Gayatri Vidya Parishad College for Degree and PG Courses (A)

Department of Mechanical Engineering

Accredited by NBA and NAAC

B.Tech MECHANICAL ENGINEERING PROGRAM (R - 22)

SEMESTER-I

Sl. No.	Code Number	Category	Course	Hours per week			Allotment of Marks		Total Marks	Credits
				L	T	P	Internal	External		
1	2209101	BSC	Engineering Mathematics -I	3	0	0	30	70	100	3
2	2209104	BSC	Engineering Physics	3	0	0	30	70	100	3
3	2209106	ESC	Engineering Graphics	1	0	4	30	70	100	3
4	2209107	ESC	Computer Programming with C and Numerical Methods	3	0	0	30	70	100	3
5	2209108	ESC	Electrical and Electronics Engineering	3	0	0	30	70	100	3
6	2209110P	ESC	Workshop	0	0	3	50	50	100	1.5
7	2209104P	BSC	Physics Lab	0	0	3	50	50	100	1.5
8	2209107P	ESC	Computer Programming with C and Numerical Methods Lab	0	0	3	50	50	100	1.5
			Total	**13**	**0**	**13**				**19.5**

SEMESTER-II

Sl. No.	Code Number	Category	Course	Hours per week			Allotment of Marks		Total Marks	Credits
				L	T	P	Internal	External		
1	2209201	BSC	Engineering Mathematics -II	3	0	0	30	70	100	3
2	2209203	BSC	Green Chemistry	3	0	0	30	70	100	3
3	2209209	HSSC	English	3	0	0	30	70	100	3
4	2209205	ESC	Engineering Mechanics	3	0	0	30	70	100	3
5	2209206	ESC	Data Structures	3	0	0	30	70	100	3
6	2209209P	HSSC	English Language Lab	0	0	3	50	50	100	1.5
7	2209203P	BSC	Engineering Chemistry Lab	0	0	3	50	50	100	1.5
8	2209205P	ESC	Electrical & Electronics Engineering Lab	0	0	3	50	50	100	1.5
			Total	**15**	**0**	**9**				**19.5**

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SEMESTER III

(II Year I Semester)

Sl. No.	Code	Category	Course Title	Hours per week			Allotment of Marks		Total Marks	Credits
				L	T	P	Internal	External		
1	2295301	BSC	Engineering Mathematics-III	3	0	0	30	70	100	3
2	2295302	PCC	Strength of Materials	3	0	0	30	70	100	3
3	2295303	HSSC	Professional Ethics & Universal Human Values	3	0	0	30	70	100	3
4	2295304	PCC	Basic Thermodynamics	3	0	0	30	70	100	3
5	2295305	PCC	Manufacturing Processes	3	0	0	30	70	100	3
6	2295306P	PCC	Fuels and Mechanics Lab	0	0	3	50	50	100	1.5
7	2295302P	PCC	Strength of Materials Lab	0	0	3	50	50	100	1.5
8	2295307S	SOC	Internet Of Things	1	0	2	50	50	100	2
9	2295308	PCC	Mechanical Engineering Drawing	0	0	3	50	50	100	1.5
			Total	**16**	**0**	**11**	**350**	**550**	**900**	**21.5**

SEMESTER IV

(II Year II Semester)

Sl. No.	Code	Category	Course Title	Hours per week			Allotment of Marks		Total Marks	Credits
				L	T	P	Internal	External		
1	2295401	PCC	Applied Thermodynamics	3	0	0	30	70	100	3
2	2295402	PCC	Kinematics of Machinery	3	0	0	30	70	100	3
3	2295403	PCC	Metal cutting & Machine tools	3	0	0	30	70	100	3
4	2295404	PCC	Fluid Mechanics and Machinery	3	0	0	30	70	100	3
5	2295405	ESC	Metallurgy and Material science	3	0	0	30	70	100	3
6	2295406	MC	Environmental Science	3	0	0	30	70	100	0
7	2295403P	PCC	Manufacturing Technology Lab-I	0	0	3	50	50	100	1.5
8	2295404P	PCC	FMM Lab	0	0	3	50	50	100	1.5
9	2295407S	SOC	Computer Aided Drafting	1	0	2	50	50	100	2
			Total	**19**	**0**	**8**	**330**	**570**	**900**	**20**
10	**2295408**	**PCC**	**Minor course-I**	**3**	**1**	**0**	**30**	**70**	**100**	**4**
11	**2295409**	**PCC**	**Honors Course-I**	**3**	**1**	**0**	**30**	**70**	**100**	**4**

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SEMESTER V

(III year I Semester)

Sl. No.	Code	Category	Course Title	Hours per week			Allotment of Marks		Total Marks	Credits
				L	T	P	Internal	External		
1	2295501	PCC	Theory of Machines-II	3	0	0	30	70	100	3
2	2295502	ESC	Metrology	3	0	0	30	70	100	3
3	2295503	PEC	Elective-I	3	0	0	30	70	100	3
4	2295504	PEC	Elective-II	3	0	0	30	70	100	3
5	2295505O	OEC	Open Elective-I	3	0	0	30	70	100	3
6	2295502P	PCC	Metrology Lab	0	0	3	50	50	100	1.5
7	2295506P	PCC	Manufacturing Technology Lab-II	0	0	3	50	50	100	1.5
8	2295507S	SOC	Introduction to Microsoft Essentials	1	0	2	50	50	100	2
9	2295508	MC	Community Service Project	0	0	0	0	100	100	1.5
			Total	**19**	**0**	**8**	**330**	**670**	**1000**	**21.5**
10	**2295509**	PCC	**Minor Course-II**	**3**	**1**	**0**	**30**	**70**	**4**	**4**
11	**2295510**	PCC	**Honors Course-II**	**3**	**1**	**0**	**30**	**70**	**4**	**4**

SEMESTER VI

(III year II Semester)

Sl. No.	Code	Category	Course Title	Hours per week			Allotment of Marks		Total Marks	Credits
				L	T	P	Internal	External		
2	2295601	PCC	Heat Transfer	3	0	0	30	70	100	3
3	2295602	PCC	Production Planning and Control	3	0	0	30	70	100	3
4	2295603	PCC	Design of Machine Elements - I	3	0	0	30	70	100	3
5	2295604	PEC	Elective - III	3	0	0	30	70	100	3
6	2295605O	OEC	OEC-II	3	0	0	30	70	100	3
7	2295606S	SOC	Python programming lab	1	0	2	50	50	100	2
8	2295607P	PCC	Engines and Mechanisms Lab	0	0	3	50	50	100	1.5
9	2295608P	PCC	Heat Transfer Lab	0	0	3	50	50	100	1.5
10	2295608	MOOC	MOOCS	0	0	3	30	70	100	1.5
			Total	**16**	**0**	**8**	**330**	**570**	**900**	**21.5**
10	**2295609**	PCC	**Minor Course-III**	**3**	**1**	**0**	**30**	**70**	**4**	**4**
11	**2095610**	PCC	**Honors Course-III**	**3**	**1**	**0**	**30**	**70**	**4**	**4**

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SEMESTER VII

(IV year I Semester)

Sl. No.	Code	Category	Course Title	Hours per week			Allotment of Marks		Total Marks	Credits
				L	T	P	Internal	External		
1	2295701	PCC	Design of Machine Elements - II	3	0	0	30	70	100	3
2	2295702	HSSC	HSSC Elective	3	0	0	30	70	100	3
3	2295703	PEC	Elective-IV	3	0	0	30	70	100	3
4	2295704O	OEC	OEC-III	3	0	0	30	70	100	3
5	2295705O	OEC	OEC-IV	3	0	0	30	70	100	3
6	2295706	PROJECT	Mini-Project/Summer Internship	0	0	3	100	0	100	1.5
7	2295707P	PCC	CAD& CAE Lab	0	0	3	50	50	100	1.5
8	2295708P	PCC	Industrial Engineering Lab	0	0	3	50	50	100	1.5
9	2295709S	SOC	Scilab	1	0	2	50	50	100	2
			Total	**16**	**0**	**11**	**400**	**500**	**900**	**21.5**
11	**2295710**	PCC	**Minor Course-IV**	**3**	**1**	**0**	**30**	**70**	**4**	**4**
12	**2295711**	PCC	**Honors Course-IV**	**3**	**1**	**0**	**30**	**70**	**4**	**4**

SEMESTER VIII

(IV year II Semester)

Sl. No.	Code	Category	Course Title	Hours per week			Allotment of Marks		Total Marks	Credits
				L	T	P	Internal	External		
1	2295801	PROJECT	PROJECT	0	0	0	50	50	100	15
			Total	0	0	3	80	120	200	15

BSC : BASIC SCIENCE COURSE

PCC : PROFESSIONAL CORE COURSE

ESC : ENGINEERING SCIENCE COURSE

PEC : PROFESSIONAL ELECTIVE COURSE

OEC : OPEN ELECTIVE COURSE

MC : MANDATORY COURSE

HSSC : HUMANITIES AND SOCIAL SCIENCES COURSE

SOC : SKILL ORIENTED COURSE

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PROFESSIONAL ELECTIVE COURSES

Elective-I:

2295504A Advanced Strength of Materials
2295504B Rapid Prototyping
2295504C Work Study
2295504D Power Plant Engineering

Elective-II:

2295505A Unconventional Machining Process
2295505B Condition Monitoring
2295505C Total Quality Management
2295506D Automobile Engineering

Elective-III:

2295605A Project Management
2295605B Composite Materials
2295605C CAD/CAM
2295605D Finite Element Analysis

Elective-IV:

2295703A Robotics
2295703B Statistical Quality Control
2295703C Renewable Energy Technologies
2295703D Heating Ventilation Air- conditioning and Refrigeration

HSSC Elective

2295705A Operations Research
2295705B Industrial Engineering and Entrepreneurship

OPEN ELECTIVE COURSES

Open Elective Course-I	: 2295505O	Basic Mechanical Engineering
Open Elective Course-II	: 2295605O	Industrial Engineering
Open Elective Course-III	: 2295704O	Additive Manufacturing
Open Elective Course-IV	: 2295705O	Non-Conventional Energy Sources

SKILL ORIENTED COURSES

Skill Oriented Course-I	: 2295307S	Internet Of Things
Skill Oriented Course –II	: 2295407S	Computer Aided Drafting
Skill Oriented Course -III	: 2295507S	Introduction to Microsoft Essentials
Skill Oriented Course -IV	: 2295606S	Python Programming Lab
Skill Oriented Course-V	: 2295709S	SCI LAB

MINORS COURSES

Thermal Engineering	:2295408
Production Technology	:2295509
Production Planning and control	:2295609
Materials Technology	:2295710

HONORS COURSES

Master in CAD	2295409
Smart Materials	2295510
Flexible Manufacturing Systems	:2295610
Green Manufacturing	2295711

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	I-I	I-II	II-I	II-II	III-I	III-II	IV-I	IV-II	TOTAL R22	As per APSCHE	TOTAL R20	
BSC	7.5	7.5	3						18	21	18	Less 14%
PCC			13.5	15	6	12	6		52.5	51	64.5	Above 26%
ESC	12	7.5		3	3				25.5	24	21.5	Less 10%
PEC					6	3	3		12	15	12	Less 20%
OEC					3	3	6		12	12	12	Equal
MC				0	1.5				1.5	0	1.5	Extra
HSSC		4.5	3				3		10.5	10.5	4.5	Less 57%
SOC			2	2	2	2	2		10	10	10	Equal
PROJECT							3	13.5	16.5	16	11.5	Less 28%
MOOCS						1.5			1.5		1.5	
TOTAL	19.5	19.5	21.5	20	21.5	21.5	23	13.5	160			

BSC : BASIC SCIENCE COURSE

PCC : PROFESSIONAL CORE COURSE

ESC : ENGINEERING SCIENCE COURSE

PEC : PROFESSIONAL ELECTIVE COURSE

OEC : OPEN ELECTIVE COURSE

MC : MANDATORY COURSE

HSSC : HUMANITIES AND SOCIAL SCIENCES COURSE

SOC : SKILL ORIENTED COURSE

GAYATRI VIDYA PARISHAD

COLLEGE FOR DEGREE AND PG COURSES (AUTONOMOUS) **R22**

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ENGINEERING AND TECHNOLOGY PROGRAM

DEPARTMENT OF MECHANICAL ENGINEERING

SEMESTER - VII

(IV year I Semester)

Sl. No.	Code	Category	Course Title	Hours per week			Allotment of Marks		Total Marks	Credits
				L	T	P	Internal	External		
1	2295701	PCC	Design of Machine Elements - II	3	0	0	30	70	100	3
2	2295702	HSSC	Operations Research	3	0	0	30	70	100	3
3	2295703	PEC	Elective IV	3	0	0	30	70	100	3
4	2295704O	OEC	Open Elective-III	3	0	0	30	70	100	3
5	2295705O	OEC	Open Elective - IV	3	0	0	30	70	100	3
6	2295706	PROJECT	Mini-Project / Summer Internship	0	0	3	100	0	100	1.5
7	2295707P	PCC	CAD & CAE Lab	0	0	3	50	50	100	1.5
8	2295708P	PCC	Industrial Engineering Lab	0	0	3	50	50	100	1.5
9	2295709S	SOC	Applications in Mechanical Engineering using Scilab	1	0	2	50	50	100	2
			Total	**16**	**0**	**8**	**330**	**570**	**900**	**21.5**
10	2295710	PCC	**Minor Course-IV**	**3**	**1**	**0**	**30**	**70**	**4**	**4**
11	2095711	PCC	**Honors Course-IV**	**3**	**1**	**0**	**30**	**70**	**4**	**4**

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ENGINEERING AND TECHNOLOGY PROGRAM

DEPARTMENT OF MECHANICAL ENGINEERING

PROFESSIONAL ELECTIVE COURSES

Elective-IV	2295703A	Robotics
	2295703B	Statistical Quality Control
	2295703C	Renewable Energy Technologies
	2295703D	Heating Ventilation Air-conditioning and Refrigeration

SKILL ORIENTED COURSES

Skill Oriented Course	2295709S	Applications in Mechanical Engineering using Scilab

OPEN ELECTIVE COURSES

Open Elective Course-III	2295704O	Additive Manufacturing
Open Elective Course-IV	2295705O	Non-Conventional Energy Sources

MINORS COURSES

Minor Course-IV	2295710	Materials Technology

HONORS COURSES

Honors Course-IV	2295711	Green Manufacturing

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ENGINEERING AND TECHNOLOGY PROGRAM

DEPARTMENT OF MECHANICAL ENGINEERING

DESIGN OF MACHINE ELEMENTS-II

Course code	:	2295701
Year /sem	:	IV-I
L-T-P	:	3-0-0
Credits	:	03
Contact Hours	:	04
Pre-requisite	:	Engineering Mechanics, Strength of Materials, Material Science
CO#	**Course Outcome**	
	By the end of this course, the student will be able to	
CO 1	Apply and analyze different spur gear systems under variable loading conditions.	
CO 2	Solve various stresses and design different components of IC Engines	
CO 3	Understand the design of clutches, brakes and apply it to various working conditions.	
CO 4	Select appropriate bearing and calculate bearing life.	
CO 5	Design wire ropes and chain drives for the given working conditions.	

Syllabus:

UNIT-I

Design of Gears: Classification, Terminology, Gear manufacturing methods, Gear materials. Design of Spur gears -Tooth failure, Face width and beam strength. Lewis equation. Design for dynamic and wear loads.
Design of Helical gears – virtual number of teeth, Force analysis, Beam strength, wear strength of helical gears.

UNIT-II

Design of IC Engine Parts: Design of cylinder – Cylinder, Cylinder liner, Cylinder Head, Studs; Design of piston – Head, Cup, piston rings, Skirt; Design of Connecting rod – Cross section, big and Small end bearings, bolts.

UNIT-III

Design of Friction clutches: Classification of clutches, Torque carrying capacity - single plate and multi-plate clutches. Design considerations-Energy considerations and Temperature rise, friction materials.

Design of Brakes: Classification of brakes, Energy equations, Band brake (Simple band brake) and block brakes (short shoe block brake), self-locking of brakes.

DEPARTMENT OF MECHANICAL ENGINEERING

UNIT-IV

Design of Sliding contact bearings: Types of journal bearings, Lubrication modes – hydrostatic and hydrodynamic lubrication, Temperature effect on viscosity, Bearing modulus. McKee equations, Design procedure of journal bearing.

Design of Rolling Contact bearings: Classification, Static and dynamic load carrying capacity, Equivalent bearing load, Load-life relationships. Selection of bearings from manufacturer`s catalogue.

UNIT-V

Design of wire ropes: Wire rope construction and classification, Stresses in wire ropes, Design of wire ropes (simple problems)

Design of Chain Drives: Classification, Terminology, Geometrical relationships, power rating of roller chains, design procedure for chain drives (simple problems).

Text books :

1. Design of Machine Elements by V.B.Bhandari, McGraw Hill Education (India) Private Limited, New Delhi, Fifth edition
2. Mechanical Engineering Design by Shigley's, Richard G. Budynas, J. Keith Nisbett. McGraw Hill Education (India) Private Limited, New Delhi, 11th edition (2020)

Reference books :

1. Machine Design by R.K.Jain, Khanna Publications, 1st Ed. (First Reprint 2024)
2. Design of Machine Elements by M. F. Spotts, T. E. Shoup, L. E. Hornberger, A P Harsha, Eighth edition (2019); Pearson India
3. Machine Design by Dr.N.C.Pandya and Dr.C.S.Shaw, Charotar publications, 21st edition.
4. A Textbook of Machine Design by R.S.Khurmi and J.K.Gupta, S.Chand Publishers; 25th edition (2020)

Note: Design Databook is allowed for the End Examination

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SYLLABUS APPROVED & RATIFIED
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GAYATRI VIDYA PARISHAD COLLEGE FOR DEGREE AND PG COURSES (A)
ENGINEERING AND TECHNOLOGY PROGRAM
IV year B.Tech DEGREE EXAMINATION.
I SEMESTER-END EXAMINATIONS (R22 REGULATION)
DESIGN OF MACHINE ELEMENTS – II (2295701)
(Effective from the admitted batch of 2022-2023)
MODEL QUESTION PAPER

Time: Three hours **Maximum: 70 marks**

Part-A is compulsory each question carries 2
Answer all questions from Part-B
Each question in Part- B will carry 12 marks
All parts of the questions must be answered at one place only

1.		PART – A		
	a.	Mention the causes for failure in gear tooth?	CO 1	2 M
	b.	What are the forces acting on connecting rod?	CO 2	2 M
	c.	What is the function of a brake?	CO 3	2 M
	d.	Explain briefly about bearing modulus?	CO 4	2 M
	e.	Classify different types of chain drives	CO 5	2 M
		PART – B		
2	a.	What is Beam strength of gear tooth?	CO 1	03 M
	b.	Design a spur gear with 20^0 full depth involute teeth consisting of 30 teeth pinion meshing with 50 teeth gear. The pinion shaft is connected to 22.5 kW, 1450 rpm electric motor. The starting torque is 150% of rated torque. The material is plain carbon steel (S_{ut} = 410 N/mm^2). While the gear is made of grey C.I (S_{ut} = 200 N/mm^2) the factor of safety is 1.5	CO 1	09 M
		OR		
3	a.	Explain the difference between spur gear and bevel gear?	CO 1	02 M
	b.	A pair of bevel gears, with 20°pressure angle, consists of a 20 teeth pinion meshing with a 30 teeth gear. The module is 4 mm, while the face width is 20 mm. The material for the pinion and gear is steel 50C4 (S_{ut} = 750 N/mm^2). The gear teeth are lapped and ground (Class-3) and the surface hardness is 400 BHN. The pinion rotates at 500 rpm and receives 2.5 kW power from the electric motor. The starting torque of the motor is 150% of the rated torque. Determine the factor of safety against bending failure and against pitting failure	CO 1	10 M
4	a.	A four stroke diesel engine has the following specifications: B.P = 5 kW; Speed = 1200 rpm; Indicated mean effective pressure = 0.35 MPa; Mechanical efficiency = 80%; Determine- a. Bore and length of the cylinder; b. Thickness of the cylinder head and c. Size of the studs for the cylinder head.	CO 2	12 M
		OR		
5	a.	Design a connecting rod for a four stroke petrol engine with the following data: Piston diameter = 0.10 m; stroke = 0.14 m; length of connecting rod = 0.315 m; weight of reciprocating parts = 18.2 N; speed = 1500 rpm with a possible	CO 2	12 M

		speed over 2500 rpm; compression ratio = 4:1; probable maximum explosion pressure = 2.45 MPa		
6	a.	A simple band brake operates on a drum 0.6 m in diameter that is running at 200 rpm. The coefficient of friction is 0.25. The brake band has a contact of 270^0 and at one end is fastened to a fixed pin and the other end to the brake arm is 0.125 m from the pin. The straight brake arm is 0.75 m long and is placed perpendicular to the diameter that bisects the angle of contact What is the minimum necessary pull on the end of the brake to stop the wheel if 30 kW of power is absorbed? What is the direction of rotation for this minimum pull?	CO 3	08 M
	b.	Explain the detailed design procedure of block brakes?	CO 3	04 M
		OR		
7	a.	Derive the torque transmission capacity of single plate clutch?	CO 3	04 M
	b.	A single plate clutch is designed to transfer a power of 10 kW at 2000 rpm. The equivalent mass and radius of gyration for the input shaft are 20 kg and 75 mm respectively. The equivalent mass and radius of gyration of output shaft are 35 kg and 125 mm. Calculate: a. The time required to bring the output shaft to rated speed from rest. b. Heat generated during clutching operation	CO 3	08 M
8	a.	A single-row deep groove ball bearing is subjected to a radial force of 8 kN and thrust force of 3 kN. The values of X and Y factors are 0.56 and 1.5 respectively. The shaft rotates at 1200 rpm. The diameter of the shaft is 75 mm and Bearing No. 6315 (C =112 000 N) is selected for this application. a. Estimate the life of this bearing, with 90% reliability. b. Estimate the reliability for 20 000 h life.	CO 4	08 M
	b.	Explain about static load carrying capacity of a bearing	CO 4	04 M
		OR		
9	a.	Why lubrication is done? Differentiate between hydrostatic and hydrodynamic lubrication	CO 4	04 M
	b.	The following data is given for full hydrodynamic bearing: radial load=1200N, journal speed = 1440 rpm, journal diameter = 50 mm, static load on journal bearing = 350 N. the values of surface roughness of journal and bearing is 2 and 1. The minimum oil thickness should be 05 times the sum of surface roughness of journal and bearing. Calculate: radial clearance, minimum oil film thickness, viscosity of lubricant.	CO 4	08 M
10	a.	Classify wire ropes with neat diagrams	CO 5	04 M
	b.	A workshop crane is lifting a load of 25 kN through a wire rope and a hook. The weight of the hook etc. is 15 kN. The rope drum diameter may be taken as 30 times the diameter of the rope. The load is to be lifted with an acceleration of 1 m/s^2. Calculate the diameter of the wire rope. Take a factor of safety of 6 and Young's modulus for the wire rope 80 kN/mm^2. The ultimate stress may be taken as 1800 MPa. The cross-sectional area of the wire rope may be taken as 0.38 times the square of the wire rope diameter	CO 5	08 M
		OR		
11	a.	Explain the design procedure for chain drives	CO 5	06 M
	b.	A single-strand chain No. 12A is used in a mechanical drive. The driving sprocket has 17 teeth and rotates at 1000 rpm. What is the factor of safety used for standard power rating? Neglect centrifugal force acting on the chain.	CO 5	06 M

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ENGINEERING AND TECHNOLOGY PROGRAM

DEPARTMENT OF MECHANICAL ENGINEERING

OPERATIONS RESEARCH

Course code	:	2295702
Year / Sem	:	IV-I
L-T-P	:	3-0-0
Credits	:	03
Contact Hours	:	04
Pre-requisite	:	Basics of Engineering Mathematics
CO#	**Course Outcome**	
	By the end of this course, the student will be able to	
CO 1	Learned to translate a real-world problem into a mathematical formulation	
CO 2	Formulate and Solve Transportation, Assignment and sequencing problems.	
CO 3	Resolve inventory problems.	
CO 4	Able to solve maximum flow and shortest path problems.	
CO 5	Capable to solve replacement problems and analyze queuing models.	

Syllabus :

UNIT-I

Introduction: Definitions of Operations Research; Phases of Operations Research; Types of Operations Research models; applications, merits and demerits of Operations Research.

Allocation: Linear Programming problem formulation; Basic assumptions; Graphical solution; Simplex method; Artificial variable technique; Two phase method; Big M method; Duality principle; Primal and Dual relation.

UNIT-II

Transportation: Formulation; Solution methods; Unbalanced transportation problems - North west corner rule; Least cost entry method; Vogel's approximation method; Optimal solution; degeneracy.

Assignment: Formulation; Variations in Assignment problem; Travelling salesman problem.
Sequencing: Sequencing of - n jobs through two machines; n jobs through three machines; n jobs through m machines; 2 jobs through m machines.

DEPARTMENT OF MECHANICAL ENGINEERING

UNIT-III

Inventory Control: Introduction; Types of Inventory; Inventory costs; Deterministic models - Economic order quantity (EOQ) and Economic Production Quantity (EPQ) with and without shortages; Quantity discounts; P system; Q system; Inventory control Techniques.

UNIT-IV

Network Analysis: Network definitions; Time estimates in network analysis; Labeling using Fulkerson's rule; Forward pass computations; Backward pass computations; Project management using Critical Path Method (CPM) and Programme Evaluation and Review Technique (PERT).

UNIT-V

Replacement: Introduction, Replacement of items that deteriorate with time - Value of money unchanging and changing, Replacement of items that fail completely.

Queuing models: Introduction; Single channel Poisson arrivals; Exponential service times; unrestricted queue with infinite population and finite population models; Multi channel Poisson arrivals; Exponential service times with infinite population and restricted queue.

Text books:

1. Operations Research- An Introduction, Hamdy Taha, Pearson India, Tenth edition (2019).
2. Introduction to Operations Research, F.S. Hiller, G.J. Liberman, B. Nag and P.Basu, McGraw Hill Education; Tenth edition (2017).
3. Operations Research, S.D.Sharma, Kedarnadh Ramnadh & Co.,2017

Reference books:

1. Operations Research, R. Panneerselvam PHI Learning; 3rd edition (2023).
2. Operations Research, Richard Bronson, Schaum's Series, McGraw Hill Education; 2nd edition (2017).
3. Operations Research- Theory and Practice, N.V.S.Raju, CRC Press; 1st edition (2023).
4. Operations Research, V.K. Kapoor, Sultan Chand & Sons (2012)
5. Operations Research, Kanti Swaroop, P.K. Gupta, Man Mohan, Sulthan Chand & Sons (2010).

SYLLABUS APPROVED & ADOPTED
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S. Rajesh

GAYATRI VIDYA PARISHAD
COLLEGE FOR DEGREE AND PG COURSES (AUTONOMOUS)
ENGINEERING & TECHNOLOGY PROGRAM
IV/IV B. Tech. :: MECHANICAL ENGINEERING
SEMESTER – I
SUBJECT :: OPERATIONS RESEARCH

(w.e.f 2022 -2023 admitted batch)

Date: **Max. Marks: 70**

TIME:

PART - A

1 **Answer All of the following questions** **5 x 2 = 10M**

a) What is meant by degenerate optimum solution? [CO 1]
b) Discuss degeneracy in transportation problems. [CO 2]
c) Explain about inventory. [CO 3]
d) What is meant by no passing rule? [CO 4]
e) Importance of replacement. [CO 5]

PART - B

Answer the following questions **5 x 12= 60 M**

2 (a) Solve the following LP problem using simplex method [CO 1]
Maximize $z = 4x_1 + 10x_2$ [6 M]
Subject to

$$2x_1 + x_2 \leq 50$$
$$2x_1 + 5x_2 \leq 100$$
$$2x_1 + 3x_2 \leq 90$$
$$x_1 \geq 0, x_2 \geq 0$$

(b) Solve the following LP problem using Big M method [CO 1]
Maximize $z = 6x_1 + 4x_2$ [6 M]
Subject to

$$2x_1 + 3x_2 \leq 30$$
$$3x_1 + 2x_2 \leq 24$$
$$x_1 + x_2 \geq 3$$
$$x_1, x_2 \geq 0$$

OR

3 Solve the following LP problem using Two Phase method [CO 1]
Maximize $z = 5x_1 + 3x_2$ [12M]
Subject to

$$2x_1 + x_2 \leq 1$$
$$x_1 + 4x_2 \geq 6$$
$$x_1, x_2 \geq 0$$

4 Find the initial basic feasible solution to the following TP using least cost method and also find optimum solution. [CO 2] [12M]

	A	B	C	D	Available
P	5	4	4	6	20
Q	11	3	7	7	30
R	8	9	11	6	50
Required	10	40	20	30	

(OR)

5 (a) Solve the travelling salesman problem [CO 2] [6 M]

	A	B	C	D	E
A	-	5	9	7	9
B	7	-	7	6	7
C	12	4	-	10	11
D	7	8	6	-	9
E	8	5	9	7	-

(b) How to solve assignment problem? Explain. [CO 2] [6 M]

6 The annual demand for a component is 7,200 units. The carrying cost is Rs. 500/unit/year, the ordering cost is Rs. 1500 per order and the shortage cost is Rs. 2000/unit/year. Find the optimal values of economic order quantity, maximum inventory, maximum shortage quantity, cycle time, inventory period and shortage period. [CO 2] [12M]

(OR)

7 Alpha industry needs 15,000 units per year of a bought-out component which will be used in tis main product. The ordering cost is Rs. 125 per order and the carrying cost per unit per year is 20% of the purchase price per unit. The purchase price per unit is Rs. 75. Find economic order quantity, number of orders per year and time between successive orders. [CO 3] [12M]

8 A small project is composed of nine activities whose time estimates are listed in the following table: [CO 4] [12M]

Activity	t_0	t_p	t_m
1-2	5	10	8
1-3	18	22	20
1-4	26	40	33
2-5	16	20	18
2-6	15	25	20
3-6	6	12	9
4-7	7	12	10

5-7	7	9	8
6-7	3	5	4

i) Find the expected task time and their variance.
ii) Earliest and latest expected time of each node.
iii) Critical path
iv) Probability that project will complete in 41.5 weeks and 44weeks.

OR

9 (a) W< X, Y means X and Y cannot start until W is completed; X, Y < W means W cannot start until X and Y are completed). With this notation construct the network diagram having the following constraints: [CO 4] [6 M]

A < D, E; B, D < F; C< G; B, G < H; F, G < I.

Find also the time of completion of the project, total float and free float, when the time (in days) of completion of each task is as follows:

task	A	B	C	D	E	F	G	H	I
time	23	8	20	16	24	18	19	4	10

(b) Distinguish between CPM and PERT.

10 (a) A manufacturer is offered two machines A and B. A is priced at Rs. 5000, and running costs are estimated at Rs.800 for each of the first five years, increased by Rs. 200 per year in the sixth and subsequent years. Machine B, which has the same capacity as A, costs Rs. 2500 but will have running costs of Rs. 1200 per year for six year thereafter. If money is worth 10% per year, which machine should be purchased?(Assume that the machine will eventually be sold for scrap at a negligible price? [CO 5] [6 M]

(b) Consider the following single-server queue: the inter-arrival time is exponentially distributed with a mean of 10 minutes and the service time has the uniform distribution with a maximum of 9 minutes and a minimum of 7 minutes, find the (i) mean wait in the queue, (ii) mean number in the queue, (iii) the mean wait in the system, (iv) mean number in the system and (v) proportion of time the server is idle. [CO 5] [6 M]

OR

11 The following failure rates have been observed for a certain type of transistors in a digital computer: [CO 5] [12 M]

End of the week	1	2	3	4	5	6	7	8
Probability of failure to date	0.05	0.13	0.25	0.43	0.68	0.88	0.96	1.00

The cost of replacement an individual failed transistor is Rs. 1.25. The decision is made to replace all these transistors simultaneously at fixed intervals, and to replace the individual transistor as they fail in service. If the cost of group replacement is 30 paise per transistor, what is the best interval between group replacements? At what group replacement price per transistor would a policy of strictly individual replacement become preferable to the adopted policy? (Assume there are 1000 transistor)

NOTE : Course outcomes (CO) which convey what the student learns from each unit of the syllabus.

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S. Rasch

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ENGINEERING AND TECHNOLOGY PROGRAM

DEPARTMENT OF MECHANICAL ENGINEERING

ROBOTICS

Course code	:	2295703A (Elective-IV)
Year /sem	:	IV-I
L-T-P	:	3-0-0
Credits	:	03
Contact Hours	:	04
Pre-requisite	:	Theory of Machines
CO#	**Course Outcome**	
	By the end of this course, the student will be able to	
CO 1	Explain the architecture and functions of robotic systems	
CO 2	Perform forward and inverse kinematic analysis of robotic manipulators.	
CO 3	Explain the dynamics of robotic arms	
CO 4	Integrate various sensors (e.g., encoders, IMUs, cameras) for environmental perception.	
CO 5	Write robot control programs and execute basic robotic tasks using simulation or real hardware.	

Syllabus:

UNIT-I

Introduction: Introduction: Background- Historical Development-Robot Arm kinematics and Dynamics- Manipulator Trajectory Planning and Motion Control-Robot Sensing- Robot Programming Language- Machine Intelligence.

UNIT-II

Robot Arm Kinematics: Introduction – The Direct Kinematics Problem-The Inverse Kinematics Solution

UNIT-III

Robot Arm Dynamics: Introduction – Lagrange-Euler Formulation- Newton-Euler Formation - Generalized D'Alemberts Equations of Motion

UNIT-IV

Planning & Control of Robotic Manipulators: Planning of Manipulator Trajectories: Introduction-General Considerations on Trajectory Planning- Joint Interpolated Trajectories-Planning of Manipulator Cartesian Path Trajectories.

Control of Robot Manipulators: Introduction – Control of the Puma Robot arm- Computed Torque Technique- near Minimum Time Control- Variable Structure Control- Nonlinear Decoupled Feedback Control- Resolved Motion Control- Adaptive Control.

UNIT-V

Sensing: Sensing: Introduction-Range Sensing-Proximity Sensing- Touch Sensors- Force and Torque Sensing.

Low-Level Vision: Introduction –Image acquisition- Illumination Techniques- Imaging Geometry- Some Basic Relationship between Pixels – Pre-processing.

Robot Programming Languages: Introduction- Characteristics of Robot Level Languages- Characteristics of Task Level Languages.

Text books :

1. **Robotics** by K.S. Fu, R.C. Gonzalez and C.S.G Lee, McGraw-Hill International Editions, 1987

Reference books :

2. Industrial Robotics by M.P.Groover, Mitchell Weiss, Roger N. Nagel and N.G.Odrey, McGraw- Hill International Editions 1986,
3. Robot Analysis- The Mechanics of Serial and Parallel Manipulators By Lung-Wen Tsai, Wiley-Interscience; 1st edition (1999)

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ENGINEERING AND TECHNOLOGY PROGRAM

DEPARTMENT OF MECHANICAL ENGINEERING

STATISTICAL QUALITY CONTROL

Course code	:	2295703B (Elective-IV)
Year /sem	:	IV-I
L-T-P	:	3-0-0
Credits	:	03
Contact Hours	:	04
Pre-requisite	:	Basic Statistics, Fundamentals of Probability and Sampling
CO#	**Course Outcome**	
	By the end of this course, the student will be able to	
CO 1	Interpret the concept of quality and summarize main TQM philosophies and their significance	
CO 2	Evaluate process quality performance by using control charts under variables consideration	
CO 3	Construct control charts for attributes using given defect or defective data.	
CO 4	Describe the steps involved in process capability analysis and explain what capability indices indicate about a process	
CO 5	Explain the principles of single, double, multiple, and sequential sampling plans and describe how OC-Curves, AOQ, and ATI relate to sampling plan performance.	

Syllabus:

UNIT-I

Introduction to quality - definitions of quality, dimensions of quality, phases of quality, quality control, costs of quality; Concept of Total quality management: TQM Philosophies - Deming's philosophy, Taguchi's philosophy; concept of Taguchi's loss function. (Simple problems).

UNIT-II

Introduction to control charts for variables, Concept of variability: types of variability; Introduction to control charts - objectives and uses of control charts; control charts for variables - $\bar{X}$ - R and Sigma control charts, control chart patterns: Average run length (ARL) and Average time to signal (ATS) - Simple problems on control charts for variables.

UNIT-III

Introduction to Control charts for attributes; Area of application attribute control charts; *p*-chart, *np* - chart, c- chart, u- chart, demerit control chart - Simple problems on control charts

for attributes.

UNIT-IV

Process capability analysis: Process capability analysis using frequency distribution; Process capability analysis using control charts; Process capability analysis using process capability ratios - C_p and C_{pk}; Process capability ratios for nominal the better type, smaller the better type and larger the better type product specifications. (Simple problems only).

UNIT-V

Introduction Acceptance sampling: Sampling methods; Single, double, multiple and sequential sampling plans; OC-Curve; AOQ, AOQL; ATI; Design of single and sequential sampling plans. (Simple problems only).

Text books:

1. Statistical Quality Control, Mahajan, Dhanpatrai & Co., 3rd edition
2. Statistical Quality Control, Eugene Grant, Richard Leavenworth, 7th edition, McGraw Hill Education

Reference books:

1. Fundamentals of Quality Control and Improvement, Amitava Mitra, 4th edition, John Wiley & Sons
2. Introduction to statistical quality control by Douglas C. Montgomery, 6th edition, John Wiley & Sons.
3. Statistical Quality Control & Quality Management by R.C. Gupta, 10th edition.

Note: Statistical tables are permitted during Examination

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ENGINEERING AND TECHNOLOGY PROGRAM
IV year B.Tech DEGREE EXAMINATION.
I SEMESTER-END EXAMINATIONS (R22 REGULATION)
STATISTICAL QUALITY CONTROL (2295703B)
(Effective from the admitted batch of 2022-2023)
MODEL QUESTION PAPER

Time: Three hours **Maximum: 70 marks**

Part-A is compulsory each question carries 2 marks
Answer all questions from Part-B
Each question in Part- B will carry 12 marks

PART-A

1.	a)	Define the term quality?	2M CO-1
	b)	Distinguish between Chance and Assignable causes.	2M CO-2
	c)	Write the difference between defect and defectives?	2M CO-3
	d)	What is meant by process capability?	2M CO-4
	e)	What is AOQ, LTPD . ?	2M CO-5

PART-B

2.		What is Deming's philosophy? Explain briefly.	12M CO-1
		(OR)	
3.		State the various stages of which need to be controlled for ensuring proper quality of product and ensuring improvement in quality.	12M CO-1
4.	a)	State the objectives of X-bar and R- charts.	6M CO-2
	b)	A drilling machine bores holes with mean diameter of 0.52mm. And standard deviation of 0.004mm. Calculate 2- sigma, 3- sigma upper and lower control limits of sample size 4 and prepare a control chart.	6M CO-2
		(OR)	
5.	a)	What is Type I Type II errors.	6M CO-2
	b)	In the production of certain rods a process is said to be in control if the outside the dia have a mean of 2.5 cm. and standard deviation of 0.002cm. Construct a	6M CO-2

control charts for means of the random samples of size 4. Means of such random samples of 10 taken are as follows.

2.5076	2.4962	2.4995	2.4993	2.4971
2.5001	2.5022	2.4966	2.5040	2.5014

6. Nonconformities in automobiles fall into three categories: serious, major, and minor. Twenty- five samples of five automobiles are chosen, and the total number of nonconformities in each category is reported. The following Table shows the results. Assuming a weighing system of 50, 10, and 1 for serious, major, and minor nonconformities, respectively, construct a demerits per unit control chart. Revise the control limits if necessary, assuming special causes for points that are out of control. 12M CO-3

Sample No.	Serious Defects	Major Defects	Minor Defects	Sample No.	Serious Defects	Major Defects	Minor Defects
1	0	5	8	6	0	3	10
2	0	3	2	7	0	1	5
3	1	0	6	8	1	2	9
4	1	2	1	9	0	4	6
5	0	6	3	10	2	6	2

(OR)

7. 10 samples of each size of a pipe were inspected in pressure testing. The results of the inspection are shown below. 12M CO-3

Sample no.	1	2	3	4	5	6	7	8	9	10
No.of defectives	2	3	2	1	2	3	2	1	2	2

Draw a suitable chart and state your conclusion.

8. a) Define PCI. How do you find PCI for a smaller the better types of quality characteristics? 6M CO-4

b) What is C_{PK}? Explain its significance. 6M CO-4

(OR)

9. a) Explain the procedure to estimate the process capability using control charts. 6M CO-4

b) Explain the steps involved in process capability 6M CO-4

10. Draw O.C.curve for the single sampling plan choosing at least 10 points. 12M CO-5

N = 1000, n = 80, c = 2.

(OR)

11. a) Draw O.C.curve for the single sampling plan choosing at least 10 points 6M CO-5

N = 1000, n = 80, c = 2.

b) Design a single sampling plan for the following, AOQ = 3%, LTPD = 10%, α = 5%, β = 10% 2019 6M CO-5

For the double sampling plan given below find the probability of acceptance of 3% defective lots.

n1 = 60 n2 = 100 c1 = 1 c2 =5

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ENGINEERING AND TECHNOLOGY PROGRAM

DEPARTMENT OF MECHANICAL ENGINEERING

RENEWABLE ENERGY TECHNOLOGIES

Course code	:	2295703C (Elective-IV)
Year /sem	:	IV-I
L-T-P	:	3-0-0
Credits	:	03
Contact Hours	:	04
Pre-requisite	:	Applied Thermodynamics, Fluid Mechanics
CO#	**Course Outcome**	
	By the end of this course, the student will be able to	
CO 1	Realize the importance and usage of alternate energy sources instead of conventional energy sources	
CO 2	Acquire and apply the principles of solar energy its measurements on various solar energy collectors and accrue the knowledge about energy storage and applications	
CO 3	Identify and analyse wind energy characteristics and types of wind mills.	
CO 4	Understand the concept of bio energy conversion and their applications.	
CO 5	Understand the concepts and applications of geothermal, ocean, tidal, wave energies and MHD, thermoelectric power generation and fuel cells.	

Syllabus:

UNIT-I

Energy Scenario: Indian energy scenario in various sectors, domestic, industrial, commercial, agriculture, transportation and others, Present conventional energy status, Present renewable energy status, Potential of various renewable energy sources, Global energy status, Per capita energy consumption in various countries.

UNIT-II

Principles of Solar Radiation: Physics of the sun, the solar constant, Extraterrestrial and terrestrial solar radiation, Solar radiation on titled surface-no derivations, Instruments for

measuring solar radiation and sun shine, Solar radiation data.

Solar Energy Collection and its Applications: Flat plate and concentrating collectors, Classification of concentrating collectors, Advanced collectors. Solar energy storage and applications: Different methods, Sensible, Latent heat and stratified storage, Solar ponds. Solar Applications- Solar heating and cooling technique, Solar distillation and drying, Photovoltaic energy conversion.

UNIT-III

Wind Energy: Wind data and energy estimation – Betz limit - Site selection for wind farms – characteristics Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues - Applications.

UNIT-IV

Bio-Energy: Bio resources – Biomass direct combustion – thermo-chemical conversion - biochemical conversion mechanical conversion - Biomass gasifier: Types of biomass gasifiers, applications, Biogas plants: Types of biogas Digesters: KVIC, Chinese, Taiwanese and hybrid models-construction, Biodiesel production, Ethanol production - Applications.

UNIT-V

Ocean and Geothermal Energy: Small hydro, Tidal energy, Wave energy: Open and closed OTEC Cycles, Limitations Geothermal energy: Geothermal energy sources, Types of geothermal power plants, Applications.

Additional Alternate Energy Sources: MHD Power Generation: Open cycle and closed cycle systems, advantages. Thermoelectric power generator, Thermoelectric materials. Fuel cells-classification, advantages and disadvantages.

Text books:

1. G.D. Rai, Non-Conventional Energy Sources, Khanna Publishers, 5th Edition.
2. Renewable Energy Technologies by Ramesh and Kumar, Narosa Publications, 1997.

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Reference books:

1. Renewable Energy Sources by Twidell & Weir, Routledge; 3rd edition (2015)
2. Solar Power Engineering by B.S Magal, Frank Kreith and J.F Kreith
3. Principles of Solar Energy by Frank Krieth and John F Kreider.
4. Non-Conventional Energy Systems by K Mittal, Wheeler.
5. Non-Conventional Energy by Ashok V Desai, Wiley Eastern Publications

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ENGINEERING AND TECHNOLOGY PROGRAM
IV year B.Tech DEGREE EXAMINATION.
I SEMESTER-END EXAMINATIONS (R22 REGULATION)
RENEWABLE ENERGY TECHNOLOGIES (2295703C)
(Effective from the admitted batch of 2022-2023)
MODEL QUESTION PAPER

Time: Three hours **Maximum: 70 marks**

Part-A is compulsory each question carries 2 marks
Answer all questions from Part-B
Each question in Part- B will carry 12 marks

PART-A

1.	a)	Mention the energy scenario in the world for various sectors.	2M	CO-1
	b)	Describe the effect of temperature on the performance of flat plate collector.	2M	CO-2
	c)	Write the merits and demerits of wind power?	2M	CO-3
	d)	List out major benefits of using Biomass energy.	2M	CO-4
	e)	Explain in brief about the hybrid energy systems.	2M	CO-5

PART-B

2.	a)	Justify the need for renewable energy resources.	6M	CO-1
	b)	Write a detailed description on the usage of energy around the world.	6M	CO-1
		(OR)		
3.	a)	Describe the impact of Energy Utilization on environment.	6M	CO-1
	b)	Define conventional and non-conventional Energy with Examples.	6M	CO-1
4.	a)	What are the types of solar radiation measuring Instruments. Explain the working of Pyrheliometer with a neat sketch.	6M	CO-2
	b)	Explain solar photo voltaic conversion process in detail.	6M	CO-2
		(OR)		

5.	a)	Enumerate the different types of concentrating type collectors.	6M CO-2
	b)	What are the types of solar radiation measuring Instruments? Explain the working of Sunshine recorder with a neat sketch.	6M CO-2
6.	a)	What are the causes for wind formation? What are the functions of various components in a wind mill?	6M CO-3
	b)	How do you calculate the wind power? Discuss the working principle of wind turbine generator?	6M CO-3

(OR)

7.	a)	Describe the working of VAWT with a neat sketch. Differentiate between HAWT and VAWT.	6M CO-3
	b)	Elaborate the factors to be considered in the selection of site for wind energy.	6M CO-3
8.		Write the characteristics of ethanol. Explain various steps involved in the production of Ethanol.	12M CO-4

(OR)

9.		What is biomass gasifier? Write its gasification reactions.	6M CO-4
		How do you classify the gasifiers? Explain anyone in detail.	6M CO-4
10.		What is the geothermal energy? Explain its extraction process.	12M CO-5

(OR)

11.		What is the basic principle of ocean thermal energy conversion? What are the main types of OTEC power plants? Describe their working.	12M CO-5

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ENGINEERING AND TECHNOLOGY PROGRAM

DEPARTMENT OF MECHANICAL ENGINEERING

HEATING VENTILATION AIR-CONDITIONING AND REFRIGERATION

Course code	:	2295703D (Elective-IV)
Year /sem	:	IV-I
L-T-P	:	3-0-0
Credits	:	03
Contact Hours	:	04
Pre-requisite	:	Applied Thermodynamics, Fluid Mechanics
CO#	**Course Outcome**	
	By the end of this course, the student will be able to	
CO 1	Explain the significance of HVAC, distinguish between various Air-conditioning systems.	
CO 2	Perform the heat load calculations and utilization of ISHRAE/ASHRAE standards.	
CO 3	Explain the significance of ventilation, filtration process, indoor and outdoor design conditions, IAQ and air distribution.	
CO 4	Describe the working of Refrigeration cycle, its applications, and various refrigerants and their properties.	
CO 5	Estimate the pipe sizes for refrigeration, chillers, pumps head calculation and designing of ducts, air outlets.	

Syllabus:

UNIT-I

Introduction to HVAC: Fundamentals of HVAC, Refrigeration Cycle, Basic Components of air-conditioners (Filters, Air outlets – Grills, Registers, Diffusers, Fans and blowers).

Air-conditioning systems: Working of – windows AC, splits AC, central air conditoning system – ducts AC, packaged AC, Chilled water systems, Components of chilled water systems – Chillers, Fan coil units, PICV valves, Primary & Secondary pumps, A brief about district cooling systems – Plate heat exchangers, AHU, FAHU's, VRF/VRV systems, heat pumps models.

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UNIT-II

Heat load calculations: Study of Psychrometric analysis, Relative Humidity, Humidity Ratio, Processes – Heating, Cooling, Cooling and Dehumidification, Heating and Humidification. Orientation of Building, U Factor for – wall, glass, Roof & Partition; Calculation of equivalent temperature, ASHRAE / ISHRAE standards, ADP & Dehumidification CFM. (Simple Problems only).

UNIT-III

Ventilation and Infiltration: Fundamental Concepts – Thermal comfort, Indoor air quality (IAQ), Ventilation for cooling, Air distribution (Simple Problems)

Thermal Insulation: Selection of Insulating materials, Types of Insulating Materials.

UNIT-IV

Refrigeration: Introduction, Working principle – Vapor Absorption Refrigeration, Vapor Compression Refrigeration (VCR), Working of Appliances – Refrigerators, VISI coolers, Cold Rooms, deep freezers, Chest coolers, Ice cube machines, Milk chillers.

Refrigerants: Different types of Refrigerants, Properties, Nomenclature.

UNIT-V

Pipe Sizing: Basic concepts – Refrigerant pipe sizing, chilled water pipe sizing, Pump head Calculation (Formulae only) Requirement for – Selection of Fan/Blower, Duct design and External Static Pressure (ESP) calculation (only formulae and simple problems), Air outlet design and selection.

Note: Psychrometric charts are allowed in the external examination. ASHRAE/ISHRAE standard books are allowed.

Text books:

1. Basic Refrigeration and Air Conditioning, PN Ananthanarayanan, McGraw Hill Education; Fourth edition (2013).
2. Arora R.C., Refrigeration and Air conditioning, Prentice Hall India Learning Private Limited (2010), India.

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Reference books:

1. Refrigeration and Air conditioning, Manohar Prasad, New Age International Pvt Ltd; Third edition (2021).
2. ISHRAE Handbook.
3. Principle of Refrigeration, Dossat Ray J., Pearson Education India, Fourth edition (2002).

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RUSHIKONDA, VISAKHAPATANAM 530045 | website: www.gvpcdpgc.edu.in
ENGINEERING AND TECHNOLOGY PROGRAM

DEPARTMENT OF MECHANICAL ENGINEERING

ADDITIVE MANUFACTURING

Course code	:	2295704O (Open Elective)
Year /sem	:	IV-I
L-T-P	:	3-0-0
Credits	:	03
Contact Hours	:	04
Pre-requisite	:	Basic knowledge in Material Science and Manufacturing Processes
CO#	**Course Outcome**	
	By the end of this course, the student will be able to	
CO 1	Understand the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Rapid Prototyping and tooling Technologies.	
CO 2	Explain the process capabilities of liquid and solid based rapid prototyping methods.	
CO 3	Understand the process capabilities and advantages of powder based Rapid prototyping techniques.	
CO 4	Select the appropriate material for processing through various rapid prototyping techniques.	
CO 5	Develop innovative components and products through RP applications and case studies.	

Syllabus :

UNIT-I

Introduction: History Development of AM systems, Overview of Additive Manufacturing (AM); AM history; Classification of AM; Merits/de-merits and applications of AM process; Brief information on different materials used for AM

UNIT-II

Liquid and Solid Based AM Technologies: Classification–Liquid based system – Stereo lithography Apparatus (SLA), details of SL process, products, Advantages, Limitations, Applications and Uses. Solid based system – Fused Deposition Modeling, principle, process, products, advantages, applications and uses – Laminated Object Manufacturing.

DEPARTMENT OF MECHANICAL ENGINEERING

UNIT-III

Powder Based Rapid Prototyping Systems: Selective Laser Sintering (SLS) – principles of SLS process, principle of sinter bonding process, Three-Dimensional Printing (3D) – process, major applications, research and development. Direct Shell Production Casting (DSPC) – key strengths, process applications and uses, laser engineered net shaping (LENS), Direct metal deposition (DMD).

UNIT-IV

Materials for Rapid Prototyping Systems: Nature of material – type of material – polymers, metals, ceramics and composites – liquid based materials, photo polymer development – solid based materials, powder – based materials – case study.

UNIT-V

Rapid Tooling: Classification: Soft tooling, Production tooling, Bridge tooling; direct and indirect – Fabrication processes, Applications. Case studies – automotive and aerospace

Text Books:

1. Rafiq I. Noorani, Rapid Prototyping, "Principles and Applications", Wiley & Sons, 2006.
2. Chua, Chee Kai, and Kah Fai Leong. 3D Printing and additive manufacturing: Principles and applications (with companion media pack)-of rapid prototyping. World Scientific Publishing Company, 2014.
3. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Ian Gibson, David W Rosen, Brent Stucker, 2nd Edition, Springer, 2015.

Reference books:

1. N. Hopkinson, R.J.M, Hauge, PM, Dickens, "Rapid Manufacturing–An Industrial revolution for the digital age", Wiley, 2006
2. Ian Gibson, "Advanced Manufacturing Technology for Medical applications: Reverse Engineering, Software conversion and Rapid Prototyping", Wiley, 2006.
3. Paul F. Jacobs, "Rapid Prototyping and Manufacturing: Fundamentals of Stereolithography", McGraw Hill 1993. 4. Pham. D.T., and Dimov. S.S., "Rapid Manufacturing", Springer Verlog 2001.
4. Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, D.T. Pham, S.S. Dimov, Springer 2001.

SYLLABUS APPROVED & RATIFIED
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GAYATRI VIDYA PARISHAD COLLEGE FOR DEGREE AND PG COURSES (A)
ENGINEERING AND TECHNOLOGY PROGRAM
IV year B.Tech DEGREE EXAMINATION.
I SEMESTER-END EXAMINATIONS (R22 REGULATION)
ADDITIVE MANUFACTURING (2295704O)
(Effective from the admitted batch of 2022-2023)
MODEL QUESTION PAPER

Time: Three hours **Maximum: 70 marks**

Part-A is compulsory each question carries 2 marks
Answer all questions from Part-B
Each question in Part- B will carry 12 marks
All parts of the questions must be answered at one place only

		PART-A		Marks
1	a)	State any two merits of Additive Manufacturing.	CO 1	2M
	b)	What is photopolymer resin?	CO 2	2M
	c)	Mention two key applications of Selective Laser Sintering.	CO 3	2M
	d)	List any two solid-based materials used in AM	CO 4	2M
	e)	Define bridge tooling.	CO 5	2M
		PART-B		
		UNIT-I		
2	a)	Describe the classification and limitations of AM processes with examples.	CO 1	6M
	b)	Explain the historical development of Additive Manufacturing technologies.	CO 1	6M
		OR		
3	a)	Explain the advantages, disadvantages, and various applications of AM.	CO 1	8M
	b)	Briefly describe different materials used for Additive Manufacturing.	CO 1	4M
		UNIT-II		
4		Explain Fused Deposition Modeling (FDM) with neat diagram. State its advantages and limitations.	CO 2	12M
		OR		
5	a)	Discuss SLA process in detail along with neat sketch.	CO 2	6M
	b)	Explain LOM and FDM processes and compare them.	CO 2	6M
		UNIT-III		
6		Describe the principle and process of Selective Laser Sintering (SLS). Mention its applications.	CO 3	12M
		OR		
7		Explain the following powder-based additive manufacturing techniques in detail: i) Direct Metal Deposition (DMD) ii) Laser Engineered Net Shaping (LENS)	CO 3	12M
		UNIT-IV		
8		Explain the classification of materials used in AM and discuss the development of photo-polymers.	CO 4	12M

		OR		
9		Discuss various types of powder-based materials used in AM with examples.	CO 4	12M
		UNIT-IV		
10	**a)**	Explain the classification of rapid tooling techniques with suitable examples.	CO 5	8M
	b)	Write a case study on the application of RP in the aerospace industry.	CO 5	4M
		OR		
11		What is rapid tooling? Explain direct and indirect methods with examples.	CO 5	12M

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ENGINEERING AND TECHNOLOGY PROGRAM

DEPARTMENT OF MECHANICAL ENGINEERING

NON-CONVENTIONAL ENERGY SOURCES

Course code	:	2295705O (Open Elective)
Year /sem	:	IV-I
L-T-P	:	3-0-0
Credits	:	03
Contact Hours	:	4
Pre-requisite	:	Basic knowledge in thermodynamics, fluid mechanics, electrical technology

CO#	Course Outcome
	By the end of this course, the student will be able to
CO 1	Explain the importance and usage of alternate energy sources
CO 2	Acquire and apply the principles on various solar energy collectors and accrue the knowledge about energy storage and applications
CO 3	Describe wind energy characteristics and types of wind mills
CO 4	Discuss the usage of bio energy, its conversion and its applications
CO 5	Understand the concepts of geothermal, ocean, tidal and wave energies

Syllabus:

UNIT-I

Energy Scenario: Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others, Present conventional energy status, Present renewable energy status Potential of various renewable energy sources, Global energy status, Per capita energy consumption in various countries.

UNIT-II

Solar Energy: Solar radiation: Measurements of solar radiation and sunshine, Solar thermal collectors: Flat plate and concentrating collectors, Solar thermal applications, Solar thermal energy storage – Fundamentals of solar photo-voltaic conversion: Solar cells, Solar PV

Systems, Solar PV applications.

UNIT-III

Wind Energy: Wind data and energy estimation, Betz limit – no derivation, Site selection for wind farms, characteristics Horizontal axis wind turbine, components, Vertical axis wind turbine, Wind turbine generators and its performance, Hybrid systems, Environmental issues, Applications.

UNIT-IV

Bio-Energy: Bio resources, Biomass direct combustion, thermo-chemical conversion, biochemical conversion mechanical conversion, Biomass gasifier: Types of biomass gasifiers, Biogas plants: Digesters, Biodiesel production, Ethanol production, Applications.

UNIT-V

Ocean and Geothermal Energy: Small hydro – Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources – Types of geothermal power plants – Applications – Environmental impact.

Text Books:

1. Non-Conventional Energy Sources, G.D. Rai, Khanna Publishers, 5th edition, 2011.
2. Renewable Energy Resources, John Twidell, Tony Weir, and Anthony D. Weir, Taylor & Francis, 2006.

Reference books:

1. Solar Energy: Principles of Thermal Collection and Storage, S.P. Sukhatme, Tata McGraw Hill, 2009.
2. Non-Conventional Energy Resources, G.S. Sawhney, PHI Pvt. Ltd. 2012.
3. Non-Conventional Energy Resources, BH Khan, 3rd Edition, McGraw Hill Education, 2017.
4. Solar Energy – Fundamentals Design, Modelling and applications, G.N. Tiwari, Alpha Science, 2015.

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IV year B.Tech DEGREE EXAMINATION.
I SEMESTER-END EXAMINATIONS (R22 REGULATION)
NON-CONVENTIONAL ENERGY SOURCES (2295705O)
(Effective from the admitted batch of 2022-2023)
MODEL QUESTION PAPER

Time: Three hours **Maximum: 70 marks**

Part-A is compulsory each question carries 2 marks
Answer all questions from Part-B
Each question in Part- B will carry 12 marks

PART-A

1.	a)	Explain the working principle of Geothermal energy.	2M CO-5
	b)	Mention the energy scenario in India for various sectors.	2M CO-1
	c)	Write about Extraterrestrial Radiation and Terrestrial Radiation.	2M CO-2
	d)	Write the merits and demerits of wind power?	2M CO-3
	e)	List out major benefits of using Biomass energy.	2M CO-4

PART-B

2.	a)	Justify the need for renewable energy resources.	6M CO-1
	b)	Write a detailed description on the usage of energy around the world.	6M CO-1
		(OR)	
3.	a)	Describe the impact of Energy Utilization on environment.	6M CO-1
	b)	Define conventional and non-conventional Energy with Examples.	6M CO-1
4.	a)	Illustrate the functions of various components in flat plate collectors.	6M CO-2
	b)	Explain solar photo voltaic conversion process in detail.	6M CO-2
		(OR)	
5.	a)	Enumerate the different types of concentrating type collectors.	6M CO-2

	b)	List the applications of solar PV cell.	6M CO-2
6.	a)	What are the causes for wind formation? What are the functions of various components in a wind mill?	6M CO-3
	b)	Write the merits and demerits of wind power? Discuss the working principle of wind turbine generator?	6M CO-3
		(OR)	
7.	a)	Describe the working of VAWT with a neat sketch. Differentiate between HAWT and VAWT.	6M CO-3
	b)	What is the impact of wind energy on environment?	6M CO-3
8.		Write the characteristics of ethanol. Explain various steps involved in the production of Ethanol.	12M CO-4
		(OR)	
9.		What is biomass gasifier? Write its gasification reactions.	6M CO-4
		How do you classify the gasifiers? Explain anyone in detail.	6M CO-4
10.		What is the geothermal energy? Explain its extraction process.	12M CO-5
		(OR)	
11.		Define the terms Flood tide, Ebb tide and Tidal range. Explain the basic components of a tidal power plant and state their merits and demerits.	12M CO-5

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ENGINEERING AND TECHNOLOGY PROGRAM

DEPARTMENT OF MECHANICAL ENGINEERING

CAD & CAE LAB

Course code	:	2295707P
Year /sem	:	IV-I
L-T-P	:	0-0-3
Credits	:	1.5
Contact Hours	:	3
Pre-requisite	:	Engineering Graphics, Mechanical Engineering Drawing

CO#	Course Outcome
	By the end of this course, the student will be able to
CO 1	Model the 3D and assembly drawings of various industrial components according to standards and can generate various views and bill of materials
CO 2	Perform the structural, modal and harmonic analysis on the various components using a FEA package
CO 3	Perform the thermal analysis on the various components using a FEA package

List of Experiments

1. 3D Part Modelling of Support using CATIA
2. 3D Part Modelling of Angle using CATIA
3. Assembly drawing of Knuckle Joint using CATIA
4. Assembly drawing of Oldham Coupling using CATIA
5. Assembly drawing of Universal Coupling using CATIA
6. Generation of various views from 3D Assembly and Creation of BoM using CATIA
7. Static analysis for a structure using FEA Package

8. Model analysis for a simple structure using FEA Package

9. Harmonic analysis for a simple structure using FEA Package

10. Thermal analysis using FEA Package for different structures under steady state thermal analysis condition

11. Transient structural analysis using FEA Package for simple structures

12. Transient thermal analysis using FEA Package for simple structures

*Software used – CATIA and ANSYS

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ENGINEERING AND TECHNOLOGY PROGRAM

DEPARTMENT OF MECHANICAL ENGINEERING

INDUSTRIAL ENGINEERING LAB

Course code	:	2295708P
Year /sem	:	IV-I
L-T-P	:	0-0-3
Credits	:	1.5
Contact Hours	:	3
Pre-requisite	:	1. Basic Statistics and Probability, 2. Fundamentals of Statistical Quality Control (SQC)

CO#	Course Outcome
	By the end of this course, the student will be able to
CO 1	The student will be capable of measuring his skill and dexterity of his wrist and figures
CO 2	The student is capable of drawing control charts for variables
CO 3	The student is capable of drawing OC curves for a specific production process

List of Experiments

1. To show that sample means from a Normal universe follow a Normal Distribution
2. To show that sample means from a Non-Normal universe follow a Normal Distribution
3. To draw p–chart for fraction defective of constant sample size and to check the control of the process for the given set of plastic balls.
4. To draw p–chart for fraction defective of constant sample size and to check the control of the process for the given set of plastic balls.
5. To draw multiple activity chart (man-machine chart) for the activity of toasting four slices of bread in two electric toasters

DEPARTMENT OF MECHANICAL ENGINEERING

6. To draw the two-handed process charts and to compare the times for bolt and washers assembly of present and improved methods.

7. To draw X and R–Chart and determine the process capability from the measurements of a given set of pins.

8. To draw the **C**–chart for a given set of metal disc and to check the control of the process by taking each disc with 10 holes as one unit.

9. To plot O.C curve for a single sampling attribute plan for **n** = 20, **C** = 0, 1 & 2 and to compare the actual O.C curve with theoretical O.C curve

10. (a) To study the difference in time required to pick up and insert pins in holes of PIN BOARDS under different conditions & to find the standard time of the PIN BOARD assembly for the given configuration.

(b) To draw SIMO chart for the PIN BOARD assembly by using THERBLIGS

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DEPARTMENT OF MECHANICAL ENGINEERING

APPLICATIONS IN MECHANICAL ENGINEERING USING SCILAB

Course code	:	2295709S
Year /sem	:	IV-I
L-T-P	:	1-0-2
Credits	:	2
Contact Hours	:	3
Pre-requisite	:	Basic Engineering Mathematics, Programming in C/Java

CO#	Course Outcome
	By the end of this course, the student will be able to
CO 1	Execute basic commands in a Scilab working environment
CO 2	Solve basic problems related to engineering mathematics, such as solving given functions, applying numerical methods and performing matrix operations.
CO 3	The student will be capable of writing, compiling and executing programs to solve simple problems in mechanical engineering.

List of Experiments

1. Performing basic mathematical operations
2. Writing and executing simple math expressions
3. Writing and executing complex math expressions
4. Performing matrix operations
5. Solve given functions programmatically using numerical methods
6. Solve given functions at command line
7. Plotting given functions in 2D (Set 1)

8. Plotting given functions in 2D (Set 2)

9. Plotting given functions in 3D

10. Plotting given implicit functions

11. Writing and executing simple Scilab programmes (Set 1)

12. Writing and executing simple Scilab programmes (Set 2)

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ENGINEERING AND TECHNOLOGY PROGRAM

DEPARTMENT OF MECHANICAL ENGINEERING

MATERIALS TECHNOLOGY

Course code	:	2295710 (Minors Subject)
Year /sem	:	IV-I
L-T-P	:	3-0-0
Credits	:	4
Contact Hours	:	4
Pre-requisite	:	Physics, Chemistry
CO#	**Course Outcome**	
	By the end of this course, the student will be able to	
CO 1	Explain the classification and mechanical behavior of materials and describe the applications of shape memory materials	
CO 2	Explain the types, properties, and applications of metallic foams and metallic armour materials used in defense and engineering systems	
CO 3	Understand the behavior and use of materials at cryogenic temperatures	
CO 4	Describe high-temperature materials and superalloys used in aerospace and power industries	
CO 5	Discuss the concept, properties, of nanomaterials in advanced engineering fields	

Syllabus

UNIT-I

Materials Science and Engineering: Introduction, Classification of Materials, Mechanical Properties of Materials, Case Study: Delhi Iron Pillar and Wootz Steel.

Shape-Memory Materials: Introduction to shape memory alloys, Potential Applications, In Space and Aero-Industries, Automobile Industries, Electrical and Electronics, Biomedical Industries, Advantages of Shape Memory Alloy, Shape Memory Polymers (SMPs)-Introduction-In Aerospace, Medical Applications, Automobile, Textile Industries, Advantages and Disadvantages of SMPs.

UNIT-II

Metallic Foams: Introduction- Definition, open cell and closed cell metallic foams, Properties, Potential applications for metal foams.

Metallic Armour: Introduction, Classifications of materials that are used in armour applications.

Metallic Armour Materials: Rolled Homogeneous Armour, High-Hardness Armour, Variable Hardness Steel Armour, Perforated Armour, Titanium Alloy Armour- applications.

UNIT-III

Introduction to Low Temperature Materials: Introduction, Cryogenic Temperatures, Materials at Low Temperatures, Cooling to Cryogenic Temperatures, Applications of Cryogenics, Benefits of Cryogenics, Long-Term Preservation of Biological Material and Food, Preservation of Biological Material, Food Freezing.

UNIT-IV

High Temperature Materials: Need for High Temperature Materials, High Temperature Materials, Historical Development of High Temperature Materials Titanium alloys for gas turbine applications.

Superalloys: History of Superalloys, Types of Superalloys, Ni-based Superalloys, Applications of Superalloys: Turbine Blades, Gas Turbine Engines, Turbine Discs, Turbine Nozzle Guide Vanes, Engine of Y2K Superbike.

UNIT-V

Nanomaterials: Introduction to Nanoscale World, History of Nanotechnology, Properties of Nanomaterials, Carbon-Based Materials-Graphene-Applications, Carbon Nanotubes (CNTs)-Classification-Application of CNTs, Introduction to Metal & Polymer -Based Nanomaterials-Applications, Nanocomposites-Metal Matrix Nanocomposites (MMNC), Ceramic Matrix Nanocomposites (CMNC), Polymer Matrix Nanocomposites (PMNC)- Application of Nanocomposites.

Text Books:

1. Behera, Ajit. Advanced Materials: An Introduction to Modern Materials Science. Springer Nature, 2021.
2. Prof. Jayanta Das, Advanced Materials and Processes, IIT Kharagpur.

Reference books:

1. Bar-Cohen, Yoseph, ed. High Temperature Materials and Mechanisms. CRC Press, 2014.
2. Srivatsan, T. S. (2009). Processing and Fabrication of Advanced Materials, XVII: Volume One. India: I.K. International Publishing House.
3. Bar-Cohen, Yoseph, ed. Low Temperature Materials and Mechanisms. CRC Press, 2016.
4. Hazell, Paul J. Armour: Materials, Theory and Design. CRC press, 2015.
5. Ashby, Michael F., et al. Metal Foams: A Design Guide. Elsevier, 2000.
6. Scheffler, Michael, and Paolo Colombo, eds. Cellular ceramics: structure, manufacturing, properties and applications. John Wiley & Sons, 2006.
7. https://nptel.ac.in/courses/113/105/113105081/#
8. https://www.tms.org/pubs/journals/JOM/0012/Banhart-0012.html#authors
9. https://ocw.mit.edu/courses/materials-science-and-engineering/3-054-cellular-solids-structure-properties-and-applications-spring-2015/lecture-notes/
10. https://ocw.mit.edu/courses/materials-science-and-engineering/3-054-cellular-solids-structure-properties-and-applications-spring-2015/syllabus/

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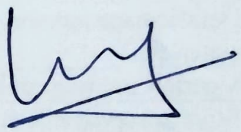
I SEMESTER-END EXAMINATIONS (R22 REGULATION)
MATERIALS TECHNOLOGY (2295710)
(Effective from the admitted batch of 2022-2023)
MODEL QUESTION PAPER

Time: Three hours **Maximum: 70 marks**

Part-A is compulsory each question carries 2 marks
Answer all questions from Part-B
Each question in Part- B will carry 12 marks
All parts of the questions must be answered at one place only

		PART-A		Marks
1	a)	Define shape memory effect and name any two shape memory materials.	CO 1	2M
	b)	Mention any two applications of metallic foams.	CO 2	2M
	c)	What are cryogenic temperatures?	CO 3	2M
	d)	Name two applications of Ni-based superalloys.	CO 4	2M
	e)	Mention any two carbon-based nanomaterials.	CO 5	2M
		PART-B		
		UNIT-I		
2	a)	Classify engineering materials and discuss their mechanical properties.	CO 1	6M
	b)	Discuss the importance of Delhi Iron Pillar.	CO 1	6M
		OR		
3	a)	Explain the working principle of shape memory alloys with examples.	CO 1	6M
	b)	List applications of shape memory polymers in medical and textile industries.	CO 1	6M
		UNIT-II		
4	a)	Define metallic foams. Explain open-cell and closed-cell structures.	CO 2	6M
	b)	What are Metallic Armour Materials? Discuss about titanium alloy armour.	CO 2	6M
		OR		
5	a)	Explain various metallic armour materials used in defence.	CO 2	6M
	b)	Compare high-hardness armour and variable hardness steel armour.	CO 2	6M
		UNIT-III		
6	a)	Describe material behaviour at cryogenic temperatures.	CO 3	6M
	b)	Explain how cryogenic technology is used in biological material preservation.	CO 3	6M
		OR		
7	a)	Discuss the benefits of cryogenics in food and medical applications.	CO 3	6M

	b)	Explain the importance of cryogenic material selection.	CO 3	6M
		UNIT-IV		
8	**a)**	Why are high-temperature materials essential in aerospace?	CO 4	6M
	b)	Discuss the development and application of titanium alloys in gas turbines.	CO 4	6M
		OR		
9	**a)**	Classify superalloys. Describe any two types.	CO 4	6M
	b)	Write a note on superalloys used in Y2K superbike engine and turbine discs.	CO 4	6M
		UNIT-IV		
10	**a)**	Explain the properties and significance of graphene and CNTs.	CO 5	6M
	b)	Write applications of carbon nanotubes in engineering fields	CO 5	6M
		OR		
11	**a)**	What are nanocomposites? Classify MMNC, CMNC, PMNC.	CO 5	6M
	b)	Explain the applications of nanocomposites in engineering industries.	CO 5	6M



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ENGINEERING AND TECHNOLOGY PROGRAM

DEPARTMENT OF MECHANICAL ENGINEERING

GREEN MANUFACTURING

Course code	:	2295711
Year /sem	:	IV-I
L-T-P	:	3-0-0
Credits	:	4
Contact Hours	:	4
Pre-requisite	:	Manufacturing processes, Metal cutting & Machine tools, Metallurgy and Material science
CO#	**Course Outcome**	
	By the end of this course, the student will be able to	
CO 1	Explain the fundamentals of green manufacturing, its motivations, principles, and strategies.	
CO 2	Discuss the different eco-friendly machining methods and their benefits	
CO 3	Describe the basic sustainable joining techniques like microwave and friction stir welding.	
CO 4	Identify simple strategies to reduce waste in manufacturing	
CO 5	Explore smart powder processing technologies and assess their role in sustainability and recycling of composite materials.	

Syllabus:

UNIT-I

Green Manufacturing: Introduction, Why Green Manufacturing? Motivations and Barriers to Green Manufacturing, Transformation to Green Manufacturing, Forces Driving Green Manufacturing, Environmental Impact of Manufacturing, Strategies for Green Manufacturing, Principles of Green Manufacturing, Technologies for Green Manufacturing, Challenges in Adopting Green.

UNIT-II

Green Machining: Sustainable Manufacturing Through Environmentally-Friendly Machining: Introduction, Sustainable Manufacturing Technologies, Dry Machining and Near-

Dry Machining, Cryogenic Machining, High Pressure Jet Assisted Machining, Assessment of Machining Process Sustainability, Assessment Methods: Material Production, Cutting Fluid Preparation, Tool Preparation, Material Removal, Cleaning Process.

UNIT-III

Sustainable Joining Techniques: Microwave Joining-Introduction, Direct Micro wave heating, micro wave hybrid heating- Properties, Advantages and limitations of Microwave Joining. Introduction to Friction stir welding (FSW), Variants of Friction Stir Welding Process-Friction-Stir Processing, Friction-Stir Spot Welding, Hybrid Friction Stir Welding, Tool Materials and its applications.

UNIT-IV

Concepts, Methods, and Strategies for Zero-Waste in Manufacturing: Concepts of Zero Waste in Manufacturing- Terms and Definitions, Waste Assessment Process and Systems Approach, Common Strategies for Zero Waste.

UNIT-V

Smart Powder Processing for Green Technologies: Introduction, Applications of Particle Bonding Process for Advanced Materials-Development of Fuel Cell Electrodes, One-Pot Synthesis of Nanoparticles from Raw Powder, Novel Recycling of Composite Materials for Sustainability Materials.

Text Books:

1. Dornfeld, David A., ed. Green Manufacturing: Fundamentals and Applications. Springer Science & Business Media, 2012.
2. Singh, Mrityunjay, Tatsuki Ohji, and Rajiv Asthana, eds. Green and Sustainable Manufacturing of Advanced Material. Elsevier, 2015.

Reference books:

1. Singh, Gurminder, et al., eds. Green Composites Manufacturing: A Sustainable Approach. Vol. 19. Walter de Gruyter GmbH & Co KG, 2024.
2. Ashby, Michael F. Materials and the environment: eco-informed material choice. Elsevier, 2012.
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GAYATRI VIDYA PARISHAD COLLEGE FOR DEGREE AND PG COURSES (A)
ENGINEERING AND TECHNOLOGY PROGRAM
IV year B.Tech DEGREE EXAMINATION.
I SEMESTER-END EXAMINATIONS (R22 REGULATION)
GREEN MANUFACTURING (2295711)
(Effective from the admitted batch of 2022-2023)
MODEL QUESTION PAPER

Time: Three hours **Maximum: 70 marks**

Part-A is compulsory each question carries 2 marks
Answer all questions from Part-B
Each question in Part- B will carry 12 marks
All parts of the questions must be answered at one place only

		PART-A		Marks
1	a)	List any two principles of green manufacturing.	CO 1	2M
	b)	Mention two benefits of cryogenic machining.	CO 2	2M
	c)	What is microwave hybrid heating?	CO 3	2M
	d)	Define zero waste manufacturing.	CO 4	2M
	e)	What are fuel cell electrodes?	CO 5	2M
		PART-B		
		UNIT-I		
2	a)	Explain the motivations and barriers to green manufacturing.	CO 1	6M
	b)	Discuss various strategies and challenges involved in adopting green manufacturing.	CO 1	6M
		OR		
3	a)	What are the environmental impacts of traditional manufacturing systems?	CO 1	6M
	b)	Describe the transformation process towards green manufacturing with suitable examples.	CO 1	6M
		UNIT-II		
4	a)	Explain the principles and advantages of dry and near-dry machining.	CO 2	6M
	b)	Explain the role of machining parameters and environmental factors in evaluating process sustainability.	CO 2	6M
		OR		
5	a)	Describe cryogenic machining and its significance in sustainable manufacturing.	CO 2	6M
	b)	What are the key parameters considered for assessing the sustainability of a machining process?	CO 2	6M
		UNIT-III		
6	a)	Describe the mechanism and advantages of microwave joining techniques.	CO 3	6M
	b)	Explain friction stir processing and its applications.	CO 3	6M
		OR		
7	a)	Explain hybrid friction stir welding and its applications.	CO 3	6M
	b)	Discuss the selection of tool materials for FSW and their influence on joint quality.	CO 3	6M

		UNIT-IV		
8	**a)**	Define zero waste manufacturing and explain the terms and definitions associated with it.	CO 4	6M
	b)	Explain the waste assessment process and systems approach in manufacturing.	CO 4	6M
		OR		
9	**a)**	Discuss common strategies adopted to achieve zero waste in industries.	CO 4	6M
	b)	How does the systems approach help in reducing manufacturing waste?	CO 4	6M
		UNIT-IV		
10	**a)**	Explain the applications of particle bonding processes in developing advanced materials.	CO 5	6M
	b)	Discuss one-pot synthesis of nanoparticles from raw powder and its sustainability aspect.	CO 5	6M
		OR		
11	**a)**	What are the green strategies for recycling composite materials?	CO 5	6M
	b)	Write a short note on novel recycling techniques for sustainable materials.	CO 5	6M

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ENGINEERING AND TECHNOLOGY PROGRAM

DEPARTMENT OF MECHANICAL ENGINEERING

SEMESTER - VIII

(IVth year 2nd Semester)

Sl. No.	Code	Category	Course Title	Hours per week			Allotment of Marks		Total Marks	Credits
				L	T	P	Internal	External		
1	2295801	PROJECT	Project	0	0	0	50	50	100	15
			Total	**0**	**0**	**0**	**50**	**50**	**100**	**15**