



GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University)

Coimbatore - 641 013

Curriculum For M. E. MANUFACTURING ENGINEERING

2023

Regulations

**OFFICE OF THE CONTROLLER OF EXAMINATIONS
GOVERNMENT COLLEGE OF TECHNOLOGY
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GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University)

VISION

To create outstanding Mechanical Engineers with strong domain knowledge and skills capable of working in an Interdisciplinary environment with exemplary ethical values contributing to society through Innovation, Entrepreneurship and Leadership.

MISSION

- To develop in each student, a strong theoretical and practical knowledge, a global outlook for a sustainable future and problem solving skills.
- To make productive members of interdisciplinary teams, capable of adapting to changing environments of Engineering, technology and society.
- To inculcate critical thinking abilities among students to enhance innovative ideas and entrepreneurial skills, leadership qualities.
- To imbibe moral and ethical values along with leadership qualities in students.

FIRST SEMESTER

S. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY COURSES										
1.	23MFFCZ1	RESEARCH METHODOLOGY AND IPR (Common to all branches)	FC	40	60	100	3	0	0	3
2.	23MFFC02	APPLIED MATHEMATICS FOR MANUFACTURING ENGINEERING	FC	40	60	100	3	1	0	4
3.	23MFPC01	THEORY OF METAL CUTTING AND PRACTICES	PC	40	60	100	3	1	0	4
4.	23MFPC02	ADVANCES IN CASTING AND WELDING TECHNOLOGIES	PC	40	60	100	3	0	0	3
5.	23MFPC03	CORROSION AND SURFACE ENGINEERING	PC	40	60	100	3	1	0	4
6.	23MFPEXX	PROFESSIONAL ELECTIVE - I	PE	40	60	100	3	0	0	3
7.	23MFACXX	AUDIT COURSE - I	AC	40	60	100	2*	0	0	0
PRACTICAL COURSES										
8.	23MFPC04	PROCESS MODELING AND SIMULATION LABORATORY	PC	60	40	100	0	0	4	2
TOTAL				340	460	800	20	3	4	23

SECOND SEMESTER

S. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY COURSES										
1.	23MFPC05	OPTIMIZATION TECHNIQUES IN MANUFACTURING	PC	40	60	100	3	1	0	4
2.	23MFPC06	MATERIAL TESTING AND CHARACTERIZATION	PC	40	60	100	3	1	0	4
3.	23MFPC07	INDUSTRIAL AUTOMATION	PC	40	60	100	3	0	0	3
4.	23MFPEXX	PROFESSIONAL ELECTIVE - II	PE	40	60	100	3	0	0	3
5.	23MFPEXX	PROFESSIONAL ELECTIVE - III	PE	40	60	100	3	0	0	3
6.	23MFACXX	AUDIT COURSE - II	AC	40	60	100	2*	0	0	0
PRACTICAL COURSES										
7.	23MFPC08	MODERN MANUFACTURING ENGINEERING LABORATORY	PC	60	40	100	0	0	4	2
8.	23MFEE01	MINI PROJECT	EEC	40	60	100	0	0	4	2
TOTAL				340	460	800	17	2	8	21

THIRD SEMESTER

S. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY COURSES										
1	23MFPEXX	PROFESSIONAL ELECTIVE IV	PE	40	60	100	3	0	0	3
2	23MFOEXX	OPEN ELECTIVE	OE	40	60	100	3	0	0	3
PRACTICAL COURSES										
3	23MFEE02	INTERNSHIP / INDUSTRIAL TRAINING	EEC	100	-	100	-	-	*	2
4	23MFEE03	PROJECT PHASE I	EEC	100	100	200	0	0	12	6
TOTAL				280	220	500	6	0	12	14

* - FOUR WEEKS OF INTERNSHIP / INDUSTRIAL TRAINING

FOURTH SEMESTER

S. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
PRACTICAL COURSES										
1	23MFEE04	PROJECT PHASE II	EEC	200	200	400	0	0	24	12
TOTAL				200	200	400	0	0	24	12

Note:* No Credit Courses

TOTAL CREDITS : 70

LIST OF PROFESSIONAL ELECTIVES										
S. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	L	T	P	C
PROFESSIONAL ELECTIVE I										
1	23MFPE01	DIGITAL MANUFACTURING	PE	40	60	100	3	0	0	3
2	23MFPE02	ADVANCES IN METROLOGY AND MEASUREMENTS	PE	40	60	100	3	0	0	3
3	23MFPE03	INDUSTRY 4.0 AND IoT	PE	40	60	100	3	0	0	3
4	23MFPE04	ADVANCED ENGINEERING MATERIALS AND METALLURGY	PE	40	60	100	3	0	0	3
5	23MFPE05	ADVANCED FINITE ELEMENT METHODS	PE	40	60	100	3	0	0	3
PROFESSIONAL ELECTIVE II										
6	23MFPE06	WEAR ANALYSIS AND CONTROL	PE	40	60	100	3	0	0	3
7	23MFPE07	MACHINE TOOL DRIVES AND CONTROL	PE	40	60	100	3	0	0	3
8	23MFPE08	SENSORS FOR INTELLIGENT MANUFACTURING	PE	40	60	100	3	0	0	3
9	23MFPE09	MEMS AND NEMS	PE	40	60	100	3	0	0	3
10	23MFPE10	LEAN MANUFACTURING SYSTEMS AND IMPLEMENTATION	PE	40	60	100	3	0	0	3
PROFESSIONAL ELECTIVE III										
11	23MFPE11	HIGH SPEED MACHINING	PE	40	60	100	3	0	0	3
12	23MFPE12	SUPPLY CHAIN MANAGEMENT	PE	40	60	100	3	0	0	3
13	23MFPE13	DESIGN FOR MANUFACTURE, ASSEMBLY AND MANUFACTURING ENVIRONMENT	PE	40	60	100	3	0	0	3
14	23MFPE14	THEORY OF METAL FORMING	PE	40	60	100	3	0	0	3
15	23MFPE15	NON-DESTRUCTIVE EVALUATION	PE	40	60	100	3	0	0	3
PROFESSIONAL ELECTIVE IV										
16	23MFPE16	GREEN MANUFACTURING	PE	40	60	100	3	0	0	3
17	23MFPE17	VIBRATION CONTROL AND CONDITION MONITORING	PE	40	60	100	3	0	0	3
18	23MFPE18	PRODUCT DESIGN AND DEVELOPMENT	PE	40	60	100	3	0	0	3
19	23MFPE19	RELIABILITY AND QUALITY ENGINEERING	PE	40	60	100	3	0	0	3
20	23MFPE20	ADVANCES IN MANUFACTURING PROCESSES	PE	40	60	100	3	0	0	3

LIST OF OPEN ELECTIVE COURSES

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	23SEOE01	BUILDING BYE-LAW AND CODES OF PRACTICE	OE	40	60	100	3	0	0	3
2	23SEOE02	PLANNING OF SMART CITIES	OE	40	60	100	3	0	0	3
3	23SEOE03	GREEN BUILDING	OE	40	60	100	3	0	0	3
4	23EEOE04	ENVIRONMENT HEALTH AND SAFETY MANAGEMENT	OE	40	60	100	3	0	0	3
5	23EEOE05	CLIMATE CHANGE AND ADAPTATION	OE	40	60	100	3	0	0	3
6	23EEOE06	WASTE TO ENERGY	OE	40	60	100	3	0	0	3
7	23GEOE07	ENERGY IN BUILT ENVIRONMENT	OE	40	60	100	3	0	0	3
8	23GEOE08	EARTH AND ITS ENVIRONMENT	OE	40	60	100	3	0	0	3
9	23GEOE09	NATURAL HAZARD AND MITIGATION	OE	40	60	100	3	0	0	3
10	23EDOE10	BUSINESS ANALYTICS	OE	40	60	100	3	0	0	3
11	23EDOE11	INTRODUCTION TO INDUSTRIAL SAFETY	OE	40	60	100	3	0	0	3
12	23EDOE12	OPERATIONS RESEARCH	OE	40	60	100	3	0	0	3
13	23MFOE13	OCCUPATIONAL HEALTH AND SAFETY	OE	40	60	100	3	0	0	3
14	23MFOE14	COST MANAGEMENT OF ENGINEERING PROJECTS	OE	40	60	100	3	0	0	3
15	23MFOE15	COMPOSITE MATERIALS	OE	40	60	100	3	0	0	3
16	23TEOE16	GLOBAL WARMING SCIENCE	OE	40	60	100	3	0	0	3
17	23TEOE17	INTRODUCTION TO NANO ELECTRONICS	OE	40	60	100	3	0	0	3
18	23TEOE18	GREEN SUPPLY CHAIN MANAGEMENT	OE	40	60	100	3	0	0	3
19	23PSOE19	DISTRIBUTION AUTOMATION SYSTEM	OE	40	60	100	3	0	0	3
20	23PSOE20	ELECTRICITY TRADING & ELECTRICITY ACTS	OE	40	60	100	3	0	0	3
21	23PSOE21	MODERN AUTOMOTIVE SYSTEMS	OE	40	60	100	3	0	0	3
22	23PEOE22	VIRTUAL INSTRUMENTATION	OE	40	60	100	3	0	0	3
23	23PEOE23	ENERGY MANAGEMENT SYSTEMS	OE	40	60	100	3	0	0	3
24	23PEOE24	ADVANCED ENERGY STORAGE TECHNOLOGY	OE	40	60	100	3	0	0	3
25	23AEOE25	DESIGN OF DIGITAL SYSTEMS	OE	40	60	100	3	0	0	3
26	23AEOE26	BASICS OF NANO ELECTRONICS	OE	40	60	100	3	0	0	3
27	23AEOE27	ADVANCED PROCESSOR	OE	40	60	100	3	0	0	3
28	23VLOE28	HDL PROGRAMMING LANGUAGES	OE	40	60	100	3	0	0	3
29	23VLOE29	CMOS VLSI DESIGN	OE	40	60	100	3	0	0	3
30	23VLOE30	HIGH LEVEL SYNTHESIS	OE	40	60	100	3	0	0	3
31	23CSOE31	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	OE	40	60	100	3	0	0	3
32	23CSOE32	COMPUTER NETWORK ENGINEERING	OE	40	60	100	3	0	0	3
33	23CSOE33	BIG DATA ANALYTICS	OE	40	60	100	3	0	0	3

LIST OF AUDIT COURSES

(Common to all branches)

S. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	HOURS			
							L	T	P	C
1	23MFACZ1	ENGLISH FOR RESEARCH PAPER WRITING	AC	40	60	100	2	0	0	0
2	23MFACZ2	DISASTER MANAGEMENT	AC	40	60	100	2	0	0	0
3	23MFACZ3	VALUE EDUCATION	AC	40	60	100	2	0	0	0
4	23MFACZ4	CONSTITUTION OF INDIA	AC	40	60	100	2	0	0	0
5	23MFACZ5	PEDAGOGY STUDIES	AC	40	60	100	2	0	0	0
6	23MFACZ6	STRESS MANAGEMENT BY YOGA	AC	40	60	100	2	0	0	0
7	23MFACZ7	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	AC	40	60	100	2	0	0	0
8	23MFACZ8	SANSKRIT FOR TECHNICAL KNOWLEDGE	AC	40	60	100	2	0	0	0

SUMMARY OF CREDIT DISTRIBUTION

S.No	Course / Subject Area	Credits					Percentage
		I SEM	II SEM	III SEM	IV SEM	Total	
1.	FC	7	0	0	0	07	10 %
2.	PC	13	13	0	0	26	37.14%
3.	PE	3	6	3	0	12	17.14 %
4.	OE	0	0	3	0	03	4.30 %
5.	AC	0	0	0	0	(Non Credit)	0%
6.	EEC	0	2	8	12	22	31.42 %
Total Credits		23	21	14	12	70	100.00%

CATEGORY-WISE CREDIT DISTRIBUTION

FUNDAMENTAL COURSE (FC)

S. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1.	23MFFCZ1	RESEARCH METHODOLOGY AND IPR (Common to all branches)	FC	40	60	100	3	0	0	3
2.	23MFFC02	APPLIED MATHEMATICS FOR MANUFACTURING ENGINEERING	FC	40	60	100	3	1	0	4
Total				80	120	200	6	1	0	7

PROFESSIONAL CORE (PC)

S. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1.	23MFPC01	THEORY OF METAL CUTTING AND PRACTICES	PC	40	60	100	3	1	0	4
2.	23MFPC02	ADVANCES IN CASTING AND WELDING TECHNOLOGIES	PC	40	60	100	3	0	0	3
3.	23MFPC03	CORROSION AND SURFACE ENGINEERING	PC	40	60	100	3	1	0	4
4.	23MFPC04	PROCESS MODELING AND SIMULATION LABORATORY	PC	60	40	100	0	0	4	2
5.	23MFPC05	OPTIMIZATION TECHNIQUES IN MANUFACTURING	PC	40	60	100	3	1	0	4
6.	23MFPC06	MATERIAL TESTING AND CHARACTERIZATION	PC	40	60	100	3	1	0	4
7.	23MFPC07	INDUSTRIAL AUTOMATION	PC	40	60	100	3	0	0	3
8.	23MFPC08	MODERN MANUFACTURING ENGINEERING LABORATORY	PC	60	40	100	0	0	4	2
Total				360	440	800	18	4	8	26

PROFESSIONAL ELECTIVE (PE)

S. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1.	23MFPEXX	PROFESSIONAL ELECTIVE I	PE	40	60	100	3	0	0	3
2.	23MFPEXX	PROFESSIONAL ELECTIVE II	PE	40	60	100	3	0	0	3
3.	23MFPEXX	PROFESSIONAL ELECTIVE III	PE	40	60	100	3	0	0	3
4.	23MFPEXX	PROFESSIONAL ELECTIVE IV	PE	40	60	100	3	0	0	3
Total				160	240	400	12	0	0	12

OPEN ELECTIVE (OE)

S. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1.	23MFOEXX	OPEN ELECTIVE	OE	40	60	100	3	0	0	3
Total				40	60	100	3	0	0	3

AUDIT COURSE (AC)

S. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1.	23MFACXX	AUDIT COURSE - I	AC	40	60	100	2	0	0	0
2.	23MFACXX	AUDIT COURSE - II	AC	40	60	100	2	0	0	0
Total				80	120	200	4	0	0	0

EMPLOYABILITY ENHANCEMENT COURSE (EEC)

S. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	23MFEE01	MINI PROJECT	EEC	40	60	100	0	0	4	2
2	23MFEE02	INDUSTRIAL TRAINING	EEC	100	0	100	0	0	**	2
3	23MFEE03	PROJECT PHASE I	EEC	100	100	200	0	0	12	6
4	23MFEE04	PROJECT PHASE II	EEC	200	200	400	0	0	24	12
Total				440	360	800	0	0	40	22

**4 WEEKS OF INTERNSHIP / INDUSTRIAL TRAINING

23MFFCZ1	RESEARCH METHODOLOGY AND IPR (Common to all branches)	I
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PREREQUISITES	CATEGORY	L	T	P	C
NIL	FC	3	0	0	3

Course Objectives	1.To impart knowledge on research methodology ,Quantitative methods for problem solving, data interpretation and report writing 2. To know the importance of IPR and patent rights.				
UNIT - I	INTRODUCTION	9 Periods			
Definition and objectives of Research - Types of research, Various Steps in Research process, Mathematical tools for analysis, Developing a research question-Choice of a problem Literature review, Surveying, synthesizing, critical analysis, reading materials, reviewing, rethinking, critical evaluation, interpretation, Research Purposes, Ethics in research - APA Ethics code.					
UNIT - II	QUANTITATIVE METHODS FOR PROBLEM SOLVING	9 Periods			
Statistical Modelling and Analysis, Time Series Analysis Probability Distributions, Fundamentals of Statistical Analysis and Inference, Multivariate methods, Concepts of Correlation and Regression, Fundamentals of Time Series Analysis and Spectral Analysis, Error Analysis, Applications of Spectral Analysis.					
UNIT - III	DATA DESCRIPTION AND REPORT WRITING	9 Periods			
Tabular and graphical description of data: Tables and graphs of frequency data of one variable, Tables and graphs that show the relationship between two variables , Relation between frequency distributions and other graphs, preparing data for analysis. Structure and Components of Research Report, Types of Report, Layout of Research Report, Mechanism of writing a research report, referencing in academic writing.					
UNIT - IV	INTELLECTUAL PROPERTY	9 Periods			
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.					
UNIT - V	PATENT RIGHTS	9 Periods			
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.					
Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total:45 Periods					

REFERENCES

1	Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students" , Juta Academic, 1996.
2	Donald H.McBurney and Theresa White, "Research Methods" , 9th Edition, engageLearning, 2013.
3	RanjitKumar, "Research Methodology: A Step by Step Guide for Beginners" , 5th Edition, 2014.
4	Dr. C. R. Kotharia and GauravGarg, "Research Methodology: Methods and Trends" , New age international publishers, Fourth Edition, 2018.

COURSE OUTCOMES:		Bloom's Taxonomy Mapped
Upon completion of the course, the students will be able to:		
C01	Formulate research question for conducting research.	K4
C02	Analyze qualitative and quantitative data.	K4
C03	Interpret research findings and give appropriate conclusions.	K4
C04	Develop a structured content to write technical report.	K4
C05	Summarize the importance of IPR and protect their research work through intellectual property.	K4

Course Articulation Matrix					
COs/POs	P01	P02	P03	P04	P05
C01	1	2	1	1	2
C02	2	-	-	-	-
C03	3	3	3	2	2
C04	2	2	2	2	2
C05	1	1	1	1	1
23MFFCZ1	2	2	1	2	2
1 – Slight, 2 – Moderate, 3 – Substantial					

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	50	30	20	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	50	30	20	-	-	100
ESE	30	30	20	20	-	-	100

23MFFC02	APPLIED MATHEMATICS FOR MANUFACTURING ENGINEERING	I
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PREREQUISITES	CATEGORY	L	T	P	C
NIL	FC	3	1	0	4

Course Objectives	To gain the concepts of probability, random variables, test of hypothesis, numerical interpolation, numerical differentiation, numerical integration, numerical solution of ordinary differential equations and partial differential equations.				
UNIT – I	PROBABILITY AND RANDOM VARIABLES	9+3 Periods			
Sample Spaces, Events, Probability Axioms, Conditional Probability, Independent Events, Bayes' Theorem. Random Variables: Distribution Functions, Expectation, Moments, Moment Generating Functions.					
UNIT – II	TESTING OF HYPOTHESIS	9+3 Periods			
Large samples: Tests for Mean and Proportions, Small Samples: Tests for Mean, Variance and Attributes using t, F, Chi-Square Distribution.					
UNIT – III	INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION	9+3 Periods			
Interpolation with equal interval: Newton's forward and backward difference methods -Interpolation with unequal intervals: Newton's divided difference and Lagrange's method-Numerical Differentiation: Newton's methods-Numerical integration: Trapezoidal rule and Simpson's 1/3 rd and 3/8 rules.					
UNIT – IV	NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS	9+3 Periods			
Ordinary differential equations: Taylor's series method-Euler and modified Euler's methods – Runge-Kutta method of fourth order for solving first and second order equations-Milne's and Adam's predictor-corrector methods					
UNIT – V	NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS	9+3 Periods			
Partial differential equations: Finite difference solution two dimensional Laplace equation and Poisson equation- Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods)-Finite difference explicit method for wave equation.					
Contact Periods:					
Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods					

REFERENCES:

1	B.S. Grewal, " Higher Engineering Mathematics ", Khanna Publishers, New Delhi, 44 th Edition, 2018.
2	Veerarajan T, " Probability and Random Processes; (with Queuing Theory and Queuing Networks) , McGraw Hill Education(India) Pvt Ltd., New Delhi, 4 th Edition, 2016.
3	Gupta S.C and Kapoor V.K., " Fundamentals of Mathematical Statistics ", Sultan Chand & Sons, New Delhi, 2015.
4	S.S. Sastry, " Introductory Methods of Numerical Analysis ", PHI, New Delhi, 5 th Edition, 2015.
5	Ward Cheney, David Kincaid, " Numerical Methods and Computing ", Cengage Learning, Delhi, 7 th Edition 2013.
6	P. Kandasamy, K. Thilagavathy, K. Gunavathi, " Numerical Methods ", S. Chand & Company, 3 rd Edition, Reprint 2013.
7	S. Larsson, V. Thomee, " Partial Differential Equations with Numerical Methods ", Springer, 2003.
8	Trivedi K.S, " Probability and Statistics with Reliability, Queuing and Computer Science Applications ", Prentice Hall of India, New Delhi.

COURSE OUTCOMES:		Bloom's Taxonomy Mapped
Upon completion of the course, the students will be able to:		
C01	Acquire fluency in solving probability oriented problems	K4
C02	Test for significance of hypothesis connected to small and large samples using different parameters.	K4
C03	Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to polynomial and transcendental equations, derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations.	K4
C04	Construct one-step and linear multistep methods for the numerical solution of initial-value problems for ordinary differential equations and systems of such equations.	K4
C05	Acquire the knowledge of principles for designing numerical schemes for PDEs in particular finite difference schemes, interpret solutions in a physical context of wave and heat equation in specified techniques.	K4

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5
C01	3	2	1	2	1
C02	1	1	2	1	3
C03	3	3	1	1	1
C04	1	2	3	1	2
C05	3	1	1	2	1
23MFFC02	3	2	1	1	1

ASSESSMENT PATTERN - THEORY (Applicable for PG only)							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	30	30	20	-	-	100
CAT2	20	30	30	20	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	30	30	20	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	30	30	20	-	-	100
ESE	20	30	30	20	-	-	100

23MFPC01	THEORY OF METAL CUTTING AND PRACTICES	I
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PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	1	0	4

Course Objectives	To acquire knowledge in orthogonal cutting, oblique cutting, thermal aspects, cutting fluids, cutting tool materials, tool life, tool wear and design of cutting tools.				
UNIT - I	ORTHOGONAL CUTTING	(9+3 Periods)			
Introduction - Machining fundamentals – Metal Cutting - Chip formation - types of chips – Chip breakers - Expression for Shear plane angle - Cutting force and velocity relationship - Ernst and Merchant Upper bound solution - Lee and Shaffer Lower bound solution - Oxley's thin shear zone model - Stress and Strain in the chip - Energy consideration in machining.					
UNIT- II	OBLIQUE CUTTING	(9+3 Periods)			
Direction of Chip flow - Normal, Velocity and Effective Rake angles - Relationship between rake angles - Cutting ratio in oblique cutting - Shear angle and Velocity relationship - Stabler's rule.					
UNIT - III	THERMAL ASPECTS AND CUTTING FLUIDS	(9+3 Periods)			
Heat distributions in machining - Experimental determination and Analytical calculation of Cutting tool temperature -Methods of Controlling Cutting Temperature - Cutting fluids - Effects of cutting fluid - Functions - Requirements -Types and Selection of Cutting Fluids.					
UNIT - IV	CUTTING TOOL MATERIALS, TOOL LIFE AND TOOL WEAR	(9+3 Periods)			
Essential requirements of tool materials – Desirable Properties of tool materials, Characteristics of Cutting Tool Materials, Indexable inserts Coated tools - Tool wear and Tool life - Machinability - Economics of metal machining - Theory of Chatter – ISO specifications for inserts and tool holders.					
UNIT - V	DESIGN OF CUTTING TOOLS	(9+3 Periods)			
Geometry of single-point cutting tool: Tool-in hand system, ASA system, Significance of various angles of single point cutting tools, Orthogonal Rake System (ORS), Conversions between ASA and ORS systems – Graphical and Analytical Methods, Normal Rake System (NRS) & relation with ORS. Drill Geometry and Mechanics of Drilling Process, Geometry of Milling Cutters and Mechanics of Milling process, Mechanics of Grinding (plunge grinding and surface grinding), Grinding wheel wear.					
Contact Periods:					
Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods					

REFERENCES:

1	<i>A. Bhattacharyya, "Metal Cutting Theory and Practice", Central Book Publishers, Calcutta, 2012.</i>
2	<i>Geoffrey Boothroyd and W.A. Knight, "Fundamentals of Machining and Machine Tools", Marcel Dekkor, New York, 2006.</i>
3	<i>M C Shaw, "Metal Cutting Principles", Oxford Press, 2005.</i>
4	<i>B.LJuneja and G.S. Sekhon, "Fundamentals of Metal Cutting and Machine Tools", New Age International Publishers Limited, 2003.</i>

COURSE OUTCOMES:		Bloom's Taxonomy Mapped
Upon completion of the course, the students will be able to:		
C01	Apply the metal cutting theory in engineering materials and employ the various aspects in orthogonal cutting activities.	K3
C02	Evaluate the oblique cutting principle in machinability and practice its various aspects.	K4
C03	Select cutting fluids for different machining conditions	K3
C04	Choose appropriate cutting tools and machining conditions for different materials.	K3
C05	Design the cutting tools for metal removal process.	K4

COURSE ARTICULATION MATRIX

COs/POs	P01	P02	P03	P04	P05
C01	2	1	1	1	3
C02	1	1	3	2	1
C03	3	2	2	1	1
C04	1	3	1	1	2
C05	3	1	2	3	1
23MFPC01	3	1	2	1	1

1 – Slight, 2 – Moderate, 3 – Substantial

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1			50	50			100
CAT2			50	50			100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1			50	50			100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2			50	50			100
ESE			50	50			100

23MFPC02	ADVANCES IN CASTING AND WELDING TECHNOLOGIES	I
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PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objectives	To acquire the metallurgical concepts during solidification of metals & alloys, special casting processes, metallurgical concepts during welding metallurgy, special welding processes, recent advances in casting and welding.				
UNIT – I	CASTING METALLURGY AND DESIGN	9 Periods			
Heat Transfer Between Metal and Mould – Solidification of Pure Metal and Alloys – Shrinkage in Cast Metals – Progressive and Directional Solidification – Principles of Gating and Rising – Degasification of the Melt – Design Considerations in Casting – Designing for Directional Solidification and Minimum Stress – Casting Defects.					
UNIT – II	SPECIAL CASTING PROCESSES	9 Periods			
Shell Molding – Precision Investment Casting – CO ₂ Molding – Centrifugal Casting – Die Casting – Continuous Casting.					
UNIT – III	WELDING METALLURGY AND DESIGN	9 Periods			
Heat Affected Zone and its characteristics – Weldability of Steels, Cast Iron, Stainless Steel, Aluminium and Titanium Alloys – Hydrogen Embrittlement – Lamellar Tearing – Residual Stress – Heat transfer and Solidification – Analysis of Stress in Welded Structures – Pre and Post Welding Heat Treatments – Weld Joint Design – Welding Defects – Testing of Weldment.					
UNIT – IV	UNCONVENTIONAL AND SPECIAL WELDING PROCESSES	9 Periods			
Friction Welding –Friction Stir Welding-Friction Stir Processing-Explosive Welding – Diffusion Bonding – High Frequency Induction Welding – Ultrasonic Welding – Electron Beam Welding – Laser Beam Welding.					
UNIT – V	RECENT ADVANCES IN CASTING AND WELDING	9 Periods			
Layout of Mechanized Foundry – Sand Reclamation – Material Handling in Foundry – Pollution Control in Foundry – Recent Trends in Casting – Computer Aided Design of Castings, Low Pressure Die Casting, Squeeze Casting and Full Mould Casting Process – Automation in Welding – Welding Robots – Overview of Automation of Welding in Aerospace, Nuclear, Surface Transport Vehicles and Under Water Welding.					
Contact Periods:					
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods					

REFERENCES:

1	<i>Richard W. Heine, Carl R. Loper, Philip C. Rosenthal, "Principles of Metal Casting", McGraw Hill Education, 2014.</i>
2	<i>Ghosh, Ghosh Amitabha, Mallik AsokKumar, "Manufacturing Science", EAST WEST, 2010.</i>
3	<i>Chakrabarti A K, "Casting technology and casting alloys", PHI Publishing Co, New Delhi, 2015.</i>
4	<i>P.N.Rao, "Manufacturing Technology (Foundry, Forming and Welding)", 2nd Edition, Tata McGraw Hill Pub.Co. Ltd, 2004.</i>
5	<i>R S Parmar, "Welding Processes and Technology", Khanna Publications, 2013.</i>

COURSE OUTCOMES:		Bloom's Taxonomy Mapped
Upon completion of the course, the students will be able to:		
C01	Apply the Thermal, Metallurgical aspects during solidification in Casting.	K2
C02	Apply on special casting process for specific applications.	K3
C03	Analyze the metallurgical aspects during solidification in welding.	K3
C04	Relate the Unconventional and Special Welding processes for Industrial production of components.	K3
C05	Evaluate the recent advances in Casting and Welding in Industrial applications.	K3

COURSE ARTICULATION MATRIX

COs/POs	P01	P02	P03	P04	P05
C01	1	1	2	1	3
C02	3	2	3	2	1
C03	2	1	2	2	3
C04	3	2	1	2	1
C05	1	3	1	2	2
23MFPC02	2	2	2	2	2
1 - Slight, 2 - Moderate, 3 - Substantial					

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		50	50				100
CAT2			100				100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1		50	50				100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2			100				100
ESE		50	50				100

23MFPC03	CORROSION AND SURFACE ENGINEERING	I
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PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	1	0	4

Course Objectives	To understand the different types of corrosion on engineering structures and testing and prevention of corrosion.				
UNIT - I	MECHANISMS AND TYPES OF CORROSION	(9+3 Periods)			
Principles of direct and Electro Chemical Corrosion, Hydrogen evolution and Oxygen absorption mechanisms – Galvanic corrosion, Galvanic series-specific types of corrosion such as uniform, Pitting, Intergranular, Cavitation’s, Crevice Fretting, Erosion and Stress Corrosion – Factors influencing corrosion					
UNIT - II	TESTING AND PREVENTION OF CORROSION	(9+3 Periods)			
Corrosion testing techniques and procedures – Prevention of Corrosion – Design against corrosion –Modifications of corrosive environment – Inhibitors – Cathodic Protection – Protective surface coatings.					
UNIT - III	CORROSION BEHAVIOR OF MATERIALS	(9+3 Periods)			
Corrosion of steels, stainless steel, Aluminum alloys, copper alloys, Nickel and Titanium alloys corrosion of Polymers, Ceramics and Composite materials.					
UNIT - IV	SURFACE ENGINEERING FOR WEAR AND CORROSION RESISTANCE	(9+3 Periods)			
Diffusion coatings – Electro and Electro less Plating – Hot dip coating – Hard facing, Metal spraying, Flame and Arc processes – Conversion coating – Selection of coating for wear and Corrosion resistance.					
UNIT - V	THIN LAYER ENGINEERING PROCESSES	(9+3 Periods)			
Laser and Electron Beam hardening – Effect of process variables such as power and scan speed – Physical vapor deposition, Thermal evaporation, Arc vaporization, Sputtering, Ion plating – Chemical vapor deposition – Coating of tools, TiC, TiN, Al ₂ O ₃ and Diamond coating – Properties and applications of thin coatings.					
Contact Periods:					
Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods					

REFERENCES:

1	<i>Ken N. Strafford, “Surface Engineering: Processes and Applications”, A Technomic Publication, Lanchester, Pennsylvania, 2018.</i>
2	<i>P. A. Dearnley, “Surface Engineering Basics”, Published online by Cambridge University Press, 2017.</i>
3	<i>J. DuttaMajumdar; I. Manna, “Laser Surface Engineering of Titanium and Its Alloys for Improved Wear, Corrosion and High-Temperature Oxidation Resistance”, Indian Institute of Technology, Kharagpur, India, 2015.</i>
4	<i>Andrew W Batchelor, MargamChandrasekaran Material, “Degradation and Its Control by Surface Engineering”, Bio-Scaffold International Pvt, Ltd, Singapore, 2013.</i>

COURSE OUTCOMES:		Bloom's Taxonomy Mapped
Upon completion of the course, the students will be able to:		
C01	Identify the mechanisms and types of corrosion	K1
C02	Analyze the corrosion and know the prevention of corrosion	K1
C03	Select the type of corrosion in the different materials and its behavior	K3
C04	Evaluate the surface coating for wear and corrosion resistance	K3
C05	Apply thin layer engineering processes for engineering materials	K3

COURSE ARTICULATION MATRIX

COs/POs	P01	P02	P03	P04	P05
C01	1	1	2	2	2
C02	1	1	2	2	2
C03	1	1	2	2	3
C04	1	1	2	3	3
C05	1	2	2	3	3
23MFPC03	1	1	2	1	3

1 - Slight, 2 - Moderate, 3 - Substantial

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	100						100
CAT2			100				100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	100						100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2			100				100
ESE	50		50				100

23MFPC04	PROCESS MODELING AND SIMULATION LABORATORY	I
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PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	0	0	4	2

Course Objectives	To give an overview of various methods of process modeling and different computational techniques for simulation.
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List of Exercises:

1. Model and simulate the Coupling Joint used in Railway Passenger Coaches
2. Model and simulate the Impeller Assembly
3. Model and simulate the Stapler Assembly
4. Model and simulate the Oldham's Coupling
5. Model and analyse the Crane Hook
6. Model and analyse the 3D Printed Components
7. Conduct stress analysis of Axis Symmetric Components using ANSYS
8. Conduct dynamic analysis of Mechanical Engineering Components
9. Make CNC Turning and Milling simulations

Contact Periods:	Lecture: 0 Periods	Tutorial: 0 Periods	Practical: 60 Periods	Total: 60 Periods
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COURSE OUTCOMES:		Bloom's Taxonomy Mapped
Upon completion of the course, the students will be able to:		
C01	Apply the concept of modeling and simulation techniques for different mechanical joints	K3
C02	Apply the techniques in model and simulation for manufacturing assembly	K3
C03	Analyze structural problems for mechanical engineering components	K4
C04	Analyze dynamic problems for mechanical engineering components	K4
C05	Apply the knowledge in the simulation practices in CNC machining	K3

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	2	3	2	1	1
CO2	2	3	2	1	1
CO3	2	3	3	1	1
CO4	3	3	2	1	1
CO5	2	3	2	1	1
23MFPC04	2	3	2	1	1
1 - Slight, 2 - Moderate, 3 - Substantial					

23MFPE01	DIGITAL MANUFACTURING	SEMESTER
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PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	To gain knowledge in concepts of rapid product development, various software tools, processes, techniques of additive manufacturing, industry 4.0, IoT, cloud computing and data analytics.				
UNIT - I	INTRODUCTION	9 Periods			
Rapid Product Development (RPD) – Product Development Cycle – Detail Design– Prototype and Tooling Principle of AM Technologies and Their Classification of AM Systems–Selection of AM Process; Issues in AM – IOT.					
UNIT - II	ADDITIVE MANUFACTURING (AM)	9 Periods			
Stereo Lithography Systems – Fusion Deposition Modeling – Laminated Object Manufacturing – Selective Laser Sintering - Direct Metal Laser Sintering (DMLS) - Three Dimensional Printing - Reverse Engineering - Engineering Applications – 4D Printing – Medical Applications – Principle – Process Parameters – Process Details – Applications – Case Study.					
UNIT - III	PROCESSING POLYHEDRAL DATA	9 Periods			
Polyhedral B-Rep Modeling–STL Format – Defects and Repair of STL Files– Processing STL Files – Overview of the Algorithms Required for RP and RT - Slicing, Support Generation, Feature Recognition.					
UNIT - IV	ADDITIVE TOOLING (AT)	9 Periods			
Introduction to AT –Indirect AT Processes – Silicon Rubber Molding, Epoxy Tooling, Spray Metal Tooling and Investment Casting Direct AT Processes – Laminated Tooling, Powder Metallurgy Based Technologies, Welding Based Technologies, Direct Pattern Making (Quick Cast, Full Mold Casting); Emerging Trends in AT.					
UNIT - V	INDUSTRY 4.0	9 Periods			
Digitalization and the Networked Economy - Introduction to Industry 4.0 - Comparison of Industry 4.0 Factory and Today's Factory - Internet of Things (IoT) - Industrial Internet of Things (IoT) - Smart Devices and Products - Smart Logistics - Support System for Industry 4.0 – Cyber- Physical Systems Requirements - Data as a New Resource for Organizations - Cloud Computing - Trends of Industrial Big Data and Predictive Analytics for Smart Business-Architecture of Industry 4.0.					
Contact Periods:					
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods					

REFERENCES:

1	<i>Kaushik Kumar Divya Zindani, J.Paulo Davim., "Digital Manufacturing and Assembly Systems in Industry 4.0", CRC Press, 2022.</i>
2	<i>Chee Kai & K F Leong "3D Printing and Additive Manufacturing - Principles and Applications", 5th Edition BSP Publishers, 2019.</i>
3	<i>Kaushik Kumar, Divya Zindani, J.Paulo Davim., "Additive Manufacturing Technologies From an Optimization Perspective", IGI Global. 2019.</i>
4	<i>Alp Ustundag, Emre Cevikcan, "Industry 4.0: Managing The Digital Transformation", Springer, 2018.</i>

5	Alasdair Gilchrist, <i>“Industry 4.0: The Industrial Internet of Things”</i> , A Press, 2016.
6	Gibson, I, Rosen, D.W., Stucker, B., <i>“Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing”</i> , 2 nd Edition, Springer, 2015.

COURSE OUTCOMES:		Bloom’s Taxonomy Mapped
Upon Completion of the Course, the Students will be Able to:		
CO1	Apply the Concept of Liquid, Solid and Powder Based Rapid Prototyping Techniques for Rapid Product Development.	K3
CO2	Apply the Rapid Tooling and Software for Rapid Manufacturing to Meet International Needs.	K3
CO3	Select Appropriate Process for Production of a Part/Component that Meet International Standards of Quality and Time Constraints	K3
CO4	To Demonstrate the Basic Technical Understanding of the Physical Principles, Materials, and Operation of the Types of AM Processes.	K4
CO5	Realize the Need of Industry 4.0 and it’s Inter- Connectivity.	K2

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	1	2	1	1	1
CO2	1	1	2	2	1
CO3	2	2	2	1	1
CO4	2	1	2	2	2
CO5	1	2	1	2	3
23MFPE01	1	2	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

ASSESSMENT PATTERN – THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1			100				100
CAT2			50	50			100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1			100				100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2			50	50			100
ESE			50	50			100

23MFPE02	ADVANCES IN METROLOGY AND MEASUREMENTS	SEMESTER
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PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	To gain knowledge in the methods of measurement, selection of measuring instruments, standards of measurement, various measuring instruments, accurate and precise measurement of a given quantity.				
UNIT - I	LASER METROLOGY	9 Periods			
Introduction – Types of Lasers – Laser in Engineering Metrology – Metrological Laser Methods for Applications in Machine Systems – Interferometer Applications – Speckle Interferometer – Laser Interferometers in Manufacturing and Machine Tool Alignment Testing – Calibration Systems for Industrial Robot’s Laser Doppler Technique – Laser Doppler Anemometry.					
UNIT - II	MEASUREMENT OF SURFACE FINISH AND MEASURING MACHINES	9 Periods			
Definitions – Types of Surface Texture: Surface Roughness Measurement Methods– Comparison, Profilometer, 3D Surface Roughness Measurement – Instruments.					
UNIT - III	CO-ORDINATE MEASURING MACHINE	9 Periods			
Co-Ordinate Metrology – CMM Configurations – Hardware Components – Software – Probe Sensors – Displacement Devices – Performance Evaluations – Software – Hardware – Dynamic Errors – Thermal Effects Diagram – Temperature Variations Environment Control – Applications.					
UNIT - IV	OPTO ELECTRONICS AND VISION SYSTEM	9 Periods			
Optoelectronic Devices – CCD – On-Line and In-Process Monitoring in Production –Applications Image Analysis and Computer Vision – Image Analysis Techniques – Spatial Feature – Image Extraction – Segmentation – Digital Image Processing – Vision System for Measurement – Comparison Laser Scanning with Vision System.					
UNIT - V	QUALITY IN MANUFACTURING ENGINEERING	9 Periods			
Importance of Manufacturing Planning for Quality – Concepts of Controllability – Need or Quality Management System and Models – Quality Engineering Tools and Techniques – Statistical Process Control – Six Sigma Concepts – Poka Yoke – Computer Controlled Systems Used in Inspection.					
Contact Periods:					
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods					

REFERENCES:

1	<i>N.V. Raghavendra, L. Krishnamurthy, “Engineering Metrology and Measurements”, Oxford University Press, USA, 2013.</i>
2	<i>Brian cantor, “Automotive Engineering: Light Weight, Functional and Novel Materials”, Taylor and Francis, 2010.</i>
3	<i>S. K. Singh, “Industrial Instrumentation and Control”, 3rd Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2009.</i>
4	<i>B.C. Nakra and K.K. Choudhary, “Instrumentation measurement and analysis”, 3rd Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2009.</i>
5	<i>A.K. Sawhney and Puneet Sawhney, “Mechanical Measurement and Instrumentation and Control”, 12th Edition, Dhanpat Rai& Co, 2009.</i>
6	<i>Thomas G. Beckwith, Roy D. Marangoni and John H. Lienhard V, “Mechanical Measurements” 6th Edition, by, Published by Addison Wesley, 2007.</i>

COURSE OUTCOMES:		Bloom's Taxonomy Mapped
Upon completion of the course, the students will be able to:		
C01	Apply principle of metrology in working of various measuring instruments.	K2
C02	Select the different measuring in the manufacturing inspection	K3
C03	Use the different measuring instruments to measure the qualitative and quantitative characteristics of components.	K2
C04	Analyze the data statistically	K3
C05	Evaluate the data and decision to be taken for controlling the quality complying with international standards.	K3

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5
C01	1	1	1	2	1
C02	1	2	2	2	1
C03	1	2	3	2	1
C04	2	1	1	2	1
C05	1	2	3	2	2
23MFPE02	1	2	2	2	1

1 - Slight, 2 - Moderate, 3 - Substantial

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		50	50				100
CAT2		50	50				100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1		50	50				100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2		50	50				100
ESE		50	50				100

23MFPE03	INDUSTRY 4.0 AND IoT	SEMESTER
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PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	To introduce and familiarize the industry 4.0 physical structure, interconnectivity, architecture, IoT, cloud computing, data analytics, concepts of integrated IoT, cloud computing and data analytics.				
UNIT - I	INDUSTRY 4.0	9 Periods			
Digitalization and the Networked Economy –Introduction to Industry 4.0 - Comparison of Industry 4.0 Factory and Today's Factory –Internet of Things (IoT) –Industrial Internet of Things (IoT) –Smart Devices and Products –Smart Logistics –Support System for Industry 4.0 –Cloud Computing –Trends of Industrial Big Data and Predictive Analytics for Smart Business – Architecture of Industry 4.0.					
UNIT - II	IoT AND ITS PROTOCOLS	9 Periods			
Definitions and Functional Requirements – Motivation – Architecture - Web 3.0 View of IoT – Ubiquitous IoT Applications – Four Pillars of IoT – DNA of IoT – Communication Middleware for IoT – IoT Information Security. IoT Reference Architecture - Unified Data Standards – Protocols – IEEE 802.15.4 – BAC Net Protocol – Modbus –KNX – Zigbee Architecture – Network Layer APS Layer – Security.					
UNIT - III	CLOUD COMPUTING	9 Periods			
Web of Things versus Internet of Things – Two Pillars of the Web – Architecture Standardization for WoT – Platform Middleware for WoT – Unified Multitier WoT Architecture – WoT Portals and Business Intelligence. Cloud of Things: Grid/SOA and Cloud Computing – Cloud Middleware – Cloud Standards – Cloud Providers and Systems – Mobile Cloud Computing – The Cloud of Things Architecture and Data Analytics.					
UNIT - IV	INTEGRATED IoT	9 Periods			
Integrated Billing Solutions in the Internet of Things Business Models for the Internet of Things – Network Dynamics: Population Models – Information Cascades – Network Effects - Network Dynamics: Structural Models – Cascading Behavior in Networks – The Small-World Phenomenon.					
UNIT - V	APPLICATIONS	9 Periods			
The Role of the Internet of Things for Increased Autonomy and Agility in Collaborative Production Environments – Resource Management in the Internet of Things: Clustering, Synchronization and Software Agents–Industry 4.0 in Car Manufacturing – Electronics Manufacturing – IOT Based Building Automation –Agricultural Automation.					
Contact Periods:					
Lecture 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods					

REFERENCES:

1	<i>Kiran Kumar Pabbathi, "Quick Start Guide to Industry 4.0: One-Stop Reference Guide for Industry 4.0", Create space Independent Publishing Platform, 2018.</i>
2	<i>Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", A Press, 2016.</i>
3	<i>Natalie Enright Jerger and Li ShiuanPeh, "On-Chip Networks, Synthesis Lectures on Computer Architecture", Morgan and Claypool Publishers, 2009.</i>
4	<i>Duato J, Yalamanchili S, and Lionel Ni, "Interconnection Networks: An Engineering Approach", Morgan Kaufmann Publishers, 2004.</i>

COURSE OUTCOMES:		Bloom's Taxonomy Mapped
Upon completion of the course, the students will be able to:		
C01	Realize the need of industry 4.0 and its inter-connectivity.	K4
C02	Interpret the architecture of IoT and its protocols	K4
C03	Recognize the uses of cloud computing and data analytics	K4
C04	Familiar the concepts of integrated IoT.	K4
C05	Plan the uses of IoT, cloud computing, data analytics and Industry 4.0 technologies.	K4

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5
C01	2	1	2	1	1
C02	1	2	2	1	2
C03	1	2	1	2	3
C04	1	1	2	1	3
C05	2	2	3	2	2
23MFPE03	1	2	2	1	3

1 - Slight, 2 - Moderate, 3 - Substantial.

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1				100			100
CAT2				100			100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1				100			100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2				100			100
ESE				100			100

23MFPE04	ADVANCED ENGINEERING MATERIALS AND METALLURGY	SEMESTER
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PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	To Gain the Concepts, Fracture Behavior, selection of modern metallic materials and non - metallic materials.				
UNIT - I	ELASTIC AND PLASTIC BEHAVIOR	9 Periods			
Elasticity in Metals and Polymers An Elastic and Visco- Elastic Behavior – Mechanism of Plastic Deformation and Non- Metallic Shear Strength of Perfect and Real Crystals – Strengthening Mechanisms, Work Hardening, Solid Solutioning, Grain Boundary Strengthening, Poly Phase Mixture, Precipitation, Particle, Fiber and Dispersion Strengthening. Effect of Temperature, Strain and Strain Rate on Plastic Behavior – Super Plasticity – Deformation of Non – Crystalline Materials.					
UNIT - II	FRACTURE BEHAVIOUR	9 Periods			
Griffith's theory, Stress Intensity Factor and Fracture Toughness – Toughening Mechanisms – Ductile, Brittle Transition in Steel – High Temperature Fracture, Creep –Larson Miller Parameter – Deformation and Fracture Mechanism Maps – Fatigue, Low and High Cycle Fatigue Test, Crack Initiation and Propagation Mechanisms and Paris Law Effect of Surface and Metallurgical Parameters on Fatigue – Fracture of Non - Metallic Materials – Failure Analysis, Sources of Failure, Procedure of Failure Analysis.					
UNIT - III	SELECTION OF MATERIALS	9 Periods			
Motivation for Selection, Cost Basis and Service Requirements – Selection for Mechanical Properties, Strength, Toughness, Fatigue and Creep – Selection for Surface Durability Corrosion and Wear Resistance – Relationship Between Materials Selection and Processing – Case Studies in Materials Selection With Relevance to Aero, Auto, Marine, Machinery and Nuclear Applications – Computer Aided Materials Selection.					
UNIT - IV	MODERN METALLIC MATERIALS	9 Periods			
Dual Phase Steels, High Strength Low Alloy (HSLA) Steel, Transformation Induced Plasticity (TRIP) Steel, Maraging Steel, Nitrogen Steel – Intermetallics, Ni and Ti-Aluminides – Smart Materials, Shape Memory Alloys – Metallic Glass and Nano Crystalline Materials.					
UNIT - V	NON - METALLIC MATERIALS	9 Periods			
Bio Materials – Polymeric Materials – Formation of Polymer Structure – Production Techniques of Fibers, Foams, Adhesives and Coating – Structure, Properties and Applications of Engineering Polymers – Advanced Structural Ceramics, WC, TiC, TaC, Al ₂ O ₃ , SiC, Si ₃ N ₄ CBN and Diamond – Properties, Processing and Applications.					
Contact Periods					
Lecture: 45 Periods Tutorial: 0 Periods Practical:0 Periods Total: 45 Periods					

REFERENCES:

1	<i>Pravin Kumar, "Basic Mechanical Engineering", Pearson Education; 2nd Edition. 2018.</i>
2	<i>Yongchang Liu, Yingquan Peng, "Advanced Material Engineering - Proceedings Of The 2015 International Conference", World Scientific Publishing Co Pt Ltd, 2015.</i>
3	<i>R. Balasubramaniam, Callister's, "Materials Science and Engineering", Wiley; 2nd Edition 2014.</i>
4	<i>Datta B.K, "Powder Metallurgy: An Advanced Technique of Processing Engineering Materials", Prentice Hall India Learning Private Limited; 2nd edition 2013.</i>

COURSE OUTCOMES:		Bloom's Taxonomy Mapped
Upon completion of the course, the students will be able to:		
CO1	Analyze the Concepts of Material Behavior for Specific Applications.	K3
CO2	Identify the Performance Requirements of a Desired Material for a Specific Engineering Application.	K2
CO3	Select Modern Materials for Automotive and Aerospace Applications.	K2
CO4	Identify and Describe Different Types of Material Processing Techniques for Advanced Materials	K3
CO5	Ability to Select Suitable Material for Specific Applications	K2

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	1	2	2	1	3
CO2	1	1	2	1	1
CO3	2	1	2	1	2
CO4	2	1	2	1	3
CO5	1	2	2	1	3
23MFPE04	1	2	2	1	3
1 - Slight, 2 - Moderate, 3 - Substantial					

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		50	50				100
CAT2		50	50				100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1		50	50				100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2		50	50				100
ESE		50	50				100

23MFPE05	ADVANCED FINITE ELEMENT METHODS	SEMESTER
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PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	To introduce non- linear computational methods to solve problems in solids & structure, basic principles of finite element analysis procedure, solutions to structural, thermal, dynamic and formulation methods in FEM.				
UNIT - I	MATHEMATICAL MODELS	9 Periods			
Modeling and Discretization – Interpolation, Elements, Nodes and degrees-of-freedom. Computational Procedures–Stiffness Matrices – Boundary Conditions–Solution of Equations Ritz Method, Variation Method, Method of Weighted residuals					
UNIT - II	BASIC ELEMENTS	9 Periods			
Interpolation and Shape Functions – Element Matrices – Linear Triangular Elements (CST) – Quadratic Triangular Elements – Bilinear Rectangular Elements – Quadratic Rectangular Elements –Solid Elements – Higher Order Elements – Nodal Loads-Stress Calculations – Example Problems.					
UNIT - III	ISOPARAMETRIC ELEMENTS	9 Periods			
Introduction– Bilinear Quadrilateral Elements – Quadratic Quadrilaterals – Hexahedral Elements – Determination of Shape Functions – Numerical Integration – Quadrature – Static Condensation – Load Considerations – Stress Calculations – Examples Of 2D and 3D Applications.					
UNIT - IV	FINITE ELEMENT FORMULATION FOR STRUCTURAL APPLICATIONS	9 Periods			
Linear Elastic Stress Analysis –2D, 3D and Ax Symmetric Problems – Analysis of Structural Vibration – Mass And Damping Matrices – Damping – Harmonic Response – Direct Integration Techniques – Explicit And Implicit Methods.					
UNIT - V	HEAT TRANSFER AND FLUID MECHANICS APPLICATIONS	9 Periods			
Nonlinear Problems – Element Formulation – Heat Conduction, Fluid flow, etc–Transient Thermal Analysis–Acoustic Frequencies and Modes- Incompressible and Rotational Flows.					
Contact Periods: 45					
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods					

REFERENCES:

1	<i>Gilbert Strang & George Fix, "An Analysis of the Finite Element Method", Wellesley-Cambridge Press,2018.</i>
2	<i>W.B. Bickford, "Advanced Mechanics of Materials", Pearson; 1st Edition, 2015</i>
3	<i>Thomas Apel, "Advanced Finite Element Methods and Applications", Springer; 2013th edition 2014.</i>
4	<i>R. D. Cook & W. C. Young, "Advanced Mechanics of Materials", Pearson; 2nd edition, 2003</i>

COURSE OUTCOMES:		Bloom's Taxonomy Mapped
Upon completion of the course, the students will be able to:		
C01	Apply numerical solutions to elasticity and possibly heat transfer problems using the finite element method.	K2
C02	Describe Energy Theorems and their implementation in the finite element setting	K2
C03	Evaluate approximations associated with the finite element method	K3
C04	Apply convergence requirements and associated modeling techniques and methods.	K4
C05	Select appropriate elements and analysis types given a physical system.	K4

COURSE ARTICULATION MATRIX

COs/POs	P01	P02	P03	P04	P05
C01	1	2	2	1	3
C02	1	2	1	3	3
C03	1	1	3	2	2
C04	1	2	2	3	1
C05	1	1	2	2	3
23MFPE05	1	2	2	2	2
1 – Slight, 2 – Moderate, 3 – Substantial.					

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		100					100
CAT2			50	50			100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1		100					100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2			50	50			100
ESE		50	25	25			100

23MFACZ1	ENGLISH FOR RESEARCH PAPER WRITING <i>(Common to all branches)</i>	SEMESTER
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PREREQUISITES	CATEGORY	L	T	P	C
NIL	AC	2	0	0	0

Course Objectives	The objective of the course is to make the learners understand the format and intricacies involved in writing a research paper.				
UNIT - I	PLANNING AND PREPARATION	6 Periods			
Need for publishing articles, Choosing the journal, Identifying a model journal paper, Creation of files for each section, Expectations of Referees, Online Resources					
UNIT - II	SENTENCES AND PARAGRAPHS	6 Periods			
Basic word in English, Word order in English and Vernacular, placing nouns, Verbs, Adjectives, and Adverb suitably in a sentence, Using Short Sentences, Discourse Markers and Punctuations- Structure of a Paragraph, Breaking up lengthy Paragraphs					
UNIT - III	ACCURACY, BREVITY AND CLARITY (ABC) OF WRITING	6 Periods			
Accuracy, Brevity and Clarity in Writing, Reducing the linking words, Avoiding redundancy, Appropriate use of Relative and Reflexive Pronouns, Monologophobia, verifying the journal style, Logical Connections between others author's findings and yours					
UNIT - IV	HIGHLIGHTING FINDINGS, HEDGING AND PARAPHRASING	6 Periods			
Making your findings stand out, Using bullet points headings, Tables and Graphs- Availing non-experts opinions, Hedging, Toning Down Verbs, Adjectives, Not over hedging, Limitations of your research.					
UNIT - V	SECTIONS OF A PAPER	6 Periods			
Titles, Abstracts, Introduction, Review of Literature, Methods, Results, Discussion, Conclusions, References					
Contact Periods:					
Lecture: 30 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 30Periods					

REFERENCES:

1	Goldbort R, " Writing for Science ", Yale University Press (available on GoogleBooks), 2006.
2	Day R, " How to Write and Publish a Scientific Paper ", Cambridge University Press, 2006.
3	Highman N, " Handbook of Writing for the Mathematical Sciences ", SIAM. Highman's book, 1998.
4	Adrian Wallwork, " English for Writing Research Papers ", Springer New York Dordrecht Heidelberg London, 2011.

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
C01	Understand the need for writing good research paper.	K2
C02	Practice the appropriate word order, sentence structure and paragraph writing	K4
C03	Practice unambiguous writing	K3
C04	Avoid wordiness in writing	K2
C05	Exercise the elements involved in writing journal paper.	K3

Course Articulation Matrix					
COs/POs	P01	P02	P03	P04	P05
C01	3	3	1	1	1
C02	3	3	1	1	1
C03	3	3	1	1	1
C04	3	3	1	1	1
C05	3	3	1	1	1
23MFACZ1	3	3	1	1	1
1 – Slight, 2 – Moderate, 3 – Substantial					

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1/Case Study 1/Seminar 1/Project 1	-	50	50	-	-	-	100
Individual Assessment 2/Case Study 2/Seminar 2/Project 2	-	50	50	-	-	-	100
ESE	30	30	40	-	-	-	100

23MFACZ2	DISASTER MANAGEMENT <i>(Common to all branches)</i>	SEMESTER
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PREREQUISITES	CATEGORY	L	T	P	C
NIL	AC	2	0	0	0

Course Objectives	1. To become familiar in key concepts and consequences about hazards, disaster and area of occurrence. 2. To know the various steps in disaster planning. 3. To create awareness on disaster preparedness and management.				
UNIT - I	INTRODUCTION	6 Periods			
Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude. Areas prone to ,EarthquakesFloods , Droughts, Landslides ,Avalanches ,Cyclone and Coastal Hazards with Special Reference to Tsunami.					
UNIT - II	REPERCUSSIONS OF DISASTERS AND HAZARDS	6 Periods			
Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.					
UNIT - III	DISASTER PLANNING	6 Periods			
Disaster Planning-Disaster Response Personnel roles and duties, Community MitigationGoals, Pre-Disaster Mitigation Plan, Personnel Training, Comprehensive Emergency Management, Early Warning Systems.					
UNIT - IV	DISASTER PREPAREDNESS AND MANAGEMENT	6 Periods			
Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and other Agencies, Media Reports: Governmental and Community Preparedness.					
UNIT - V	RISK ASSESSMENT	6 Periods			
Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment, Strategies for Survival.					
Lecture:30 Periods Tutorial: 0 Periods Practical: 0Periods Total: 30 Periods					

REFERENCES:

1	<i>R. Nishith, Singh AK, "Disaster Management In India: Perspectives, Issues And Strategies", New Royal book Company, 2007.</i>
2	<i>Sahni, PardeepEt.Al. (Eds.), "Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi, 2010</i>
3	<i>Goel S. L, "Disaster Administration And Management Text And Case Studies", Deep &Deep Publication Pvt. Ltd., New Delhi, 2008.</i>
4	<i>Jagbir Singh, "Disaster Management: Future Challenges And Opportunities", I.K. International Publishing House Pvt. Ltd., New Delhi, 2007.</i>
5	<i>Damon Coppola "Introduction To International Disaster Management", Butterworth-Heinemann, 2015</i>
6	<i>Ryan Lanclos "Dealing With Disasters: Gis For Emergency Management",ESRI Press 2021.</i>

COURSE OUTCOMES:		Bloom's Taxonomy Mapped
Upon completion of the course, the students will be able to:		
CO1	Differentiate hazard and disaster with their significance.	K4
CO2	Analyse the causes and impact of natural and manmade disaster.	K4
CO3	Execute the steps involved in disaster planning.	K4
CO4	Predict vulnerability of disaster and to prevent, mitigate their impact.	K4
CO5	Prepare risk assessment strategy for national and global disaster.	K4

Course Articulation Matrix					
COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	2	1	1	2	2
CO2	1	2	1	1	1
CO3	1	1	1	2	2
CO4	1	1	1	2	2
CO5	2	1	1	2	2
23MFACZ2	1	1	1	2	2
1 – Slight, 2 – Moderate, 3 – Substantial					

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	50	50					100
CAT2			100				100
Individual Assessment 1/Case Study 1/Seminar 1/Project 1	50	50					100
Individual Assessment 2/Case Study 2/Seminar 2/Project 2			100				100
ESE	25	25	50				100

23MFACZ3	VALUE EDUCATION <i>(Common to all branches)</i>	SEMESTER
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PREREQUISITES	CATEGORY	L	T	P	C
NIL	AC	2	0	0	0

Course Objectives	1. Value of education and self- development. 2. Requirements of good values in students. 3. Importance of character.				
UNIT - I	ETHICS AND SELF-DEVELOPMENT	6 Periods			
Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements.					
UNIT - II	PERSONALITY AND BEHAVIOR DEVELOPMENT	6 Periods			
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.					
UNIT - III	VALUES IN HUMAN LIFE	6 Periods			
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 - IV	VALUES IN SOCIETY	6 Periods			
True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature.					
UNIT - V	POSITIVE VALUES	6 Periods			
Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.					
Lecture:30 Periods Tutorial: 0 Periods Practical: 0Periods Total: 30 Periods					

REFERENCES:

1	<i>Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi,1998</i>
2	<i>Dr.Yogesh Kumar Singh, "Value Education", A.P.H Publishing Corporation,New Delhi,2010</i>
3	<i>R.P Shukla, "Value Education and Human Rights", Sarup and Sons, NewDelhi,2004</i>
4	https://nptel.ac.in/courses/109104068/36

COURSE OUTCOMES:		Bloom's Taxonomy Mapped
Upon completion of the course, the students will be able to:		
C01	Know the values and work ethics.	K3
C02	Enhance personality and behaviour development.	K3
C03	Apply the values in human life.	K3
C04	Gain Knowledge of values in society.	K3
C05	Know the importance of positive values in human life.	K3

Course Articulation Matrix					
COs/POs	P01	P02	P03	P04	P05
C01	1	1	1	2	2
C02	1	2	1	1	2
C03	1	2	1	2	2
C04	1	1	1	2	2
C05	1	1	2	2	2
23MFACZ3	1	1	1	2	2
1 – Slight, 2 – Moderate, 3 – Substantial					

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1			100				100
CAT2			100				100
Individual Assessment 1/Case Study 1/Seminar 1/Project 1			100				100
Individual Assessment 2/Case Study 2/Seminar 2/Project 2			100				100
ESE			100				100

23MFACZ4	CONSTITUTION OF INDIA (Common to all branches.)	SEMESTER
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PREREQUISITES	CATEGORY	L	T	P	C
NIL	AC	2	0	0	0

Course Objectives	1. To address the importance of constitutional rights and duties 2. To familiarize about Indian governance and local administration. 3. To know about the functions of election commission.				
UNIT - I	INDIAN CONSTITUTION	6 Periods			
History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working) - Philosophy of the Indian Constitution: Preamble Salient Features.					
UNIT - II	CONSTITUTIONAL RIGHTS & DUTIES	6 Periods			
Contours of Constitutional Rights & Duties: 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	6 Periods			
Organs of Governance: 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	LOCAL ADMINISTRATION	6 Periods			
Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayat raj: Introduction, PRI: Zila Panchayat. Elected officials and their roles, CEO Zila Panchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.					
UNIT - V	ELECTION COMMISSION	6 Periods			
Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.					
Lecture:30 Periods Tutorial: 0 Periods Practical: 0Periods Total: 30 Periods					

REFERENCES:

1	<i>"The Constitution of India", 1950 (Bare Act), Government Publication.</i>
2	<i>Dr. S. N. Busi, Dr. B. R. Ambedkar "Framing of Indian Constitution", 1st Edition, 2015.</i>
3	<i>M. P. Jain, "Indian Constitution Law", 7th Edn., Lexis Nexis, 2014.</i>
4	<i>D.D. Basu, "Introduction to the Constitution of India", Lexis Nexis, 2015.</i>

COURSE OUTCOMES:		Bloom's Taxonomy Mapped
Upon completion of the course, the students will be able to:		
C01	Discuss the growth of the demand for civil rights in India.	K2
C02	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.	K2
C03	Know the various organs of Indian governance.	K2
C04	Familiarize with the various levels of local administration.	K2
C05	Gain knowledge on election commission of India.	K2

Course Articulation Matrix					
COs/POs	PO1	PO2	PO3	PO4	PO5
C01	1	1	1	2	2
C02	1	1	2	1	2
C03	1	2	1	1	2
C04	1	1	1	2	2
C05	1	1	1	2	2
23MFACZ4	1	1	1	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		100					100
CAT2		100					100
Individual Assessment 1/Case Study 1/Seminar 1/Project 1		100					100
Individual Assessment 2/Case Study 2/Seminar 2/Project 2		100					100
ESE		100					100

23MFACZ5	PEDAGOGY STUDIES <i>(Common to all branches)</i>	SEMESTER
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PREREQUISITES	CATEGORY	L	T	P	C
NIL	AC	2	0	0	0

Course Objectives	1. To Understand of various theories of learning, prevailing pedagogical practices and design of curriculum in engineering studies. 2. Application of knowledge in modification of curriculum, its assessment and introduction of innovation in teaching methodology.				
UNIT - I	INTRODUCTION	6 Periods			
Introduction and Methodology: 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	PEDAGOGICAL PRACTICES	6 Periods			
Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education. Evidence on the effectiveness of pedagogical practices Methodology for the in depth stage: quality assessment of included studies.					
UNIT - III	PEDAGOGICAL APPROACHES	6 Periods			
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. Teacher's attitudes and beliefs and Pedagogic strategies.					
UNIT - IV	PROFESSIONAL DEVELOPMENT	6 Periods			
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	CURRICULUM AND ASSESSMENT	6 Periods			
Research gaps and future directions Research design Contexts Pedagogy Teacher education Curriculum and assessment Dissemination and research impact.					
Lecture:30 Periods Tutorial: 0 Periods Practical: 0Periods Total: 30 Periods					

REFERENCES:

1	<i>Ackers J, Hardman F ,Classroom interaction in Kenyan primary schools,Compare, 31 (2): 245-261, 2001.</i>
2	<i>Alexander RJ ,Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell, 2001</i>
3	<i>Akyeampong K, Lussier K, Pryor J, Westbrook J,Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272-282, 2013.</i>
4	<i>Agrawal M ,Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379, 2004</i>

COURSE OUTCOMES:		Bloom's Taxonomy Mapped
Upon completion of the course, the students will be able to:		
C01	Explain the concept of curriculum, formal and informal education systems and teacher education.	K3
C02	Explain the present pedagogical practices and the changes occurring in pedagogical approaches	K3
C03	Know the relation between teacher and community, support from various levels of teachers to students and limitation in resources and size of the class.	K3
C04	Perform research in design a problem in pedagogy and curriculum development.	K3

Course Articulation Matrix					
COs/POs	P01	P02	P03	P04	P05
C01	1	2	1	2	2
C02	1	1	2	1	1
C03	1	2	1	1	1
C04	1	2	1	1	1
23MFACZ5	1	2	1	1	1

1 – Slight, 2 – Moderate, 3 – Substantial

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1			100				100
CAT2			100				100
Individual Assessment 1/Case Study 1/Seminar 1/Project 1			100				100
Individual Assessment 2/Case Study 2/Seminar 2/Project 2			100				100
ESE			100				100

23MFACZ6	STRESS MANAGEMENT BY YOGA <i>(Common to all branches)</i>	SEMESTER
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PREREQUISITES	CATEGORY	L	T	P	C
NIL	AC	2	0	0	0

Course Objectives	1. To create awareness on the benefits of yoga and meditation. 2. To understand the significance of Asana and Pranayama.				
UNIT – I	PHYSICAL STRUCTURE AND ITS FUNCTIONS				6 Periods
Yoga - Physical structure, Importance of physical exercise, Rules and regulation of simplified physical exercises, hand exercise, leg exercise, breathing exercise, eye exercise, kapalapathy, maharasana, body massage, acupressure, body relaxation.					
UNIT – II	YOGA TERMINOLOGIES				6 Periods
Yamas - Ahimsa, satya, astheya, bramhacharya, aparigraha Niyamas- Saucha, santosha, tapas, svadhyaya, Ishvarapranidhana.					
UNIT – III	ASANA				6 Periods
Asana - Rules & Regulations – Types & Benefits					
UNIT – IV	PRANAYAMA				6 Periods
Regularization of breathing techniques and its effects-Types of pranayama					
UNIT – V	MIND				6 Periods
Bio magnetism & mind - imprinting & magnifying – eight essential factors of living beings, Mental frequency and ten stages of mind, benefits of meditation, such as perspicacity, magnanimity, receptivity, adaptability, creativity.					
Lecture:30 Periods Tutorial: 0 Periods Practical: 0Periods Total: 30 Periods					

REFERENCES:

1	<i>Janardan Swami Yogabhyasi Mandal, "Yogic Asanas for Group Training-Part-I", Nagpur.</i>
2	<i>Swami Vivekananda, "Rajayoga or conquering the Internal Nature", Advaita Ashrama (Publication Department), Kolkata.</i>
3	<i>Pandit Shambhu Nath, "Speaking of Stress Management Through Yoga and Meditation", New Dawn Press, New Delhi, 2016.</i>
4	<i>K. N. Udupa, "Stress and its management by Yoga", Motilal Banarsidass Publishers, New Delhi, 2007.</i>

COURSE OUTCOMES:		Bloom's Taxonomy Mapped
Upon completion of the course, the students will be able to:		
CO1	Practice physical exercises and maintain good health.	K3
CO2	Attain knowledge on the various concepts of Yoga.	K3
CO3	Perform various Asanas with an understanding on their benefits.	K3
CO4	Practice breathing techniques in a precise manner.	K3
CO5	Attain emotional stability and higher level of consciousness.	K3

Course Articulation Matrix					
COs/POs	P01	P02	P03	P04	P05
C01	-	-	-	2	2
C02	-	-	-	2	1
C03	-	-	-	1	2
C04	-	-	-	2	1
C05	-	-	-	1	2
23MFACZ6	-	-	-	2	2
1 – Slight, 2 – Moderate, 3 – Substantial					

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		50	50				100
CAT2			100				100
Individual Assessment 1/Case Study 1/Seminar 1/Project 1		50	50				100
Individual Assessment 2/Case Study 2/Seminar 2/Project 2			100				100
ESE		50	50				100

23MFACZ7	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS <i>(Common to all branches)</i>	SEMESTER
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PREREQUISITES	CATEGORY	L	T	P	C
NIL	AC	2	0	0	0

Course Objectives	1. To familiar with Techniques to achieve the highest goal in life. 2. To become a person with stable mind, pleasing personality and determination.				
UNIT - I					6 Periods
Neetisatakam-Holistic development of personality-Verses- 19,20,21,22 (wisdom)-Verses29,31,32 (pride & heroism)-Verses- 26,28,6.					
UNIT - II					6 Periods
Verses- 52,53,59 (don't's)-Verses- 71,73,75,78 (do's). - Approach to day to day work and duties.- Shrimad BhagwadGeeta - Chapter 2-Verses 41, 47,48,					
UNIT - III					6 Periods
Shrimad BhagwadGeeta -Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,- Chapter 18-Verses 45, 46, 48.					
UNIT - IV					6 Periods
Statements of basic knowledge.-Shrimad BhagwadGeeta: -Chapter2-Verses 56, 62, 68 -Chapter 12 -Verses 13, 14, 15, 16,17, 18-Personality of Role model.					
UNIT - V					6 Periods
Shrimad BhagwadGeeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, Chapter 4-Verses 18, 38,39-Chapter18 - Verses 37,38,63.					
Lecture:30 Periods Tutorial: 0 Periods Practical: 0Periods Total: 30 Periods					

REFERENCES:

1	Swami SwarupanandaAdvaita Ashram " Srimad Bhagavad Gita ", AdvaitaAshrama , Kolkata,2016
2	P.Gopinath, Rashtriya Sanskrit Sansthanam" Bhartrihari's Three Satakam " (Niti-sringar-vairagya), New Delhi, 1986.
3	Swami Mukundananda, JagadguruKripalujiYog" Bhagavad Gita: The Song Of God ", USA,2019
4	A.C. Bhaktivedanta Swami Prabhupada" Bhagavad-Gita As It Is ",Bhaktivedanta Book Trust Publications,2001.

COURSE OUTCOMES:		Bloom's Taxonomy Mapped
Upon completion of the course, the students will be able to:		
CO1	Apply the Holistic development in life.	K4
CO2	Effective Planning of day to day work and duties.	K4
CO3	Identify mankind to peace and prosperity.	K4
CO4	Develop versatile personality.	K4

Course Articulation Matrix					
COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	-	-	-	1	1
CO2	-	-	-	2	1
CO3	-	-	-	1	1
CO4	-	-	-	2	1
23MFACZ7	-	-	-	2	1
1 - Slight, 2 - Moderate, 3 - Substantial					

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1				100			100
CAT2				100			100
Individual Assessment 1/Case Study 1/Seminar 1/Project 1				100			100
Individual Assessment 2/Case Study 2/Seminar 2/Project 2				100			100
ESE				100			100

23MFACZ8	SANSKRIT FOR TECHNICAL KNOWLEDGE (Common to all branches)	SEMESTER
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PREREQUISITES	CATEGORY	L	T	P	C
NIL	AC	2	0	0	0

Course Objectives	1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world. 2. Learning of Sanskrit to improve brain functioning. 3. Enhancing the memory power. 4. Learning of Sanskrit to develop the logic in mathematics, science & other subjects.				
UNIT - I	BASICS OF SANSKRIT	6 Periods			
Alphabets in Sanskrit, Past/Present/Future Tense.					
UNIT - II	SENTENCES AND ROOTS	6 Periods			
Simple Sentences - Order, Introduction of roots.					
UNIT - III	SANSKRIT LITERATURE	6 Periods			
Technical information about Sanskrit Literature					
UNIT - IV	TECHNICAL CONCEPTS -1	6 Periods			
Technical concepts of Engineering-Electrical, Mechanical					
UNIT - V	TECHNICAL CONCEPTS -2	6 Periods			
Technical concepts of Engineering-Architecture, Mathematics					
Lecture:30 Periods Tutorial: 0 Periods Practical: 0Periods Total: 30 Periods					

REFERENCES:

1	Dr.Vishwas, " Abhyaspustakam ", Samskrita-Bharti Publication, New Delhi, 2020.
2	Prathama DeekshaVempatiKutumbshastri, " Teach Yourself Sanskrit ", Rashtriya Sanskrit Sansthanam, New Delhi, Publication, 2009.
3	Suresh Soni, " India's Glorious Scientific Tradition ", Ocean books (P) Ltd., New Delhi,2006.

COURSE OUTCOMES:		Bloom's Taxonomy Mapped
Upon completion of the course, the students will be able to:		
CO1	Recognize ancient literature and their basics	K3
CO2	Formulate the sentences with order and understand the roots of Sanskrit	K3
CO3	Acquire familiarity of the major traditions of literatures written in Sanskrit	K3
CO4	Distinguish the Technical concepts of Electrical & Mechanical Engineering	K3
CO5	Categorize the Technical concepts of Architecture & Mathematics	K3

Course Articulation Matrix					
COs/POs	PO1	PO2	PO3	PO4	PO5
C01	1	2	1	2	2
C02	1	2	-	1	2
C03	1	1	1	1	2
C04	2	1	1	1	1
C05	1	2	1	1	1
23MFACZ8	1	2	1	1	2
1 – Slight, 2 – Moderate, 3 – Substantial					

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		50	50				100
CAT2		50	50				100
Individual Assessment 1/Case Study 1/Seminar 1/Project 1		50	50				100
Individual Assessment 2/Case Study 2/Seminar 2/Project 2		50	50				100
ESE		50	50				100