORATORY

L	T	P	C
0	0	4	2

COURSE OBJECTIVE:

To provide a hands on experience to understand the effect of heat treatments on the microstructural behavior of some common types of metals and alloys.

LIST OF EXPERIMENTS

1. Mounting and preparation of metallurgical samples.
2. Study of metallurgical microscope and sample preparation.
3. Quantitative Metallography & image analysis.
4. Macro etching - cast, forged and welded components.
5. Electrolytic Etching and Polishing
6. Microscopic examination of cast irons - Gray, White, Malleable and Nodular types
7. Microscopic examination of Plain carbon steels (low carbon, medium carbon, high carbon steels).
8. Microscopic examination of Austenitic Stainless steels and High Speed Steels.
9. Microscopic examination of banded structure in steels and welded joints.
10. Microscopic examination of Copper alloys

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Students will be able:

- To prepare the samples for microscopic examination
- To recognize the microstructures of various ferrous and non- ferrous materials
- To differentiate the different types of cast irons based on their morphology and analyse the effect of the processing on the microstructure.
- To interpret the microstructures of various materials and also understand the effect of the various phase constituents on the properties of the materials
- To perform a quantitative analysis on any given microstructure.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.9											0.3			
CO2	0.9			0.6								0.3			
CO3	0.9	0.3		0.6											
CO4	0.6	0.3		0.9								0.6			
CO5	0.3	0.6			0.9										

ML5312	MATERIALS TESTING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

1. To make the student familiarize with various mechanical testing.
2. To offer hands-on training in the evaluation of mechanical properties and the standards.
3. To know the importance of testing standards.
4. To demonstrate the importance of stress-strain curves and resistance to indentation in materials selection.
5. To expose the different methods of evaluating the soundness of weldment.

LIST OF EXPERIMENTS

1. To perform tensile test and draw stress-strain plot, determination of yield/proof stress, Ultimate tensile strength, breaking stress and % elongation.
2. Comparison of the stress-strain curves of aluminium alloys, steels, polymers and composites.
3. To perform hardness test and determine hardness value using Rockwell Hardness/ Brinnel Tester.
4. To determine hardness distribution using Micro vicker's hardness.
5. Determination of hardness by LEEB's Hardness tester.
6. Determination of fracture toughness by charpy impact test.
7. To perform compression test and compare the compressive behaviour of steels/ aluminium alloys.
8. To perform the torsion test.
9. To perform Longitudinal and transverse welds test.
10. To perform guide and root bend tests in welded specimen.
11. To perform Scratch hardness tests are to determine the hardness of a material to scratches and abrasion in Mohrs scale.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

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

1. Select a suitable mechanical test method to evaluate the properties of material.
2. Identify appropriate test method while performing failure analysis.
3. Use the stress-strain plot in materials selection.
4. Evaluate the soundness of the weldments.
5. Discriminate hardness and hardenability.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.9											0.3			
CO2	0.9			0.6								0.3			
CO3	0.9	0.3		0.6											
CO4	0.6	0.3		0.9								0.6			
CO5	0.3	0.6			0.9										

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ML5401 EXPERIMENTAL TECHNIQUES AND METHODS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To understand the fundamentals of spectroscopic methods.
2. To understand and describe the principles behind UV-visible, IR, Raman and Atomic spectroscopy.
3. To characterize materials using thermal and surface analytical methods.
4. To estimate samples using separation techniques.
5. To understand the theory, instrumentation of analytical and spectroscopic equipments and their applications in material analysis.

UNIT – I INTRODUCTION TO SPECTROSCOPY 9

Atomic and Molecular spectroscopy – interaction of EMR with matter – Energy levels in atoms and molecules – Absorption and Emission techniques – Fluorescence, Phosphorescence and Chemiluminescence – Beer Lambert's law – Qualitative and Quantitative analyses – limitations – Visible absorption spectroscopy.

UNIT – II UV VISIBLE SPECTROSCOPY 9

Electronic transitions and energy level diagrams – choice of solvents, cut off wavelengths for solvents – Woodward Fieser Rule for absorption maxima – effect of conjugation – UV-Visible spectrophotometer – Photometric titration – Applications.

UNIT – III IR, RAMAN AND ATOMIC SPECTROSCOPY 9

IR spectroscopy – theory and principle – vibration modes of simple molecules – instrumentation and applications; Raman spectroscopy – theory, differences between IR and Raman – Uses; AAS – principle and instrumentation – Hollow cathode lamp detector – applications; FES – principle, instrumentation and applications in qualitative analysis – ICP-AES – principle, instrumentation and applications.

UNIT – IV SEPARATION TECHNIQUES 9

Solvent extraction and ion exchange techniques – principles and applications; Chromotographic techniques – adsorption chromatography – Paper, TLC and Coloumn- GC and HPLC.

UNIT – V THERMAL AND SURFACE ANALYSIS METHODS 9

Thermal analysis – TGA, DTA, DSC and DMA – principles, instrumentation and applications. Surface analysis – TEM, SEM and AFM – Principle, instrumentation and applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. To understand the fundamentals of spectroscopic methods.
2. To apply the principles of UV-visible, IR, Raman and Atomic spectroscopic techniques for material characterization.
3. To evaluate the thermal and surface properties of materials using analytical techniques.
4. To qualitatively and quantitatively estimate samples using separation techniques.
5. To interpret the results of spectroscopic and analytical methods of specimen analysis.

TEXT BOOKS

1. Skoog D.A., James Leary F., and. Nieman T. A., "Principles of instrumental analysis, Fifth Edn., Saunders Publications, 1998.
2. Willard, H. H., Merritt, I. I., Dean J. A. and Settle, F. A., "Instrumental methods of analysis", Sixth Edn., CBS publishers, 1986.

REFERENCES:

1. Sharma B.K., "Instrumental methods of analysis", Goel Publishing House, 1995
2. Yang Leng, "Material Characterization: Introduction to microscopic and spectroscopic methods", Wiley and Sons, 1st edn., 2008.
3. Skoog D. A., Holler F. J. and Crouch S. R., "Principles of instrumental analysis, Sixth Edn., Thomas Brookes Cole, 2007.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
C01	0.3	0.3	0.6	0.9	0.9								0.9	0.9	
C02	0.3	0.3	0.6	0.9	0.9								0.9	0.9	
C03	0.3	0.3	0.6	0.9	0.9								0.9	0.9	
CO4	0.3	0.3	0.6	0.9	0.9								0.9	0.9	
CO5	0.3	0.3	0.6	0.9	0.9								0.9	0.9	

ML5402 **IRON AND STEEL MAKING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

1. To provide a basic knowledge on the need for the beneficiation of iron ores and the different preliminary treatments given to the iron ores.
2. To inculcate the knowledge on the various parts of blast furnace and the reactions that take place in the various zones of blast furnace
3. To make the students to understand the principles and kinetics of pig iron production as well as steel making.
4. To import knowledge on various primary and secondary processes employed for making of steel
5. To import knowledge on ladle metallurgy to produce different types of steel

UNIT I RAW MATERIALS AND BURDEN PREPARATION 9

Iron ore classification, Indian iron ores, limestone and coking coal deposits, problems associated with Indian raw materials, Iron ore beneficiation and agglomeration, Briquetting, sintering, Nodulising and pelletizing, testing of burden materials, burden distribution on blast furnace performance.

UNIT II PRINCIPLES AND PROCESSES OF IRON MAKING 9

Blast furnace parts, construction and design aspects, ancillary equipment for charging, preheating the blast, hot blast stoves, gas cleaning, Blast furnace operation, irregularities and remedies, Blast furnace instrumentation and control of furnace Compositional control of metal and slag in blast furnace, modern trends in blast furnace practice.

Reduction of iron ores and oxides of iron by solid and gaseous reductions-thermodynamics and kinetics study of direct and indirect reduction, Gruner's theorem, blast furnace reactions. C-O and Fe-C-O equilibria, Rist diagrams, Ellingham diagram, material and heat balance- Sponge Iron making.

UNIT III PRINCIPLES OF STEEL MAKING 9

Development of steel making processes, physico-chemical principles and kinetic aspects of steel making, carbon boil, oxygen-transport mechanism, desulphurisation, dephosphorisation, Slag Theories, slag-functions, composition, properties and theories, raw materials for steelmaking and plant layout.

UNIT IV STEEL MAKING PROCESSES 9

Open Hearth process- constructional features, process types, operation, modified processes, Duplexing, pre-treatment of hot metal. Bessemer processes, Side Blown Converter, Top Blown processes-L.D, L.D.A.C., Bottom blown processes, combined blown processes, Rotating oxygen processes - Kaldo and Rotor, Modern trends in oxygen steel making processes-Electric Arc and Induction furnace-constructional features. Steel Classifications and Standards-National and International- Alloy Designation.

UNIT V LADLE METALLURGY 9

Production practice for plain carbon steels, stainless steels, tool steels and special steels, Secondary steel making processes, continuous steel casting process – Deoxidation and teeming practice. Principle, methods and their comparison, Killed, Rimmed and Capped steels, Degassing practices, ingot production, ingot defects and remedies. Recent trends in steel making technology.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students will be able:

1. To identify the suitable preliminary treatments to be given to the iron ore for the beneficiation of ores.
2. To explain the construction of Blast furnace, its operation and the various reactions that takes place in the various zones of blast furnace.
3. To interpret the slag theories and slag functions in the steel making processes.
4. To compare the various steel making processes and analyse the advantages and limitations of the different processes.
5. To identify suitable secondary refining processes for producing a good quality steel.

TEXT BOOKS

1. Dipak Mazumdar, “A First Course in Iron and Steel Making”, Universities press – IIM, Series in Metallurgy and Materials Science, India, 2015.
2. Tupkary, R. H.&Tupkary V.R., “An Introduction to Modern Iron Making”, Khanna Publishers, 4th edition, 2016 & “An Introduction to Modern Steel Making”, Khanna Publishers, New Delhi, 2000.

REFERENCES

1. Ahindra Ghosh and Amit chatterjee, “Iron Making and Steel Making – Theory and Practice”, Prentice Hall of India Private Ltd., New Delhi 2008.
2. Biswas, A. K., “Principles of blast furnace iron making: theory and practice”, SBA Publications, Kolkata, 1994.
3. Bashforth, G. R., “Manufacture of Iron and Steel”, Vol. I, Chapman and Hall London, 1964.Bashforth, G. R., “Manufacture of Iron and Steel”, Vol.2, 3rd Edition, Chapman & Hall,London, 1964.
4. “Making, Shaping and Treating of Steel”, US Steel Corporation, 11th edition, 1994.

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.9	0.3											0.6		
CO2	0.9		0.3			0.6									
CO3		0.6		0.9									0.6		
CO4	0.6	0.9					0.3								
CO5		0.6	0.9		0.3										

ML5403 MECHANICAL BEHAVIOUR OF MATERIALS L T P C

3 0 0 3

COURSE OBJECTIVES:

1. To give an overview of elastic and plastic behaviour of materials
2. To enlighten the different strengthening mechanisms.
3. To give insight into the types of fracture and mechanics of fracture.
4. To provide acumen towards fatigue behavior of materials.
5. To render exposure to high temperature behavior of materials.

UNIT – I ELASTIC AND PLASTIC BEHAVIOUR 9

Elastic behaviour of materials - Hooke's law, plastic behaviour: dislocation theory , Types of dislocations- Burger's vectors and dislocation loops, dislocations in the FCC, HCP and BCC lattice, stress fields and energies of dislocations, forces on and between dislocations, dislocation climb, intersections of dislocations, Jogs, dislocation sources, multiplication of dislocations, dislocation pile-ups, Slip and twinning. Methods of observing dislocations

UNIT – II STRENGTHENING MECHANISMS 9

Elementary discussion of cold working, grain boundary strengthening. Solid solution strengthening, Martensitic strengthening, Precipitation strengthening, Particulate Strengthening, Dispersion strengthening, Fiber strengthening, Yield point phenomenon, strain aging and dynamic strain aging

UNIT – III FRACTURE AND FRACTURE MECHANICS 9

Types of fracture, Basic mechanisms of ductile and brittle fracture, Griffith's theory of brittle fracture, Orowan's modification. Izod and Charpy Impacts tests, Ductile to Brittle Transition Temperature (DBTT), Factors affecting DBTT, Determination of DBTT. Fracture mechanics-Introduction, Modes of fracture, Stress intensity factor, Fracture toughness and Determination of KIC.

UNIT – IV FATIGUE BEHAVIOUR AND TESTING 9

Fatigue: Stress cycles, S-N curves, Effect of mean stress, Factors affecting Fatigue, Structural changes accompanying fatigue, Cumulative damage- Miner law, HCF / LCF, creep- fatigue interactions, micro-mechanisms of fatigue crack initiation and growth, fatigue testing machines- Pari's Equation, Residual life prediction under Fatigue. Macro, Microstructural features of fatigue fracture.

UNIT – V CREEP BEHAVIOUR AND TESTING 9

Creep curve, Stages in creep curve and explanation, Structural changes during creep, Creep mechanisms, Metallurgical factors affecting creep, High temperature alloys, Stress rupture testing, Creep testing machines, creep life prediction-Omega (Damage rate) method, Larson-Miller (parametric) method. Deformation Mechanism Maps according to Frost/Ashby, Superplasticity.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Identify the role of dislocations and the mechanisms of plastic deformation.
2. Explain the strengthening mechanisms of polycrystalline and composite materials.
3. Analyze the nature of fracture and its underlying mechanism.
4. Appraise the micro-mechanics, factors and life predictions of components under fatigue loading.
5. Assess the behavior of materials under high temperature, metallurgical factors and life prediction of high temperature materials.

TEXT BOOKS:

1. Dieter, G. E., "Mechanical Metallurgy", McGraw-Hill Co., SI Edition, 1995
2. Thomas H. Courtney, " Mechanical Behaviour of Materials", Waveland Press, 2nd edition, 2005

REFERENCES:

1. Bhargava A K & Sharma C P, "Mechanical behavior and Testing of materials" PHI learning
2. 2011.
3. Norman E Dowling, "Mechanical Behaviour of Materials, Pearson 2013.
4. Prashant Kumar, "Elements of Fracture Mechanics", McGraw-Hilll, 2009.
5. Shetty M N, Dislocations and mechanical behavior of materials", PHI learning 2013.
   William F.Hosford., "Mechanical behaviour of Materials", Cambridge University press, 2010.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0.9	0.3											0.6		
CO2	0.9		0.3			0.6									
CO3		0.6		0.9									0.6		
CO4	0.6	0.9					0.3								
CO5		0.6	0.9		0.3										

ML5404 HEAT TREATMENT OF METALS AND ALLOYS L T P C
3 0 0 3

COURSE OBJECTIVES:

1. To impart necessary background to design/select the necessary heat treatment for attaining the appropriate microstructure for the desired properties.
2. To provide a comprehensive understanding of the various transformation reactions associated with the changes in microstructures and properties that occur due to controlled heat treatment.
3. To import knowledge on different case hardening techniques used in industries
4. To expose the students to various Heat treatment furnaces, Quenching media and the heat treatment of some special alloys.
5. To import knowledge on heat treatments employed for special alloys

UNIT I TRANSFORMATIONS IN STEELS 9

Allotropic changes in Iron, Iron-Iron carbide equilibrium diagram – transformations on heating and cooling - influence of alloying elements – general principles of heat treatment of steels – isothermal and continuous cooling transformations in steels – Time-Temperature-Transformation curves (TTT-diagrams), continuous cooling transformations – CCT-diagrams– effect of alloying additions on TTT diagrams, mechanism and kinetics of pearlitic, bainitic and martensitic transformations – habit plane – Bain distortion model

UNIT II HEAT TREATMENT PROCESSES 9

Annealing- Types, Normalising, Hardening & Quenching –Mechanisms-hardenability studies– Jominy end-quench test, Grossman's experiments, tempering – Hollomon& Jaffe tempering correlations, retained austenite, tempering – Stages – effects of alloying elements on tempering, austempering and martempering, precipitation hardening, thermo-mechanical treatment, intercritical heat treatment, sub-zero treatment – cryogenic quenching, patenting

UNIT III CASE HARDENING 9

Introduction, carburisation – principle – carbon potential – mechanism – application of Fick's law– depth of carburisation and its control – methods of carburising – heat treatment after carburizing – structure, properties and defects in carburising, nitriding – mechanism –- effect of microstructure – nitriding methods, ion-nitriding and nitro-carburising, boronising, chromising, cyaniding and carbonitriding, induction and flame hardening, Laser and Electron beam welding – principles – methods – operating variables, measurement of case depth.

UNIT IV FURNACES, ATMOSPHERE AND PROCESS CONTROL 9

Various heating atmosphere used for heat treatment, temperature and atmosphere control– carburising atmosphere and carbon potential measurement, Temperature Measurement Control devices – Nitriding gas atmospheres, quenching media and their characteristics, Stages of Quenching, polymer quenching, Various Heat Treatment furnaces- Roller and Mesh type continuous furnaces- fluidised bed furnaces, cryo-chamber, cryo-treatment of steels, sealed quench furnace, Vacuum furnace, Plasma equipment-Elements of Process control systems-PLC ,PID controllers and continuous monitoring systems.

UNIT V HEAT TREATMENT OF SPECIFIC ALLOYS 9

Heat treatment of special purpose steels – tool steels, high speed steels, maraging steels, HSLA steels and die steels, heat treatment of cast irons – gray cast irons, white cast irons and S.G.irons, austempering of S.G.Iron, heat treatment of non-ferrous alloys – aluminium alloys, copper alloys, nickel alloys and titanium alloys, defects in heat treated parts – causes and remedies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students will be able:

1. To have a comprehensive understanding of the various transformation reactions associated with the changes in microstructures and properties that occur due to controlled heat treatment.
2. To explain the various heat treatment processes that can be applied for different ferrous and non-ferrous alloys.
3. To classify the various case hardening treatments and analyse the effect of various case hardening treatments on the metals and alloys.
4. To compare the advantages and limitations various heat treatment furnaces, quenching media and furnace atmospheres.
5. To interpret the results of heat treatments on the various other non-ferrous materials, alloy steels and cast irons.

TEXT BOOKS:

1. Rajan, T. V., Sharma, C. P., Ashok Sharma., "Heat Treatment Principles and Techniques" Prentice-Hall of India Pvt. Ltd., New Delhi, 2011
2. Vijendra Singh, "Heat Treatment of Metals", Second edition, Standard Publishers Distributors New Delhi, 2012.

REFERENCES:

1. ASM Hand book "Heat Treating", Vol.4., ASM International, 1999.
2. I. Novikov, "Theory of Heat Treatment of Metals", MIR Publishers, Moscow, 1978
3. Prabhudev. K. H. "Handbook of Heat Treatment of Steels", Tata McGraw-Hill, Publishing Co., New Delhi, 1988.
4. Sydney H. Avner, "Introduction to Physical Metallurgy", Tata McGraw Hill, New Delhi, 1997.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.9	0.3											0.6	0.3	
CO2	0.6			0.9									0.6	0.3	
CO3	0.9	0.6													
CO4	0.6					0.3							0.9	0.3	
CO5	0.9	0.6											0.3		

ML5405 POWDER METALLURGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To provide a thorough knowledge on powder preparation, characterization, compaction and sintering.
2. To make the students well versed with the various methods for manufacturing powders.
3. To expose the students to various testing methods available for metal powders.
4. To enable the students to identify suitable powder production methods, compaction process and sintering method for a given application.
5. To impart knowledge on the various areas of applications of powder metallurgy components.

UNIT I POWDER MANUFACTURE AND CONDITIONING 9

Mechanical methods: Machine milling, ball milling, shotting- Chemical methods, condensation, thermal decomposition, Reduction, electrodeposition, precipitation from aqueous solution and fused salts, hydrometallurgical method. Physical methods: Electrolysis and atomisation processes, types of equipment, factors affecting these processes, examples of powders produced by these methods, applications, Powder conditioning- blending and mixing, equipments, Self-propagating high-temperature synthesis (SHS), sol-gel synthesis- Nanopowder production methods.

UNIT II CHARACTERISTICS AND TESTING OF METAL POWDERS 9

Sampling, chemical composition, Particle Size and its measurement- Sieve analysis- Principle and procedure, sedimentation, elutriation & permeability, Particle size Topography, Surface area, True, Apparent and Tap Density, Flow rate, Compressibility, Green Strength, Pyrophoricity and Toxicity, particle shape, classifications

UNIT III POWDER COMPACTION 9

Pressureless compaction: Loose Shaping, slip casting and slurry casting. Pressure compaction- Die compaction, Role of lubrication, single ended and double ended compaction, isostatic pressing, powder rolling, Vibratory Compaction, Centrifugal compaction, explosive forming.

UNIT IV SINTERING 9

Stages of sintering, Mechanisms of sintering, liquid phase sintering and infiltration, Activated sintering, Hot pressing and Hot Isostatic Pressing (HIP), Vacuum sintering, Sintering furnaces-batch and continuous-sintering atmosphere, Finishing operations – Heat treatment, Surface treatments, Impregnation, sizing, coining, Special sintering processes - Microwave sintering, Spark plasma sintering, Field assisted sintering, Reactive sintering, Sintering of nanostructured materials.

UNIT V APPLICATIONS of P/M COMPONENTS 9

Major applications in Aerospace, Nuclear and Automobile industries- Bearing Materials-types, Self-lubrication and other types, Methods of production, Properties, Applications. Sintered Friction Materials-Clutches, Brake linings, Tool Materials- Cemented carbides, Oxide ceramics, Cermets- Dispersion strengthened materials.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The Students will be able:

1. To classify the various powder production methods and the Powder conditioning treatments.
2. To interpret the various characteristics of metal powders.
3. To compare the different compaction processes and identify a suitable compaction methodology for a component meant for specific application
4. To explain the sintering mechanisms and the various types of Sintering processes as well as the finishing processes.
5. To get acquainted with the applications of various powder metallurgy components.

TEXT BOOKS

1. Anish Upadhya and G S Upadhaya, “Powder Metallurgy: Science, Technology and Materials, Universities Press, 2011
2. P.C.Angelo and R.Subramanian.,“ Powder Metallurgy: Science, Technology and Applications” Prentice Hall, 2008

REFERENCES

1. ASM Handbook. Vol. 7, “Powder Metallurgy”, Metals Park, Ohio, USA, 1990.
2. Erhard Klar., “Powder Metallurgy Applications, Advantages and Limitations”, American Society for Metals, Ohio, 1983.
3. Kempton. H Roll, “Powder Metallurgy”, Metallurgical Society of AMIE, 1988.
4. Ramakrishnan. P., “Powder Metallurgy-Opportunities for Engineering Industries”, Oxford and IBH Publishing Co., Pvt. Ltd, New Delhi, 1987.
5. Sands. R. L. and Shakespeare. C. R. “Powder Metallurgy”, George Newes Ltd. London, 1966
6. Sinha A. K., “Powder Metallurgy”, Dhanpat Rai & Sons. New Delhi, 1982

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.9				0.6							0.3			
CO2	0.9			0.6									0.3		
CO3	0.9												0.3	0.6	
CO4	0.9				0.6								0.3		
CO5	0.9											0.6			

ML5411 **POWDER METALLURGY LABORATORY** **L T P C**
0 0 4 2

OBJECTIVE:
To impart practical knowledge on powder metallurgy steps such as: powder synthesis, compaction and sintering and testing powder compacts and sinters.

LIST OF EXPERIMENTS

1. Powder Production by a chemical method
2. Powder size reduction by Ball Milling
3. Particle size distribution by Sieve analysis
4. Measurement of Apparent and Tap Density of Powders
5. Measurement of Flow Rate of Powders
6. Production of green compacts.
7. Density determination of sintered product.
8. Effect of Sintering temperature on the density
9. Fracture Toughness determination of sintered product.
10. Preparation of porous ceramic product.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
The students will be able:

- To produce metal powders of desired size and shape by selecting the suitable powder production method.
- To interpret the distribution of powders and the effect of distribution on the final properties of the component.
- To characterize the powders in terms of tap density, apparent density, flow rate and so on.
- To produce a compact of desired size and shape and also have the hands on experience to eject the compact from the die smoothly.
- To compare the properties of the sintered compact with that of the green compact.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO11	PO12	PSO 1	PSO 2	PSO 3
C01	0.9	0.3													0.6
C02	0.6			0.9										0.3	
C03	0.9											0.6		0.6	
CO4	0.6				0.3									0.9	
CO5	0.6	0.9			0.3										

ML5412 **HEAT TREATMENT LABORATORY** **L T P C**
0 0 4 2

OBJECTIVE:
To provide a practical knowledge on the various heat treatment processes applicable to Ferrous as well as Non-Ferrous materials and also to get acquainted with the microstructural changes and hardness evaluation under various heat treatment conditions.

LIST OF EXPERIMENTS:
1. Hardening and tempering of High carbon steels
2. Annealing and normalising of hardened steels
3. Spheroidization annealing of high carbon steels
4. Effect of quenching media on hardening of steel
5. Effect of tempering temperature and time on tempering of steel
6. Effect of carbon percentage on the hardening of steel
7. Carburizing of low carbon steel
8. Case hardness depth measurements
9. Hardenability test – Jominy End Quench Test
10. Heat treatment of cast iron
11. Heat treatment of Stainless Steels and High speed steels
12. Heat treatment of non-ferrous alloys

TOTAL: 60 PERIODS

COURSE OUTCOMES:
Students will be able:
- To perform various heat treatment processes on plain carbon steels and analyse the effect of the processes on steels.
- To execute the case hardening effect on a low carbon steel and to analyse the case depth measurements.
- To interpret the effect of quenching media and the carbon percentage on the hardening of steel
- To exemplify the effect of Jominy end quench test on the hardenability of steel.
- To do heat treatment on the various non-ferrous materials and analyse the effect of heat treatment on these materials.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.9			0.6								0.3	0.6		
CO2	0.9			0.9										0.3	
CO3	0.9	0.9													
CO4				0.9	0.6										0.3
CO5	0.9	0.6		0.3											

Attested

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GE5451 **TOTAL QUALITY MANAGEMENT** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
- Explain the TQM Principles for application.
- Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
- Describe Taguchi's Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR.
- Illustrate and apply QMS and EMS in any organization.

UNIT I INTRODUCTION **9**

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

UNIT II TQM PRINCIPLES **9**

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

UNIT III TQM TOOLS & TECHNIQUES I **9**

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

UNIT IV TQM TOOLS & TECHNIQUES II **9**

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

UNIT V QUALITY MANAGEMENT SYSTEM **9**

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to apply TQM concepts in a selected enterprise.
CO2: Ability to apply TQM principles in a selected enterprise.
CO3: Ability to understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
CO4: Ability to understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.
CO5: Ability to apply QMS and EMS in any organization.

Attested

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

TEXT BOOK:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Bester field,MaryB.Sacre,HemantUrdhwareshe and RashmiUrdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.

REFERENCES:

1. Joel.E. Ross, "Total Quality Management – Text and Cases", Routledge.,2017.
2. Kiran.D.R, "Total Quality Management: Key concepts and case studies, Butterworth – Heinemann Ltd, 2016.
3. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, Third Edition, 2003.
4. Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006 .

ML5501 THEORY AND APPLICATIONS OF METAL FORMING L T P C

3 0 0 3

COURSE OBJECTIVES

1. To import knowledge on stress-strain relations and stress tensor approach applied in metal forming
2. To import knowledge on fundamentals of metal forming processes
3. To import knowledge on principle of metal working, load calculation and the applications of metal working.
4. To import knowledge on extrusion and drawing processes
5. To import knowledge on sheet metal forming processes.

UNIT-I STRESS - STRAIN TENSOR 9

State of stress, components of stress, symmetry of stress tensor, principle stresses, stress deviator, Von Mises, Tresca Yield criteria, comparison of yield criteria, Octahedral shear stress and shear strain, Slip, twinning, Forming load calculations, Strain Rate Tensor

UNIT-II FUNDAMENTALS OF METAL FORMING 9

Classification of forming process- Mechanics of metal working, Flow stress determination, Effect of temperature, strain rate and metallurgical structure on metal working, Friction and lubrication. Deformation zone geometry, Workability, Residual stresses.

UNIT-III FORGING AND ROLLING 9

Forging-Hot, Cold and Warm Forging – types of presses and hammers. Classification, Open die forging and Closed die forging, die design, forging in plane strain, calculation of forging loads, use of software for analysis - forging defects – causes and remedies, residual stresses in forging. Rolling: Classification of rolling processes, types of rolling mills, hot and cold rolling, rolling of bars and shapes, forces and geometrical relationship in rolling, analysis of rolling load, torque and power, rolling mill control, rolling defects- causes and remedies.

UNIT-IV EXTRUSION AND DRAWING 9

Direct and indirect extrusion, variables affecting extrusion, deformation pattern, equipments, port – hole extrusion die, hydrostatic extrusion, defects and remedies, simple analysis of extrusion ,tube extrusion and production of seamless pipe and tube. Drawing of road, wires and tubes.

UNIT-V SHEET METAL FORMING AND OTHER PROCESSES 9

Forming methods – Shearing, Fine and Adiabatic blanking, bending, stretch forming, deep drawing, defects in formed part, sheet metal formability, super plastic forming limit diagram. High velocity forming, Comparison with conventional forming, Explosive forming, Electro hydraulic, Electro Magnetic forming, Dynapark and petroforge forming

TOTAL :45 PERIODS

COURSE OUTCOMES:

On Completion of the course the student will be able to

1. Ability to learn stress-strain concepts of materials during plastic deformation.
2. Apply the theory of plasticity and its application for analysing various metal forming Processes.
3. Understand the principle of metal working, load calculation and the applications of metal working.
4. Ability to calculate the forming loads for extrusion and drawing processes.
5. Understand the various sheet metal forming methods.

TEXT BOOKS:

1. Dieter.G.E., “Mechanical Metallurgy”, McGraw – Hill Co., SI Edition, 2007.
2. Surender Kumar, “Technology of Metal Forming Processes”, PHI, New Delhi, 2008.

REFERENCES:

1. Avitzur, “Metal Forming – Process and Analysis”, Tata McGraw – Hill Co., New Delhi, 1977.
2. Dr.Sadhu Singh, “Theory of plasticity and Metal Forming Processes”, Khanna Publishers, 2005.
3. Kurt Lange, “Handbook of Metal Forming”, Society of Manufacturing Engineers, Michigan, USA, 1998.
4. Nagpal G. R., “Metal Forming Processes”, Khanna Pub., New Delhi, 2000
5. Shiro Kobayshi, Altan. T, Metal Forming and Finite Element Method, Oxford University Press, 1987

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	0.9	0.6	0.3									0.3	0.6	0.3	0.3
CO2	0.9	0.6	0.3									0.3	0.6	0.3	0.3
CO3	0.9	0.6	0.3									0.3	0.3	0.6	0.3
CO4	0.9	0.6										0.3	0.3	0.6	0.3
CO5	0.9											0.3	0.3	0.6	0.3

ML5502 CHARACTERISATION OF MATERIALS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To educate students on various techniques of structural characterisation of materials.
2. To enable student to interpret microstructure, crystal structure and surface structure of materials.
3. To import knowledge on X-Ray diffraction techniques and analysis
4. To import knowledge on different electron microscopy techniques used for characterisation
5. To import knowledge on different electron microscopy techniques used for characterisation
6. To import knowledge on techniques of elemental chemical composition and structure of surface.

UNIT I METALLOGRAPHIC TECHNIQUES 9

Macroexamination -applications, metallurgical microscope - construction and principle of working, specimen preparation, light material interaction – Rayleigh Scattering, Abbes theory; magnification, numerical aperture, resolving power, depth of focus, depth of field, different light sources; lenses aberrations and their remedial measures, Principles of microscopy -bright field , dark field, phase-contrast, polarization, differential interference contrast, high temperature microscopy; Quantitative metallography – Image analysis for grain size distribution and grain/precipitate shape.

UNIT II X-RAY DIFFRACTION TECHNIQUES 9

Reciprocal lattice, Stereographic projection, X-ray generation, absorption edges, characteristic and continuous spectrum, Bragg's law, Ewald's Sphere, Diffraction methods – Laue, rotating crystal and powder methods. Intensity of diffracted beams –structure factor calculations and other factors. Diffractometer – General features and optics, Counters - Proportional, Scintillating, Geiger counters and semiconductor based.

UNIT III ANALYSIS OF X-RAY DIFFRACTION 9

Line broadening-crystallite size, residual stress; Texture Analysis; Crystal structure determination-indexing -Phase identification- ASTM catalogue of Materials identification, quantitative phase estimation, Phase diagram determination, Precise lattice parameter calculation, Determination of residual stress – double angle diffraction.

UNIT IV ELECTRON MICROSCOPY 9

Electron specimen interaction; Construction and operation of Transmission electron microscope (TEM) – specimen preparation techniques- Diffraction mode and image mode, Sources of contrast- Selected Area Electron Diffraction, Zone axis, indexing ; Construction, modes of operation and sources of contrast of Scanning electron microscope(SEM), Electron probe micro analysis, Basics of Field ion microscopy (FIB), Scanning Tunneling Microscope (STM) and Atomic Force Microscope(AFM).

UNIT V SURFACE ANALYSIS 9

X-ray emission spectroscopy - Energy Dispersive Spectroscopy- Wave Dispersive Spectroscopy- Ultraviolet Photo Electron Spectroscopy (UPS), X ray Photoelectron Spectroscopy (XPS), Auger Electron Spectroscopy (AES), Electron Energy Analysers, Secondary ion mass spectrometry - Quadrapole mass spectrometer ; Surface Structure -Unit meshes of five types of surface nets - diffraction from diperiodic structures - Low Energy Electron Diffraction (LEED)- Reflection High Energy Electron Diffraction (RHEED).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. Understanding of the techniques of the metallography and analysis the microstructure of materials.
2. Understanding of the techniques of XRD.
3. Ability to interpret and analysis the XRD materials.
4. Understanding of the techniques of electron microscopy and their application.
5. Understanding on techniques of elemental chemical composition and structure of surface.

TEXT BOOKS

1. Angelo, P.C., "Materials Characterisation", 1st Edition Cengage Publication, 2016.
2. Cullity, B. D.,Stock, S.R. " Elements of X-ray diffraction", Pearson New International Edition, 3rd Edition, 2014

REFERENCES

1. Brandon D. G, "Modern Techniques in Metallography", Von Nostrand Inc. NJ, USA, 1986.
2. D. A. Skoog, F. James Leary and T. A. Nieman, "Principles of Instrumental Analysis", 7th edition, Cengage Learning, 2017.
3. Thomas G., "Transmission electron microscopy of metals", John Wiley, 1996.
4. Whan R E (Ed), ASM Handbook, Volume 10, Materials Characterisation ", Nineth Edition, ASM international, USA, 1986.
5. Yang Leng, Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, Hong Kong University Of Science And Technology, John Wiley & Sons (Asia) Pte Ltd. 2010.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.3	0.3	0.6	0.9	0.9								0.9	0.9	
CO2	0.3	0.3	0.6	0.9	0.9								0.9	0.9	
CO3	0.3	0.3	0.6	0.9	0.9								0.9	0.9	
CO4	0.3	0.3	0.6	0.9	0.9								0.9	0.9	
CO5	0.3	0.3	0.6	0.9	0.9								0.9	0.9	

ML5503 CASTING METALLURGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To impart knowledge about patterns, moulding materials and furnaces used in foundries.
2. To impart knowledge on the various moulding processes.
3. To impart knowledge on the gating system design for castings.
4. To impart knowledge on the ferrous casting metallurgy
5. To impart knowledge on the non-ferrous casting metallurgy

UNIT I PATTERN, MOULDING MATERIALS, FURNACES 9

Introduction to foundry process-Pattern, types- allowances- selection of pattern materials, -Sand-Core for foundry applications – types, properties of prepared sand.-Moulding and Cores additives- preparations-Types of furnaces –Crucible, Cupola, Oil fired furnaces, Electric furnaces , Arc and Induction types.

UNIT II MOULDING PROCESSES 9

Green Sand -Hand Moulding, Jolt Squeeze and High Pressure Moulding, - CO_2 and Nishiyama process- No Bake- Two part and Three-part Process, - Shell- Investment Casting- Permanent Moulding – Pressure Die casting processes- Ceramic- Plaster of Paris- Centrifugal- Squeeze- Electro Magnetic - Lost Foam process.

UNIT III DESIGN OF GATING SYSTEM 9

Design of Gating Systems –Types – Pressure & Un pressurized systems -Sprue- runner- gates –problems in design and manufacture of thin and unequal Sections-designing for directional solidification- Riser design-Chvorinov's rule, Caines- Section Modulus- Naval Research Laboratory methods, feeding distances – Calculations and number of Risers required, chills and feeding aids –Exothermic And Insulating sleeves Design problems of L, T, V, X and Y junctions, Computer Applications in casting design—Software for casting design CAE –Stress, Liquid metal flow and solidification analysis.

UNIT IV FERROUS CAST ALLOYS 9

Solidification of pure metals and alloys and eutectics -Nucleation - Growth Process, Critical nucleus size- Super cooling- Niyama Criterion -G/R ratio- Cell- Dendritic - Random dendritic structure-Segregation and Coring- Eutectics-Compositions and alloys in Cast Irons, FG-CGI-SG structures, Metallic Glass- Mold dilation, Mold metal reactions- Structure and Section sensitivity Cast irons- family & microstructures-Alloying effects- Malleable Iron, ADI, Charge calculations- Effect of normal elements and alloying elements in steels- Compositional aspects and properties of alloy steels- melting procedure and composition control for carbon steels- low alloy steels - stainless steels- composition control- slag-metal reactions-desulphurization-dephosphorisation, specifications for carbon steels- low alloy steels and stainless steels

UNIT V NON FERROUS CAST ALLOYS 9

Copper- Aluminium- Magnesium- zinc - Nickel base alloys- melting practices - Al alloys, Mg alloys, Nickel alloys, Zinc alloys and copper alloys-modification and grain refinement of Al alloys- problems in composition control- degassing techniques -Heat Treatment of Aluminium alloys – Basics of Solution and Precipitation process. - Applications of Aluminium Alloy castings in various fields. Residual Stresses- defects in castings

COURSE OUTCOMES:

1. Should be able to select a proper material for making a pattern, design patterns, and decide on the composition of sand and core and know about the different furnaces for available for melting metals.
2. Will be able to understand the various casting processes available for casting a component.
3. Will be able to design suitable gating system for casting a component.
4. Will be able to cast ferrous castings which are metallurgically sound.
5. Will be able to cast nonferrous castings which are metallurgically sound.

TEXT BOOKS

1. A.K.Chakrabarthi 'Casting Technonology and Cast Alloys ,Prentice Hall of India
2. Heine R W, Loper C R and Rosenthal P C, "Principles of Metal Castings", Tata McGraw Hill, 2017

REFERENCES

1. ASM Metals, Hand book "Casting", Volume 15, ASM International, 2007.
2. Beeley P, "Foundry Technology" Butterworth-Heinemann London, 2001.
3. John Campbell, "Casting", Butterworth- Heinemann, 2003.
4. The Foseco "Foundryman's Hand book", Pergamon Press, 2007.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0.3	0.3	0.6	0.9	0.9								0.9	0.9	
CO2	0.3	0.3	0.6	0.9	0.9								0.9	0.9	
CO3	0.3	0.3	0.6	0.9	0.9								0.9	0.9	
CO4	0.3	0.3	0.6	0.9	0.9								0.9	0.9	
CO5	0.3	0.3	0.6	0.9	0.9								0.9	0.9	

ML5511 **METAL FORMING LABORATORY** **L T P C**
0 0 4 2

COURSE OBJECTIVE:
To acquire knowledge on basic metal forming processes by experimental study and analysis

LIST OF EXPERIMENTS:
1. Formability of sheet metal by Ericsson cupping test
2. Construction of Formability limit diagram
3. Water hammer test
4. Ring Compression test
5. Diameter reduction in Wire drawing
6. Deep drawing for simple cup shape
7. Extrusion of Cylindrical component
8. Thickness reduction in Sheet metal rolling.
9. Study of Sheet metal forming using FEA analysis software
10. Study of Super plastic forming Process

TOTAL: 60 PERIODS

COURSE OUTCOMES:
1. Ability to analyse the formability behaviour of the metal forming process.
2. Ability to carry out various metal forming experiments.
3. Ability to evaluate the defects in the deformed components.
4. Ability to use software tools for analysing the metal forming process.
5. Ability to demonstrate the formability of different materials

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.9	0.6	0.3									0.3	0.6	0.3	0.3
CO2	0.9	0.6	0.3									0.3	0.6	0.3	0.3
CO3	0.9	0.6	0.3									0.3	0.3	0.6	0.3
CO4	0.9	0.6										0.3	0.3	0.6	0.3
CO5	0.9											0.3	0.3	0.6	0.3

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ML5512 **FOUNDRY AND WELDING LABORATORY** **L T P C**
0 0 4 2

COURSE OBJECTIVES:

1. To train on the various sand testing methods.
2. To understand the effect of welding parameters on the weld bead by GTAW and GMAW processes.
3. To train on the Microstructural analysis of Carbon Steel, Stainless Steel, Aluminium Alloy and Titanium Alloy welded specimens.

LIST OF EXPERIMENTS

1. Determination of Average Sand grain Fineness.
2. Determination of Permeability of Green sand.
3. Estimation of Active clay content in Sand
4. Loss of Ignition Test for Green sand Mould
5. Determination of Green compression and Shear Strength.
6. Determination of Dry compression Strength
7. Determination of Scratch hardness.
8. Determination of Compactability.
9. Metal casting by Green and sand and full mould process.
10. Arc striking practice.
11. Bead-on-plate welding
    Effect of welding parameters on weld bead by
    (i) GTA welding
    (ii) GMA Welding
    (iii) Submerged Arc Welding
12. Microstructural Observation of Weldment
    (i) Carbon Steel
    (ii) Stainless Steel
    (ii) Aluminium Alloy
    (iv) Titanium Alloy

TOTAL: 60 PERIODS:

COURSE OUTCOMES:

(i) After the completion of the course the student will be able to estimate the properties of the system sand.
(ii) After the completion of the course the student will be to understand the effect of welding parameters on the weld bead by GTAW and GMAW processes.
(iii) After the completion of the course the student will be able to carry out the microstructural analysis of Carbon Steel, Stainless Steel, Aluminium Alloy and Titanium Alloy welded specimens.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.9	0.6	0.3									0.3	0.6	0.3	0.3
CO2	0.9	0.6	0.3									0.3	0.6	0.3	0.3
CO3	0.9	0.6	0.3									0.3	0.3	0.6	0.3
CO4	0.9	0.6										0.3	0.3	0.6	0.3
CO5	0.9											0.3	0.3	0.6	0.3

Attested

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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 non-renewable 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 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 47 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:

- To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
- To identify the causes, effects and environmental pollution and natural disasters and contribute to the preventive measures in the immediate society.
- To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.
- To recognize different forms of energy and apply them for suitable applications in for technological advancement and societal development.
- 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 analyse effect of population dynamics on human value education, consumerism and role of technology in environmental issues.

TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th 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).

ML5601 COMPOSITE MATERIALS L T P C
3 0 0 3

COURSE OBJECTIVES

1. To impart knowledge about different matrix and reinforcement materials and selection of them for composite making.
2. To impart knowledge on various manufacturing methods for making polymer matrix composites.
3. To impart knowledge on various manufacturing techniques interface design and developing different in-situ reactions for making metal matrix composites.
4. To impart knowledge to fabricate different ceramic matrix composites and carbon-carbon composites
5. To impart knowledge to develop constitutive equations for different laminates.

UNIT I INTRODUCTION TO COMPOSITES 9

Fundamentals of composites - need for composites – enhancement of properties - classification of composites – Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC) – Reinforcement – particle reinforced composites, Fibre reinforced composites. Applications of various types of composites. Fiber production techniques for glass, carbon and ceramic fibers

UNIT II POLYMER MATRIX COMPOSITES 9

Polymer resins – thermosetting resins, thermoplastic resins – reinforcement fibres – rovings – woven fabrics – non woven random mats – various types of fibres. PMC processes - hand lay up processes – spray up processes – compression moulding – reinforced reaction injection moulding - resin transfer moulding – Pultrusion – Filament winding – Injection moulding. Fibre reinforced plastics (FRP), glass fibre reinforced plastics (GRP). Laminates- Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates.-applications of PMC in aerospace, automotive industries

UNIT III METAL MATRIX COMPOSITES 9

Characteristics of MMC, various types of metal matrix composites alloy vs. MMC, advantages of MMC, limitations of MMC, Reinforcements – particles – fibres. Effect of reinforcement - volume fraction – rule of mixtures. Processing of MMC – powder metallurgy process - diffusion bonding – stir casting – squeeze casting, In-situ reactions-Interface-measurement of interface properties-applications of MMC in aerospace, automotive industries

UNIT IV CERAMIC MATRIX COMPOSITES AND SPECIAL COMPOSITES 9

Engineering ceramic materials – properties – advantages – limitations – monolithic ceramics - need for CMC – ceramic matrix - various types of ceramic matrix composites- oxide ceramics – non oxide ceramics – aluminium oxide – silicon nitride – reinforcements – particles- fibres-whiskers. Sintering - Hot pressing – Cold isostatic pressing (CIPing) – Hot isostatic pressing (HIPing). applications of CMC in aerospace, automotive industries- Carbon /carbon composites – advantages of carbon matrix – limitations of carbon matrix carbon fibre – chemical vapour deposition of carbon on carbon fibre perform. Sol-gel technique

UNIT V MECHANICS OF COMPOSITES 9

Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Q_{ij}), Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply

Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.

TOTAL : 45 PERIODS

COURSE OUTCOMESl

On completion of this course, the students can able to

1. Design and fabricate composite structures.
2. Identify suitable process for different composite components.
3. Design new composites materials for specific requirement.
4. Test and characterize the composites and qualify for the engineering acceptance.
5. Develop and use the constitutive equation for the composite components design

TEXT BOOKS

1. Chawla K. K., “Composite materials”, Springer – Verlag, Second Edition, 1998.
2. Mathews F. L. and Rawlings R. D., “Composite Materials: Engineering and Science”, Chapman and Hall, London, England, 1st edition, 1994.

REFERENCES

1. Broutman, L.J. and Krock,R.M., “ Modern Composite Materials”, Addison-Wesley, 1967
2. Clyne, T. W. and Withers, P. J., “Introduction to Metal Matrix Composites”, Cambridge University Press, 1993.
3. Sharma, S.C., “Composite materials”, Narosa Publications, 2000.
4. Strong, A.B., “Fundamentals of Composite Manufacturing”, SME, 1989.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.6	0.3	0.6	0.9	0.9								0.9	0.9	
CO2	0.6	0.3	0.6	0.9	0.9								0.9	0.9	
CO3	0.6	0.3	0.6	0.9	0.9								0.9	0.9	
CO4	0.6	0.3	0.6	0.9	0.9								0.9	0.9	
CO5	0.6	0.3	0.6	0.9	0.9								0.9	0.9	

ML5602 MATERIALS ELECTION AND DESIGN

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To give an overview of criteria, use of property chart and economics of materials selection.
2. To impart knowledge about the manufacturing system, process selection and DFM.
3. To give insight to the manufacturing considerations in design.
4. To provide understanding about the influence of the nature of load and material properties in design
5. To impart the framework in materials design for various kinds of failures.

UNIT – I MATERIAL SELECTION IN DESIGN 9

Introduction, relation of materials selection to design, general criteria for selection, performance characteristics of materials, materials selection process, design process and materials selection, Types of design, material property chart, material performance indices, materials selection procedure, Structural index, economics of materials, recycling and materials selection

UNIT – II MATERIALS PROCESSING AND DESIGN 9

Role of Processing in Designing, classification of manufacturing processes, types of manufacturing systems, influence of material on process selection. Design for manufacturability, DFM guidelines, Design for assembly, DFA guidelines, computer methods for DFMA, Design for machining, casting, forging, welding and heat treatment and its DFM guidelines

UNIT – III MANUFACTURING CONSIDERATIONS IN DESIGN 9

Surface finish, texture, Standardization, Interchangeable manufacturing, Selective assembly, selection of materials based on mechanical properties -- Preferred numbers, Limits, fits and tolerances, Types of fits and tolerances. Geometric tolerance, types of form and position tolerances, tolerance and manufacturing methods, selection of fits.

UNIT – IV MATERIALS PROPERTIES AND DESIGN 9

Stress - Strain diagram, design for strength, rigidity, design under static loading, stress due to torsion and bending, variable loading, stress concentration, fluctuating stress, eccentric loading – stress concentration. Design examples with shaft design and spring design.

UNIT – V MATERIALS IN DESIGN 9

Design for brittle fracture, plane strain fracture toughness, fatigue failure, Design criteria, fatigue parameters, infinite, safe life and damage tolerance design , fatigue life prediction, corrosion resistance, forms of corrosion, corrosion prevention, Design against wear, types of wear, wear prevention, Designing with plastics, design for stiffness, Time dependent part performance..

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Identify criteria and apply the Ashby charts during materials selection.
2. Recognize the different manufacturing process and diagnose their role in design.
3. Elucidate the manufacturing considerations in design.
4. Analyse the influence of material properties and the nature of loading on design.
5. Develop a design procedure for various types of failures.

TEXT BOOKS:

1. Dieter George E, Engineering Design, Tata McGraw-Hill education, 1991.
2. Michael F Ashby, Materials selection in Machine Design , Butterworth and Heinemann,2010

REFERENCES:

1. Bhandari V B, Design of Machine Elements, 3rd edition, Tata McGraw-Hill Education, 2010
2. Charles J A & Crane F A A, Selection and Use of Engineering Materials, Elsevier, 2013
3. Mangonan P L, The Principles of Materials Selection for Engineering Design, Prentice Hall, 1999
4. ASM Handbook : Materials Selection and Design, Volume 20, Taylor & Francis,1997
5. Mahmoud M Farag, Materials and Process Selection for Engineering Design, CRC Press, 2013

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.6	0.3	0.6	0.9	0.9								0.9	0.9	
CO2	0.6	0.3	0.6	0.9	0.9								0.9	0.9	
CO3	0.6	0.3	0.6	0.9	0.9								0.9	0.9	
CO4	0.6	0.3	0.6	0.9	0.9								0.9	0.9	
CO5	0.6	0.3	0.6	0.9	0.9								0.9	0.9	

ML5611 **MATERIAL CHARACTERIZATION LABORATORY**

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

1. To gain practical experience of handling sophisticated instruments.
2. To obtain hands-on-practice for sample preparation.
3. To experience the procedure involved in the instrumentation methods.
4. To calibrate and standardize the sensitive instruments.
5. To use the spectrometers, electron microscopes and thermal analyzers for analyzing the specimens.

LIST OF EXPERIMENTS:

1. Verification of Beer Lambert's law using Absorption Spectrophotometer.
2. Determination of concentration of metal ions using UV Visible spectrophotometer.
3. Determination of thermal coefficient using dilatometer.
4. Determination of conductivity using conductivity meter.
5. Identification of organic compounds using IR spectroscopy.
6. Quantitative analysis using column chromatography.
7. Qualitative identification of species using TLC.
8. Thermal degradation analysis using TGA.
9. Thermal transition analysis using DSC.
10. Surface analysis of materials using electron microscopy.

COURSE OUTCOMES:

1. To apply the theoretical principles and concepts and verify them practically.
2. To analyze and interpret the results obtained from the instrumental methods.
3. To handle the samples for analysis.
4. To understand and evaluate the data suitably.
5. To derive useful information from the outputs.

TOTAL: 60 PERIODS

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0.3	0.3	0.6	0.9	0.9								0.9	0.9	
CO2	0.3	0.3	0.6	0.9	0.9								0.9	0.9	
CO3	0.3	0.3	0.6	0.9	0.9								0.9	0.9	
CO4	0.3	0.3	0.6	0.9	0.9								0.9	0.9	
CO5	0.3	0.3	0.6	0.9	0.9								0.9	0.9	

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ML5612 **COMPOSITE MATERIALS LABORATORY** **L T P C**
0 0 4 2

COURSE OBJECTIVES

1. To train the students to fabricate and test the polymer matrix composites
2. To train the students to fabricate and test the metal matrix composites
3. To train the students to develop in-situ reactions for particle reinforced metal matrix composites
4. To train the students to test to predict the interface bonding strength of metal –reinforcement
5. To train the student to understand the various standards and testing procedures

LIST OF EXPERIMENTS:

1. Preparation of Continuous Fiber reinforced Polymer Composites
2. Study of Tensile strength and young's modulus of FRP composites
3. Study of Flexural strength of FRP composites
4. Study of fracture toughness of the PMC by drop weight impact testing
5. Preparation of Al-TiB2 composite by in-situ reaction
6. Study of Microstructure, hardness and density of Al-TiB2 composites
7. Preparation of Al-SiC composites by stir casting method
8. Study of microstructure, hardness and density of Al-SiC composite
9. Study of Tensile strength of Al-SiC composites
10. Study of interface bonding strength of glass fiber reinforced polymer composite
11. Environmental Testing (Humidity and temperature)

TOTAL: 60 PERIODS

COURSE OUTCOMES :

The student can able to

1. Fabricate the PMC
2. Test the composite and predict different mechanical properties required for the design
3. predict the interface properties
4. develop newer in-situ composites
5. Predict the changes in composites when exposed to humidity and temperature.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0.3	0.3	0.6	0.9	0.9								0.9	0.9	
CO2	0.3	0.3	0.6	0.9	0.9								0.9	0.9	
CO3	0.3	0.3	0.6	0.9	0.9								0.9	0.9	
CO4	0.3	0.3	0.6	0.9	0.9								0.9	0.9	
CO5	0.3	0.3	0.6	0.9	0.9								0.9	0.9	

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ML5701	SURFACE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To educate Important of Surface Engineering in Industries
2. To provide knowledge on Thermal Spray For Coating
3. To import knowledge on the Process and Mechanism Of Different Diffusion Coating Process
4. To provide knowledge on the Methods Of Non Metallic Coating
5. To import knowledge on the Testing Procedure For Quality Assurance.

UNIT-I INTRODUCTION 9

Introduction To Tribology, Surface Degradation, Wear And Corrosion, Types Of Wear, Adhesive, Abrasive, Oxidative, Corrosive, Erosive And Fretting Wear, Roles Of Friction And Lubrication-, Expressions For Corrosion Rate. Emf And Galvanic Series – Merits And Demerits -Pourbaix Diagram For Iron, Magnesium And Aluminium. Forms Of Corrosion – Uniform, Pitting, Intergranular, Stress Corrosion. Corrosion Fatigue. Dezincification. Erosion Corrosion, Crevice Corrosion – Cause And Remedial Measures – Pilling Bedworth Ratio – High Temperature Oxidation-Hydrogen Embrittlement – Remedial Measures.

UNIT-II KINETICS OF CORROSION 9

Exchange Current Density, Polarization – Concentration, Activation And Resistance, Tafel Equation; Passivity, Electrochemical Behaviour Of Active/Passive Metals, Flade Potential, Theories Of Passivity, Effect Of Oxidizing Agents

UNIT-III CORROSION OF INDUSTRIAL COMPONENTS 9

Corrosion In Fossil Fuel Power Plants, Automotive Industry, Chemical Processing Industries, Corrosion In Petroleum Production Operations And Refining, Corrosion Of Pipelines.- Wear Of Industrial Components

UNIT-IV TESTING 9

Purpose Of Corrosion Testing – Classification – Susceptibility Tests For Intergranular Corrosion-Stress Corrosion Test. Salt Spray Test Humidity And Porosity Tests, Accelerated Weathering Tests. ASTM Standards For Corrosion Testing And Tests For Assessment Of Wear

UNIT-V PROTECTION METHODS 9

Organic, Inorganic And Metallic Coatings, Electro And Electroless Plating And Anodising – Cathodic Protection, Corrosion Inhibitors – Principles And Practice – Inhibitors For Acidic Neutral And Other Media. Special Surfacing Processes – CVD And PVD Processes, Sputter Coating. Laser And Ion Implantation, Arc Spray, Plasma Spray, Flame Spray, HVOF.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. Explain The Important Of Surface Engineering To Industries
2. Use Of Thermal Spray For Coating
3. Explain The Process And Mechanism Of Different Diffusion Coating Process
4. Explain The Methods Of Non Metallic Coating
5. Explain The Testing Procedure For Quality Assurance.

TEXT BOOKS:

1. Stand Grainger Engineering Coatings – Design and Application Jaico Publishing House, 1994.

REFERENCES:

1. Gabe. D.R., “Principles Of Metal Surface Treatment And Protection”, Pergamon, 1990
2. Metals Hand Book Vol.2 8th Edition, American Society Of Metals 1994
3. Niku-Lavi, “Advances In Surface Treatments”, Pergamon, 1990
4. Parthasarathy. N.V., Electroplating Handbooks, Prentice Hall, 1992

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.6	0.3	0.6	0.9	0.9								0.9	0.9	
CO2	0.6	0.3	0.6	0.9	0.9								0.9	0.9	
CO3	0.6	0.3	0.6	0.9	0.9								0.9	0.9	
CO4	0.6	0.3	0.6	0.9	0.9								0.9	0.9	
CO5	0.6	0.3	0.6	0.9	0.9								0.9	0.9	

ML5702 NONFERROUS METALLURGY L T P C
3 0 0 3

COURSE OBJECTIVES:

- To make the students to understand the structure, property relations of nonferrous alloys with special emphasis on engineering applications.
- To expose the students to important alloys used for critical applications.
- To provide knowledge on the phase diagrams of industrially relevant portions of some important alloys.
- To inculcate knowledge on the selection of suitable non-ferrous alloy for a given application.
- To make the students well versed with the properties and applications of precious metals.

UNIT I COPPER AND COPPER ALLOYS 9

Methods of Production of Copper, Properties and applications of metallic copper. Major alloys of copper and designation- Brasses. Phase diagram of industrially relevant portion. Copper, characteristics and uses. Bronzes: Tin bronze. Composition, properties and uses. Other bronzes like Cu-Al, Cu-Si, Cu-Mn and Cu-Be alloys. Cu-Ni alloys. Typical microstructure of copper alloys.

UNIT II ALUMINIUM AND ITS ALLOYS 9

Methods of Production of Aluminium- Properties of Pure aluminium. Alloys of aluminium and designation, classification. Wrought and cast alloys. Heat treatable and non-heat treatable alloys. Age hardening of Al-Cu alloy. Al-Mg-Si, Al-Zn-Mg and Al-Li alloys. Typical microstructure of aluminium alloys. Applications of Al alloys in Automobile and Aircraft industries.

UNIT III MAGNESIUM AND TITANIUM ALLOYS 9

Methods of Production of Magnesium- properties and uses. Magnesium alloys and designation, Applications. Methods of Production of Titanium- unique characteristics of Ti metal- alpha, alpha+beta and beta titanium alloys- major types. Titanium aluminides – their properties and uses. Typical microstructure of magnesium and titanium alloys- Applications of Ti alloys in Aircraft, Chemical and Medical industries.

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UNIT IV NICKEL AND ZINC ALLOYS 9

Methods of Production of Nickel-Properties and uses of nickel. Nickel alloys and designation– their properties and uses. Nickel aluminides. Methods of Production of Zinc-Use of zinc in corrosion protection of ferrous materials. Zinc alloys – properties and uses. Typical microstructure of nickel and zinc alloys, Applications.

UNIT V LEAD, TIN AND PRECIOUS METALS 9

Methods of Production of Lead and Tin-Major characteristics and applications of lead and tin and their alloys and designation. Low melting nature of solder alloys. Gold, silver and platinum – nobility of these metals. Engineering properties and applications of these metals and their alloys. Typical microstructure of solder alloys.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students will be able:

- To correlate the structure - property relations of various copper alloys with special emphasis on engineering applications.
- To compare the differences between various aluminium alloys with respect to their composition, properties and applications.
- To identify suitable magnesium and titanium alloys for applications which involves magnesium and titanium alloys.
- To classify the different types of Nickel and Zinc alloys and understand the implications of these compositions on the properties and applications of the various alloys.
- To explain the importance of precious metals, their properties and applications as well as the properties and applications of Lead and Tin alloys.

TEXT BOOKS

1. K.G.Budinski and M.K.Budinski,"Engineering Materials-- Properties and Selection", PHI Learning Pvt. Ltd., New Delhi, 2010.
2. Sidney H. Avner, "Introduction to Physical Metallurgy", Tata McGraw-Hill, 2nd Edition, 1997

REFERENCES

1. Ahindra Ghosh, Hem Shanker Ray, "Principles of Extractive Metallurgy", New Age International, Reprint 2001.
2. Balram Gupta,"Aerospace Materials", Vol. 1, 2 and 3, S. Chand and Co., New Delhi, 1996.
3. Clark and Varney,"Physical Metallurgy for Engineers", Affiliated East West Press, New Delhi, 1987.
4. W.H. Dennis,"Metallurgy of the Nonferrous Metals", Sir Isaac Pitman and Sons, London,1967
5. William F. Smith,"Structure and Properties of Engineering Alloys", McGraw Hill, USA, 1993

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.6			0.9									0.3		
CO2	0.9	0.3													0.3
CO3	0.9		0.3										0.6		
CO4	0.9	0.3													0.6
CO5	0.9											0.6			0.3

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ML5751 NON-DESTRUCTIVE EVALUATION OF MATERIALS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To make the students to understand the importance of NDT in quality assurance.
- To imbibe the students the basic principles of various NDT techniques, its applications, limitations, codes and standards.
- To equip the students with proper competencies to locate a flaw in various materials, products.
- To make the students to be ready to use NDT techniques for in-situ applications too.
- To inculcate the knowledge of selection of the right NDT technique for a given application

UNIT I INTRODUCTION & VISUAL INSPECTION METHODS 9

NDT versus Mechanical testing, Need for NDT, Relative merits and limitations, various physical characteristics of materials and their applications in NDT.

Visual Inspection -Unaided, Aided- Borescopes -Videoscopes, Special features in Borescopes, Selection of borescopes, Optical sensors, Microscopes & replication Microscopy Technique and applications, Holography, Case study.

UNIT II LIQUID PENETRANT TESTING& MAGNETIC PARTICLE TESTING 9

LPT - Principle, types, Procedures, Penetrants and their characteristics, Emulsifiers, Solvent Cleaners / Removers, Developers- properties and their forms, Equipments, Advantages and limitations, Inspection and Interpretation, Applications and case study.

MPT-Principle, Theory of Magnetism, Magnetising current, Magnetisation methods, Magnetic particles, Procedure, Interpretation, Relevant and Non-relevant indications, Residual magnetism, Demagnetisation – need, methods, Advantages and Limitations, Applications, Magnetic Rubber Inspection, Magnetic Printing, Magnetic Painting, Case study.

UNIT III THERMOGRAPHY & EDDY CURRENT TESTING 9

Thermography – Introduction, Principle, Contact & Non-Contact inspection methods, Active & Passive methods, Liquid Crystal – Concept, example, advantages & limitations. Electromagnetic spectrum, infrared thermography- approaches, IR detectors, Instrumentation and methods and applications, Case study.

Eddy current Testing – Principle, properties of eddy currents, Eddy current sensing elements, probes, Instrumentation, Types of arrangement, Advantages & Limitations, Interpretation of Results& applications, Case study.

UNIT IV ULTRASONIC TESTING & ACOUSTIC EMISSION TESTING 9

Ultrasonic Testing-Principle, Basic Equipment, Transducers, couplants, Ultrasonic wave, Variables in UT, Transmission and Pulse-echo method, Straight beam and angle beam, A-Scan, B-Scan & C-Scan, Phased Array Ultrasound& Time of Flight Diffraction, Advantages & Limitations, Interpretation of Results& Applications, Case study

Acoustic Emission Technique – Introduction, Types of AE signal, AE wave propagation, Source location, Kaiser effect, AE transducers, Principle, AE parameters, AE instrumentation, Advantages & Limitations, Interpretation of Results, Applications, Case study.

UNIT V RADIOGRAPHY 9

Introduction, Principle, X-ray Production, Gamma ray sources, tubing materials, X-ray tubing characteristics, Interaction of X-ray with matter, Imaging, Film techniques, Filmless techniques, Types and uses of filters and screens, Real time radiography, geometric factors, inverse square law, characteristics of film, graininess, density, speed, contrast, characteristic curves,

Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Digital Radiography – Film Digitisation, Direct Radiography &Computed Radiography, Computed Tomography, Gamma ray Radiography, Safety in X- ray and Gamma Ray radiography, Case study.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able

- To compare the differences between the various visual inspection techniques and apply the same to the components to be inspected.
- To recognise the importance of Penetrant testing in NDT with the understanding of the procedures involved in the Penetration methods
- To interpret the images and the results obtained from the Thermographic technique and the Eddy current testing
- To evaluate and interpret the results obtained in the Ultrasonic inspection and Acoustic Emission technique
- To explain the techniques involved in the Radiographic testing and the various advancements in Radiography.

TEXT BOOKS:

1. ASM Metals Handbook, “Non-Destructive Evaluation and Quality Control”, American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
2. Paul E Mix, “Introduction to Non-destructive testing: a training guide”, Wiley, 2nd edition New Jersey, 2005

REFERENCES:

1. ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook, Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol. 7, Ultrasonic Testing.
2. Baldev Raj, T.Jayakumar, M.Thavasimuthu “Practical Non-Destructive Testing”, Narosa Publishing House, 2009.
3. Charles, J. Hellier,“ Handbook of Non-destructive evaluation”, McGraw Hill, New York 2001.
4. G. Gaussorgues, “Infrared Thermography”, Chapman & Hall, University Press, Cambridge, 1994.
5. Ravi Prakash, “Non-Destructive Testing Techniques”, New Age International Publishers, 1st revised edition, 2010.

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	0.9	0.6										0.3	0.3		
C02	0.9	0.3		0.6									0.3		
C03	0.6			0.9										0.3	
CO4	0.6			0.9											0.3
CO5	0.9	0.6		0.3									0.3		

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ML5711	SURFACE ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

1. To import knowledge on different coating techniques employed in industries
2. To demonstrate corrosion test and evaluate the corrosion resistance of different alloys
3. To provide hand on training on wear testing of materials

LIST OF EXPERIMENTS

1 Estimation of corrosion rate of mild steel by weight loss method and determination of inhibitor efficiency in acid and neutral media.
2 Electroplating of Cu and Ni
3 Electroless nickel coating
4 Oxalic acid etch test for Intergranular corrosion (Streicher test)
5 Evaluation of corrosion characteristics by potentiostatic /galvanostatic polarisation techniques - Study of passivation characteristics of MS and SS steels in acid media
6 Evaluation of corrosion characteristics by potentiostatic/galvanostatic polarisation techniques - Determination of pitting potential of various steels
7 Evaluation of corrosion characteristics by potentiostatic /galvanostatic polarisation techniques – Potentiostatic investigation of the effectiveness of inhibitors
8 Determination of wear, wear rate and wear characteristics pin on disc wear testing

TOTAL: 60 PERIODS

COURSE OUTCOMES:

1. Able to demonstrate electroplating
2. Able to demonstrate Electroless Ni coating
3. Able to perform corrosion test and evaluate the corrosion resistance of different alloys
4. Able to perform wear testing of materials
5. Able to interpretation of results of corrosion and wear test

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.6	0.3	0.6	0.9	0.9								0.9	0.9	
CO2	0.6	0.3	0.6	0.9	0.9								0.9	0.9	
CO3	0.6	0.3	0.6	0.9	0.9								0.9	0.9	
CO4	0.6	0.3	0.6	0.9	0.9								0.9	0.9	
CO5	0.6	0.3	0.6	0.9	0.9								0.9	0.9	

ML5001 **BIO AND SMART MATERIALS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To study different concepts in selecting bio and smart materials
- To import knowledge on different electro-rheological and piezoelectric materials
- To import knowledge on different shape memory materials and their applications of materials in biomedical engineering and special materials for actuators, sensors, etc.
- To import knowledge on Materials for oral and maxillofacial surgery
- To import knowledge on materials for cardiovascular opthalmology and skin regeneration

UNIT I INTRODUCTION **9**

Intelligent / Smart materials – Functional materials – Polyfunctional materials – Structural materials, Electrical materials, bio-compatible materials. – Intelligent biological materials – Biomimetics – Wolff's Law – Biocompatibility – Material response: swelling and leaching, corrosion and dissolution, deformation and failure, friction and wear – host response: the inflammatory process – coagulation and hemolysis – in vitro and in vivo evaluation of biomaterials.

UNIT II ELECTRO-RHEOLOGICAL AND PIEZOELECTRIC MATERIALS **9**

The principal ingredients of smart materials –microsensors- hybrid smart materials - an algorithm for synthesizing smart materials – active, passive reactive actuator based smart structures- suspensions and electro-rheological fluids - Bingham body model – principal characteristics of electro-rheological fluids – charge migration mechanism for the dispersed phase – electro- rheological fluid domain – fluid actuators- design parameter – application of Electo-rheological fluids – Basics, Principles and instrumentation and application of Magnetorheological fluids – Piezoelectric materials: polymers and ceramics, mechanism, properties and application. Introduction to electro-restrictive and magneto-restrictive materials

UNIT III SHAPE MEMORY MATERIALS **9**

Nickel – Titanium alloy (Nitinol) – Materials characteristics of Nitinol – martensitic transformations – austenitic transformations – thermoelastic martensitic transformations– classification of SMA alloys- mechanism of magnetic SMA – applications of SMA – continuum applications of SMA fasteners – SMA fibers – reaction vessels, nuclear reactors, chemical plant, etc. – micro robot actuated by SMA – SMA memorization process (Satellite Antenna Applications) SMA blood clot filter – Impediments to applications of SMA – Shape memory polymers– mechanism of shape memory-Primary moulding – secondary moulding– types and applications

UNIT IV ORTHOPAEDIC AND DENTAL MATERIALS **9**

Bone and teeth composition, formation and properties – bioresorbable, bioinert, bioactive materials - temporary fixation devices – joint replacement – biomaterials used in bone and joint replacement metals and alloys- Fillings and restoration materials – Materials for oral and maxillofacial surgery – dental cements and dental amalgams – dental adhesives- bone tissue engineering

UNIT V APPLICATIONS OF BIO MATERIALS FOR CARDIOVASCULAR OPTHALMOLOGY AND SKIN REGENERATION **9**

Blood clotting – blood theology– approaches to thrombo resistance materials development– blood vessels – The heart – aorta and valves – geometry of blood circulation – cardiac pacemakers – blood substitutes – extracorporeal blood circulation devices.The lungs – vascular implants: vascular graft, cardiac valve prostheses, card– Biomaterials in opthalmology –skin grafts -connective tissue grafts – tissue adhesives – drug delivery methods and materials.

COURSE OUTCOMES

1. Use of Bio materials for cardiovascular Opthalmology and Skin Regeneration
2. Use of Bio materials for Dental & Bone application
3. Use of shape memory alloys in engineering application
4. Explain the characteristics of Bio and smart materials
5. Use of smart materials as sensors, actuators

TEXT BOOKS

1. M. V. Gandhi and B. S. Thompson, “Smart Materials and Structures”, Chapman and Hall, London, First Edition, 1992
2. Sujata V., Bhat., “Biomaterials”, Narosa Publication House, New Delhi, 2002

REFERENCES

1. Buddy D. Ratner (Editor), Allan S. Hoffman (Editor), Frederick J. Schoen (Editor), Jack E. Lemons, “Biomaterials Science: An Introduction to Materials in Medicine”, Academic Press,2nd edition, 2004
2. Duerig,T. W., Melton, K. N, Stockel, D. and Wayman, C.M., “Engineering aspects of Shapememory Alloys”, Butterworth – Heinemann, 1990
3. Mohsen Shahinpoor and Hans-Jo¨rg Schneider “Intelligent Materials”, RSC Publishing,2008
4. Mel Schwartz (Ed), Encyclopaedia of Smart Materials” Volume –I and II, John Wiley & Sons, Inc.2002
5. Rogers, C. A., Smart Materials, “Structures and Mathematical issues”, Technomic Publishing Co., U.S.A, 1989

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO3
CO1	0.6			0.9									0.3		
CO2	0.9	0.3													0.3
CO3	0.9		0.3										0.6		
CO4	0.9	0.3													0.6
CO5	0.9											0.6			0.3

ML5002 CREEP AND FATIGUE BEHAVIOUR OF MATERIALS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To provide the framework of plastic deformation, its mechanism and the role of dislocations.
2. To cognize the mechanism, metallurgical variables and methods of life prediction of materials under creep
3. To give insight to the nature of stress, factors and life prediction under fatigue.
4. To discern the micro-mechanics and micro structural aspects involved in fatigue
5. To render an exposure to perform failure analysis.

UNIT – I INTRODUCTION **9**

Mechanisms of plastic deformation- Slip and Twinning, Critically resolved stress, Strength of perfect crystal, Lattice resistance to dislocation movement, Elastic properties of dislocation , Dislocation interactions, Partial dislocation, Dislocation multiplication, Dislocation pile up, effect of stacking fault and strain hardening exponent on dislocation.

UNIT – II HIGH – TEMPERATURE DEFORMATION RESPONSE **9**

Creep of Solids, Temperature stress – Strain rate relation, Deformation mechanism, Super plasticity deformation mechanism maps, Creep and stress rupture test, Effect of metallurgical and test variables on creep and fracture. Generation and analysis of creep and creep-rupture data, Parametric methods for prediction of long time properties data, materials for elevated temperature.

UNIT – III CYCLIC STRESS AND STRAIN FATIGUE **9**

Macro fractrography of fatigue failures , Characteristics of fatigue failure, Stress cycles, Fatigue tests, fatigue limit and fatigue strength, S-N curves, types of stress variations, terminology, High cycle and low cycle fatigue , Effect of mean stress on fatigue, Soderberg, Goodman and Gerber equations, stress raisers, stress concentration factor, notch sensitivity factor, factors affecting fatigue limit, finite life, equivalent stress, combined variable stress

UNIT – IV FATIGUE CRACK INITIATION PROPAGATION **9**

Mechanisms of fatigue crack nucleation and propagation, Effect of metallurgical variables on fatigue, effect of overloading pulse, variable stress amplitude, crack closure, Stress and crack lengths correlations with FCP, Fracture modes in Fatigue ,Micro structural aspects of FCP in metal alloys. Thermo-mechanical fatigue, cumulative damage- Miner law, corrosion fatigue, case studies.

UNIT – V ANALYSIS OF ENGINEERING FAILURES **9**

Typical defects, Microscopic surface examination, metallographic and fractographic examination, Fracture surface preservation – Cleaning and replication techniques and image interpretation, failure data retrieval, Component failure analysis : procedural steps for investigation of a failure for failure analysis, Preparation of failure analysis report.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Identify the mechanism role of dislocation and stacking fault on plastic deformation.
2. Assess the behavior of materials under high temperature, metallurgical factors and life prediction of high temperature materials.
3. Distinguish the characteristics, factors and method of life prediction in the stress and strain controlled fatigue.

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4. Appraise the micro-mechanics and micro-structural aspects of fatigue.
5. Design and develop a procedure to perform failure analysis and generate a report.

TEXT BOOKS:

1. Richard. W. Hertzberg ," Deformation and Fracture Mechanism of Engineering Materials", John Willey and Sons, 5th edition, 2012.
2. Thomas H Courtney," Mechanical Behaviour of Materials", Waveland press, 2005.

REFERENCES:

1. Josef Cadek, .," Creep in Metallic Materials", Elsevier,1988
2. Norman E Dowling, "Mechanical Behavior of Materials: Engineering Methods for Deformation, Fracture and Fatigue" Pearson. 2013.
3. Prashant Kumar," Elements of Fracture Mechanics", Tata McGraw-Hill,2009.
4. Suresh S, " Fatigue of materials", Cambridge University press, 1998.
5. William T Becker, Failure analysis and Prevention, ASM international, 2002.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.6			0.9									0.3		
CO2	0.9	0.3													0.3
CO3	0.9		0.3										0.6		
CO4	0.9	0.3													0.6
CO5	0.9											0.6			0.3

ML5003 NANOSTRUCTURED MATERIALS L T P C
3 0 0 3

COURSE CBJECTIVES :

1. To motivate the students to understand the evolution of nanomaterials in the scientific era and make them to understand different processing methods, properties of nanomaterials for the future engineering applications
2. To import knowledge on processing zero dimensional nanomaterials and use them in engineering applications
3. To import knowledge on processing one dimensional nanomaterials and use them in engineering applications
4. To import knowledge on processing two dimensional nanomaterials and use them in engineering applications
5. To render an exposure to characterisation techniques used for nanomaterials.

UNIT I INTRODUCTION TO NANOMATERIALS 9

Amorphous, Crystalline, microcrystalline, quasicrystalline and nanocrystalline materials- historical development of nanomaterials – Nanomaterials classification (Gleiter's Classification) – properly changes done to size effects, Hall – petch, inverse Hall- petch effects - polymeric nanostructures

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UNIT II ZERO DIMENSIONAL NANOMATERIALS 9

Nanoparticles – Properties – Processing – Liquid state processing - Sol-gel process, wet chemical synthesis – Vapour state processing – PVD, CVD, Aerosol processing, solid state processing – mechanical, mechanochemical synthesis – Application of nanoparticle.

Quailing Dots – Quantum confinement – Pauli Exclusion Principle – Processing – Optical lithography – MOCVD – Droplet epitaxy - Applications.

UNIT III ONE DIMENSIONAL NANOMATERIALS 9

Carbon nanotubes – Old and new forms of carbon – Structure of CNT and classification – Processing – Solid carbon based production techniques – Gaseous carbon based production technique - growth mechanisms – Applications- Boron nanotube-Synthesis-Applications

Nanowire – processing – Laser ablation – Oxide assisted growth – carbo thermal reactions – Thermal evaporation – Temperature based synthesis – Electro spinning – Vapour–Solid growth (VS growth) - vapour – liquid – solid growth (VLS technique) – Applications.

UNIT IV SUPER HARD COATINGS AND BULK NANOSTRUCTURED MATERIALS 9

Superhard coating – types – characteristics – thermal stability – case studies (nc-TiN/a-Si_3N_4 coating) – Applications.

Buck nanostructure formation – Equal Channel angular pressing(ECAP) – High pressure torsion(HPT), Accumulative roll bending – Reciprocating extrusion - compression, cyclic close die forging – Repetitive corrugation and straightening – Grain refinement mechanisms.

UNIT V CHARACTERIZATION OF NANOMATERIALS 9

Nano indentation – Types of nanoindenter – Force actuation-Displacement measurement-factors affecting nanoindentation- Different models for calculation of E and hardness- Atomic force microscope (AFM) cantilever dynamics–Electrostatic force mode (EFM) – Magnetic force mode (MFM)

TOTAL: 45 PERIODS

OUTCOMES

1. Ability to evaluate nanomaterials and employ different processing methods, properties of nanomaterials for the future engineering applications
2. Ability to process zero dimensional nanomaterials and use them in engineering applications
3. Ability to process one dimensional nanomaterials and use them in engineering applications
4. Ability to process two dimensional nanomaterials and use them in engineering applications
5. Ability to use characterisation techniques to characterize different nanostructures.

TEXT BOOKS:

1. Bhusan, Bharat (Ed), “Springer Handbook of Nanotechnology”, 2nd edition, 2007.
2. Carl C. Koch (ed.), NANOSTRUCTURED MATERIALS, Processing, Properties and Potential Applications, NOYES PUBLICATIONS, Norwich, New York, U.S.A.

REFERENCES:

1. Bamberg, D., Grundman, M. and Ledentsov, N.N., “Quantum Dot Heterostructures”, Wiley, 1999.
2. Charles P. Poole Jr., Frank J. Ownes, ‘Introduction to Nanotechnology”, Wiley Interscience, 2003.
3. G Timp (ed), “Nanotechnology”, AIP press/Springer, 1999.
4. G. Wilde, “Nanostructured Materials’, Elsevier, 2008.
5. Mark Ratner and Daniel Ratner, “Nano Technology”, Pearson Education, New Delhi, 2003.

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.6			0.9									0.3		
CO2	0.9	0.3													0.3
CO3	0.9		0.3										0.6		
CO4	0.9	0.3													0.6
CO5	0.9											0.6			0.3

ML5004 FUELS, FURNACES AND REFRACTORIES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To provide the knowledge about different modes of heat transfer.
2. To import knowledge on different types of fuels
3. To give insight to the different furnaces.
4. To import knowledge about the different refractories

UNIT I FUNDAMENTALS **9**

Thermal Energy, conversion. Heat Transfer, conduction, radiation, convection. Thermoelectric effect. Thermocouples, Peltier effect. Temperature measurement.

UNIT II FUELS **9**

Thermal Energy conversion. Fossil fuels, availability, deposits, calorific content. Nuclear Fuels, Solar and geothermal heating.

UNIT III FURNACES **9**

Firing, electric Resistance, Radiation, Induction. Temperature control - PID. Multi zone furnaces. Batch and tunnel furnaces.

UNIT IV REFRACTORIES **9**

Heat resistant materials in steel making and non-ferrous production plants. Applications in the power, energy conversion, petroleum and chemical industries.

UNIT V ADVANCED ISSUES **9**

Energy and Environment, Environmental optimization, recycling of thermal energy. Emissions control.

COURSE OUTCOMES:

1. Understand fundamental on different modes of heat transfer
2. Use of different fuels for energy generation system
3. Use of different furnaces and temperature control
4. Use of Refractories in furnace
5. Ability to discuss the issues in environmental.

TEXT BOOKS:

1. Gupta. O. P., "Elements of Fuels, Furnaces and Refractories", 4th edition, Khanna Publishers, New Delhi, 2000.
2. Gupta. O. P., "Elements of Fuels, Furnaces and Refractories", 4th edition, Khanna Publishers, New Delhi, 2000.

REFERENCES:

1. Gilchrist, J. D., "Fuels, Furnaces and Refractories", Pergamon Press, 1977.
2. Yeshvant V. Deshmukh, "Industrial Heating: Principles, Techniques, Materials, Applications, and Design", CRC Press, 2005

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.6	0.3	0.3	0.9									0.3		
CO2	0.9	0.3	0.3												0.3
CO3	0.9	0.3	0.3										0.6		
CO4	0.9	0.3	0.3												0.6
CO5	0.9	0.3	0.3									0.6			0.3

ML5005 CRYOGENIC TREATMENT OF MATERIALS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. Students are to study and become familiar with this very specialized form of material treatment at low temperature.
2. To import knowledge on cryocooler and effects of materials
3. To import knowledge on cryogenic treatment
4. To import knowledge on characteristics of cryo treated materials
5. To inculcate the knowledge of applications of cryoprocessing of materials

UNIT I INTRODUCTION **9**

Insight on Cryogenics-Basics, Properties of Cryogenic fluids, Liquefaction Cycles - Carnot Liquefaction Cycle, F.O.M. and Yield of Liquefaction Cycles. Inversion Curve – Joule Thomson Effect. Linde Hampson Cycle, Precooled Linde Hampson Cycle, Claude Cycle, Dual Cycle

UNIT II CRYOCOOLER **9**

Cryocooler requirement- Satellite communication, Surveillance Imaging, Military applications, Impact of regenerative materials on cooler performance, Impact of material properties on cryocooler performance-Materials used, Thermal Properties, Electrical Properties, and Mechanical properties.

UNIT III CRYOGENIC PROCESSING **9**

Historical Development of Cryogenic Treatment, Cryogenic for Ferrous Metals, Need for cryogenic treatment, Types of low temperature treatment and processors, Benefits of cryogenic treatment-Wear resistance, Stress Relieving, Hardness Precautions during cryogenic treatment.

UNIT IV MATERIALS ENGINEERING 9

Desirable qualities for materials used in cryogenic applications, History and applications of metallic / non-metallic materials, Understanding properties and fabrication processes of superconducting Nb_3Sn wires, High temperature superconductors. Characterization of cryogenically processed materials.

UNIT V APPLICATIONS 9

Cryogenic processing of materials for Space applications, Superconductivity, Medical applications, Food Preservation-Individual Quick Freezing, Tool Industry, Automobiles etc

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. Ability to perform cryogenic treatment of materials
2. Ability to specify cryocooler requirements and performance
3. Ability to select materials for cryogenic treatment
4. Ability to characterise the cryo treated materials
5. Ability to Discuss the properties and application after cryogenic treatment of materials

TEXT BOOK

1. Randall F. Barron, “Cryogenic Systems”, McGraw-Hill, 1985.

REFERENCES

1. Jha, A. R., “Cryogenic Technology and Applications”, Butterworth-Heinemann, 2006
2. Klaus D. Timmerhaus and Richard P. Reed, “Cryogenic Engineering”, Springer, 2007.
3. Scott R. B., “Cryogenic Engineering”, Van Nostrand and Co., 1962.
4. William E. Bryson, “Cryogenics”, HanserGardner Publications,1999.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.6	0.3	0.3	0.9									0.3	0.3	
CO2	0.9	0.3	0.3										0.3		0.3
CO3	0.9	0.3	0.3										0.6	0.3	
CO4	0.9	0.3	0.3										0.3		0.6
CO5	0.9	0.3	0.3									0.6	0.3		0.3

ML5006 ELECTRON MICROSCOPY AND DIFFRACTION ANALYSIS OF MATERIALS

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

1. To educate the crystal structure, symmetry elements and diffraction theory for electron microscopy technique.
2. To analyse sub-micron to nano-structured materials using electron microscopy and their diffraction.

UNIT I BASICS OF CRYSTALLOGRAPHY AND ELECTRON OPTICS 9

Introduction – Electron Optics – microscopy and the concept of resolution – interaction of electrons with matter – depth of field and depth of focus, crystallography – symmetry elements – symmetry operations, point groups, space groups, indexing planes, indexing lattice directions – plane normals – zones and the zone law, stereographic projection –Wulff Net

UNIT II ELECTRON DIFFRACTION THEORY 9

Basics of electron diffraction – scattering by an individual atom, scattering by a crystal – Bragg law – Laue conditions, reciprocal lattice and diffraction by a single crystal – Ewald sphere construction, elastic scattering, inelastic scattering, Structure Factor, intensity distribution in reciprocal space - Typical patterns of BCC, FCC and HCP for different zone axis

UNIT III TRANSMISSION ELECTRON MICROSCOPES 9

Working principle of TEM – important aspects of microscope operation and alignment – aberration correction – resolution, calibration - formation of diffraction patterns and images – SAED – bright and dark field images – Centered dark field images - weak beam images – sample preparation, advanced TEMs – HRTEM

UNIT IV DIFFRACTION ANALYSIS 9

Types of diffraction patterns – ring pattern – spot pattern – Kikuchi pattern, indexing diffraction patterns – spots/ kikuchi lines produced by planes in one zone – spots/ Kikuchi lines arising from different zones – imperfect patterns – Kikuchi maps – Electron Back Scattered Diffraction Pattern (EBSD), standard spot patterns, uniqueness in indexing diffraction patterns - 180° ambiguity, usage of electron diffraction patterns – orientation relationship determination – second phase identification – defect analysis, other diffraction spots – extra spots, satellite spots and streaks – identification of materials

UNIT V SCANNING ELECTRON MICROSCOPES 9

Working principles of SEM, depth of field and focus, interaction volume, secondary electrons, backscattered electrons, Spectroscopy – Energy Dispersive X-ray spectroscopy – wavelength dispersive X-ray spectroscopy – Electron energy loss spectroscopy, microscope operation – imaging – sample preparation, advanced SEMs – Scanning Transmission Electron Microscope (STEM)- Electron backscattered diffraction –Orientation Imaging.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. The student will able to understand symmetry, crystal structure, orientation and Texture of crystalline materials.
2. Understand the theory of diffraction and microscopic image formation.
3. Understanding on various types of TEM and their capabilities.
4. Ability for interpret the diffraction pattern for determination of crystal structure, defects and orientations.
5. Knowledge on image formation in SEM, chemical analysis of material by X-ray and electron loss spectroscopy.

TEXT BOOKS

1. David B. Williams and C. Barry Carter, “Transmission Electron Microscopy: A Text Book for Materials Science”, Springer, 2009.
2. Peter J. Goodhew, John Humphreys, Richard Beanland, “Electron Microscopy and Analysis”, 3rd Edition, CRC Press, 2000.

REFERENCES

1. Dale E. Newbury, David C. Joy and E.Charles, “Scanning Electron Microscopy and X-ray Microanalysis”, Springer Science, New York, 2003.
2. J. W. Edington, “Electron Diffraction in the Electron Microscope”, N. V.Philips’ Gloeilampenfabrieken, Eindhoven, 1975.
3. Marc De Graef, “Introduction to Conventional Transmission Electron Microscopy”, Cambridge University Press, UK, 2003.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.3	0.3	0.6	0.9	0.9								0.9	0.9	
CO2	0.3	0.3	0.6	0.9	0.9								0.9	0.9	
CO3	0.3	0.3	0.6	0.9	0.9								0.9	0.9	
CO4	0.3	0.3	0.6	0.9	0.9								0.9	0.9	
CO5	0.3	0.3	0.6	0.9	0.9								0.9	0.9	

ML5007 PHASE TRANSFORMATIONS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To provide opportunity to learn about the diffusion mechanisms and the various phase transformations that happen due to diffusion.
- To make the students understand the significance and importance of phase transformations and its influence on the mechanical behaviour.
- To inculcate knowledge on the diffusion less transformations that occurs in ferrous and non-ferrous materials.
- To make the students to understand the concepts involved in the precipitation processes.
- To make the students understand the concepts of recovery, grain growth and recrystallisation in detail.

UNIT I DIFFUSION MECHANISMS 9

Basics of thermodynamic & kinetics: equilibrium - configurational entropy - free energy of mixing - miscibility gap – chemical potential. Diffusion – uphill diffusion – downhill diffusion – atomic mechanisms of diffusion, Fick's 1^{st} and 2^{nd} law – solution to the diffusion equation – error functions – application of the non-steady state diffusion, spinodal decomposition

UNIT II DIFFUSION CONTROLLED PHASE TRANSFORMATIONS 9

Nucleation and growth - types of nucleation – concept of free energy during solidification – thermodynamics and kinetics of homogeneous and heterogenous nucleation – critical nucleus size and critical free energy change – nucleation rate and growth rate – overall transformation rate, concept of activation energy – Arrhenius equation – Johnson-Mehl-Avrami equation, Pearlitic transformations.

UNIT III DIFFUSIONLESS PHASE TRANSFORMATIONS 9

Martensite transformation – definition – characteristic features of Martensitic transformation in steels – morphology of Martensite – lath and acicular martensite – crystallography of martensitic transformation – martensite in non-ferrous systems – thermoelastic martensite – shape memory effect – examples and applications of shape memory alloys.

UNIT IV PRECIPITATION REACTIONS 9

Precipitation reaction – thermodynamic considerations, structure and property during ageing– sequence of ageing – formation of G-P zones and intermediate precipitates, theories of precipitation hardening – effect of time, temperature and alloy compositions – precipitation free zones, crystallographic aspects of transformation, coarsening kinetics.

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UNIT V RECOVERY, RECRYSTALLISATION AND GRAIN GROWTH 9

Cold working and hot working, recovery – polygonisation and dislocation movements in polygonisation, recrystallisation – effect of time, temperature, strain and other variables – Mechanism of nucleation and growth, grain growth – grain growth law, geometrical collisions, preferred orientation, secondary recrystallisation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to:

1. To explain the various diffusion mechanisms and the thermodynamic and kinetic principles.
2. To classify the various diffusion controlled transformations and infer the effect of various parameters on the kinetics and growth of nucleation
3. To compare the differences between the diffusion controlled and diffusionless transformations and explain the diffusionless transformations in steels and non-ferrous alloys.
4. To interpret the thermal cycle on the alloys and the effect of time, temperature and composition during precipitation hardening.
5. To recall the concept of recovery, recrystallization and grain growth in cold worked and hot worked steels.

TEXT BOOKS

1. David A. Porter, Kenneth E. Easterling, Mohamed Y. Sherif, “Phase Transformations in Metals and Alloys”, CRC Press, New York, 3rd edition, 2009.
2. Jena, A.K., and Chaturvedi, M., “Phase Transformations in Materials”, Prentice-Hall, 1993.

REFERENCES

1. Anil Sinha, “Physical Metallurgy Handbook”, McGraw-Hill Professional; 1st edition, 2002.
2. Reed Hill. R. E., “Physical Metallurgy Principles”, Affiliated East West Press, New Delhi, 1992.
3. Romesh C. Sharma, “Phase Transformation in Materials”, CBS Publishers & Distributors, New Delhi, 2002.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.6	0.9		0.3											
CO2	0.6	0.3		0.6											
CO3	0.9			0.6									0.3		
CO4	0.6	0.3		0.9											
CO5	0.9											0.3			

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ML5008 MAKING AND METALLURGY OF STAINLESS STEELS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To provide a comprehensive knowledge on various aspects of Stainless steel making, metallurgy, Properties and its applications.
- To impart knowledge on the classification of stainless steels and their properties.
- To impart the importance of use of stainless steels in various fields of technology.
- To make the student to understand how the characteristics of stainless steels varies with respect to composition and heat treatments as well as the corrosion behaviour of stainless steels.
- To instil thorough knowledge on the numerous applications and importance of stainless steels.

UNIT I HISTORY AND EVOLUTION OF STAINLESS STEEL 9

Essential elements, evolution, development of alloys, selection of Stainless steels, Recent processing enhancements. Some Metallurgical Principles.

UNIT II CLASSIFICATION OF STAINLESS STEELS 9

Wrought and Cast Stainless steels – Ferritic, Martensitic, Austenitic, Cr-Ni-Mo Stainless steels, Precipitation Hardened, Duplex, Heat Resistant, Abrasive and Wear resistant steels- Composition, Metallurgy, Properties, Phase Diagrams, Fretting and Galling, Welding and Weldability of Stainless steels.

UNIT III MELTING AND SECONDARY REFINING OF STAINLESS STEELS 9

Raw Materials selection, Melting Furnaces (EAF, EIF), melt treatment, Continuous casting, secondary refining –AOD, VOD, IOC converters processing, advantages and limitations.

UNIT IV CORROSION BEHAVIOUR OF STAINLESS STEELS 9

Atmospheric, aqueous, stress corrosion, cracking and Hydrogen Embrittlement, High Temperature corrosion, Corrosion of Cast stainless steels, PREN Index, Corrosion rate estimations- ASTM Practices.

UNIT V APPLICATIONS OF STAINLESS STEELS 9

Architecture and construction, Automotive and Marine systems, Petroleum, Chemical, Pulpand Paper Industries applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students will be able:

1. To recall the essential elements responsible for the unique properties of stainless steels and basic metallurgical principles involved.
2. To classify the various types of stainless steels based on the microstructure and the effect of microstructure on the properties of stainless steels.
3. To explain the production methodology of stainless steel making and the influence of the process on the quality of the stainless steel.
4. To interpret the results of corrosion testing and PREN index and understand the influence of the various environmental factors on the corrosion of stainless steels.
5. To identify the suitable stainless steel material for a given application.

TEXT BOOKS

1. John C. Lippold, Damien J. Kotecki, “Welding Metallurgy and Weldabiiity of Stainless steels”, Wiley and Sons, Edition 2005
2. Jonathan Beddoes, J. Gordon Parr, “Introduction to Stainless Steels”,ASM International, 2000
3. Joseph R. Davis , “STAINLESS STEELS”, ASM International, 3rd print,--1999

REFERENCES

1. Donald Peckner, Irving Melvis Bernstein , “Hand Book of Stainless steels”, McGraw Hill, 1977.
2. Joseph R.Davis, “Alloy Digest Source Book: Stainless Steels”, ASM International,2000.
3. Michael F. McGuire , “Stainless steels for Design Engineers”, ASM International,2008
4. R.A. Lula, James Gordon Parr , “Stainless steels”, American Society for Metals, 1996.
5. Source book on Stainless steels, American Society for Metals, 1976.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.9												0.6	0.3	
CO2	0.9	0.6											0.3		
CO3		0.6			0.3										
CO4	0.6			0.9			0.3								
CO5	0.9												0.3		

ME5751 FINITE ELEMENT ANALYSIS L T P C
3 0 0 3

COURSE OBJECTIVES:

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

1. Developing mathematical models for Boundary Value Problems and their numerical solution.
2. Applying concepts of Finite Element Analysis to solve one dimensional problem.
3. Determining field variables for two dimensional scalar variable problems.
4. Determining field variables for two dimensional vector variable problems.
5. Applying the need for Isoparametric transformation and the use of numerical integration.

UNIT I INTRODUCTION 9

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

UNIT II ONE-DIMENSIONAL PROBLEMS 9

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

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UNIT III TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS 9

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation – Finite Element formulation – Triangular elements and Quadrilateral elements- Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems – Torsion of Non circular shafts.

UNIT IV TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS 9

Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Constitutive matrices and Strain displacement matrices – Stiffness matrix – Stress calculations - Plate and shell elements.

UNIT V ISOPARAMETRIC FORMULATION AND ADVANCED TOPICS 9

Natural co-ordinate systems – Isoparametric elements – Shape functions for isoparametric elements – One and two dimensions – Serendipity elements – Numerical integration - Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software- Introduction to Non Linearity.

TOTAL = 45 PERIODS

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

1. Develop mathematical models for Boundary Value Problems and their numerical solution
2. Apply concepts of Finite Element Analysis to solve one dimensional problems
3. Determine field variables for two dimensional scalar variable problems
4. Determine field variables for two dimensional vector variable problems
5. Apply the need for Isoparametric transformation and the use of numerical integration

TEXT BOOKS:

1. Rao, S.S., “The Finite Element Method in Engineering”, 6th Edition, Butterworth-Heinemann,2018.
2. Reddy,J.N. “Introduction to the Finite Element Method”, 4thEdition, Tata McGrawHill,2018.

REFERENCES:

1. David Hutton, “Fundamentals of Finite Element Analysis”, Tata McGrawHill, 2005
2. Dhanaraj. R and Prabhakaran Nair. K, “Finite Element Analysis”, Oxford Publications, 2015.
3. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, “Concepts and Applications of Finite Element Analysis”, 4th Edition, Wiley Student Edition, 2004.
4. Seshu.P, “Text Book of Finite Element Analysis”, PHI Learning Pvt. Ltd., NewDelhi, 2012.
5. Tirupathi R. Chandrupatla and Ashok D. Belegundu, “Introduction to Finite Elements in Engineering”, International Edition, Pearson Education Limited, 2014.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.6												0.9		
2		0.9											0.9		
3			0.6										0.9		
4		0.9											0.9		
5					0.6										0.3

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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:

- CO1: Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities.
- CO2: Acquire knowledge on process of transforming a concept into the final product in AM technology.
- CO3: Elaborate the vat polymerization and material extrusion processes and its applications.

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- CO4: Acquire knowledge on process and applications of powder bed fusion and direct energy deposition.
- CO5: 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	0.9						0.3	0.9		0.6		0.9	0.3	0.3	0.3
2	0.9	0.6	0.3	0.3	0.6		0.9	0.6		0.6		0.9	0.3	0.9	0.6
3	0.9	0.3					0.6			0.6		0.9	0.6	0.6	0.3
4	0.9	0.3					0.6			0.6		0.9	0.6	0.6	0.3
5	0.9	0.3					0.6			0.6		0.9	0.6	0.6	0.3

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", 2nd edition, Springer., United States, 2015, ISBN-13: 978-1493921126.

REFERENCES:

1. Amit Bandyopadhyay and Susmita Bose, "Additive Manufacturing", 1st 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.

ME5084 **SURFACE ENGINEERING TRIBOLOGY** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

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

1. Describe the fundamentals of surface features and different types of friction associated with metals and non metals
2. Analyze the different types of wear mechanism and its standard measurement.
3. Analyze the different types of corrosion and its preventive measures
4. Analyze the different types of surface properties and surface modification techniques
5. Analyze the various types of materials used in the friction and wear applications

UNIT I SURFACES AND FRICTION 9

Basics of surfaces features – Roughness parameters – surface measurement - Cause of friction- Laws of friction – Static friction – Rolling Friction – Stick-slip Phenomenon - Friction properties of metal and nonmetals – Friction in extreme conditions – Thermal considerations in sliding contact.

UNIT II WEAR 9

Laws of Wear - Types of Wear mechanism – wear debris analysis - Theoretical wear models - Wear of metals and nonmetals – International standards in friction and wear measurements

UNIT III CORROSION 9

Introduction – Types of corrosion – Factors influencing corrosion – Testing of corrosion – In-service monitoring, Simulated service, Laboratory testing – Prevention of Corrosion – Material selection, Alteration of environment, Design, Cathodic and Anodic Protection, Corrosion inhibitors

UNIT IV SURFACE TREATMENTS 9

Surface properties – Hydrophobic – Super hydrophobic – Hydrophilic - surface metallurgy – Surface coating Techniques – PVD – CVD – Physical CVD – Ion implantation – Surface welding – Thermal spraying – Laser surface hardening and alloying - New trends in coating technology – DLC – CNC – Thick coatings – Nano-engineered coatings – Other coatings, Corrosion resistant coatings

UNIT V ENGINEERING MATERIALS 9

Introduction – High and low friction materials - Advanced alloys – Super alloys, Titanium alloys, Magnesium alloys, Aluminium alloys, and Nickel based alloys – Ceramics – Polymers – Biomaterials – Bio Tribology - Nano Tribology

TOTAL = 45 PERIODS

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

1. Describe the fundamentals of surface features and different types of friction associated with metals and non metals
2. Analyze the different types of wear mechanism and its standard measurement.
3. Analyze the different types of corrosion and its preventive measures
4. Analyze the different types of surface properties and surface modification techniques
5. Analyze the various types of materials used in the friction and wear applications.

TEXT BOOKS:

1. G.W.Stachowiak and A.W.Batchelor , “Engineering Tribology”, Butterworth-Heinemann, 2005.
2. S.K.Basu, S.N.Sengupta and B.B.Ahuja ,”Fundamentals of Tribology”, Prentice Hall of India, 2005.

REFERENCES:

1. Fontana G., “Corrosion Engineering”, McGraw Hill, 1985.
2. Halling, J. (Editor), “Principles of Tribology “, MacMillian, 1984.
3. Rabinowicz.E., “Friction and Wear of materials”, John Willey &Sons,1995.
4. Williams J.A., “Engineering Tribology”, Oxford University Press, 1994.
5. Joseph R. Davis, Corrosion: Understanding the Basics, ASM International, 2000.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.3	0.6		0.6	0.6			0.6				0.6	0.9	0.6	0.3
2	0.6	0.6		0.6	0.6			0.6				0.6	0.9	0.6	0.3
3	0.3	0.6		0.6	0.6			0.6				0.6	0.6	0.9	0.3
4	0.3	0.6		0.6	0.9			0.6				0.6	0.6	0.9	0.3
5	0.3	0.3		0.6	0.3			0.6				0.9	0.3	0.6	0.3

ML5009 **MEMS AND MICROFABRICATION** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

1. To impart knowledge about the materials used in MEMS.
2. To provide insight about the microfabrication technologies.
3. To give a comprehensive knowledge on micromanufacturing methods.
4. To make the students familiarize with microdevices.
5. To develop the skills to utilize MEMS devices in the real-time applications.

UNIT – I MATERIAL ASPECTS OF MEMS AND NEMS 9

Overview of MEMS and NEMS. Material Aspects – Silicon and its compounds – Thin metal films – semiconductor – optical properties – Polymers – Smart materials.

UNIT – II MICRO AND NANO FABRICATION PROCESSES 9

Hot Processing and Ion implantation - Diffusion, Thermal Oxidation, Ion implantation, Rapid Thermal Processing. Pattern Transfer- Photolithography, Extreme UV lithography, X-ray Lithography, Electron Beam lithography Focused ion beam Lithography, nanoimprint.

UNIT – III MICROMANUFACTURING PROCESSES 9

Thin films – Physical deposition: Evaporation and sputtering – Chemical Vapor Deposition – Epitaxial growth. Etching – Isotropic etching – Anisotropic etching – Deep Reactive ion etching (DRIE). Surface micromachining, Bulk Micro-manufacturing, LIGA Process.

UNIT – IV MEMS DEVICES 9

MEMS Sensors and Actuators – Mechanical Sensors and Actuators – Thermal Sensors and Actuators – Magnetic Sensors and Actuators – Micro-optoelectromechanical Systems – Radio Frequency (RF) MEMS. Microfluidic Systems; Chemical and Biomedical Microsystems.

UNIT – V MEMS AND NEMS APPLICATIONS 9

Applications in Computer industry – Making of ICs and Microprocessors – Data storage devices. Automobile – Safety and Stability Control. Health care – Lab-on-a-Chip. Consumer Products; Micro reactor; Micro-bots; MOEMS; Molecular machines.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Identify suitable materials for MEMS applications.
2. Discuss the micro and nanofabrication techniques.
3. Explain the method of etching, surface and bulk micromanufacturing methods.
4. Describe the MEMS components and Devices.
5. Select and Implement MEMS devices for the required application.

Attested

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TEXT BOOKS:

1. Stephen A.Campbell, "Fabrication Engineering at the micro and nano scale", Oxford University Press, 4th edition, 2013.
2. Tai-Ran Hsu, "MEMS and Micro systems Design and Manufacture", McGraw Hill Education, 2015.

REFERENCES:

1. Bharat Bhushan, "Handbook of Nanotechnology", Springer, 2006.
2. Maria Stepanova and Stephen Dew, "Nanofabrication: Techniques and Principles", Springer, 2011.
3. Marc Madou, "Fundamentals of Microfabrication", CRC Press, 2002.
4. Mark A. Ratner and Daniel Ratner, "Nanotechnology: A Gentle Introduction to the Next Big Idea, Pearson, 2003.
5. Stephen D Senturia, "Microsystem Design", Kluwer Academic Publishers, 2002.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.9		0.6										0.6		
CO2	0.9		0.6										0.6		
CO3	0.9		0.9										0.6		
CO4	0.9	0.6											0.9		
CO5	0.9		0.9						0.6				0.9		0.9

ML5010 COMPUTATIONAL METHODS FOR MATERIALS ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To give an insight to the numerical methods for fitting and interpolation of experimental data in materials science.
2. To impart knowledge about the use partial differential equations in diffusion and mass transport of materials.
3. To acumen the application of Monte Carlo simulation for nucleation and grain growth problems.
4. To bestow the adoption of matrix algebra to study the anisotropy in materials.
5. To employ computational methods for modeling and property prediction.

UNIT – I SOLUTIONS OF EQUATIONS AND INTERPOLATION 9

Application for the fitting and interpolation of experimental data in Materials Science Roots of equations – Methods of bisection and false position – Newton-Raphson method– Simultaneous equations – Gauss elimination – Gauss Jordan method - Newton's and Langrange's interpolation methods.

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UNIT – II PARTIAL DIFFERENTIAL EQUATIONS 9

Applications in diffusion and mass transport in materials. Type of equations – Elliptic equations – Laplace's equation – Hyperbolic equations – Wave equations – The Lax method – Eulerian and Lagrangian methods - Parabolic Equations – Diffusion – The Dufort-Frankel Method – Conservative methods – The Equation of continuity– The Diffusion equations.

UNIT – III MONTE CARLO METHODS AND SIMULATION 9

Monte Carlo Method for simulating nucleation and growth of grains in materials. Monte Carlo – Random Number Generators – Monte-Carlo Integration – The Metropolis Algorithm – Thermodynamic Averages – Quantum Monte-Carlo – Molecular Dynamics – General Principles.

UNIT – IV MATRIX ALGEBRA 9

Study of anisotropy in materials. Introduction – types of matrix– simple matrix problems – elliptic equations – Poisson's equation– systems of equations and matrix inversion – Exact Methods – Iterative Methods - The Jacobi Method – The Gauss-Seidel Method – Matrix Eigen value Problems – Schrödinger's equation– Full and Partial Diagonalisation - Sturm Sequence.

UNIT – V SELECTED APPLICATIONS IN MATERIALS SCIENCE 9

Modeling and property Prediction-Ability to use computational techniques the Materials Engineering - Use of mathematical equation to predict the properties of materials

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Identify suitable methods for fitting and interpolation of experimental data.
2. Explain the art of using partial differential equations for predicting the diffusion and mass transport in the materials.
3. Realize the utilization of Monte Carlo simulation for nucleation and grain growth problems.
4. Recognize the appositeness of matrix algebra in the investigation of anisotropic materials.
5. Adjudicate the apt the computational techniques for modeling and property prediction.

TEXT BOOKS:

1. Lily Chen, "Computational Materials Science: Theory and Applications", Willford press, 2018.
2. Martin E. Glicksman, James E. Mark, Steven P. Marsh," Computational Methods in Materials Science", Materials Research Society,1992.

REFERENCES:

1. Ellad B. Tadmor, Ronald E. Miller," Modeling Materials: Continuum, Atomistic and Multiscale Techniques", Cambridge University press, 2011.
2. Ghosh Dastidar, P. S., "Computer Simulation of Flow and Heat Transfer", Tata McGraw Hill, New Delhi, 1998.
3. Koenraad George Frans Janssens, Dierk Raabe, Ernest Kozeschnik, Mark A Miodownik, Britta Nestler, "Computational Materials Engineering: An Introduction to Microstructure Evolution", Academic Press, 2010.
4. Michel Rappaz, Michel Bellet, Michel Deville," Numerical Modeling in Materials Science and Engineering, Springer Science & Business Media, 2010.
5. Nenad Mitrovic, Milos Milosevic, Goran Mladenovic, "Experimental and Numerical Investigations in Materials Science and Engineering",Springer 2018

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.9	0.3	0.6	0.6	0.3				0.3						0.6
CO2	0.6	0.9	0.3	0.6	0.9								0.6	0.9	
CO3	0.9	0.6	0.6	0.9	0.6		0.6						0.6	0.6	
CO4	0.6	0.6	0.6	0.9	0.6			0.3					0.6	0.3	
CO5	0.9	0.9	0.9	0.6	0.9									0.9	0.9

ML5011 INTRODUCTION TO TRANSPORT PHENOMENA L T P C
3 0 0 3

COURSE OBJECTIVES:

1. To import knowledge on fluid mechanics specific to materials processing
2. To import knowledge on different flow in pipes
3. To train the students to use heat transfer equations in solving casting related problems
4. To import knowledge on different modes and heat transfer and use of them in materials processing

UNIT I FLUID MECHANICS 9

Properties of fluids such as density, viscosity and specific weight. Fluid statics - Pressure at a point - Pressure variations in horizontal and vertical directions - Concept of gauge and absolute pressure. Use of manometer for pressure measurements. Introduction to Hydrostatic Forces.

Energy Balance in Fluid Flow: Types of flow - continuity equation - Application to one dimensional problems. Derivation of Bernoulli's equation and Euler's equation - Examples illustrating the use of energy equation in metallurgical processes.

UNIT II INTERNAL AND EXTERNAL FLOW 9

Classification of flow - Reynolds number - Laminar flow between parallel plates and circular pipes - Simple problems.
Pressure in Fluid Flow: Head loss due to friction -Darcy - Weisbach equation - flow through pipes - use of Moody diagram - Minor losses - Simple problems.

UNIT III CONDUCTION HEAT TRANSFER 9

Steady state heat conduction - simple examples. Transient heat conduction - Systems with negligible internal resistance - Lumped heat analysis - Response time of a temperature measuring instrument - System with negligible surface resistance- heat flow in an infinitely thin plate (Semi infinite body) - System with finite surface and internal resistance - Chart solutions of transient heat conduction problems – Examples on Heat Treatment

UNIT IV CONVECTIVE HEAT TRANSFER 9

Forced and free convention - Boundary layer concept -velocity and thermal boundary layers (no derivation) - Simple problems - Flow over flat plate - laminar and turbulent boundary layers (no derivation) - Simple problems – Boundary layer development in a circular duct (no derivation) - Flow over cylinders and spheres-Simple problem- applications in metallurgical processes.

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UNIT V RADIATION HEAT TRANSFER 9

Nature of thermal radiation, Concept of Black body, Emissive power – Gray body - Shape factor - Simple problems on Radiation heat transfer between surfaces. Introduction to Gas radiation.
Mass Transfer: Diffusion mass transfer. Simple problems using Fick's law of diffusion. Introduction to convective mass transfer-Introduction to computational fluid dynamics- software.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

This course enables the students apply the knowledge of

1. fluid mechanics, mass transport with respect to temperature and pressure as specific to mineral processing, liquid metal – solidification, etc. of materials technology
2. flow behaviour in pipes and use of this knowledge in casting
3. use of conductive heat principles in materials processing
4. use of convective heat transfer in materials processing
5. use of mass transfer principle in materials processing

TEXT BOOKS

1. Kothandaraman C.P. and Rudramoorthy, R., "Basic Fluid Mechanics", New Age International Publishers, Chennai 1998
2. Sachdeva, R C," Fundamentals of Engineering Heat and Mass Transfer", New Age International Publishers, New Delhi, 1996.

REFERENCES

1. Byron Bird R, W E Shawart, "Transport Phenomena", John-Wiley & Sons Inc, 1994.
2. Irving H Shames," Mechanics of Fluids", third edition, McGraw Hill Publishing Co., New York, 1992.
3. Kothandaraman C P , "Fundamentals of heat and Mass Transfer", second edition, New Age International Publishers, Chennai, 1997.
4. Robert, W Fox, "Introduction to Fluid Mechanics", John Wiley & Sons, New York, USA, 1994

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.9	0.3	0.6	0.6	0.3										0.6
CO2	0.6	0.9	0.3	0.6	0.9								0.6	0.9	
CO3	0.9	0.6	0.6	0.9	0.6								0.6	0.6	
CO4	0.6	0.6	0.6	0.9	0.6								0.6	0.3	
CO5	0.9	0.9	0.9	0.6	0.9									0.9	0.9

ML5012 MODELING AND SIMULATION IN MATERIALS ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES:

1. To introduce different mathematical concepts related to modeling of materials
2. To train the students to solve one dimensional problems related to heat transfer
3. To train the students to solve two dimensional problems related to heat transfer
4. To introduce different software packages and their capabilities in solving material processing problems
5. To train the student to understand the computer applications in physical metallurgy

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UNIT I INTRODUCTION TO MODELING AND MATHEMATICAL CONCEPTS 9

Mathematical modeling, physical simulation, advantages and limitations - Review of differential equations, numerical methods, introduction to FEM, FDM- Governing differential equations of elastic, plastic deformation, fluid flow and heat transfer – basic steps in FEM

UNIT II ONE DIMENSIONAL PROBLEMS 9

Classical Techniques in FEM – Weighted residual method – Galarkin and Ritz method – Coordinates and shape functions- Potential energy approach –– Assembly of stiffness matrix and load vector – Finite element equations – Quadratic shape functions – Applications to elastic deformation of bar, plane trusses and beam – steady state heat transfer

UNIT III TWO DIMENSIONAL AND AXISYMMETRIC CONTINUUM 9

Triangular and quadrilateral elements – Natural co-ordinates – Isoparametric formulation- 2D shape functions - Element stiffness matrix – Force vector – Solution procedure, Gaussian elimination and Cholskey decomposition techniques - Axisymmetric formulation - Boundary conditions – Applications in 2D elastic deformation and heat transfer problems.

UNIT IV SOFTWARE PACKAGES 9

Introduction to standard software packages – General purpose FEA packages– Special purpose packages for simulation of rolling, forging and casting simulations. - Applications of FEA in simulation of sheet metal and bulk forming, solidification of casting and weldment, Concepts of coupled analysis

UNIT V COMPUTER APPLICATIONS IN PHYSICAL METALLURGY 9

Use of computers for the construction of phase diagrams, Expert system for alloy design and selection of materials – computer applications in crystallography

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. Apply numerical techniques to a variety of materials process including solidification, heat treatment, grain from the recovery stabilization
2. Able to evaluate the capabilities and limitation of commercial software

TEXT BOOKS

1. AMIE, “Modeling of casting and welding process”, Volume I & II, the Metallurgical society of AMIE, 1981&1983
2. Reddy J. N., “An Introduction to Finite Element Method”, McGraw-Hill International Student Edition, 1985

REFERENCES

1. Cerjak H., “Mathematical Modeling of Weld Phenomenon-2”, The Institute of Materials, 1995
2. Cerjak H., “Mathematical Modeling of Weld Phenomenon-2”, The Institute of Materials, 1995
3. Piwonoka T.S., Vollen V., Katgerman I., “Modeling of Casting, Welding, and Advanced Solidification Process”, 4th edition, TMS-AIME, USA, 1993
4. Stocks G.M., Turchi P.E.A., “Alloy Modeling and Design”, the Metals Society, AMIE, USA, 1994
5. Trivedi R., Sekhar J.A., Majumudar J., “Principles of Solidification and Material Processing”, Volume I&II, Oxford and IBH, New Delhi, 1989

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.9	0.3	0.6	0.6	0.3										0.6
CO2	0.6	0.9	0.3	0.6	0.9								0.6	0.9	
CO3	0.9	0.6	0.6	0.9	0.6								0.6	0.6	
CO4	0.6	0.6	0.6	0.9	0.6								0.6	0.3	
CO5	0.9	0.9	0.9	0.6	0.9									0.9	0.9

ML5013 LASER PROCESSING OF MATERIALS L T P C

3 0 0 3

COURSE OBJECTIVES:

1. To give an overview of principle and types of laser
2. To impart knowledge about the fundamentals of heat and fluid flow during laser processing.
3. To give insight to the metallurgical aspects involved during laser processing.
4. To inculcate the methodology, parameters and imperfections laser welding and surface modification.
5. To render exposure to laser instrumentation, parameters and material considerations in laser cutting and drilling process.

UNIT – I PRINCIPLES OF INDUSTRIAL LASERS 9

Principle of laser generation, Simulated and spontaneous emissions, Einstein's coefficients, Population inversion, optical resonators, laser modes- mode selection, laser pumping, Rate equation, line- broadening mechanisms, laser beam modifications, types of industrials lasers, Solid state lasers, Gas lasers and semiconductor laser.

UNIT – II THERMAL PROCESS- HEAT AND FLUID FLOW 9

Heat flow in the work piece, Temperature distribution: thick plate with point heat source, thin plate with line heat source, peak temperature ,cooling rates and Gaussian heat source. Fluid flow in molten pool: continuity equation, Navier-Stokes equation and surface tension effects.

UNIT – III LASER METALLURGY 9

Process microstructure- fusion zone, zone of partial melting, HAZ. discontinuities- porosity, cracking, lack of fusion, incomplete penetration and undercut.

UNIT – IV LASER WELDING AND SURFACE MODIFICATIONS 9

Laser welding parameters, Laser efficiency, Process mechanisms (Key hole and Plasmas), Material considerations, imperfections and industrial applications. Recent developments Laser surface modifications: Laser surface heat treatment, Laser surface melting- Glazing, Laser direct Metal deposition– Laser surface alloying, Laser surface cladding and Hard coatings, Laser physical vapour deposition and Laser shock peening.

UNIT – V LASER MACHINING 9

Laser instrumentation for cutting and drilling, cut quality and process characteristics methods of cutting material consideration, practical performance, process variations , industrial applications of Laser cutting and drilling. New developments- Micromachining.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Identify suitable laser source required during laser processing.
2. Explain the heat and fluid flow during laser processing.
3. Analyse the microstructure and discontinuities in the materials subjected to laser processing.
4. Appraise the appropriate methodology, parameters and remedy for imperfections during laser surface modifications
5. Devise the instrumentation for laser cutting and drilling based on the nature of material.

TEXT BOOKS:

1. Elijah kannatey-Asibu, Jr., "Principles of Laser Materials processing ", John Wiley & Sons, 2009
2. John Ion," Laser Processing of Engineering Materials: Principles, Procedure and Industrial Application", Elsevier, 2005

REFERENCES:

1. Jacques Perriere, Eric Millon, Eric Fogarassy, "Recent Advances in Laser Processing of Materials", Elsevier Science, 2006
2. Jonathan R. Lawrence," Advances in Laser Materials Processing: Technology, Research and Application", Elsevier Science, 2010
3. Kamleshwar Upadhya, "Plasma and Laser Processing of Material", TMS, 1991.
4. Peter Schaaf, "Laser Processing of Materials: Fundamentals, Applications and Developments", Springer Science & Business Media,2010
5. Walter W Duley," Laser Processing and Analysis of Materials", Springer Science & Business Media, 2012.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.9	0.6		0.6										0.9	
CO2	0.9		0.6		0.3										
CO3	0.9	0.6		0.6									0.9		
CO4	0.9			0.6											
CO5	0.9	0.6		0.6								0.3	0.9		

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GE5075 **ENGINEERING ETHICS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

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

1. Applying the core values toward the ethical behavior of an engineer.
2. Applying the ethical and moral principles in engineering experimentation.
3. Applying the ethical and moral principles in engineering for safety.
4. Applying standard codes of moral conduct toward the ethical behavior of an engineer.
5. Applying ethical and moral principles for engineers as managers, consultants, expert witness. Resolving global issues of ethics concerning weapon development and multinational companies.

UNIT I 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 – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories.

UNIT II ENGINEERING AS SOCIAL EXPERIMENTATION **9**

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics-Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study

UNIT III ENGINEERING FOR SAFETY **9**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk –The Government Regulator's Approach to Risk - Chernobyl Case Studies and Bhopal.

UNIT IV ENGINEER'S RESPONSIBILITIES AND RIGHTS **9**

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights –Intellectual Property Rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES **9**

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics – Role in Technological Development – Weapons Development – Engineers as Managers –Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct

TOTAL = 45 PERIODS

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

1. Apply the core values toward the ethical behavior of an engineer.
2. Apply the ethical and moral principles in engineering experimentation.
3. Apply the ethical and moral principles in engineering for safety.
4. Apply standard codes of moral conduct toward the ethical behavior of an engineer.
5. Apply ethical and moral principles for engineers as managers, consultants, expert witness. Resolve global issues of ethics concerning weapon development and multinational companies.

TEXT BOOKS:

1. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics Concepts and Cases", Thompson Learning, 2000.
2. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, 2005.

REFERENCES:

1. Charles D Fleddermann, “Engineering Ethics”, Prentice Hall, New Mexico, 1999.
2. David Ermann and Michele S Shauf, “Computers, Ethics and Society”, Oxford University Press, 2003.
3. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, 2001.
4. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, 2003.
5. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, “Business Ethics – An Indian Perspective”, Biztantra, New Delhi, 2004.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1						0.	0.3	0.9				0.6	0.3		
2						0.6	0.6	0.9				0.6	0.3	0.6	
3						0.9	0.6	0.9				0.6	0.3	0.6	
4						0.9	0.6	0.9				0.6	0.3	0.6	
5						0.6	0.6	0.9				0.6	0.3		

ME5080 PRECISION MANUFACTURING L T P C
3 0 0 3

COURSE OBJECTIVES:

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

1. Explaining the need, significance and progress of precision manufacturing and the different levels of manufacturing.
2. Explaining the principle and working of different methods of precision machining.
3. Explaining the special construction requirements of precision machine tools.
4. Explaining the errors involved in precision machine tools and calculate the error budgets for a given situation.
5. Selecting a suitable measurement solution to measure and characterize precision machined features.

UNIT I PRECISION ENGINEERING 9

Introduction to Precision Engineering, Need for precision manufacturing, Taniguchi diagram, Four Classes of Achievable Machining Accuracy – Normal, Precision, High-precision, Ultra-precision Processes and Nanotechnology.

UNIT II PRECISION MACHINING 9

Overview of Micro- and Nano-machining, Conventional micro machining techniques - micro-turning, micro-milling, micro-grinding, Ultra-precision diamond turning, Non-conventional micromachining techniques – abrasive jet and water jet micromachining, Ultrasonic micromachining, micro electrical discharge machining, photochemical machining, electro chemical micromachining, laser beam micromachining, Electron beam micromachining, Focused Ion Beam micromachining, etc.

UNIT III MACHINE DESIGN FOR PRECISION MANUFACTURING 9

Philosophy of precision machine design, Ultra-Precision Machine Elements: Guide- ways, Drive Systems, Friction Drive, Linear Motor Drive, Spindle Drive. Bearings: Principle, construction and application of Rolling, Hydrodynamic and Hydrostatic Bearings, Aerostatic Bearings, Magnetic bearings.

UNIT IV MECHANICAL AND THERMAL ERRORS 9

Sources of error, Principles of measurement, Errors due to machine elements, bearings, spindles, Kinematic design, Structural compliance. Vibration, Thermal errors – background, thermal effects, Environmental control of precision machinery. Error mapping and error budgets.

UNIT V MEASUREMENT AND CHARACTERISATION 9

Optical dimensional metrology of precision features – Machine vision, Multi-sensor coordinate metrology, Laser Tracking Systems, Laser scanners, White-Light Interference 3D Microscopes, Focus-Based Optical Metrology- Fringe projection method, Measurement of Typical Nanofeatures.

Surface metrology - 3D surface topography - Need, Measurement – Chromatic confocal Microscopy, Interferometry, Non-optical Scanning Microscopy – Scanning electron Microscopes, Scanning probe microscopes, Parameters for characterizing 3D surface topography.

TOTAL = 45 PERIODS

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

1. Explain the need, significance and progress of precision manufacturing and the different levels of manufacturing.
2. Explain the principle and working of different methods of precision machining.
3. Explain the special construction requirements of precision machine tools.
4. Explain the errors involved in precision machine tools and calculate the error budgets for a given situation.
5. Select a suitable measurement solution to measure and characterize precision machined features.

TEXT BOOKS:

1. Jain, V.K., Introduction to micromachining, Narosa publishers, 2018
2. Venktesh V.C., Sudin Izman, Precision Engineering, Tata Mc.Graw Hill Publishing Company, New Delhi 2007.

REFERENCES:

1. David Dornfeld, Dae-Eun Lee, Precision Manufacturing, Springer, 2008.
2. Jain, V.K., Micromanufacturing Processes, CRC Press, 2012.
3. Joseph McGeough, Micromachining of Engineered Materials, Marcel Dekker Inc., 2002.
4. Kevin Harding, “Handbook of Optical Dimensional Metrology, Series: Series in Optics and optoelectronics”, Taylor & Francis, 2013.
5. Murty, R.L., Precision Engineering in Manufacturing, New Age publishers, 2005.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.6	0.6	0.6	0.6	0.6								0.6		
2	0.6	0.6	0.6	0.6	0.6								0.6	0.6	
3	0.6	0.6	0.6	0.6	0.6								0.3	0.6	
4	0.6	0.6	0.6	0.6	0.6								0.6		
5	0.6	0.6	0.6	0.6	0.6								0.9	0.9	0.3

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ML5014 MATERIALS FOR AUTOMOTIVE APPLICATIONS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To give an overview of material properties, use of materials selection chart and considerations for material selection
2. To impart knowledge about the basis of materials selection
3. To give insight about the factors that influence materials selection for engines and transmission system
4. To instill the knowledge required for the selection of materials for automotive structures
5. To render the basis of material selection for electronics devices in the automobile.

UNIT – I ENGINEERING MATERIALS AND THEIR PROPERTIES 9

Classes of engineering materials - the 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. Selection of materials for automotive, aerospace, marine and defence applications.

UNIT – II BASIS OF MATERIAL SELECTION 9

Selection strategy, Attribute limits and Material indices, structural index Selection procedure: 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, Recyclability, Environmental consideration. Computer aided selection.

UNIT – III MATERIALS FOR ENGINES AND TRANSMISSION SYSTEMS 9

Materials selection for IC engines: Piston, piston rings, cylinder, Engine block, Connecting rod, Crank shaft, Fly wheels, Gear box, Gears, Splines, Clutches.

UNIT – IV MATERIALS FOR AUTOMOTIVE STRUCTURES 9

Materials selection for bearings, leaf springs, chasis & frames, Bumper, shock absorbers, Damping fluid, wind screens, panels, brake shoes, Disc, wheels, differentials , damping and antifriction fluids, Tyres and tubes.

UNIT – V ELECTRONIC MATERIALS FOR AUTOMOTIVE APPLICATIONS 9

Materials for electronic devices meant for engine control, ABS, Steering, Suspension, Sensors, temperature sensors for climate control, anti-collision, Anti-fog, Head lamps.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Identify the criteria and forces that cause the changes in materials selection.
2. Investigate the influence of structural index, manufacturing process, design and functional requirements on selection strategies.
3. Recognize the temperature regime, nature of load and property requirements of materials for engines and transmission system.
4. Analyse the various stresses acting on the structural members of automobile under dynamic loading and select suitable material.

5. Adjudicate the apt material for electronic devices used in automobiles.

TEXT BOOKS:

1. Charles J A and Crane. F A. A., “Selection and Use of Engineering Materials”, 3rd Edition, Butterworths, London UK, 1996.
2. Jason Rowe, “Advanced Materials in Automotive Engineering”, Wood Head Publishing, 2012.

REFERENCES:

1. Ahmed E, “Advanced composite materials for Automotive applications, Wiley, 2013
2. Don H Wright,” Testing Automotive Materials and Components”, SAE 1993.
3. Geoff Davis, “ Materials for Automobile bodies”, Butter Worth Heinemann, 2012
4. Hiroshi Yamagata, “The Science and Technology of Materials in Automotive Engines”, Elsvier, 2005
5. Mstislav A M, Valentin N A, Gleb V M, “Automotive materials: a handbook for the mechanical engineer”, NTIS, 1972.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.9	0.3	0.6	0.6	0.3										0.6
CO2	0.6	0.9	0.3	0.6	0.9								0.6	0.9	
CO3	0.9	0.6	0.6	0.9	0.6								0.6	0.6	
CO4	0.6	0.6	0.6	0.9	0.6								0.6	0.3	
CO5	0.9	0.9	0.9	0.6	0.9									0.9	0.9

ML5015 **METALLURGY OF TOOL MATERIALS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To make the students to gain knowledge on the various types of tool materials and their characteristics and applications.
- To expose the students to various methods of testing tool steels.
- To make the students understand thoroughly the various existing manufacturing processes, heat treatment and properties of advanced tool materials.
- To impart the various heat treatments that can be given to tool steels and its effect on the mechanical properties.
- To make the students to understand the need for coating the tool materials and its implications.

UNIT I CLASSIFICATION AND MANUFACTURE OF TOOL STEELS 9

Classification – AISI system, selection of tool steels from the point of view of mechanical properties, Effect of alloying elements such as W, Mo, Ni, V, Ti etc., in Tool steels, Production techniques –problems in melting – powder metallurgy route, Refining methods like VAR, ESR– forming of tool steels.

UNIT II HEAT TREATMENT OF TOOL STEELS AND DEFECTS 9

HEAT TREATMENT AND METALLURGY OF W, S, O, A & D TYPE TOOL STEELS Water hardening tool steels, shock resistance tool steels, cold work tool steels-oil hardening, mediumalloy and high carbon-high Cr(O,A&D types): Constitution, classification of principal types,heat treatment process, hardenability, distortion characteristics, properties and application.

HEAT TREATMENT AND METALLURGY OF H, T, M, SPECIAL PURPOSE TOOL STEELS-Hot work tool steels, high speed tool steels, maraging tool steels, special purpose tool steels: constitution, classification of principal types, heat treatment process, specific requirements and applications.

UNIT III PROPERTIES, TESTING AND FAILURE OF TOOL STEELS 9

Mechanical properties of Tool steels with respect to applications – Elevated temperature properties – Microstructures –Carbide distribution –Coating thickness, micro hardness – Adhesion and Scratch resistance. Tool failures – material heat treatment, manufacturing processes and Operational factors.

UNIT IV ADVANCED TOOL MATERIALS 9

Sintered Tungsten Carbide tools – ISO classification, Uses of P, M, K,H,W, S, O, A ,T grades Cermet – ceramics, mixed and reinforced grades –WC, Al_2O_3, SiC , CBN, PCD, TaC, TiC, Solid Carbide tools – Manufacturing techniques, heat treatment and properties, Stellites, Cemented carbides, ceramic tools, Special purpose tool steels.

UNIT V SURFACE TREATMENTS AND COATINGS 9

Sulphidizing of tool steels – TiN coating by PVD, coating of Carbide tools –Mono and multilayer Coatings of TiC, TiN, Alumina and DLC by PVD and CVD processes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students will be able:

- To classify the various tool materials that are used for engineering applications and understand the influence of various alloying elements on the properties of tool materials
- To select suitable heat treatment for the different tool materials inorder to improve the performance of tools.
- To test the tool materials for various properties and analyse on the various possible failures that occur in tools.
- To explain the need for advanced tool materials and the advantages of various special tool materials over conventional tool materials.
- To infer the effect of coating on the tool materials and are exposed to the various possible coating techniques that are available for tool materials.

TEXT BOOKS

1. George Roberts, George Krauss, Richard Kennedy, “Tool Steels” 5th edition, ASM International,1998.
2. Payson, Peter – “Metallurgy of Tool Steels” – John Wiley & Sons, New York 1962

REFERENCES

1. Joseph R. Davies – “Tool Materials”, ASM International, 1995
2. Robert Wilson, “Metallurgy and Heat treatment of Tool Steels, McGraw Hill New York,1975

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0.9	0.3										0.6	0.3		
CO2		0.9	0.3										0.6		
CO3	0.9	0.3		0.6									0.3		
CO4	0.9				0.6									0.3	
CO5	0.9		0.3												0.6

ML5016 THIN FILM TECHNOLOGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To enable the students to have a comprehensive knowledge on the basics involved in thin films and development of thin films.
- To expose the students to various methods of preparation of thin films.
- To make the students understand the methods of deposition monitoring and control and its importance.
- To impart the students the knowledge of surface modification technologies of deposition of thin film for different application like optical emission, abrasion resistance, dielectric, electronic applications, energy conversion, etc.
- To educate the students the applications of thin films in various fields.

UNIT I BASICS OF THIN FILMS 9

Cosine law of emission.Emission from a point source.Mass of material condensing on the substrate. Chemical methods: Qualitative study of preparation of thin films by Electroplating, vapour phase growth and anodization. Physical methods: Vacuum evaporation

UNIT II PREPARATION OF THIN FILMS 9

Study of thin film vacuum coating unit - Construction and uses of vapour sources-wire, sublimation, crucible and electron bombardment heated sources. Arc and Laser evaporation. Sputtering - Study of glow Discharge - Physical nature of sputtering - Sputtering yield- Experimental set up for DC sputtering, AC sputtering and RF sputtering. Nucleation and growth of thin films (qualitative study only): Four stages of film growth.

UNIT III DEPOSITION MONITORING AND CONTROL 9

Microbalance, Crystal oscillator thickness monitor, optical monitor, Resistance Monitor. Thickness measurement: Multiple Beam Interferometer, Fizeau (Tolansky) technique - Fringes of equal chromatic order (FECO) method - Ellipsometry (qualitative only).

UNIT IV PROPERTIES OF THIN FILM 9

Sheet resistance - size effect - Electrical conduction in thin metallic films.Effect of Ageing and Annealing - Oxidation - agglomeration. Dielectric properties: DC conduction mechanism - Low field and high field conduction. Breakdown mechanism in dielectric films - AC conduction mechanism. Temperature dependence of conductivity. Optical properties: Optical constants and their determination - Spectrophotometer method. Anti-reflection coatings. Interference filters. Thin film Solar Cells CuInSe2 solar cell.

UNIT V APPLICATION OF THIN FILMS 9

Thin film resistors: Materials and Design of thin film resistors (Choice of resistor and shape and area) - Trimming of thin film resistors - sheet resistance control - Individual resistor trimming. Thin film capacitors: Materials - Capacitor structures - Capacitor yield and capacitor stability. Thin film field effect transistors: Fabrication and characteristics - Thin film diodes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students will be able:

- To explain the fundamental principles of Thin film technology.
- To compare the various techniques of preparation of thin films with respect to the processes, advantages, limitations and applications.
- To interpret the results obtained from Microbalance, Crystal oscillator thickness monitor, optical monitor, Resistance Monitor and Thickness measurements.
- To interpret the effect of size of thin films and ageing and annealing on the optical and conductive properties of thin films.
- To identify suitable surface modification technologies of deposition of thin film for different application like optical emission, abrasion resistance, dielectric, electronic applications, energy conversion, etc.

TEXT BOOKS

1. Goswami A, “Thin Film Fundamentals”, New Age International (P) Ltd., 1996.
2. K.L. Chopra, “Thin Film Phenomena”, McGraw-Hill,1983

REFERENCES

1. AichaElshabini-Riadaud Fred D Barlow III, “Thin Film Technology Hand book”, Mc Graw Hill Company, 1997.
2. Anders H, “Thin Films in Optics”, Focal press, 1967.
3. Guthrie A, “Vacuum Technology”, John Wiley and Sons, 1963.
4. Maissel L.I and Glang R, “Hand Book of Thin Film Technology”, McGraw Hill, 1970.
5. Rao V V, Ghosh, T.B., Chopra, K.L., “Vacuum Science and Technology”, Allied Publications, 1998
6. Schwartz B and Schwartz N, “Measurement Techniques for Thin Films”, John Wiley & Sons, 1967.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.9	0.6		0.6										0.9	
CO2	0.9		0.6		0.3									Attested	

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CO3	0.9	0.6		0.6									0.9		
CO4	0.9			0.6											
CO5	0.9	0.6		0.6								0.3	0.9		

ML5017 ENERGY STORING DEVICES AND FUEL CELLS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To explain the basic characteristics of a battery.
2. To understand the fuel cell technology.
3. To justify the importance of green energy.
4. To know the merits and demerits of hydrogen as energy carrier.
5. To understand the future prospects of renewable energy systems.

UNIT – I BATTERY CHARACTERISTICS 9

Voltage, current, capacity, electricity storage density, power, discharge rate, cycle life, energy efficiency, shelf life. Primary batteries: Mechanism, fabrication, performance aspects, packing and rating of zinc-carbon, magnesium, alkaline, manganous dioxide, mercuric oxide, silver oxide batteries, zinc/air and lithium button cells- solid electrolyte cells.

UNIT – II SECONDARY BATTERIES 9

Fabrication, mechanism and performance aspects of lead acid, nickel-cadmium, nickel-zinc, lithium and lithium ion batteries - Rechargeable zinc alkaline battery. Reserve batteries: Zinc-silver oxide, lithium anode cell, thermal batteries.

Batteries for electric vehicles: Metal/air, zinc-bromine, sodium-beta alumina and lithium/iron sulphide batteries. (outline only) Photogalvanic cells. Battery specifications for cars, heart pacemakers, computer standby supplies.

UNIT – III FUEL CELLS 9

Introduction – relevance, importance and classification of fuel cells. Background theory - thermodynamic aspects of electrochemistry-energy conversion and its efficiency – factors affecting efficiency, electrode kinetics of electrochemical energy conversion.

UNIT – IV TYPES OF FUEL CELLS 9

Description, working principle, components, applications of alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate, direct methanol fuel cells. Proton Exchange Membrane fuel cells - basic aspects – working and high temperature operation – recent development in technology.

UNIT – V HYDROGEN AS FUEL, SOLAR CELL AND ENVIRONMENT 9

Sources of hydrogen and preparation – clean up and storage – use as fuel in cells.
Energy conversion devices, photovoltaic and photo electrochemical cells – photo biochemical conversion cell. Future prospects-renewable energy and efficiency of renewable fuels – economy of hydrogen energy – life cycle assessment of fuel cell systems.

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TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. To remember and understand the basic characteristics of a battery.
2. To understand and appreciate the fuel cell technology.
3. To understand the need for green energy and sustainable technology developments.
4. To analyse the cost effectiveness and eco-friendliness of hydrogen technology.
5. To develop models of renewable energy systems.

TEXT BOOKS

1. Aulice Scibioh M.and Viswanathan B, "Fuel Cells – principles and applications', University Press (India), 2006
2. Lindon David, "Handbook of Batteries", McGraw Hill, 2002

REFERENCES:

1. Barbir F "PEM fuel cells: theory and practice" Elsevier, Burlington, MA 2005.
2. Christopher M A Brett, "Electrochemistry – Principles, Methods and Applications", Oxford University, 2004.
3. Dell, Ronald M Rand, David A J, "Understanding Batteries", Royal Society of Chemistry, 2001
4. Newman J S and Thomas -Alyea K.E. "Electrochemical systems" (3rd ed) Wiley, Hoboken, NJ 2004.
5. Pletcher D and Walsh C,"Industrial Electrochemistry", Blackie Academic and Professional, 1993

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.9	0.6		0.6										0.9	
CO2	0.9		0.6		0.3										
CO3	0.9	0.6		0.6									0.9		
CO4	0.9			0.6											
CO5	0.9	0.6		0.6								0.3	0.9		

ML5018 FRACTURE MECHANICS AND FAILURE ANALYSIS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To import knowledge on basic concepts of fracture mechanics
2. To import knowledge on strain energy principle and use of it for developing theories
3. To train the students to understand and analyse the fatigue failure
4. To import knowledge and train the students to do failure analysis on the components failing by creep, corrosion and wear failure
5. To provide knowledge on corrosion and wear failure of materials.

UNIT I BASIC CONCEPTS IN FRACTURE MECHANICS 9

Introduction to fracture- - elastic deformation, plastic and elasto-plastic deformation, Brittle fracture: Griffiths theory, Ductile fracture, Inglis solution-LEFM-EPFM- Different modes of fracture- photo elastic fringes- characteristics-crack emanating from inner and outer boundaries of cylinder-

UNIT II MECHANICS OF FRACTURE- STATIC LOADING 9

Strain energy- strain energy in the presence of crack- energy release rate- fracture criteria- crack branching based on energy approach- Analytical solutions yielding near a crack front – westergaads stess function- plastic zone size – Dugdaale model – J integral and its relation to crack opening displacement. Strain energy release and stress intensity factor. Evaluation of fracture Toughness of different materials: size effect & control.

UNIT III FAILURE ANALYSIS OF FATIGUE FRACTURE 9

Fundamental sources of failures- Deficiency in design, Empirical Relation describing crack growth by fatigue – Life calculations for a given load amplitude – effects of changing the load spectrum – Effects of Environment. Micro-structural analysis of fatigue failures, some case studies in analysis of fatigue failures

UNIT IV FAILURE ANALYSIS OF CREEP RUPTURE 9

Fracture at elevated temperature: Time dependent mechanical behavior, stress rupture, Microstructural changes during creep, Mechanism of creep deformation and Creep deformation maps, Prediction of time to rupture, Creep-fatigue interaction. Some case studies in analysis of creep failures.

UNIT V FAILURE ANALYSIS OF CORROSION AND WEAR 9

Types of corrosion, Corrosion stress, corrosion cracking, Analysis of corrosion failure. Procedure for analysis of stress corrosion cracking. Effect of Environment. Analysis of corrosion characteristics of metals and alloys in different environment. Types of wear, Role of friction, Interaction of corrosion and wear. Analysis of wear failure.

COURSE OUTCOMES:

1. Ability to design structure to prevent failure from the internal defect that unit within the structure
2. Ability to derive the stress field solutions for fracture problems
3. Ability to design structure to prevent fatigue and creep
4. Ability to define different deformation and related theories
5. Ability to analyse the corrosion and wear failure and system methods to prevent corrosion and wear

TEXT BOOKS

1. Hertz berg R W, “Deformation and fracture mechanics of Engineering materials” second edition John Wiley sons inc, New York 1983.
2. Knott. J.F, “Fundamentals of Fracture Mechanics” Butterworth London, 1973.

REFERENCES

1. Campbel J E, Underwood J H, and Gerberich W W., “Applications of Fracture Mechanics for the selection of Materials “, American Society for Metals, Metals Park Ohio, 1982.
2. Evalds H L and RJH Warnhil, ”Fracture Mechanics”, Edward Arnold Ltd, Baltimore,1984.
3. Fracture Mechanics Metals Handbook, ninth edition, vol. 8 437-491, American Society of Metals Metal Park ohio, 1985
4. Kare Hellan,“Introduction of Fracture Mechanics”, McGraw-Hill Book Company, 1985.

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5. Prashant Kumar, “Elements of Fracture Mechanics”, Wheeler Publishing,1999.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0.9	0.3	0.6	0.6	0.3										0.6
CO2	0.6	0.9	0.3	0.6	0.9								0.6	0.9	
CO3	0.9	0.6	0.6	0.9	0.6								0.6	0.6	
CO4	0.6	0.6	0.6	0.9	0.6								0.6	0.3	
CO5	0.9	0.9	0.9	0.6	0.9									0.9	0.9

ML5019 MATERIALS SCIENCE AND ENGINEERING OF GREEN ENERGY L T P C
3 0 0 3

COURSE OBJECTIVES:

1. To provide knowledge on green energy technology.
2. To import knowledge on different sources of renewable energies.
3. To introduce nanotechnology in green energy.
4. To import knowledge on different green energy materials.
5. To give overview about the green management concept and its applications.
6.

UNIT I GREEN ENERGY AND SUSTAINABLE DEVELOPMENT 9

Global warming; greenhouse gas emissions, impacts, mitigation and adaptation; future energy Systems- clean/green energy technologies. Criteria for choosing appropriate green energy technologies, life cycle cost; the emerging trends – process/product innovation-, technological/ environmental aspects.

UNIT II RENEWABLE ENERGY RESOURCES 9

Current energy requirements - Review ofconventional energy resources. Solar Energy and its conversion methods, solar thermal collectors – photovoltaic; Wind energy – Ocean, Wave and Tidal energy. Smart batteries – Fuel Cells and Types – Materials. Other Sources: Hydropower, Nuclear fission and fusion-Geothermal energy.

UNIT III GREEN NANOTECHNOLOGY 9

Nanoparticles preparation techniques, Greener Nanosynthesis: Greener Synthetic Methods for Functionalized Metal Nanoparticles, Greener Preparations of Semiconductor and Inorganic Oxide Nanoparticles, green synthesis of Metal nanoparticles, Nanomaterials for Alternative Energy: Nanomaterials for Fuel Cells and Hydrogen Generation and storage, Nanostrcutures for efficient solar hydrogen production, Metal Nanoclusters in Hydrogen Storage Applications, Metal Nanoparticles as Electrocatalysts in Fuel Cells, Nanowires as Hydrogen Sensors, Nanomaterials in Energy Storage Devices: MWNT for Li Ion Batteries, Nanomaterials in Electrodes, Hybrid Nanotubes: Anode Material, Supercapacitor, Battery Electrodes

UNIT IV PROCESSING OF GREEN ENERGY MATERIALS 9

Silicon processing methods - Fabrication methods: physical and chemical vapour deposition techniques, photolithography, electroless and electrochemical deposition, etching, mask plating. Newer Energy Materials: Carbon nano-tubes (CNTs) and multiwall carbon nanotubes (MWCNTs) -methods of production, properties and its utility in energy devices.

UNIT V GREEN MANAGEMENT 9

Concept of green management; evolution; nature, scope, importance and types; developing a theory; green management in India; relevance in twenty first century.

COURSE OUTCOMES:

- To obtain an enriched knowledge of green energy technology.
- To know the different sources of renewable energies.
- To understand the technological and economical aspects of conversion of renewable energies into useful forms.
- To obtain a basic understanding of energy sciences, its importance, utility.
- To understand the green management concept and its applications.

REFERENCES:

1. A. Johansson, Clean Technology", Lewis 1992.
2. Ed K. Mulder, Sustainable Development for Engineering, Greenleaf Publishing, 2006.
3. Green Management and Green Technologies: Exploring the Causal Relationship by Jazmin SeijasNogarida, 2008.
4. J Fiksel, Design for Environment, Mcgraw Hill, 1996.
5. M. Charter and U. Tischner, Sustainable Solutions, Greenleaf Publishing, 2001.
6. M. Graziani and P. Fornasiero, Renewable resources and renewable energy- A global challenge, CRC-Taylor and Francis, 2007.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0.9	0.6		0.6										0.9	
CO2	0.9		0.6		0.3										
CO3	0.9	0.6		0.6									0.9		
CO4	0.9			0.6											
CO5	0.9	0.6		0.6								0.3	0.9		

ML5020 HIGH TEMPERATURE MATERIALS L T P C

3 0 0 3

COURSE OBJECTIVES:

1. To give an overview of creep behaviour of materials and metallurgical factors.
2. To impart knowledge about the design for high temperature applications..
3. To give insight into the facture mechanisms of elevated temperature.
4. To provide the principles of oxidation and hot corrosion.
5. To render exposure to super alloys and its application at elevated temperature..

UNIT – I CREEP 9

Factors influencing the functional life of components at elevated temperatures, definition of creep curve, various stages of creep, metallurgical factors influencing various stages, effect of

stress, temperatures and strain rate.

UNIT – II DESIGN FOR CREEP RESISTANCE 9

Design of transient creep time, hardening, strain hardening, expressions of rupture life of creep, ductile and brittle materials, Monkman-Grant relationship.

UNIT – III FRACTURE 9

Various types of fracture, brittle to ductile from low temperature to high temperature, cleavage fracture due to micro void coalescence – diffusion controlled void growth: fracture maps for different alloys and oxides.

UNIT – IV OXIDATION AND HOT CORROSION 9

Oxidation, Pilling, Bedworth ratio, kinetic laws of oxidation – defect structure and control of Oxidation by alloy additions, hot gas corrosion deposit, modified hot gas corrosion, fluxing mechanisms, effect of alloying elements on hot corrosion, interaction of hot corrosion and creep, methods of combat hot corrosion.

UNIT – V SUPER ALLOYS AND OTHER MATERIALS 9

Iron base, Nickel base and Cobalt base super alloys, composition control, solid solution strengthening, precipitation hardening by gamma prime, grain boundary strengthening, TCP phase, embrittlement, solidfication of single crystals, Intermetallics, high temperature ceramics.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Identify principle and factors influencing the creep.
2. Explain the factors to be considered while designing for high temperature applications.
3. Explicit appropriate mechanism of fracture in the materials subjected to high temperature.
4. Realize the fundamentals, mechanisms and methods of combating oxidation and hot corrosion
5. Select suitable materials for high temperature applications

TEXT BOOKS:

1. G.W. Meetham, M.H. Van de Voorde “Materials for High Temperature Engineering Applications”, Springer Science & Business Media, 2012.
2. Yoseph Bar-Cohen,” High Temperature Materials and Mechanisms” CRC Press, 2014.

REFERENCES:

1. Boyle J.T, Spencer J, “Stress Analysis for Creep” ,Butterworths, UK, 1983.
2. Bressers.J., “Creep and Fatigue in High Temperature Alloys”, Applied Science, 1981.
3. George Y. Lai, ‘High-Temperature Corrosion and Materials Applications”, ASM International, 2007
4. Josef Cadek, .,“ Creep in Metallic Materials”, Elsevier,1988.
5. McLean D., “Directionally Solidified Materials for High Temperature Service”, The Metals Society, USA, 1985.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3

CO1	0.9	0.6		0.6										0.9	
CO2	0.9		0.6		0.3										
CO3	0.9	0.6		0.6									0.9		
CO4	0.9			0.6											
CO5	0.9	0.6		0.6								0.3	0.9		

GE5552 ENGINEERING MANAGEMENT L T P C
3 0 0 3

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

1. Explaining basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.
2. Applying various functions of management in professional organization.
3. Applying organizational theory in professional organization.
4. Applying the principles of productivity and operations management in professional organization.
5. Applying modern concepts and marketing in management in professional organization.

UNIT I INTRODUCTION TO MANAGEMENT 9

Definition and functions of Management - Approaches to the study of Management – Mintzberg's Ten Managerial Roles – Principles of Taylor; Fayol; Weber; Parker – Forms of Organization: Sole Proprietorship; Partnership; Company (Private and Public); Cooperative – Public Sector Vs Corporate Organization – Business Environment: Economic; Social; Political; Legal – Trade Union: Definition; Functions; Pros and cons.

UNIT II FUNCTIONS OF MANAGEMENT 9

Planning: Characteristics; Nature; Importance; Steps; Limitation – Organizing: Features; Process; Principles; Types – Departmentalization: Functional – Divisional (Product; Customer; Geographic) – Staffing: Systems Approach; Recruiting and Selection Process – Directing (Leading): Traits; Style; Managerial Grid (Blake-Mounton, Reddin) – Communication: Purpose; Model; Barriers – Controlling: Types; Audit (External, Internal, Merits) – Decision Making: Elements; Characteristics; Process; Classification – Controlling techniques.

UNIT III ORGANIZATION THEORY 9

Human Resource Development (HRD): Goals – Organizational Conflict: Positive Aspects; Individual; Role; Interpersonal; Intra Group; Inter Group; Conflict Management – Need and Motivation Theories: Maslow's Hierarchy of Needs Theory; Herzberg's Motivation-Hygiene Theory; McClelland's Needs Theory of Motivation – Change Management: Concept of Change; Lewin's Process of Change Model; Sources of Resistance; Overcoming Resistance; Guidelines to managing Conflict.

UNIT IV PRODUCTIVITY AND OPERATIONS MANAGEMENT 9

Productivity: Concept; Measurements; Affecting Factors; Methods to Improve – Operations Management Tools: (Simple problems in) Transportation Model (Balanced); Assignment Model (Hungarian); Network Model (Shortest path); Critical Path Method; Decision Trees.

UNIT V MODERN CONCEPTS AND MARKETING MANAGEMENT 9

Concept, features, merits and demerits of: SWOT Analysis; Business Process Re-engineering (BPR); Supply Chain Management (SCM) – Marketing: Concept; Functions; Importance; Segmentation; Mix; Problems of Marketing in Small Enterprise; Competitive Analysis and Advantage – E-marketing.

TOTAL = 45 PERIODS

COURSE OUTCOMES:

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

1. Explain basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.
2. Apply various functions of management in professional organization.
3. Apply organizational theory in professional organization.
4. Apply the principles of productivity and operations management in professional organization.
5. Apply modern concepts and marketing in management in professional organization.

TEXT BOOKS:

1. Koontz. H. and Weihrich. H., Essentials of Management: An International Perspective, 8th Edition, Tata McGrawhill, New Delhi, 2010.
2. M. Govindarajan and S. Natarajan, Principles of Management, Prentice Hall of India, New Delhi, 2009.

REFERENCES:

1. Joseph J, Massie, 'Essentials of Management' Prentice Hall of India Pvt. Ltd., 1985.
2. M. Govindarajan, Marketing Management, Prentice Hall of India, New Delhi, 2010.
3. R. Panneerselvam, Operations Research, Prentice Hall of India, New Delhi, 2013.
4. S.Chandran, Organizational Behaviours, Vikas Publishing House Pvt. Ltd., 1994.
5. Saxena, P.K., Principles of Management: A Modern Approach, Global India Publications, 2009.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1						0.6		0.6				0.3	0.3		
2						0.6		0.6				0.3	0.3		
3						0.6		0.6	0.9	0.9		0.3	0.3		
4	0.9	0.9	0.9	0.9		0.6		0.3			0.9	0.3	0.6		
5						0.6		0.6			0.3	0.3	0.6		

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MF5651 NON-TRADITIONAL MACHINING PROCESSES L T P C
3 0 0 3

COURSE OBJECTIVES:

- To classify non-traditional machining processes and describe mechanical energy based non-traditional machining processes.
- To differentiate chemical and electro chemical energy based processes.
- To describe thermo-electric energy based processes
- To explain nano finishing processes.
- To introduce hybrid non-traditional machining processes and differentiate hybrid non-traditional machining processes

UNIT I INTRODUCTION AND MECHANICAL ENERGY BASED PROCESSES 9

Introduction - Need for non-traditional machining processes - Classification of non-traditional machining processes - Applications, advantages and limitations of non-traditional machining processes - Abrasive jet machining, Abrasive water jet machining, Ultrasonic machining their principles, equipment, effect of process parameters, applications, advantages and limitations.

UNIT II CHEMICAL AND ELECTRO CHEMICAL ENERGY BASED PROCESSES 9

Principles, equipments, effect of process parameters, applications, advantages and limitations of Chemical machining, Electro-chemical machining, Electro-chemical honing, Electro-chemical grinding, Electro chemical deburring.

UNIT III THERMO-ELECTRIC ENERGY BASED PROCESSES 9

Principles, equipments, effect of process parameters, applications, advantages and limitations of Electric discharge machining, Wire electric discharge machining, Laser beam machining, Plasma arc machining, Electron beam machining, Ion beam machining.

UNIT IV NANO FINISHING PROCESSES 9

Principles, equipments, effect of process parameters, applications, advantages and limitations of Abrasive flow machining – Chemo mechanical polishing, Magnetic abrasive finishing, Magnetorheological finishing, Magneto rheological abrasive flow finishing.

UNIT V HYBRID NON-TRADITIONAL MACHINING PROCESSES 9

Introduction - Various hybrid non-traditional machining processes, their working principles, equipments, effect of process parameters, applications, advantages and limitations. Selection and comparison of different non-traditional machining processes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1: Formulate different types of non-traditional machining processes and evaluate mechanical energy based non-traditional machining processes.
- CO2: Illustrate chemical and electro chemical energy based processes.
- CO3: Evaluate thermo-electric energy based processes.
- CO4: Interpret nano finishing processes.
- CO5: Analyse hybrid non-traditional machining processes and differentiate non- traditional machining processes.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9						0.3			0.3		0.3	0.6	0.6	0.6
2	0.9		0.3		0.3		0.3			0.3		0.3	0.6	0.6	0.6
3	0.9		0.3		0.3		0.3			0.3		0.3	0.6	0.6	0.6
4	0.9		0.6		0.3		0.3			0.3		0.3	0.6	0.6	0.6
5	0.9		0.9	0.6	0.9		0.3			0.3		0.3	0.9	0.9	0.9

TEXT BOOKS:

1. Adithan. M., "Unconventional Machining Processes", Atlantic, New Delhi, India, 2009. ISBN 13: 9788126910458
2. Anand Pandey, "Modern Machining Processes", Ane Books Pvt. Ltd., New Delhi, India, 2019.

REFERENCES:

1. Benedict, G.F., "Non-traditional Manufacturing Processes", Marcel Dekker Inc., New York 1987. ISBN-13: 978-0824773526.
2. Carl Sommer, "Non-Traditional Machining Handbook", Advance Publishing., United States, 2000, ISBN-13: 978-1575373256.
3. Golam Kibria, Bhattacharyya B. and Paulo Davim J., "Non-traditional Micromachining Processes: Fundamentals and Applications", Springer International Publishing., Switzerland, 2017, ISBN:978-3-319-52008-7.
4. Jagadeesha T., "Non-Traditional Machining Processes", I.K. International Publishing House Pvt. Ltd., New Delhi, India, 2017, ISBN-13: 978-9385909122.
5. Kapil Gupta, Neelesh K. Jain and Laubscher R.F., "Hybrid Machining Processes: Perspectives on Machining and Finishing", 1st edition, Springer International Publishing., Switzerland, 2016, ISBN-13: 978-3319259208.

ML5021 PRINCIPLES OF METAL CUTTING L T P C
3 0 0 3

COURSE OBJECTIVES:

1. To give overview about the tool nomenclature and different nomenclatures used.
2. To provide knowledge on chip formation mechanism and forces during machining
3. To import knowledge on tool wear and tool life and how it is affected by temperature
4. To provide knowledge on different cutting tool materials used
5. To provide knowledge on modelling of metal cutting process

UNIT I CUTTING TOOL NOMENCLATURE 9

Single point tool-significance of the various angles - Machine reference system- normal toll reference system - ORS – interrelation between different tool nomenclatures - Nomenclature of drills, milling cutters and broaches

UNIT II CHIP FORMATION MECHANISM AND FORCES IN MACHINING 9

Orthogonal and oblique cutting - Mechanisms of formation of chips-types of chips -Merchant's circle diagram-Force and Velocity relationship, shear plane angle, Energy considerations in matching-Ernst Merchant's theory of shear angle relationship - Forces in turning, drilling, milling and grinding- specific cutting pressure-specific horse power- construction and principle of

operation of tool dynamometers for turning, drilling and milling.

UNIT III THERMAL ASPECTS IN MACHINING, TOOL WEAR AND LIFE 9

Sources of heat generation in machining heat in PSDZ and SDZ – heat flow in cutting tools temperature measurement techniques in machining, Functions of cutting fluid - characteristics of cutting fluid-types - application of cutting fluids - Tool wear, type of tool failure - mechanisms, tool life equation- tool life analysis - machinability - chatter in machining.

UNIT IV CUTTING TOOL MATERIALS 9

Requirements of tool materials-properties of HSS - advances in tool materials- carbides and coated carbides, ceramic, cermets, CBN, Diamond, PCD - ISO-specifications for inserts and tool holders - -Need for chip breakers – types of chip breakers

UNIT V MODELING OF METAL CUTTING 9

Introduction to modeling – empirical models – mechanistic models – FEA based models – artificial intelligence based models for turning, milling and drilling

TOTAL: 45 PERIODS

OUTCOMES

The course will enable a student to gain Theory and practical knowledge on the metal cutting operations and design of cutting tool.

1. Understand and compare the different metal cutting tool nomenclature
2. Learn the basic concepts of metal cutting mechanism and forces in machining
3. acquire fundamental knowledge and understanding of thermal aspects in machining, tool wear and life
4. Recommend appropriate Cutting tools for part manufacturing processes
5. learn the modelling concepts in metal cutting process

TEXT BOOKS

1. Bhattacharya, “Metal Cutting Theory and Practice “, Central Book Publishers, Calcutta, 1984.
2. Kuppuswamy, G., “Principals of Metal Cutting”, Universities Press Limited, Hyderabad, 1996.

REFERENCES

1. Boothroyd, G., “Fundamentals of Metal Machining and Machine Tools”, McGraw-Hill Co., 1975.
2. Edward M. Trent and Paul K. Wright “Metal Cutting” Butterworth-Heinemann; 4th edition 2000.
3. Milton C. Shaw,“ Metal Cutting Principles”, Oxford University Press, 2nd edition 2004.
4. Sadasiavm, T.A. and Sarathy, D., “Cutting tools for productive machining” WIDIA India limited, Bangalore, 1999.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0.9	0.3	0.6	0.6	0.3				0.3						0.6
CO2	0.6	0.9	0.3	0.6	0.9								0.6	0.9	
CO3	0.9	0.6	0.6	0.9	0.6		0.6						0.6	0.6	
CO4	0.6	0.6	0.6	0.9	0.6			0.3					0.6	0.3	

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CO5	0.9	0.9	0.9	0.6	0.9									0.9	0.9

ME5085 QUALITY AND RELIABILITY ENGINEERING L T P C
3 0 0 3

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

1. Applying the 7 QC tools in problem solving for continuous improvement.
2. Designing online sampling plan for quality control using control charts and perform process capability studies.
3. Applying the strategies of acceptance sampling plan to perform quality audit in the customer site.
4. Evaluating the different reliability measurements applying the reliability concepts
5. Selecting the suitable method of improving the reliability and integrate reliability concepts in new product design and development.

UNIT I INTRODUCTION AND STATISTICAL PROCESS CONTROL 9

Introduction:-definitions of quality, Evolution of Quality: Inspection, Quality Control, Quality assurance Customer-Orientation: Internal & External Customer Concept, Life cycle approach to quality costs- Prevention; Appraisal and Failure costs. Seven SPC tools -Histogram, Check sheets, Ishikawa diagrams, Pareto, Scatter diagrams, Control charts and flow chart.

UNIT II ONLINE QUALITY CONTROL 9

Control chart for attributes –control chart for non conforming– p chart and np chart – control chart for nonconformities– C and U charts, Control chart for variables – X chart, R chart and σ chart -State of control and process out of control identification in charts, pattern study and process capability studies.

UNIT III OFFLINE QUALITY CONTROL 9

Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producers Risk and consumers Risk. AQL, LTPD, AOQL concepts standard sampling plans for AQL and LTPD- uses of standard sampling plans.

UNIT IV RELIABILITY CONCEPTS 9

Reliability engineering - fundamentals – failure data analysis, Mean failure rate, Mortality curves concept of burn –in period, useful life and wear out phase of a system, mean time to failure, meantime between failure, hazard rate – failure density and conditional reliability-Maintainability and availability – simple problems

UNIT V RELIABLITY ESTIMATION 9

System reliability: Series, Parallel and Mixed configurations, Reliability improvement techniques, use of Pareto analysis – design for reliability – redundancy unit and standby redundancy- fault tree analysis – Optimization in reliability – Product design – Product analysis – Product development –Product life cycles.

TOTAL = 45 PERIODS

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

1. Apply the 7 QC tools in problem solving for continuous improvement.
2. Design online sampling plan for quality control using control charts and perform process capability studies.
3. Apply the strategies of acceptance sampling plan to perform quality audit in the customer site.
4. Evaluate the different reliability measurements applying the reliability concepts
5. Select the suitable method of improving the reliability and integrate reliability concepts in new product design and development.

TEXT BOOKS:

1. Douglas.C. Montgomery, "Introduction to Statistical quality control", 7th edition, John Wiley2012.
2. Srinath. L.S., "Reliability Engineering", 4th edition Affiliated East west press, 2011

REFERENCES:

1. Besterfield D.H., "Quality Control", 8th edition, Prentice Hall, 2009..
2. Connor, P.D.T.O., "Practical Reliability Engineering", 5 theditionWiley India, 2012
3. Grant, Eugene .L "Statistical Quality Control", TMH, 2005
4. John.S. Oakland. "Statistical process control", Elsevier Butterworth-Heinemann, 2008.
5. Monohar Mahajan, "Statistical Quality Control", Dhanpat Rai & Sons 2016.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.3	0.6	0.6		0.3								0.6	0.6	
2		0.6	0.6	0.3									0.6	0.6	
3	0.3	0.6		0.6									0.3	0.9	
4	0.3	0.6												0.6	
5			0.6	0.6										0.9	

ML5022 **WELDING METALLURGY** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

1. To impart knowledge on the various Metal Joining Processes.
2. To train on the analytical methods available to assess the effect of heat transfer in welding.
3. To impart knowledge on the ferrous welding metallurgy.
4. To impart knowledge on the non ferrous welding metallurgy.
5.To impart knowledge on the causes and remedies of various welding defects ,weldability ,testing of weldments ,welding standards and codes.

UNIT I FUNDAMENTALS OF METAL JOINING 9

Welding - Principle of Gas Welding- Equipment-Technique- Principle of Arc –Arc Welding - Electrode types and classification- Gas Tungsten Arc Welding-Gas Metal Arc Welding-Submerged arc Welding-Atomic Hydrogen welding-plasma Arc Welding-Thermit Welding-Electro Slag Welding-Laser Beam Welding, Electron Beam Welding, magnetic pulse Welding-Principle - Resistance Welding - Spot Welding - Projection Welding - Upset Welding - Flash

Welding - Forge Welding - Friction Welding, Friction stir welding - Diffusion Bonding - Explosion Welding, Soldering and Brazing-Adhesive Bonding.

UNIT II WELDING METALLURGY PRINCIPLES 9

Thermal cycles in welding: basic heat transfer equations, temperature distributions and cooling curves, dependence of cooling rate on heat input, joint geometry, preheat and other factors. Comparison of welding processes based on these considerations.

UNIT III PHYSICAL METALLURGY OF WELDING 9

Welding of ferrous materials: Iron- Iron carbide diagram, TTT and CCT diagrams, effects of steel composition, formation of different microstructural zones in welded plain-carbon steels. Welding of C-Mn and low-alloy steels, phase transformations in weld and heat - affected zones, cold cracking, role of hydrogen and carbon equivalent, formation of acicular ferrite and effect on weld metal toughness.

UNIT IV WELDING OF ALLOY STEELS AND NON-FERROUS METALS 9

Welding of stainless steels, types of stainless steels, overview of joining ferritic and martensitic types, welding of austenitic stainless steels, Sensitisation, hot cracking, sigma phase and chromium carbide formation, ways of overcoming these difficulties, welding of cast iron. Welding of non-ferrous materials: Joining of aluminium, copper, nickel and titanium alloys, problems encountered and solutions

UNIT V DEFECTS, WELDABILITY AND STANDARDS 9

Defects in welded joints: Defects such as arc strike, porosity, undercut, slag entrapment and hot cracking, causes and remedies in each case. Joining of dissimilar materials, weldability and testing of weldments. Introduction to International Standards and Codes

COURSE OUTCOMES:

1. Will be able to understand the various welding processes available for welding a component.
2. Will be able to analytically analyse the heat transfer associated with the welding process.
3. Will be able to weld ferrous alloys which are metallurgically sound.
4. Will be able to weld non-ferrous alloys which are metallurgically sound.
5. Will be able find out the remedy for a welding defect becomes familiar with the various welding standards and codes.

TEXT BOOKS

1. Baldev Raj,Shankar V,Bhaduri A K".Welding Technology for Engineers" Narosa Publications 2009.
2. R.S.Parmar 'Welding Engineering and Technology' Khanna Publishers 2010

REFERENCES

1. Lancaster, J. F. "Metallurgy of Welding", 4th Londre: George Allen & Unwin.1987.
2. Linnert, G. E., "Welding Metallurgy". Vol. 1 and 2. 4th edition. A W S. USA, 1994.
3. Sindo Kuo, "Welding Metallurgy", John Wiley & Sons, 2003

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.6
2	0.9	0.9	0.9	0.9	0.9	0.3	0.3	0.3	0.3	0.3	0.3	0.9	0.9	0.9	0.9
3	0.6	0.9	0.9	0.6	0.6	0.3	0.3	0.3	0.3	0.3	0.3	0.6	0.6	0.9	0.9
4	0.6	0.9	0.6	0.6	0.6	0.3	0.3	0.3	0.3	0.3	0.3	0.9	0.9	0.9	0.9

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5	0.6	0.9	0.9	0.9	0.9	0.3	0.3	0.3	0.3	0.3	0.3	0.9	0.9	0.9	0.9

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 **9**

History of Making of the Indian Constitution-Drafting Committee- (Composition & Working) - Philosophy of the Indian Constitution-Preamble-Salient Features

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:

CO1: Able to understand history and philosophy of Indian Constitution.
CO2: Able to understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
CO3: Able to understand powers and functions of Indian government.
CO4: Able to understand emergency rule.
CO5: Able to understand structure and functions of local administration.

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

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

L T 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
- 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

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TOTAL: 45PERIODS

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COURSE OUTCOMES:

CO1 – Gain knowledge of self-development
CO2 – Learn the importance of Human values
CO3 – Develop the overall personality through value education
CO4 – Overcome the self destructive habits with value education
CO5 – Interpret social empowerment with value education

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

REFERENCES:

1. Chakroborty , S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press ,New Delhi

AD5093 **PEDAGOGY STUDIES** **L T P C**
3 0 0 0

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.

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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:

- Understand the methodology of pedagogy.
- Understand Pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Find how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Know the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

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

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

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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: 45PERIODS

COURSE OUTCOMES:
CO1 – Develop healthy mind in a healthy body thus improving social health also improve efficiency
CO2 – Learn Do's and Don't's in life through Yam
CO3 – Learn Do's and Don't's in life through Niyam
CO4 – Develop a healthy mind and body through Yog Asans
CO5 – Learn breathing techniques through Pranayam

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

REFERENCES:
1. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata
2. 'Yogic Asanas for Group Tarining-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: 45PERIODS

COURSE OUTCOMES:

CO1: To develop basic personality skills holistically
CO2: To develop deep personality skills holistically to achieve happy goals
CO3: To rewrite the responsibilities
CO4: To reframe a person with stable mind, pleasing personality and determination
CO5: To awaken wisdom in students

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

REFERENCES:

1. Gopinath,Rashtriya Sanskrit Sansthanam P, Bhartrihari's ThreeSatakam , Niti-sringar-vairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram,Publication Department, Kolkata,2016

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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

- Understand philosophy of Indian culture.
- Distinguish the Indian languages and literature.
- Learn the philosophy of ancient, medieval and modern India.
- Acquire the information about the fine arts in India.
- Know the contribution of scientists of different eras.
- Understand education systems in India

REFERENCES:

1. Kapil Kapoor, “Text and Interpretation: The India Tradition”,ISBN: 81246033375, 2005
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

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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:

1. Introduction to Sanga Tamil Literature.
2. 'Agathinai' and 'Purathinai' in Sanga Tamil Literature.
3. 'Attruppadai' in Sanga Tamil Literature.
4. 'Puranaanuru' in Sanga Tamil Literature.
5. 'Pathitrupaththu' 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 – Mesaage to Society from Purathinai.

UNIT III 'ATTRUPPADAI'. 9

Attruppadai Literature – Attruppadai in 'Puranaanuru' - Attruppadai in 'Pathitrupaththu' – Attruppadai in 'Paththupaattu'.

UNIT IV 'PURANAANURU' 9

Puranaanuru on Good Administration, Ruler and Subjects – Emotion & its Effect in Puranaanuru.

UNIT V 'PATHITRUPATHTHU' 9

Pathitrupaththu in 'Ettuthogai' – Pathitrupaththu's Parables – Tamil dynasty: Valor, Administration, Charity in Pathitrupaththu - Mesaage to Society from Pathitrupaththu.

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 'Pathitrupaththu' 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 Puranānuru, 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.

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	P												PS		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1									0.9						0.6
2									0.9						0.6
3															
4															
5									0.9						0.6

HSMC– ELECTIVES – HUMANITIES I (ODD SEMESTER)

HU5171 LANGUAGE AND COMMUNICATION L T 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

- ➢ Students will be able to use linguistic and non linguistic resources of language in an integrated manner for communication.
- ➢ Students will be able to analyse communication in terms of facts and opinions.
- ➢ 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

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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
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:

CO1: Able to understand definition and classification of values.
CO2: Able to understand purusartha.
CO3: Able to understand sarvodaya idea.
CO4: Able to understand sustenance of life.
CO5: Able to understand views of hierarchy of values.

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

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

CO1: Understand the importance of self-management.
CO2: Know how to deal with people to develop teamwork.
CO3: Know the importance of staying healthy.
CO4: Know how to manage stress and personal problems.
CO5: Develop the personal qualities essential for career growth.

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

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 – Cognitve 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

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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. 188-21 7). 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
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

- Understand the various apps of technology apps and use them to access, generate and present information effectively.
- 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 Constuctivism – 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

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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 L T P C
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 – Taittriya 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.

HU5177 APPLICATIONS OF PSYCHOLOGY IN EVERYDAY LIFE

L	T	P	C
3	0	0	3

UNIT I INTRODUCTION **7**

Nature and fields.

UNIT II PSYCHOLOGY IN INDUSTRIES AND ORGANIZATIONS **9**

Job analysis; fatigue and accidents; consumer behavior.

UNIT III PSYCHOLOGY AND MENTAL HEALTH **11**

Abnormality, symptoms and causes psychological disorders

UNIT IV PSYCHOLOGY AND COUNSELING **7**

Need of Counseling, Counselor and the Counselee, Counseling Process, Areas of Counseling.

UNIT V PSYCHOLOGY AND SOCIAL BEHAVIOUR **11**

Group, group dynamics, teambuilding, Prejudice and stereotypes; Effective Communication, conflict and negotiation.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Schultz, D. & Schultz, S.E. (2009). Psychology and Work Today (10th ed.). New Jersey:Pearson/Prentice Hall
2. Butcher, J. N., Mineka, S., & Hooley, J. M. (2010). Abnormal psychology (14th ed.). New York: Pearson
3. Gladding, S. T. (2014). Counselling: A comprehensive profession. New Delhi: Pearson Education
4. Aronson, E., Wilson, T. D., & Akert, R. M. (2010). Social Psychology (7th Ed.). Upper Saddle River, NJ: Prentice Hall

HSMC– ELECTIVES – HUMANITIES II (EVEN SEMESTER)

HU5271 GENDER, CULTURE AND DEVELOPMENT

L	T	P	C
3	0	0	3

COURSE DESCRIPTION

This course offers an introduction to Gender Studies that asks critical questions about the meanings of sex and gender in Indian society. The primary goal of this course is to familiarize students with key issues, questions and debates in Gender Studies, both historical and contemporary drawing from Indian literature and media studies, to examine cultural assumptions about sex, gender, and sexuality. This course integrates analysis of current events through student presentations, aiming to increase awareness of contemporary and historical experiences of women, and of the multiple ways that sex and gender interact with class, caste and other social identities. This course also seeks to build an understanding of the concepts of gender, gender-based violence, sexuality, and rights and their impact on development through a number of discussions, exercises and reflective activities.

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OBJECTIVES

- ✓ To familiarize students with the concepts of sex and gender through literary and media texts.
- ✓ To help students ask critical questions regarding gender roles in society.
- ✓ To provide students with the material to discuss gender issues such as gender based discrimination, violence and development.
- ✓ To help students think critically about gender based problems and solutions.

LEARNING OUTCOMES

- ➢ Students will be able to critically read literary and media texts and understand the underlying gender perspectives in them.
- ➢ Students will be able to analyse current social events in the light of gender perspectives.
- ➢ 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

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, Ethico - 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.

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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.

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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.
- To make them realize the impact of film in society.
- To analyse the visual media and interpret the underlying messages.

UNIT I THE COMPONENTS OF FILMS **9**

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.

UNIT II EVOLUTION OF FILM **9**

History of Films – Early Cinema – Silent Movies – Talkies – Film Language, Form, Movement – Film Theories – Realist, Auteurists, Feminist, Psychonalyic, Idealogical Theories.

UNIT III FILMS ACROSS THE WORLD **9**

European Films – Russian Films – Japanese Films – Korean Films – Hollywood Film – Studio Culture – All Time Great Movies.

UNIT IV INDIAN FILMS **9**

The Early Era – History Of Indian Cinema – Movies for Social Change – Hindi Movies that Created Impact – Regional Movies – Documentaries – Cultural Identity.

UNIT V INTERPRETING FILMS **9**

Film Criticism & Appreciation – Censorship in Movies – Cultural Representation in Movies – Television – New Media & Online Media – Films Beyond Entertainment.

TOTAL: 45 PERIODS

Attested

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OUTCOMES

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

- Recognize types of films, their impact on society and their roles in our lives.
- Have an understanding of the concepts of storytelling, Mise en Scene, and other elements of film making.
- Interpret the underlying messages in the movies.

Teaching Methods

- 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

- 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)

- Assignment 1: Write a movie review with critical analysis (20 marks).
- Assignment 2: Write a script for a scene taken from a short story / novella (20 marks).
- Presentation: Students choose any one topic related to films and present it to the audience. (25 marks)
- Group discussion: Students discuss in groups on the various aspects of movies and its impact on society. (25 marks)
- 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.

HU5275 FUNDAMENTALS OF LANGUAGE AND LINGUISTICS L T P C
3 0 0 3

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.

Attested

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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.

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.11th 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

- Can identify the connections among language, literature and culture.
- Is able to relate between seemingly different aspects of life.
- Understands the fractions in modern life and can assimilate meanings.