ANNA UNIVERSITY, CHENNAI
NON-AUTONOMOUS AFFILIATED COLLEGES
REGULATIONS 2021
CHOICE BASED CREDIT SYSTEM

B. E. MANUFACTURING ENGINEERING

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

I.	Be employed in jobs related to designing, modeling, analyzing and managing modern complex systems, implementing and improving systems in manufacturing sectors at local, regional, national and global levels.
II.	Have engaged in life-long learning, such as graduate studies and research, certification from professional organizations, fundamentals of engineering certification, or active participation in professional societies/activities.
III.	Demonstrate professional success as evidenced by, among others, increased job responsibilities and leadership role at the place of employment and in greater society
IV.	Become product and process design professionals for sustainable manufacturing.
V.	Become entrepreneurs in Design and Manufacturing Engineering sector.

PROGRAM OUTCOMES (POs)

PO	GRADUATE ATTRIBUTE
1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles ofmathematics, natural sciences, and engineering sciences.
3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data,and synthesis of the information to provide valid conclusions.
5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, andmodern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6	**The engineer and society**: Apply reasoning informed by the contextual knowledge toassess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write

effective reports and design documentation, make effective presentations, and give and receive clear instructions.

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

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

PROGRAM SPECIFIC OUTCOMES (PSOs)

1. Engineering/Foundational Knowledge in mathematics, engineering sciences, applied] probability, computer science, humanities, and social science.
2. Professional Skills to communicate in both oral and written forms and to be proficient in working in diverse teams of individuals
3. Manufacturing Engineering Knowledge/Skills in materials and manufacturing processes, process, assembly, and product engineering, manufacturing competitiveness, and manufacturing systems design,
4. Confidence in Engineering and professional skills.
5. Understanding of Professional and Ethical Behavior to be prepared for ethical decision making, service to the engineering profession, and have the means to continue in the acquisition of knowledge.

PEO's – PO's & PSO's MAPPING:

PEO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I.	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓
II.	✓	✓				✓	✓	✓	✓	✓		✓	✓	✓	
III.	✓			✓		✓	✓	✓	✓	✓				✓	✓
IV.	✓		✓		✓	✓		✓		✓	✓		✓		✓
V.	✓		✓		✓	✓		✓		✓	✓		✓	✓	

ANNA UNIVERSITY, CHENNAI
NON-AUTONOMOUS AFFILIATED COLLEGES
REGULATIONS 2021
CHOICE BASED CREDIT SYSTEM
B. E. MANUFACTURING ENGINEERING
CURRICULUM FOR SEMESTERS I TO VIII AND SYLLABI FOR SEMESTERS III AND IV

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	IP3151	Induction Programme	-	-	-	-	-	0
THEORY								
2.	HS3151	Professional English - I	HSMC	3	0	0	3	3
3.	MA3151	Matrices and Calculus	BSC	3	1	0	4	4
4.	PH3151	Engineering Physics	BSC	3	0	0	3	3
5.	CY3151	Engineering Chemistry	BSC	3	0	0	3	3
6.	GE3151	Problem Solving and Python Programming	ESC	3	0	0	3	3
7.	GE3152	அறிவியல் தமிழ் / Scientific Thoughts in Tamil	HSMC	1	0	0	1	1
PRACTICAL								
7	GE3171	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
8	BS3171	Physics and Chemistry Laboratory	BSC	0	0	4	4	2
9.	GE3172	English Laboratory [$]	EEC	0	0	2	2	1
			TOTAL	**16**	**1**	**10**	**27**	**22**

[$] Skill Based Course

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	HS3251	Professional English - II	HSMC	2	0	0	2	2
2.	MA3251	Statistics and Numerical Methods	BSC	3	1	0	4	4
3.	PH3251	Materials Science	BSC	3	0	0	3	3
4.	BE3251	Basic Electrical and Electronics Engineering	ESC	3	0	0	3	3
5.	GE3251	Engineering Graphics	ESC	2	0	4	6	4
6.	GE3252	தமிழர் மரபு /Heritage of Tamils	HSMC	1	0	0	1	1
7.		NCC Credit Course Level 1*	-	2	0	0	2	2
PRACTICAL								
8.	GE3271	Engineering Practices Laboratory	ESC	0	0	4	4	2
9.	BE3271	Basic Electrical and Electronics Engineering Laboratory	ESC	0	0	4	4	2
10.	GE3272	Communication Laboratory / Foreign Language [$]	EEC	0	0	4	4	2
			TOTAL	**14**	**1**	**16**	**31**	**23**

[#] NCC Credit Course level 1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.
[$] Skill Based Course

SEMESTER III

S. No.	Course Code	Course title	Cate Gory	Periods per week			Total contact periods	Credits
				L	T	P		
THEORY								
1.	MA3351	Transforms and Partial Differential Equations	BSC	3	1	0	4	4
2.	ME3392	Engineering Materials and Metallurgy	PCC	3	0	0	3	3
3.	MF3301	Machining Technology	PCC	3	0	0	3	3
4.	CE3391	Fluid Mechanics and Machinery	ESC	3	1	0	4	4
5.	MF3391	Mechanics of Materials	ESC	3	0	0	3	3
6.	MF3302	Foundry Technology	PCC	3	0	0	3	3
PRACTICALS								
7.	MF3311	Strength of Materials and Metallurgy Laboratory	ESC	0	0	4	4	2
8.	MF3361	Machining Technology Laboratory	PCC	0	0	4	4	2
9.	MF3312	Fluid Machinery Laboratory	ESC	0	0	4	4	2
10.	GE3361	Professional Development[$]	EEC	0	0	2	2	1
			TOTAL	**18**	**2**	**14**	**34**	**27**

[$] **Skill Based Course**

SEMESTER IV

S. No.	Course Code	Course title	Cate Gory	Periods per week			Total contact periods	Credits
				L	T	P		
THEORY								
1.	ME3391	Engineering Thermodynamics	PCC	3	0	0	3	3
2.	MF3401	Engineering Metrology and Computer Aided Inspection	PCC	3	0	0	3	3
3.	MF3491	CNC Machining Technology	PCC	3	0	0	3	3
4.	PR3451	Materials Joining Technology	PCC	3	0	0	3	3
5.	ML3591	Metal and Powder Forming Techniques	PCC	3	0	0	3	3
6.	GE3451	Environmental Sciences and Sustainability	BSC	2	0	0	2	2
7.		NCC Credit Course Level 2[#]		3	0	0	3	3[#]
PRACTICALS								
8.	MF3411	Computer Aided Product Design and Assembly Laboratory	PCC	0	0	4	4	2
9.	MF3412	CNC Machining Laboratory	PCC	0	0	4	4	2
			TOTAL	**17**	**0**	**8**	**25**	**21**

[#] **NCC Credit Course level 2 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.**

SEMESTER V

S. No.	Course Code	Course title	Cate Gory	Periods per week			Total contact periods	Credits
				L	T	P		
THEORY								
1.	MF3501	Basics of Plastics Engineering	PCC	3	0	0	3	3
2.	MF3502	Geometric Dimensioning and Tolerancing	PCC	3	1	0	4	4
3.		Professional Elective I	PEC	-	-	-	-	3
4.		Professional Elective II	PEC	-	-	-	-	3
5.		Professional Elective III	PEC	-	-	-	-	3
6.		Professional Elective IV	PEC	-	-	-	-	3
7.		Mandatory Course-I[&]	MC	3	0	0	3	0
PRACTICALS								
8.	MF3511	Plastics Engineering Laboratory	PCC	0	0	4	4	2
9.	MF3512	Summer Internship*	EEC	0	0	0	0	1
10.	MF3513	Metrology and Computer Aided Inspection Laboratory	PCC	0	0	4	4	2
			TOTAL	-	-	-	-	**24**

***Two weeks Summer Internship carries one credit and it will be done during IV semester summer vacation and same will be evaluated in V semester.**

[&] Mandatory Course-I is a Non-credit Course (Student shall should select one course from the list given under MC- I)

SEMESTER VI

S. No.	Course Code	Course title	Cate Gory	Periods per week			Total contact periods	Credits
				L	T	P		
THEORY								
1.	MF3691	Mechatronics	PCC	3	0	0	3	3
3.		Professional Elective V	PEC	-	-	-	-	3
4.		Professional Elective VI	PEC	-	-	-	-	3
5.		Professional Elective VII	PEC	-	-	-	-	3
		Open Elective – I*	OEC	3	0	0	3	3
6.		Mandatory Course-II[&]	MC	3	0	0	3	0
7.		NCC Credit Course Level 3[#]		3	0	0	3	
PRACTICALS								
8.	MF3611	Computer Aided Simulation and Analysis Laboratory	PCC	0	0	4	4	2
9.	MF3681	Mechatronics Laboratory	PCC	0	0	4	4	2
			TOTAL	-	-	-	-	**19**

***Open Elective – I shall be chosen from the emerging technologies.**

[&] Mandatory Course-II is a Non-credit Course (Student shall should select one course from the list given under MC- II)

[#] NCC Credit Course level 3 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA

SEMESTER VII/VIII*

S. No.	Course Code	Course title	Cate Gory	Periods Per week			Total contact periods	Credits
				L	T	P		
THEORY								
1.	MF3701	Additive Manufacturing	PCC	3	0	0	3	3
2.		Human Values and Ethics	HSMC	2	0	0	2	2
3.		Elective – Management #	HSMC	3	0	0	3	3
4.		Open Elective – II**	OEC	3	0	0	3	3
5.		Open Elective – III***	OEC	3	0	0	3	3
6.		Open Elective – IV***	OEC	3	0	0	3	3
PRACTICALS								
7.	MF3711	Additive Manufacturing Laboratory	PCC	0	0	4	4	2
8.	MF3712	Summer Internship#	EEC	0	0	0	0	1
			TOTAL	**17**	**0**	**4**	**21**	**20**

#Two weeks Summer Internship carries one credit and it will be done during VI semester summer vacation and same will be evaluated in VII semester.

***If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII.**

****Open Elective – II shall be chosen from the emerging technologies.**

*****Open Elective III and IV (Shall be chosen from the list of open electives offered by other Programmes).**

#**Elective – management shall be chosen from the Elective – Management Courses**

SEMESTER VIII/VII*

S. No.	Course Code	Course Title	Cate Gory	Periods per week			Total Contact Periods	Credits
				L	T	P		
PRACTICALS								
1.	MF3811	Project Work /Internship	EEC	0	0	20	20	10
			TOTAL	**0**	**0**	**20**	**20**	**10**

***If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII**

TOTAL CREDITS: 166

ELECTIVE – MANAGEMENT COURSES

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	GE3751	Principles of Management	HSMC	3	0	0	3	3
2.	GE3752	Total Quality Management	HSMC	3	0	0	3	3
3.	GE3753	Engineering Economics and Financial Accounting	HSMC	3	0	0	3	3
4.	GE3754	Human Resource Management	HSMC	3	0	0	3	3
5.	GE3755	Knowledge Management	HSMC	3	0	0	3	3
6.	GE3792	Industrial Management	HSMC	3	0	0	3	3

MANDATORY COURSES I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MX3081	Introduction to Women and Gender Studies	MC	3	0	0	3	0
2.	MX3082	Elements of Literature	MC	3	0	0	3	0
3.	MX3083	Film Appreciation	MC	3	0	0	3	0
4.	MX3084	Disaster Management	MC	3	0	0	3	0

MANDATORY COURSES II

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MX3085	Well Being with Traditional Practices (Yoga, Ayurveda and Siddha)	MC	3	0	0	3	0
2.	MX3086	History of Science and Technology in India	MC	3	0	0	3	0
3.	MX3087	Political and Economic Thought for a Humane Society	MC	3	0	0	3	0
4.	MX3088	State, Nation Building and Politics in India	MC	3	0	0	3	0
5.	MX3089	Industrial Safety	MC	3	0	0	3	0

PROFESSIONAL ELECTIVE COURSES: VERTICALS			
Vertical 1	**Vertical 2**	**Vertical 3**	**Vertical 4**
PRODUCT DESIGN AND DEVELOPMENT	**TOOL ENGINEERING**	**QUALITY, MANAGEMENT AND PROCESS CONTROL**	**MANUFACTURING PROCESSES**
Design of Machine Elements	Design of Jigs and Fixtures	Non Destructive Testing and Evaluation	Unconventional MachiningProcesses
Design for Manufacture, assembly and Environments	Design of Press Tools	Reliability Engineering	Micro and PrecisionEngineering
Plastics Product Design	Design of Cutting Tools	Safety Engineering	Composite Materials andProcessing
Reverse Engineering	Design of Tooling forThermoplastics	Statistical QualityControl	Process Planning and CostEstimation
Product Development Process	Design of Tooling for Die Casting	Engineering Management	Surface Engineering
Engineering Failure Analysis	Design of Tooling forThermosets	Supply Chain Management	Plant and Machinery Maintenance
Applied design for industries	Design of Gauges	Operations Research	Industrial 4.0

Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered in Semesters V and VI. These courses are listed in groups called verticals that represent a particular area of specialisation / diversified group. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI.

The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E/B.Tech (Honours) or Minor degree also. For more details on B.E./B.Tech (Honours) or Minor degree refer to the Regulations 2021, Clause 4.10.

PROGRESS THROUGH KNOWLEDGE

PROFESSIONAL ELECTIVE COURSES : VERTICALS

VERTICAL 1 : PRODUCT DESIGN AND DEVELOPMENT

Sl. No.	Course code	Course title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	ME3591	Design of Machine Elements	PEC	3	0	0	3	3
2.	MF3001	Design for Manufacture, Assembly and Environments	PEC	3	0	0	3	3
3.	MF3002	Plastics Product Design	PEC	3	0	0	3	3
4.	MF3003	Reverse Engineering	PEC	3	0	0	3	3
5.	MF3004	Product Development Process	PEC	3	0	0	3	3
6.	MF3005	Engineering Failure Analysis	PEC	3	0	0	3	3
7.	MF3006	Applied Design for Industries	PEC	3	0	0	3	3

VERTICAL 2: TOOL ENGINEERING

Sl. No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	CMF331	Design of Jigs and Fixtures	PEC	3	0	0	3	3
2.	CMF332	Design of Press Tools	PEC	3	0	0	3	3
3.	CMF333	Design of Cutting Tools	PEC	3	0	0	3	3
4.	CMF334	Design of Tooling forThermoplastics	PEC	3	0	0	3	3
5.	CMF335	Design of Tooling for Die Casting	PEC	3	0	0	3	3
6.	CMF336	Design of Tooling for Thermosets	PEC	3	0	0	3	3
7.	CMF337	Design of Gauges	PEC	3	0	0	3	3

VERTICAL 3: QUALITY, MANAGEMENT AND PROCESS CONTROL

Sl. No.	Course Code	Course Title	Category	Periods Per week			Total contact periods	Credits
				L	T	P		
1.	CMF338	Non Destructive TestingAnd Evaluation	PEC	3	0	0	3	3
2.	CIE348	Reliability Engineering	PEC	3	0	0	3	3
3.	MF3007	Safety Engineering	PEC	3	0	0	3	3
4.	MF3008	Statistical Quality Control	PEC	3	0	0	3	3
5.	MF3009	Engineering Management	PEC	3	0	0	3	3
6.	IE3792	Supply Chain Management	PEC	3	0	0	3	3
7.	IE3491	Operations Research	PEC	3	0	0	3	3

VERTICAL 4: MANUFACTURING PROCESSES

Sl. No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	CMF339	Unconventional Machining Processes	PEC	3	0	0	3	3
2.	MF3010	Micro and Precision Engineering	PEC	3	0	0	3	3
3.	CME382	Composite materials and Processing	PEC	3	0	0	3	3
4.	CME396	Process Planning and Cost estimation	PEC	3	0	0	3	3
5.	CME398	Surface Engineering	PEC	3	0	0	3	3
6.	MF3011	Plant and Machinery Maintenance	PEC	3	0	0	3	3
7.	CMF340	Industry 4.0	PEC	3	0	0	3	3

OPEN ELECTIVES

(Students shall choose the open elective courses, such that the course contents are not similar to any other course contents/title under other course categories).

OPEN ELECTIVE I AND II

(EMERGING TECHNOLOGIES)

To be offered other than Faculty of Information and Communication Engineering

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OCS351	Artificial Intelligence and Machine Learning Fundamentals	OEC	2	0	2	4	3
2.	OCS352	IoT Concepts and Applications	OEC	2	0	2	4	3
3.	OCS353	Data Science Fundamentals	OEC	2	0	2	4	3
4.	OCS354	Augmented and Virtual Reality	OEC	2	0	2	4	3

OPEN ELECTIVES – III

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OHS351	English for Competitive Examinations	OEC	3	0	0	3	3
2.	OCE353	Lean Concepts, Tools And Practices	OEC	3	0	0	3	3
3.	OMG352	NGOs and Sustainable Development	OEC	3	0	0	3	3
4.	OMG353	Democracy and Good Governance	OEC	3	0	0	3	3
5.	OME353	Renewable Energy Technologies	OEC	3	0	0	3	3
6.	OME354	Applied Design Thinking	OEC	2	0	2	4	3
7.	OMF353	Sustainable Manufacturing	OEC	3	0	0	3	3
8.	OAU351	Electric and Hybrid Vehicle	OEC	3	0	0	3	3
9.	OAS352	Space Engineering	OEC	3	0	0	3	3
10.	OIM351	Industrial Management	OEC	3	0	0	3	3
11.	OIE354	Quality Engineering	OEC	3	0	0	3	3
12.	OSF351	Fire Safety Engineering	OEC	3	0	0	3	3
13.	OML351	Introduction to non-destructive testing	OEC	3	0	0	3	3
14.	OMR351	Mechatronics	OEC	3	0	0	3	3
15.	ORA351	Foundation of Robotics	OEC	3	0	0	3	3
16.	OAE352	Fundamentals of Aeronautical engineering	OEC	3	0	0	3	3
17.	OGI351	Remote Sensing Concepts	OEC	3	0	0	3	3
18.	OAI351	Urban Agriculture	OEC	3	0	0	3	3
19.	OEN351	Drinking Water Supply and Treatment	OEC	3	0	0	3	3

20.	OEE352	Electric Vehicle technology	OEC	3	0	0	3	3
21.	OEI353	Introduction to PLC Programming	OEC	3	0	0	3	3
22.	OCH351	Nano Technology	OEC	3	0	0	3	3
23.	OCH352	Functional Materials	OEC	3	0	0	3	3
24.	OBT352	Biomedical Instrumentation	OEC	3	0	0	3	3
25.	OFD352	Traditional Indian Foods	OEC	3	0	0	3	3
26.	OFD353	Introduction to food processing	OEC	3	0	0	3	3
27.	OPY352	IPR for Pharma Industry	OEC	3	0	0	3	3
28.	OTT351	Basics of Textile Finishing	OEC	3	0	0	3	3
29.	OTT352	Industrial Engineering for Garment Industry	OEC	3	0	0	3	3
30.	OTT353	Basics of Textile Manufacture	OEC	3	0	0	3	3
31.	OPE351	Introduction to Petroleum Refining and Petrochemicals	OEC	3	0	0	3	3
32.	OPE352	Energy Conservation and Management	OEC	3	0	0	3	3
33.	OPT351	Basics of Plastics Processing	OEC	3	0	0	3	3
34.	OEC351	Signals and Systems	OEC	3	0	0	3	3
35.	OEC352	Fundamentals of Electronic Devices and Circuits	OEC	3	0	0	3	3
36.	OBM351	Foundation Skills in integrated product Development	OEC	3	0	0	3	3
37.	OBM352	Assistive Technology	OEC	3	0	0	3	3
38.	OMA352	Operations Research	OEC	3	0	0	3	3
39.	OMA353	Algebra and Number Theory	OEC	3	0	0	3	3
40.	OMA354	Linear Algebra	OEC	3	0	0	3	3

OPEN ELECTIVES – IV

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OHS352	Project Report Writing	OEC	3	0	0	3	3
2.	OCE354	Basics of Integrated Water Resources Management	OEC	3	0	0	3	3
3.	OMA355	Advanced Numerical Methods	OEC	3	0	0	3	3
4.	OMA356	Random Processes	OEC	3	0	0	3	3
5.	OMA357	Queuing and Reliability Modelling	OEC	3	0	0	3	3
6.	OMG354	Production and Operations	OEC	3	0	0	3	3

		Management for Entrepreneurs						
7.	OMG355	Multivariate Data Analysis	OEC	3	0	0	3	3
8.	OME352	Additive Manufacturing	OEC	3	0	0	3	3
9.	OME353	New Product Development	OEC	3	0	0	3	3
10.	OME355	Industrial Design & Rapid Prototyping Techniques	OEC	2	0	2	4	3
11.	OAU352	Batteries and Management system	OEC	3	0	0	3	3
12.	OAU353	Sensors and Actuators	OEC	3	0	0	3	3
13.	OAS353	Space Vehicles	OEC	3	0	0	3	3
14.	OIM352	Management Science	OEC	3	0	0	3	3
15.	OIE353	Operations Management	OEC	3	0	0	3	3
16.	OSF352	Industrial Hygiene	OEC	3	0	0	3	3
17.	OSF353	Chemical Process Safety	OEC	3	0	0	3	3
18.	OML352	Electrical, Electronic and Magnetic materials	OEC	3	0	0	3	3
19.	OML353	Nanomaterials and applications	OEC	3	0	0	3	3
20.	OMR352	Hydraulics and Pneumatics	OEC	3	0	0	3	3
21.	OMR353	Sensors	OEC	3	0	0	3	3
22.	ORA352	Foundation of Automation	OEC	3	0	0	3	3
23.	ORA353	Concepts in Mobile Robotics	OEC	3	0	0	3	3
24.	OMV351	Marine Propulsion	OEC	3	0	0	3	3
25.	OMV352	Marine Merchant Vehicles	OEC	3	0	0	3	3
26.	OMV353	Elements of Marine Engineering	OEC	3	0	0	3	3
27.	OAE353	Drone Technologies	OEC	3	0	0	3	3
28.	OGI352	Geographical Information System	OEC	3	0	0	3	3
29.	OAI352	Agriculture Entrepreneurship Development	OEC	3	0	0	3	3
30.	OEN352	Biodiversity Conservation	OEC	3	0	0	3	3
31.	OEE353	Introduction to control systems	OEC	3	0	0	3	3
32.	OEI354	Introduction to Industrial Automation Systems	OEC	3	0	0	3	3
33.	OCH353	Energy Technology	OEC	3	0	0	3	3
34.	OCH354	Surface Science	OEC	3	0	0	3	3
35.	OBT353	Environment and Agriculture	OEC	3	0	0	3	3
36.	OFD354	Fundamentals of Food Engineering	OEC	3	0	0	3	3
37.	OFD355	Food safety and	OEC	3	0	0	3	3

		Quality Regulations						
38.	OPY353	Nutraceuticals	OEC	3	0	0	3	3
39.	OTT354	Basics of Dyeing and Printing	OEC	3	0	0	3	3
40.	OTT355	Fibre Science	OEC	3	0	0	3	3
41.	OTT356	Garment Manufacturing Technology	OEC	3	0	0	3	3
42.	OPE353	Industrial safety	OEC	3	0	0	3	3
43.	OPE354	Unit Operations in Petro Chemical Industries	OEC	3	0	0	3	3
44.	OPT352	Plastic Materials for Engineers	OEC	3	0	0	3	3
45.	OPT353	Properties and Testing of Plastics	OEC	3	0	0	3	3
46.	OEC353	VLSI Design	OEC	3	0	0	3	3
47.	OEC354	Industrial IoT and Industry 4.0	OEC	2	0	2	4	3
48.	OBM353	Wearable devices	OEC	3	0	0	3	3
49.	OBM354	Medical Informatics	OEC	3	0	0	3	3

B.E.MANUFACTURING ENGINEERING

S.No	Subject Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSMC	4	3					5		12
2	BSC	12	7	4	2					25
3	ESC	5	11	11						27
4	PCC			11	19	11	7	5		53
5	PEC					12	9			21
6	OEC						3	9		12
7	EEC	1	2	1		1		1	10	16
8	Non-Credit /(Mandatory)					√	√			
Total		22	23	27	21	24	19	20	10	166

ENROLLMENT FOR B.E. / B. TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree.

For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only.

For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes, Moreover, for minor degree the student can register for courses from any one of the following verticals also.
Complete details are available in clause 4.10 of Regulations 2021.

VERTICALS FOR MINOR DEGREE
(In addition to all the verticals of other programmes)

Vertical I	Vertical II	Vertical III	Vertical IV	Vertical V
Fintech and Block Chain	**Entrepreneurship**	**Public Administration**	**Business Data Analytics**	**Environment and Sustainability**
Financial Management	Foundations of Entrepreneruship	Principles of Public Administration	Statistics for Management	Sustainable infrastructure Development
Fundamentals of Investment	Team Building and Leadership Management for Business	Constitution of India	Datamining for Business Intelligence	Sustainable Agriculture and Environmental Management
Banking, Financial Services and Insurance	Creativity and Innovation in Entrepreneurship	Public Personnel Administration	Human Resource Analytics	Sustainable Bio Materials
Introduction to Blockchain and its Applications	Principles of Marketing Management for Business	Administrative Theories	Marketing and Social Media Web Analytics	Materials for Energy Sustainability
Fintech Personal Finance and Payments	Human Resource Management for Entrepreneurs	Indian Administrative System	Operation and Supply Chain Analytics	Green Technology
Introduction to Fintech	Financing New Business Ventures	Public Policy Administration	Financial Analytics	Environmental Quality Monitoring and Analysis
-	-	-	-	Integrated Energy Planning for Sustainable Development
-	-	-	-	Energy Efficiency for Sustainable Development

(Choice of courses for Minor degree is to be made from any one vertical of other programmes or from

anyone of the following verticals)

VERTICAL 1: FINTECH AND BLOCK CHAIN

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG331	Financial Management	PEC	3	0	0	3	3
2.	CMG332	Fundamentals of Investment	PEC	3	0	0	3	3
3.	CMG333	Banking, Financial Services and Insurance	PEC	3	0	0	3	3
4.	CMG334	Introduction to Blockchain and its Applications	PEC	3	0	0	3	3
5.	CMG335	Fintech Personal Finance and Payments	PEC	3	0	0	3	3
6.	CMG336	Introduction to Fintech	PEC	3	0	0	3	3

VERTICAL 2: ENTREPRENERUSHIP

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG337	Foundations of Entrepreneruship	PEC	3	0	0	3	3
2.	CMG338	Team Building and Leadership Management for Business	PEC	3	0	0	3	3
3.	CMG339	Creativity and Innovation in Entrepreneurship	PEC	3	0	0	3	3
4.	CMG340	Principles of Marketing Management for Business	PEC	3	0	0	3	3
5.	CMG341	Human Resource Management for Entrepreneurs	PEC	3	0	0	3	3
6.	CMG342	Financing New Business Ventures	PEC	3	0	0	3	3

VERTICAL 3: PUBLIC ADMINISTRATION

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG343	Principles of Public Administration	PEC	3	0	0	3	3
2.	CMG344	Constitution of India	PEC	3	0	0	3	3
3.	CMG345	Public Personnel Administration	PEC	3	0	0	3	3
4.	CMG346	Administrative Theories	PEC	3	0	0	3	3
5.	CMG347	Indian Administrative System	PEC	3	0	0	3	3
6.	CMG348	Public Policy Administration	PEC	3	0	0	3	3

VERTICAL 4: BUSINESS DATA ANALYTICS

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG349	Statistics for Management	PEC	3	0	0	3	3
2.	CMG350	Datamining for Business Intelligence	PEC	3	0	0	3	3
3.	CMG351	Human Resource Analytics	PEC	3	0	0	3	3
4.	CMG352	Marketing and Social Media Web Analytics	PEC	3	0	0	3	3
5.	CMG353	Operation and Supply Chain Analytics	PEC	3	0	0	3	3
6.	CMG354	Financial Analytics	PEC	3	0	0	3	3

PROGRESS THROUGH KNOWLEDGE

VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CES331	Sustainable infrastructure Development	PEC	3	0	0	3	3
2.	CES332	Sustainable Agriculture and Environmental Management	PEC	3	0	0	3	3
3.	CES333	Sustainable Bio Materials	PEC	3	0	0	3	3
4.	CES334	Materials for Energy Sustainability	PEC	3	0	0	3	3
5.	CES335	Green Technology	PEC	3	0	0	3	3
6.	CES336	Environmental Quality Monitoring and Analysis	PEC	3	0	0	3	3
7.	CES337	Integrated Energy Planning for Sustainable Development	PEC	3	0	0	3	3
8.	CES338	Energy Efficiency for Sustainable Development	PEC	3	0	0	3	3

PROGRESS THROUGH KNOWLEDGE

MA3351 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS L T P C
3 1 0 4

OBJECTIVES

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

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 9+3

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

UNIT II FOURIER SERIES 9+3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root mean square value – Perceval's identity – Harmonic analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9+3

Classification of PDE – Method of separation of variables - Fourier series solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (Cartesian coordinates only).

UNIT IV FOURIER TRANSFORMS 9+3

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

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS 9+3

Z-transforms - Elementary properties – Convergence of Z-transforms - – Initial and final value theorems - Inverse Z-transform using partial fraction and convolution theorem - Formation of difference equations – Solution of difference equations using Z - transforms.

TOTAL: 60 PERIODS

OUTCOMES:

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

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

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2018.
2. Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, India, 2016.

REFERENCES:

1. Andrews. L.C and Shivamoggi. B, "Integral Transforms for Engineers" SPIE Press, 1999.
2. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 10th Edition, Laxmi Publications Pvt. Ltd, 2015.
3. James. G., "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, New Delhi, 2016.
4. Narayanan. S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.
6. Wylie. R.C. and Barrett. L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

ME 3392 ENGINEERING MATERIALS AND METALLURGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1 To learn the constructing, the phase diagram and using of iron-iron carbide phase diagram for microstructure formation.
2 To learn selecting and applying various heat treatment processes and its microstructure formation.
3 To illustrate the different types of ferrous and non-ferrous alloys and their uses in engineering field.
4 To illustrate the different polymer, ceramics and composites and their uses in engineering field.
5 To learn the various testing procedures and failure mechanism in engineering field.

UNIT I CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS 9

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

UNIT II HEAT TREATMENT 9

Definition – Full annealing, stress relief, recrystallization and spheroidising –normalizing, hardening and Tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram – continuous cooling Transformation (CCT) diagram – Austempering, Martempering – Hardenability, Jominy end quench test -case hardening, carburizing, Nitriding, cyaniding, carbonitriding – Flame and Induction hardening – Vacuum and Plasma hardening – Thermo-mechanical treatments- elementary ideas on sintering.

UNIT III FERROUS AND NON-FERROUS METALS 9

Effect of alloying additions on steel (Mn, Si, Cr, Mo, Ni, V,Ti& W) – stainless and tool steels – HSLA - Maraging steels – Grey, white, malleable, spheroidal – alloy cast irons, Copper and its alloys – Brass, Bronze and Cupronickel – Aluminium and its alloys; Al-Cu – precipitation strengthening treatment – Titanium alloys, Mg-alloys, Ni-based super alloys – shape memory alloys- Properties and Applications-overview of materials standards

UNIT IV NON-METALLIC MATERIALS 9

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS,PAI, PPO, PPS, PEEK, PTFE, Thermoset polymers – Urea and Phenol formaldehydes –Nylon, Engineering Ceramics – Properties and applications of Al2O3, SiC, Si3N4, PSZ and SIALON – intermetallic- Composites- Matrix and reinforcement Materials- applications of Composites - Nano composites.

UNIT V MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS 9

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

TOTAL : 45 PERIODS

OUTCOMES:

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

1. Explain alloys and phase diagram, Iron-Iron carbon diagram and steel classification.
2. Explain isothermal transformation, continuous cooling diagrams and different heat treatment processes.
3. Clarify the effect of alloying elements on ferrous and non-ferrous metals.
4. Summarize the properties and applications of non-metallic materials.
5. Explain the testing of mechanical properties.

TEXTBOOKS:

1. Kenneth G.Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint 2002.
2. Sydney H.Avner, "Introduction to Physical Metallurgy", McGraw Hill Book Company, 1994

REFERENCES:

1. A. Alavudeen, N. Venkateshwaran, and J. T.WinowlinJappes, A Textbook of Engineering Materials and Metallurgy, Laxmi Publications, 2006.
2. Amandeep Singh Wadhwa, andHarvinder Singh Dhaliwal, A Textbook of Engineering Material and Metallurgy, University Sciences Press, 2008.
3. G.S. Upadhyay and Anish Upadhyay, "Materials Science and Engineering", Viva Books Pvt.Ltd, New Delhi, 2006.
4. Raghavan.V, "Materials Science and Engineering", Prentice Hall of India Pvt.Ltd. 1999.
5. Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, Revised Indian edition 2007.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	3	2								2	2	1	2
2	3	1	3	1		2		1				2	2	1	2
3	3	1	3									2	2	1	2
4	3	1	3				2					2	2	1	2
5	3	1	3	2	2							2	2	1	2
Low (1) ; Medium (2) ; High (3)															

PROGRESS THROUGH KNOWLEDGE

MF3301 MACHINING TECHNOLOGY LT P C

3 0 0 3

COURSE OBJECTIVES:

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

- To impart knowledge on basics of metal cutting.
- to solve problems on cutting forces, tool life and analytical methods of estimating cutting temperature.
- To describe the basic principles of machine tools and processes
- To elaborate abrasive and finishing operations.
- To outline basics of automation and structure of machine tools.

UNIT I FUNDAMENTALS OF METAL CUTTING 9 Hours

Tool geometry- Mechanics of orthogonal and oblique cutting - mechanism of chip formation- Types of chips produced in cutting -Cutting forces - Merchant's circle diagram — simple problems -Cutting temperature-causes, effects, measurement, estimation and Control-Tool failure modes-wear mechanisms — tool life - simple problems- Machinability -Surface finish and integrity of machined surfaces- Machining economics-cutting tool materials- Cutting tool
Reconditioning-Cutting fluids.

UNIT II BASIC MACHINING PROCESSES 9 Hours

Lathe: Kinematic arrangement -Specification - Types - Mechanisms - work holding devices-Operations - Drilling: Specification - Types - Mechanism - Operations - Drill tool nomenclature –- Boring: Specification - Types - Operations - Boring tool - Jig Boring machine – Reamer andtap Milling: Specification – Types - Cutter nomenclature - Types of cutters - mounting of cutters- Operations - Indexing - Cam and thread milling- Shaper: Specification - Types – Mechanism-Planer: Specification - Types - Mechanism - Broaching: Specification - Types - Tool nomenclature- Broaching process

UNIT III GRINDING AND FINISHING OPERATIONS 9 Hours

Grinding: Types of grinding machine - Designation and selection of grinding wheel - Abrasives- Bonds - bonded abrasives - Reconditioning of grinding wheel - grinding operations and machines wheel grinding - Design Considerations for grinding- economics of grinding- finishing operation. - deburring - lapping, honing, burnishing.

UNIT IV GEAR CUTTING 9 Hours

Gear cutting Methods-Kinematics of gear shaping and gear hobbing – template gear cutting Methods-Gear generation principles specifications - Bevel gear generator - Gear finishingmethods-gear grinding –lapping

UNIT V MACHINE TOOL STRUCTURE AND AUTOMATION 9 Hours

Classification Machine Tool Structures-Vibration and chatters in machining-erecting and testing of machine Tools-Automation: Cam controlled automats, single spindle and multi spindle automats - Swiss type, automatic screw mechanism - Feeding mechanism - Transfer mechanism, Tracer controller mechanism.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- Apply the knowledge in the basics of metal cutting.
- Apply suitable machining processes based on requirements.
- Distinguish different finishing operations.
- Test the machine tool structure and differentiate various automation.
- solve problems on cutting forces, tool life and analytical methods of estimating cutting temperature.

PROGRESS THROUGH KNOWLEDGE

TEXT BOOKS:

1. Sharma P.C., “A Textbook of Production Technology (Manufacturing Processes)”, 8th Edition, S. Cha Publishing., India 2014 ISBN:9788121911146.
2. Jain R.K., “Production Technology: Manufacturing Processes, Technology and Automation”, 17 Edition, Khanna publication, India, 2014, ISBN-10: 9788174090997, ISBN-3: 978-8174090997

REFERENCES:

1. John R. Walker and Bob Dixon, “Machining Fundamentals”, 9th Edition, The Goodheart-Willcox C United States,2014, ISBN: 978-1-61960-209-0.
2. Krar S.F., “Technology of Machine Tools”, 7th Edition, McGraw-Hill, New York, 2011, ISBN-13: 97 0073510835, ISBN-10: 0073510831.
3. Roy A. Lindberg, “Processes and Materials of Manufacture”, 4th Edition, PHI Learning, United State 1994, Reprint 2008, ISBN: 9788120306639, 8120306635
4. Serope Kalpakjian, Steven Schmid, “Manufacturing Engineering & Technology”,7thEdtion, Pearsc United States, 2013, ISBN: 0131489658.
5. Winston A. Knight, Geoffrey Boothroyd, “Fundamentals of Metal Machining and Machine Too (Mechanical Engineering)”, 3rd Edition, United States, 2005, ISBN 0070850577, 9780070850576.

CE3391 FLUID MECHANICS AND MACHINERY L T P C
3 1 0 4

COURSE OBJECTIVES:

1. To introduce the students about properties of the fluids, behaviour of fluids under static conditions.
2. To impart basic knowledge of the dynamics of fluids and boundary layer concept.
3. To expose to the applications of the conservation laws to a) flow measurements b) flow through pipes (both laminar and turbulent) and c) forces on pipe bends.
4. To exposure to the significance of boundary layer theory and its thicknesses.
5. To expose the students to basic principles of working of hydraulic machineries and to design Pelton wheel, Francis and Kaplan turbine, centrifugal and reciprocating pumps.

UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS 10+3

Properties of fluids – Fluid statics - Pressure Measurements - Buoyancy and floatation - Flow characteristics - Eulerian and Lagrangian approach - Concept of control volume and system - Reynold's transportation theorem - Continuity equation, energy equation and momentum equation - Applications.

UNIT II FLOW THROUGH PIPES AND BOUNDARY LAYER 9+3

Reynold's Experiment - Laminar flow through circular conduits - Darcy Weisbach equation - friction factor - Moody diagram - Major and minor losses - Hydraulic and energy gradient lines - Pipes in series and parallel - Boundary layer concepts - Types of boundary layer thickness.

UNIT III DIMENSIONAL ANALYSIS AND MODEL STUDIES 8+3

Fundamental dimensions - Dimensional homogeneity - Rayleigh's method and Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.

UNIT IV TURBINES 9+3

Impact of jets - Velocity triangles - Theory of rotodynamic machines - Classification of turbines - Working principles - Pelton wheel - Modern Francis turbine - Kaplan turbine - Work done - Efficiencies - Draft tube - Specific speed - Performance curves for turbines - Governing of turbines.

UNIT V PUMPS 9+3

Classification of pumps - Centrifugal pumps - Working principle - Heads and efficiencies– Velocity triangles - Work done by the impeller - Performance curves - Reciprocating pump working principle - Indicator diagram and it's variations - Work saved by fitting air vessels - Rotary pumps.

TOTAL: 60 PERIODS

OUTCOMES: On completion of the course, the student is expected to be able to

1. Understand the properties and behaviour in static conditions. Also to understand the conservation laws applicable to fluids and its application through fluid kinematics and dynamics
2. Estimate losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel. Also to understand the concept of boundary layer and its thickness on the flat solid surface.
3. Formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performances of prototype by model studies
4. Explain the working principles of various turbines and design the various types of turbines.
5. Explain the working principles of centrifugal, reciprocating and rotary pumps and design the centrifugal and reciprocating pumps

TEXT BOOKS:

1. Modi P.N. and Seth, S.M. Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, 22nd edition (2019)
2. Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014.
3. Kumar K. L., Engineering Fluid Mechanics, Eurasia Publishing House(p) Ltd. New Delhi, 2016.

REFERENCES:

1. Fox W.R. and McDonald A.T., Introduction to Fluid Mechanics John-Wiley and Sons, Singapore,

2011.
2. Pani B S, Fluid Mechanics: A Concise Introduction, Prentice Hall of India Private Ltd, 2016.
3. Cengel Y A and Cimbala J M, Fluid Mechanics, McGraw Hill Education Pvt. Ltd., 2014.
4. S K Som; Gautam Biswas and S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Pvt. Ltd., 2012.
5. Streeter, V. L. and Wylie E. B., Fluid Mechanics, McGraw Hill Publishing Co., 2010.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	1	2	2	1	2	1	1	2	3	2	3
2	3	3	3	2	1	2	2	1	2	1	1	2	3	2	3
3	3	3	3	3	1	2	2	1	2	1	1	2	3	3	3
4	3	3	3	3	1	2	2	1	2	1	1	3	3	2	2
5	3	3	3	3	1	2	2	1	2	1	1	3	3	2	2
Low (1) ; Medium (2) ; High (3)															

MF3391 MECHANICS OF MATERIALS LT P C

3 0 0 3

COURSE OBJECTIVES:

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

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

UNIT I STRESS AND STRAIN 9 Hours

Introduction, Hooke's law, Calculation of stresses in straight, Stepped and tapered sections, Composite sections, Stresses due to temperature change, Shear stress and strain, Lateral strain and Poisson's ratio, Generalized Hooke's law, Bulk modulus, Relationship between elastic constants

UNIT II ANALYSIS OF STRESS AND STRAIN 9 Hours

Plane stress, Stresses on inclined planes, Principal stresses and maximum shear stress, Principal angles, Shear stresses on principal planes, Maximum shear tress, Mohr circle for plane stress conditions. **Cylinders:** Thin cylinder: Hoop's stress, maximum shear stress, circumferential and longitudinal strains, thick cylinders: Lames equations.

UNIT III SHEAR FORCES AND BENDING MOMENTS 9 Hours

Type of beams, Loads and reactions, Relationship between loads, shear forces and bending moments, Shear force and bending moments of cantilever beams, Pin support and roller supported beams subjected to concentrated loads and uniformly distributed constant / varyingloads.

Stress in Beams: Pure bending, Curvature of a beam, Longitudinal strains in beams, Normal stresses in Beams with rectangular, circular, 'I' and 'T' cross sections, Flexure Formula, Bending Stresses, Deflection of beams (Curvature).

UNIT IV TORSION **9 Hours**

Circular solid and hallow shafts, Torsional moment of resistance, Power transmission of straight and stepped shafts, Twist in shaft sections, Thin tubular sections, thin- w a l l e d sections**Columns:** Buckling and stability, Critical load, Columns with pinned ends, Columns with othersupport conditions, Effective length of columns, Secant formula for columns.

UNIT V STRAIN ENERGY **9 Hours**

Castiglioni's theorem I and II, Load deformation diagram, Strain energy due to normalstresses, Shear stresses, Modulus of resilience, Strain energy due to bending and torsion.

Theories of Failure: Maximum Principal stress theory, Maximum shear stress theory.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Apply the principal concepts behind stress, strain and deformation of solids for various engineering applications.
- Analyze the transverse loading on beams and stresses in beam for various engineering applications.
- Analyze the torsion principles on shafts and springs for various engineering applications.
- Analyze the deflection of beams for various engineering applications.
- Understanding the concept of theories of failure

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.
5. Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004.

MF3302 FOUNDRY TECHNOLOGY **L T P C**

3 0 0 3

COURSE OBJECTIVES:

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

- To impart the basics of casting and foundry practice.
- To introduce various casting processes
- To be acquainted with design of gating system and to obtain defect free castings
- An overview of the designing of molds, casting defects, inspection and testing of castings and modernization of foundries.
- Casting of ferrous and non-ferrous materials.

UNIT I INTRODUCTION: **9 Hours**

Introduction to moulding and casting processes - steps involved advantages, limitations, application of casting process. Patterns - types, applications, pattern allowances-pattern materials, colour coding as per BIS, pattern making, core and core making, core boxes, core prints, core blowers, core shooters. Sand mould making: Moulding and core sands,
ingredients, properties, types of sands, sand selection - machine moulding, types of machines, applications.

UNIT II CASTING PROCESSES: **9 Hours**

Sand preparation and sand reclamation-sand control tests. Sand casting process, types ofmoulding processes - plaster mould casting, die casting process - die casting methods.
Centrifugal casting, continuous casting, shell moulding, CO2 moulding - investment casting,full mould process.

UNIT III MELTING, POURING AND TESTING: **9 Hours**

Foundry remelting furnaces – selection of furnaces – crucible furnaces -oil fired furnace,electric furnaces – resistance, arc, induction furnaces –cupola steel melting, non-ferrous
melting practices - pouring equipments – cleaning and inspection of casting –destructive andnon-destructive testing - defects in sand casting and remedies.

UNIT IV GATING, FEEDING AND MECHANIZATION: 9 Hours

Elements of gating system, functions, types and design of gating systems, gating ratio, risers, functions, types and designs, methods controlling solidification, solidification time calculations, foundry mechanization

UNIT V FERROUS AND NON-FERROUS METALS: 9 Hours

Production of iron castings - Steel foundry practice - Copper alloy foundry practice - Aluminium alloy foundry practice - Magnesium alloy foundry practice - Zinc alloy foundry practice. Foundry metallurgy: Heat treatment of castings, inspection, testing and quality control in foundries, salvage in defective castings, foundry mechanization. Foundry environment, health and safety: Dust problems in foundries, preventive maintenance in
foundries, returning a sick foundry to profitability.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Gain basic knowledge in casting.
- Select suitable casting process for application requirement.
- Apply gating design and mould design knowledge to overcome defects in casting.
- Selecting the type of sand, for molds and cores as well as the molding process.
- Know about the special molding processes and when their use is warranted.
- Have a broad knowledge of casting of ferrous and non-ferrous alloys and of the inspection techniques to detect casting defects.

TEXT BOOKS:

1. O.P. Khanna, “A Text Book of Foundry Technology”, Dhanpat Rai & Sons, 15th Edition, 2011.
2. P.N. Rao, “Manufacturing Technology”, TMH, 5th Edition, 2013.

REFERENCES:

1. Campbell J., “Castings Practice: The Ten Rules of Castings”, Butterworth-Heinemann., United Kingdom, 2004, ISBN (13): 978 0750647915, (10) 9780750647915.
2. R.K. Jain, “Production Technology”, Khanna Publishers, 17th Edition, 2011.
3. Peter Beeley “foundry technogy”, Butterworth Heinemann 2nd Edition, 2001
4. P.L.Jain, ”Principle of foundry Technology “ Tata McGraw hill 4th Edition, 2006
5. T.R.Banga,”Foundry Engineering” Khanna Publishers, 5th Edition, 2014

MF3311 **STRENGTH OF MATERIALS AND METALLURGY LABORATORY** **L T P C**

0 0 4 2

COURSE OBJECTIVES:

- To study the mechanical properties of materials when subjected to different types of loading.
- To impart practical knowledge of heat treatment processes.
- To elaborate the effect of various parameters on heat treatment process
- To get conversant with the microstructural changes
- To gain practical knowledge on heat treatment of various materials.
-

LIST OF EXPERIMENTS

A) Strength of Materials Laboratory

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

B) Metallurgy Laboratory

1. Specimen preparation for macro – examination.
2. Specimen preparation for micro examination and study of Micro structure of –
    a) Carbon steel s(High, Medium, and Low)
    b) Cast Iron (Gray, White, Nodular, Malleable)
    c) Brass (70/30), Bronze (tin bronze), Al-Si alloy, Cupro-nickel, Ti alloy.

3. Quantitative metallography – Estimation of volume fraction, particle size, size distribution, and shape.
4. Cooling curves
    a) Pure Metal (Pb or Sn)
    b) Alloy (Pb-Sn or Pb-Sb)
5. study the micro structure before and after the following heat treatments
    a) Annealing
    b) Normalizing
    c) Quench Hardening
    d) Tempering
6. Jominy End Quench Test

TOTAL: 60 PERIODS

MF3361 MACHINING TECHNOLOGY LABORATORY LT P C

0 0 4 2

COURSE OBJECTIVES:

- To Study and practice the various operations that can be performed in lathe, shaper, drilling, milling machines etc.
- To equip with the practical knowledge required in the core industries.
- To prepare the process planning sheets for all the operations and then follow the sequences during the machining processes.

LIST OF EXPERIMENTS

1. Lathe: Facing, Plain turning, Step Turning
2. Lathe: Taper Turning, Threading, Knurling
3. Lathe: Multi start Threading, Burnishing
4. Shaper: Cube
5. Shaper: Cube, V-Block
6. Drilling: Counter sinking, Counter Boring, Tapping
7. Milling Vertical: Surfacing, Pocket Milling
8. Milling Horizontal: Polygonal shape milling
9. Grinding: Surface & Cylindrical grinding
10. Slotting: Machining an internal spline
11. Tool angle grinding with tool and Cutter Grinder
12. Measurement of cutting forces in Milling / Turning Process

TOTAL : 60 PERIODS

COURSE OUTCOMES:

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

- Select appropriate turning process to obtain finished components.
- Select appropriate milling process to obtain finished components.
- Select appropriate shaper and slotting process to obtain finished components.
- Select appropriate grinding process to obtain optimum surface finish.
- Coordinate various machining process in sequence to get desired design in finalcomponents.

PROGRESS THROUGH KNOWLEDGE

MF3312 **FLUID MACHINERY LABORATORY** **LT P C**

0 0 4 2

COURSE OBJECTIVES:

- To verify the principles studied in Fluid Mechanics theory by performing experiments in lab.

LIST OF EXPERIMENTS

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

TOTAL : 60 PERIODS

OUTCOMES:

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

- Use the measurement equipment's for flow measurement.
- Perform test on different fluid machinery.
- Verify and apply Bernoulli equation for flow measurement like orifice/venturi meter.
- Measure friction factor in pipes and compare with Moody diagram and verify momentum conservation law.
- Determine the performance characteristics of roto-dynamic pumps.
- Determine the performance characteristics of positive displacement pumps.
- Determine the performance characteristics of turbine.

PROGRESS THROUGH KNOWLEDGE

ME 3391 **ENGINEERING THERMODYNAMICS** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

1 Impart knowledge on the basics and application of zeroth and first law of thermodynamics.

2 Impart knowledge on the second law of thermodynamics in analyzing the performance of thermal devices.

3 Impart knowledge on availability and applications of second law of thermodynamics

4 Teach the various properties of steam through steam tables and Mollier chart.

5 Impart knowledge on the macroscopic properties of ideal and real gases.

UNIT I BASICS, ZEROTH AND FIRST LAW 9

Review of Basics – Thermodynamic systems, Properties and processes Thermodynamic Equilibrium - Displacement work - P-V diagram. Thermal equilibrium - Zeroth law – Concept of temperature and Temperature Scales. First law – application to closed and open systems – steady and unsteady flow processes.

UNIT II SECOND LAW AND ENTROPY 9

Heat Engine – Refrigerator - Heat pump. Statements of second law and their equivalence & corollaries. Carnot cycle - Reversed Carnot cycle - Performance - Clausius inequality. Concept of entropy - T-s diagram - Tds Equations - Entropy change for a pure substance.

UNIT III AVAILABILITY AND APPLICATIONS OF II LAW 9

Ideal gases undergoing different processes - principle of increase in entropy. Applications of II Law. High- and low-grade energy. Availability and Irreversibility for open and closed system processes - I and II law Efficiency

UNIT – IV PROPERTIES OF PURE SUBSTANCES 9

Steam - formation and its thermodynamic properties - p-v, p-T, T-v, T-s, h-s diagrams. PVT surface. Determination of dryness fraction. Calculation of work done and heat transfer in non-flow and flow processes using Steam Table and Mollier Chart.

UNIT – V GAS MIXTURES AND THERMODYNAMIC RELATIONS 9

Properties of Ideal gas, real gas - comparison. Equations of state for ideal and real gases. vander Waal's relation - Reduced properties - Compressibility factor - Principle of Corresponding states - Generalized Compressibility Chart. Maxwell relations - TdS Equations - heat capacities relations - Energy equation, Joule-Thomson experiment - Clausius-Clapeyron equation.

TOTAL: 45 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Apply the zeroth and first law of thermodynamics by formulating temperature scales and calculating the property changes in closed and open engineering systems.
2. Apply the second law of thermodynamics in analyzing the performance of thermal devices through energy and entropy calculations.
3. Apply the second law of thermodynamics in evaluating the various properties of steam through steam tables and Mollier chart
4. Apply the properties of pure substance in computing the macroscopic properties of ideal and real gases using gas laws and appropriate thermodynamic relations.
5. Apply the properties of gas mixtures in calculating the properties of gas mixtures and applying various thermodynamic relations to calculate property changes.

TEXTBOOKS:

1. Nag.P.K., “Engineering Thermodynamics”, 6th Edition, Tata McGraw Hill (2017), New Delhi.
2. Natarajan, E., “Engineering Thermodynamics: Fundamentals and Applications”, 2nd Edition (2014), Anuragam Publications, Chennai

REFERENCES:

1. Cengel, Y and M. Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill,9th Edition, 2019.
2. Chattopadhyay, P, “Engineering Thermodynamics”, 2nd Edition Oxford University Press, 2016.
3. Rathakrishnan, E., “Fundamentals of Engineering Thermodynamics”, 2nd Edition, Prentice Hall of India Pvt. Ltd, 2006.
4. Claus Borgnakke and Richard E. Sonntag, “Fundamentals of Thermodynamics”, 10th Edition, Wiley Eastern, 2019.
5. Venkatesh. A, “Basic Engineering Thermodynamics”, Universities Press (India) Limited, 2007.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	1								2			
2	3	3	2	1								2			
3	3	3	2	1					1		1	2	3		3
4	3	3	2	1		1			2		1	2	3	2	
5	3	3	2	1		1			2		1	2	3	2	3
Low (1) ; Medium (2) ; High (3)															

MF3401 ENGINEERING METROLOGY AND COMPUTER AIDED INSPECTION **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To impart the basics of metrology, measurement concepts and perform measurement tasks accurately.
- To identify the right measurement practices for linear and angular measurements.
- To be familiarized with the right instrument and method of measurement for surface finish and form measurements
- To describe the various measurement techniques using laser metrology.
- To gain knowledge on computer aided inspection and advances in metrology.

UNIT I CONCEPT OF MEASUREMENT **9 Hours**

General concept — Generalized measurement system-Units and standards-measuring instruments: sensitivity, stability, range, accuracy and precision-static and dynamic response-repeatability systematic and random errors-correction, calibration - Introduction to Dimensional and Geometric Tolerancing – interchangeability.

UNIT II LINEAR AND ANGULAR MEASUREMENT **9 Hours**

Definition of metrology-Linear measuring instruments: Vernier, micrometer, Slip gauges and Classification, - Tool Makers Microscope - interferometry, optical flats, - Comparators: limit gauges Mechanical, pneumatic and electrical comparators, applications. Angular measurements: - Sine bar, Sine center, bevel protractor and angle Decker.

UNIT III FORM MEASUREMENT **9 Hours**

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

UNIT IV LASER AND ADVANCES IN METROLOGY **9 Hours**

Precision instruments based on Laser-Principles- laser interferometer-application in measurements and machine tool metrology- Coordinate measuring machine (CMM): need, construction, types, applications - computer aided inspection- Tool Makers Microscope- Non contact and in-process inspection, Vision system.

UNIT V IMAGE PROCESSING **9 Hours**

Overview, Computer imaging systems, Image Analysis, Pre-processing, Human vision system, Image model, Image enhancement, gray scale models, histogram models, Image Transforms.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course the student will be able

- Recognize the basics of metrology, measurement concepts and perform measurement tasks accurately.
- Identify the right measurement practices for linear and angular measurements.
- Identify the right instrument and method of measurement for surface finish and form measurements
- Describe various measurement techniques using laser metrology.
- Recognize the computer aided inspection and advances in metrology.

TEXT BOOKS:

1. Bewoor A.K., and Kulkarni,V.A., “Metrology and Measurement”, Tata McGraw-Hill., India, 2009.ISBN: 978-0070140004.
2. Jain R.K., “Engineering Metrology”, Khanna Publishers., India, 2009,

REFERENCES:

1. Gupta S.C, “Engineering Metrology”, Dhanpat rai Publications, 2005
2. Jayal A.K, “Instrumentation and Mechanical Measurements”, Galgotia Publications2000
3. “ASTE Handbook of Industries Metrology”, Prentice Hall of India Ltd., India, 1992.
4. Galyer J.F.W. and Shotbolt C.R., “Metrology for Engineers”, Cassel O.R., London, 1993, ISBN-13: 978-0304318445
5. Rajput R.K., “Engineering Metrology and Instrumentations”, Kataria & Son Publishers., India, 2001.
6. Whitehouse D.J., “The Handbook of Surface and Nano metrology”, 2nd Edition, CRC Press., United States, 2011, ISBN: 9781420082029.

PROGRESS THROUGH KNOWLEDGE

MF3491 **CNC MACHINING TECHNOLOGY** **LT P C**

3 0 0 3

COURSE OBJECTIVES:

- To introduce the concepts and applications of CAD
- To introduce the various concepts and techniques used for Product design and to develop product design skills.
- To introduce the evolution, types and principles of CNC machine tools
- To familiarize the students with constructional features of CNC machine tools
- To gain knowledge on manual part program and generation of CNC part program using CAM packages

UNIT I FUNDAMENTALS OF COMPUTER GRAPHICS **9 Hours**

Product cycle- Design process- sequential and concurrent engineering- Computer aided design — CAD system architecture- Computer graphics — co-ordinate systems- 2D and 3D transformations homogeneous coordinates - Line drawing -Clipping- viewing transformation

UNIT II GEOMETRIC MODELING **9 Hours**

Geometric Modeling — types — Wire frame, surface and solid modeling — Boundary Representation, constructive solid geometry – Graphics standards – assembly modeling – use of software packages - Data exchange standards - IGES, STEP, CALS etc. - communication standards.

UNIT III CNC MACHINES **9 Hours**

NC, CNC & DNC – types of CNC – constructional features – drives and control systems – feedback devices — Interchangeable tooling system — preset & qualified tools — ISO specification – Machining center – Turning center – CNC EDM- CNC wire cut EDM.

UNIT IV CNC PROGRAMMING **9 Hours**

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

UNIT V FUNDAMENTALS OF CAM **9 Hours**

Brief introduction to CAM – Manufacturing Planning, Manufacturing control- Concurrent Engineering-CIM concepts – Computerized elements of CIM system –Types of production - Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In-Time Production

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course the student will be able

- Apply concept of CAD systems for 3D modeling and visual realism.
- Recognize the evolution, types and principle of CNC machine tools
- Acquire knowledge on constructional features of CNC machine tools
- Identify drives and axis measuring system used in CNC machine tools
- Demonstrate competency in manual part program and generation of CNC part program using CAM packages
- Elaborate various tooling and work holding devices used in CNC machine tools

TEXT BOOKS:

1. Nagpal G.R., "Machine Tool Engineering", Khanna Publishers, 2002
2. Ibrahim Zeid “Mastering CAD CAM” Tata McGraw-Hill Publishing Co.2007

REFERENCES:

1. Groover.M.P., "Automation, production systems and computer integrated manufacturing", Prentice Hall, 2008
2. Mike Mattson., “CNC Programming Principles and Applications”, 2nd Edition, Delmar Cengage learning, United States, 2010, ISBN: 9781418060992.
3. Radhakrishnan P., “Computer Numerical Control Machines and Computer Aided Manufacturing”, New Age International Publishers., United States, 2018, ISBN-13: 978-8122433975.
4. Rao P.N., “CAD/CAM Principles and Applications”, 3rd Edition, Tata McGraw, Hill Publishing Company Limited, New Delhi, 2010, ISBN-13: 978-0070681934.
5. Smid P., “CNC Programming Hand book”, 3rd Edition, Industrial Press Inc., United States, 2008, ISBN-13: 978-0831133474.

PR3451	MATERIALS JOINING TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To study SMAW, GMAW, GTAW, Oxy-acetylene welding and resistance spot welding processes.
2. To study the various types of resistance welding process.
3. To study the various solid state welding process.
4. To study advanced welding process.
5. To study the various welding design and testing methods.

UNIT – I GAS AND ARC WELDING PROCESSES 9

Fundamental principles – Air Acetylene welding, Oxyacetylene welding, Carbon arc welding, shielded metal arc welding, Submerged arc welding, TIG and MIG welding, Plasma arc welding and Electro slag welding processes - advantages, limitations and applications.

UNIT – II RESISTANCE WELDING PROCESSES 9

Spot welding, Seam welding, Projection welding, Resistance Butt welding, Flash Butt welding, Percussion welding and High frequency resistance welding processes - advantages, limitations and applications.

UNIT – III SOLID STATE WELDING PROCESSES 9

Cold welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction welding, Forge welding, Roll welding and Hot pressure welding processes - advantages, limitations and applications.

UNIT – IV OTHER WELDING PROCESSES 9

Thermit welding, atomic hydrogen welding, Electron beam welding, Laser Beam welding, Friction stir welding, Under Water welding, Welding automation in aerospace, nuclear and surface transport vehicles.

UNIT – V DESIGN OF WELD JOINTS, WELDABILITY AND TESTING OF WELDMENTS 9

Various weld joint designs – Welding defects – causes and remedies - Weldability of Aluminium, Copper, and Stainless steels. Destructive and nondestructive testing of weldments.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: To understand the basic working principles SMAW, GMAW, GTAW, Oxy-acetylene welding and resistance spot welding processes

CO2: To know the various types of the resistance welding process

CO3: To familiarize about the various solid state welding process

CO4: To know the advanced welding process

CO5: To apply the various welding design and testing methods

Mapping of COs with POs and PSOs															
COs/Pos&PSOs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	3	2	1	-	-	-	-	1	3	2	3	2
CO2	2	2	2	3	2	1	-	-	-	-	1	3	2	3	2
CO3	2	2	2	2	2	1	-	-	-	-	1	3	2	2	2
CO4	3	3	3	3	2	1	-	-	-	-	1	3	2	3	2
CO5	3	3	3	3	2	2	-	-	-	-	1	3	2	2	2
CO/PO & PSO Average	2	2	2	3	2	1	0	0	0	0	1	3	2	3	2
1 – Slight, 2 – Moderate, 3 – Substantial															

TEXT BOOKS:

1. Parmer. R.S, “Welding Processes and Technology”, Khanna Publishers,2018.
2. O P Khanna, “A text book of Welding Technology”, Dhanpat Rai Publication Edition 2011.

REFERENCES:

1. Curry.B., “Modern Welding Technology”, Prentice Hall ,2011.
2. Little, “Welding Technology”, Tata McGraw Hill, 2017.
3. Larry Jeff, “Welding Principle & applications”, Delmar Cengage Learning,2021.
4. Sharma P. C “A Textbook of Production Technology”, S Chand & Co Ltd, 2014.
5. Parmer. R.S, “Welding Engineering and Technology”, Khanna Publishers,2013

ML3591 METAL AND POWDER FORMING TECHNIQUES L T P C
3 0 0 3

COURSE OBJECTIVES:

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

- Describing types of deformations and classification of forming processes.
- Classifying and explain bulk forming processes.
- Describing sheet metal forming processes
- Distinguishing differences between conventional forming and special forming processes.
- Elaborating various stages involved in the powder forming processes.

UNIT I INTRODUCTION 9

Mechanical behavior of materials- Elastic and plastic deformations - Classification of forming processes - Temperature in metal working: Cold, Warm and hot working - Introduction to the theoryof plastic deformation.

UNIT II BULK FORMING 9

Introduction - Plastic deformation in forging, rolling, extrusion, rod/wire, tube drawing and swaging processes and their applications - Effect of friction, calculation of forces, work done, process parameters, equipment’s and defects - Design for manufacturing - Economics of bulk forming.

UNIT III SHEET METAL FORMING 9

Introduction - Sheet metal characteristics - Conventional sheet metal forming processes like shearing, bending and miscellaneous forming processes - High energy rate forming processes - Super plastic forming processes - Deep drawing process - Principles, process parameters, advantages, limitations and applications of the above - Formability of sheet metals - Equipment’s - Defects - Design for manufacturing - Economics of sheet metal forming.

UNIT IV SPECIAL FORMING 9

Orbital forging - Isothermal forging - Hot and cold Isostatic pressing - High speed extrusion - High speed forming machines - Rubber pad forming - Water hammer forming - Fine blanking - Incremental forming and comparing the above with conventional forming.

UNIT V POWDER FORMING 9

Introduction - Powder production methods - Particle size characterization – Blending – Compacting - Sintering - Secondary and finishing operations - Advantages and applications of powder metallurgy - Design for manufacturing - Powder forging, rolling, extrusion, drawing - Economics of powder forging.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Illustrate deformation types and classification of forming processes.
2. Describe bulk forming processes and their applications.
3. Elaborate different sheet metal forming processes and their applications.
4. Compare and distinguish conventional and special forming processes.
5. Discuss powder forming processes and its applications

TEXT BOOKS:

1. Kalpakjian S. and Schmid S.R., “Manufacturing Engineering and Technology”, Pearson., New Delhi, India, 2018.
2. Sadhu Singh, “Theory of plasticity and metal forming processes”, Khanna Publishers, 2008

REFERENCES:

1. Heinz Tschätsch, “Metal Forming Practise: Processes - Machines – Tools”, Springer-Verlag Berlin Heidelberg., Germany, 2006.
2. Juneja B.L., “Fundamentals of Metal forming Processes”, New Age International Publishers Ltd., Chennai, India, 2018.
3. Kumar Surender, “Technology of Metal Forming Processes”, PHI learning Pvt. Ltd., New Delhi, India, 2008.
4. Nagpal G.R.,“Metal Forming Processes”, Khanna Publishers., New Delhi, India, 2000.
5. Mikell P. Groover, “Fundamental of Modern Manufacturing: Materials, Processes and Systems”, John Wiley and Sons Ltd., United States, 2013.

PROGRESS THROUGH KNOWLEDGE

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

GE3451 ENVIRONMENTAL SCIENCES AND SUSTAINABILITY L T P C
2 0 0 2

UNIT - I: ENVIRONMENT AND BIODIVERSITY

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, 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.

UNIT – II: ENVIRONMENTAL POLLUTION

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts.

UNIT – III: RENEWABLE SOURCES OF ENERGY.

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT - IV: SUSTAINABILITY AND MANAGEMENT

Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and Protocols-Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT - V: SUSTAINABILITY PRACTICES

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles-carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio-economic and technological change.

TOTAL: 30 PERIODS

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.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

REFERENCES:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38.
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.
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MF3411 **COMPUTER AIDED PRODUCT DESIGN AND ASSEMBLY LABORATORY** **L T P C**

0 0 4 2

COURSE OBJECTIVES:

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

A) DRAWING STANDARDS & FITS AND TOLERANCES

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

B) 2D DRAFTING

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

C) GEOMETRIC MODELING AND ASSEMBLY

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

- Couplings – Flange, Universal, Oldham's, Muff, Gear couplings
- Joints – Knuckle, Gib & cotter, strap, sleeve & cotter joints
- Engine parts – Piston, connecting rod, cross-head (vertical and horizontal), stuffingbox, multi-plate clutch
- Miscellaneous machine components – Screw jack, machine vice, tail stock, chuck, vane and gear pump.
- Design and Assembly of real time industrial products.
- 3D modeling from 2D product drawing
- Preparation of 2D drawing from 3D model for manufacturing

TOTAL : 60 PERIODS

COURSE OUTCOMES:

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

- Apply standard drawing practices using fits and tolerances.
- Model orthogonal views of machine components.
- Model orthogonal views of assembled components.
- Re-create part drawings, sectional views and assembly drawings as per standards
- Prepare standard drawing layout for modeled parts or assemblies with BoM.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

MF3412 **CNC MACHINING LABORATORY** **LT P C**

0 0 4 2

COURSE OBJECTIVES:

- To introduce the evolution, types and principles of CNC machine tools
- To familiarize the students with constructional features of CNC machine tools
- To familiarize students with manual CNC part programming for milling and turning machines
- To generate part programs using CNC programming and simulation s/w for CNC Lathe, CNC Milling
- To get hands on experience by machining the parts on actual machines like CNC Lathe, CNC milling machine and CNC Wire EDM

LIST OF EXPERIMENTS

1. Study of different types of CNC Machines
2. Study of different control systems and NC codes.
3. Program for Turning, Facing operation and Machining
4. Program for circular interpolation, Taper turning operation and Machining
5. Program for thread cutting operation and Machining
6. Program using Do-Loop and Sub-routine and Machining
7. Program for profile milling operation, circular interpolation and Machining
8. Program for Circular, rectangular pocket milling and Machining
9. Program for drilling cycle and Machining
10. Program for tool compensation and Program offset and Machining
11. NC code generation and Simulation using CAM software packages
12. Simulation of various machining operations using CNC Simulators
13. CAM Programming and CNC milling
14. CAM Programming and CNC Turning
15. Programming and CNC EDM
16. Programming and CNC wire EDM

- Recognize the evolution, types and principle of CNC machine tools
- Acquire knowledge on constructional features of CNC machine tools
- Display competency in manual CNC part programming for milling and turning machines
- Exhibit generation of part programs using CNC programming and simulation s/w for CNC Lathe, CNC Milling
- Demonstrate machining the parts on actual machines CNC Lathe, CNC Milling Machine and CNC Wire EDM.

ANNA UNIVERSITY
PROGRESS THROUGH KNOWLEDGE