

**PROGRAMME: B.E.
MECHANICAL ENGINEERING
CURRICULUM**

SEMESTER 1										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	MARKS		Page No.
								CAE	ESE	
1	Theory	SMTA1101	Engineering Mathematics - I	3	*	0	3	50	50	1
2	Theory	SPHA1101	Physics for Engineers	3	1	0	4	50	50	2
3	Theory	SBTA1101	Environmental Science and Engineering	2	0	0	0	-	-	4
4	Theory	SCSA1103	Programming in C	3	*	0	3	50	50	5
5	Theory	SMEA1101	Engineering Graphics	1	0	4	3	50	50	6
6	Theory	SMEA1203	Fundamentals of Mechanical Engineering	3	0	0	3	50	50	7
7	Practical	SPHA2101	Physics Lab	0	0	2	1	25	25	8
8	Practical	SCSA2104	Programming in C Lab	0	0	4	2	50	50	9
9	Practical	SMEA2101	Computer Aided Design Lab	0	0	4	2	50	50	10
Total Credits for Semester 1 - 21										
Total Marks for Semester 1 - 750										

SEMESTER 2										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1	Theory	SHSA1101	Technical English	3	0	0	3	50	50	11
2	Theory	SMTA1201	Engineering Mathematics - II	3	*	0	3	50	50	14
3	Theory	SEEA1101	Basic Electrical and Electronics Engineering	3	0	0	3	50	50	15
4	Theory	SCYA1101	Engineering Chemistry	3	1	0	4	50	50	16
5	Theory	SMEA1201	Engineering Materials and Metallurgy	3	0	0	3	50	50	18
6	Theory	SMEA1202	Engineering Mechanics	3	*	0	3	50	50	20
7	Practical	SCYA2101	Engineering Chemistry Lab	0	0	2	1	25	25	21
8	Practical	SMEA2201	Workshop Practice	0	0	4	2	50	50	22
Total Credits for Semester 2 - 22										
Total Marks for Semester 2 - 750										

L - LECTURE HOURS, T - TUTORIAL HOURS, P - PRACTICAL HOURS, C - CREDITS,
CAE - CONTINUOUS ASSESSMENT EXAMINATION,
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SEMESTER 3										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1	Theory	SMTA1301	Engineering Mathematics - III	3	*	0	3	50	50	23
2	Theory	SMEA1301	Engineering Metrology	3	0	0	3	50	50	24
3	Theory	SMEA1302	Engineering Thermodynamics	3	*	0	3	50	50	26
4	Theory	SMEA1303	Fluid Mechanics and Machinery	3	*	0	3	50	50	27
5	Theory	SMEA1304	Machine Drawing	1	0	4	3	50	50	28
6	Theory	SMEA1305	Mechanics of Solids	3	*	0	3	50	50	30
7	Practical	SMEA2301	Fluid Mechanics and Machinery Lab	0	0	4	2	50	50	31
8	Practical	SMEA2302	Material Testing and Metallurgy Lab	0	0	4	2	50	50	32
Total Credits for Semester 3 - 22										
Total Marks for Semester 3 - 800										

SEMESTER 4										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1	Theory	SMTA1401	Engineering Mathematics - IV	3	*	0	3	50	50	33
2	Theory	SAIC4001	Industry 4.0	2	0	0	2	50	50	34
3	Theory	SMEA1401	Manufacturing Technology - I	3	0	0	3	50	50	35
4	Theory	SMEA1402	Mechanics of Machines	3	*	0	3	50	50	36
5	Theory	SMEA1403	Power Plant Engineering	3	0	0	3	50	50	37
6	Theory	SMEA1404	Thermal Engineering	3	*	0	3	50	50	38
7	Practical	SMEA2401	Engineering Metrology and Dynamics Lab	0	0	4	2	50	50	39
8	Practical	SMEA2402	Manufacturing Processes Lab	0	0	4	2	50	50	40
Total Credits for Semester 4 - 21										
Total Marks for Semester 4 - 800										

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SEMESTER 5										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1	Theory	SMEA1501	CAD/CAM	3	0	0	3	50	50	41
2	Theory	SMEA1502	Design of Machine Elements	3	*	0	3	50	50	43
3	Theory	SMEA1503	Finite Element Analysis	3	*	0	3	50	50	44
4	Theory	SMEA1504	Heat and Mass Transfer	3	*	0	3	50	50	45
5	Theory	SMEA1505	Manufacturing Technology - II	3	0	0	3	50	50	46
6	Theory		Open Elective - I	3	0	0	3	50	50	-
7	Practical	S15APT1	Professional Training	0	0	4	2	50	50	-
8	Practical	SMEA2501	CAD / CAM Lab	0	0	4	2	50	50	47
9	Practical	SMEA2502	Thermal Engineering Lab - I (Engines)	0	0	4	2	50	50	48
Total Credits for Semester 5 - 24										
Total Marks for Semester 5 - 900										

SEMESTER 6										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1	Theory	SMEA1601	Design of Transmission Systems	3	*	0	3	50	50	49
2	Theory	SMEA1602	Gas Dynamics and Jet propulsion	3	*	0	3	50	50	50
3	Theory		Elective - I	3	0	0	3	50	50	-
4	Theory		Elective - II	3	0	0	3	50	50	-
5	Theory		Open Elective - II	3	0	0	3	50	50	-
6	Practical	SMEA2601	Design and Analysis Lab	0	0	4	2	50	50	51
7	Practical	SMEA2602	Thermal Engineering Lab - II (Heat Transfer)	0	0	4	2	50	50	52
8	Project	S15APT2	Inter Disciplinary project	0	0	6	3	50	50	-
Total Credits for Semester 6 - 22										
Total Marks for Semester 6 - 800										

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SEMESTER 7										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1	Theory	SMEA1701	Automobile Engineering	3	0	0	3	50	50	53
2	Theory	SMEA1702	Industrial Mechatronics	3	0	0	3	50	50	54
3	Theory		Elective - III	3	0	0	3	50	50	-
4	Theory		Elective - IV	3	0	0	3	50	50	-
5	Theory		Open Elective - III	3	0	0	3	50	50	-
6	Practical	SMEA2701	Robotics and Automation Lab	0	0	4	2	50	50	55
7	Project	S15APROJ1	Project Work (Phase - I)	0	0	6	3	50	50	-
Total Credits for Semester 7 - 20										
Total Marks for Semester 7 - 700										

SEMESTER 8										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1	Theory		Elective - V	3	0	0	3	50	50	-
2	Theory		Elective - VI	3	0	0	3	50	50	-
3	Project	S15APROJ2	Project Work (Phase - II)	0	0	14	7	50	50	-
Total Credits for Semester 8 - 13										
Total Marks for Semester 8 - 300										

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LIST OF ELECTIVES

PROFESSIONAL ELECTIVE COURSES									
Sl. No.	Course Code	Course Title	L	T	P	C	Marks		Page No.
							CAE	ESE	
1	SMEA3001	Additive Manufacturing	3	0	0	3	50	50	56
2	SMEA3002	Advanced Internal Combustion Engines	3	0	0	3	50	50	57
3	SMEA3003	Computational Fluid Dynamics	3	*	0	3	50	50	58
4	SMEA3004	Fluid Power Systems	3	0	0	3	50	50	59
5	SMEA3005	Non Destructive Testing and Techniques	3	0	0	3	50	50	61
6	SMEA3006	Refrigeration and Air-conditioning	3	*	0	3	50	50	62
7	SMEA3007	Computer Integrated Manufacturing Systems	3	0	0	3	50	50	63
8	SMEA3008	Composite Materials	3	*	0	3	50	50	64
9	SMEA3009	Product Design and Development	3	0	0	3	50	50	66
10	SMEA3010	Automation in Manufacturing	3	0	0	3	50	50	67
11	SMEA3011	Design of Jig and Fixtures	3	0	0	3	50	50	68
12	SMEA3012	Industrial Robotics and Expert Systems	3	*	0	3	50	50	69
13	SMEA3013	Non-Conventional Energy Systems	3	0	0	3	50	50	70
14	SMEA3014	Concurrent Engineering	3	0	0	3	50	50	71
15	SMEA3015	Material handling and Storage systems	3	0	0	3	50	50	72
16	SMEA3016	Modern Manufacturing Systems	3	0	0	3	50	50	73
17	SMEA3017	Industrial Safety Engineering	3	0	0	3	50	50	75
18	SMEA3018	Fundamentals of Nano materials and Technology	3	0	0	3	50	50	76
19	SMEA3019	Vibration and Noise Control	3	*	0	3	50	50	77
20	SECA3007	MEMS and its Applications	3	0	0	3	50	50	78

OPEN ELECTIVE COURSES									
Sl. No.	Course Code	Course Title	L	T	P	C	Marks		Page No.
							CAE	ESE	
1	SALA4001	Intellectual Property Law	3	0	0	3	50	50	A1
2	SAEA4001	Fundamentals of Aerospace Technology	3	0	0	3	50	50	A2
3	SBAA4001	Fundamentals of Management	3	0	0	3	50	50	A3
4	SBAA4002	Principles of Management and Professional Ethics	3	0	0	3	50	50	A4
5	SBTA4001	Biology for Engineers	3	0	0	3	50	50	A5
6	SBMA4001	Neurology	3	0	0	3	50	50	A6
7	SBMA4002	Modelling of Physiological Systems	3	0	0	3	50	50	A7
8	SBMA4003	Drug Delivery System	3	0	0	3	50	50	A8
9	SBMA4004	Fundamentals of Mechatronics	3	0	0	3	50	50	A9
10	SBMA4005	Virtuality and Augmented Reality	3	0	0	3	50	50	A10
11	SBMA4006	Medical Optics and Laser Applications	3	0	0	3	50	50	A11
12	SBMA4007	Forensic Science	3	0	0	3	50	50	A12
13	SBMA4008	Artificial Intelligence and Expert Systems	3	0	0	3	50	50	A13
14	SBMA4009	Human Factors in Engineering and Design	3	0	0	3	50	50	A14
15	SCHA4001	Corrosion Engineering	3	0	0	3	50	50	A15
16	SCHA4002	Energy Engineering	3	0	0	3	50	50	A16
17	SCHA4003	Environmental Impact Assessment	3	0	0	3	50	50	A17
18	SCHA4004	Environmental Pollution and Control	3	0	0	3	50	50	A18
19	SCIA4001	Disaster Management	3	0	0	3	50	50	A19
20	SCSA4001	R Programming	3	0	0	3	50	50	A20
21	SCSA4002	5 G Networks	3	0	0	3	50	50	A21
22	SECA4001	Software Tools for Engineering Applications	3	0	0	3	50	50	A22
23	SMEA4001	Resource Management Techniques	3	0	0	3	50	50	A23
24	SMEA4002	Wind and Solar Energy	3	0	0	3	50	50	A24

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Semester	Theory courses (including elective courses)			Practical Courses (including PT and project)		
	Total no.	Total Credits	Total Marks	Total no.	Total Credits	Total Marks
1	6	16	500	3	5	250
2	6	19	600	2	3	150
3	6	18	600	2	4	200
4	6	17	600	2	4	200
5	6	18	600	3	6	300
6	5	15	500	3	7	300
7	5	15	500	2	5	200
8	2	6	200	1	7	100
Overall Total	42	124	4100	18	41	1700

Overall total credits for B.E Mechanical Engineering	165
Overall total marks for B.E Mechanical Engineering	5800

SMEA2101	COMPUER AIDED DESIGN LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To gain practical knowledge in engineering modeling through computer aided systems.
- To understand the functioning of 2D drafting and 3D modeling softwares.

INTRODUCTION TO CAD

Basics, Fundamentals of feature-based modeling.

TWO DIMENSIONAL OBJECTS

Create basic drawing objects: Points, Lines, Circles, Arcs, Planes and their combinations.

Layout and sketching.

Setup a drawing with correct scales. Draw with precision using Coordinate input and object Snaps,

Isometric drawings, Orthographic projections, Auxiliary views.

Dimensioning, Dimension styles.

Various other AutoCAD commands and relevant keyboard shortcuts.

THREE DIMENSIONAL OBJECTS

Creating and editing 3D solid objects.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the fundamentals of computer aided design.
- CO2 - Implement the knowledge in creating a model.
- CO3 - Understand the various limits and tolerances.
- CO4 - Understand various dimensioning styles.
- CO5 - Implement the knowledge to model various 2D and 3D models.
- CO6 - Understand various commands and keyboard shortcuts for faster modeling skills.

SMEA1304	MACHINE DRAWING	L	T	P	Credits	Total Marks
		1	0	4	3	100

COURSE OBJECTIVES

- To understand and apply national standards while drawing machine components based on BIS.
- To understand the conventions, abbreviations and symbols to be followed by Engineers for making assembly drawings.
- To make the students to understand sectioning, concept of limits, fits and tolerances used for component design.
- To understand surface texture, riveted joints, welded joints and keys.
- To know various thread forms and its engineering applications.
- To make the students learn to draw the assembly, orthographic and sectional views of various machine components and to interpret the assembly drawing.

1. CONVENTIONS, ABBREVIATIONS AND SYMBOLS

Conventional representation of shaft, hollow shaft, bar - Conventional representation of common machine elements such as threads, slotted head, bearings, straight and diamond knurling, holes on a linear and circular pitch, helical spring, leaf spring - Conventional representation of metals, glass, packing and insulating materials, liquids, concrete and wood - Conventional representation of screw, rivet and pin in section. Abbreviations for iron, carbon steel, alloy steel - Abbreviations for across corners, across flats, assembly, bearing, center of gravity, counterbore, countersunk, insulation, left hand, right hand, nominal, pitch circle diameter, tolerance, undercut.

2. SECTIONAL VIEWS

Full section, half section, partial or local section, revolved or superimposed section, removed section, successive section, parts that are not sectioned.

3. LIMITS, FITS AND TOLERANCES

Definitions: Limits, Fits and Tolerances - Upper limit, lower limit, tolerance, deviation, upper deviation, lower deviation, tolerance zone - Standard tolerance grades - Computation of IT tolerance using formulae and tables - Fundamental deviation - Computation of fundamental deviation - System of fits - Clearance fit - Interference fit - Transition fit - Problems on clearance and interference fit on shaft and hole basis system.

4. SURFACE TEXTURE

Nominal surface - Roughness - Waviness - Lay - Sampling length - Indication of surface roughness by roughness values, roughness grade number, roughness symbols - Indication of surface roughness by surface texture symbol with all the characteristics.

5. THREADED FASTENERS AND ITS APPLICATIONS

Screw thread terminology - Basic forms of screw threads - Standard forms of V threads - Basic form of square threads - Modified forms of square threads - Basic knuckle thread - Standard form of knuckle thread - Conventional representation of internal V thread and external V thread - Square thread - Designation of threads - Empirical proportions of hexagon and square head bolt and nut.

6. RIVETED JOINTS, WELDED JOINTS AND KEYS

Application of riveted joints - Difference between a bolt and a rivet - Disadvantages of riveted joints - Types of riveted joints - Empirical proportions of riveted joints - Types of welded joints - Symbolic representation of weld - Elementary weld symbols - Keys - Application of keys.

7. ASSEMBLY DRAWING (USING MINI-DRAFTER) FOR THE FOLLOWING WITH PART DRAWINGS GIVEN

Preparation of assembled views from exploded views for the following components: Cotter joint with sleeve, screw jack, snug type pedestal bearing, swivel bearing, tail stock.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Identify the national standards related to the machine drawing based on BIS and applying the standards.
- CO2 - Analyze limits and tolerances for assembly and evaluate to choose appropriate fits for the assembly.
- CO3 - Understand and apply surface finish and welding symbols.
- CO4 - Assemble machine components through drawings.
- CO5 - Interpret the machine components and conventions used in the drawing.
- CO6 - Interpret the components such as fasteners, riveted joints, welded joints and keys

TEXT / REFERENCE BOOKS

1. Engineering drawing practice for schools and colleges, SP 46 - 1988.
(http://web.iitd.ac.in/~achawla/public_html/201/lectures/sp46.pdf).
2. Gopalakrishnan, K.R., Machine Drawing, Subhas Publications, 16th Edition, 2008.
3. Bhatt, N.D., Machine Drawing, Charotar Publishing House, 48th Edition, 2013.
4. Brian Griffiths, "Engineering Drawing for Manufacture", Kogan Page Science, 2003.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Maximum Marks: 100****Exam Duration: 3 Hrs.****PART A:** Questions from sections 1 - 6 (Each section 10 marks)**60 Marks****PART B:** One question from section 7 with no choice (Assembly Drawing)**40 Marks**

SMEA1503	FINITE ELEMENT ANALYSIS	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To understand the concepts of Mathematical Modeling of Engineering Problems.
- To apply the use of FEM in various engineering problems.
- To learn the efficient implementation of finite element method in solving of simple problems.
- To solve simple and complicated 2D structural problems for stress analysis under impact loads from general engineering aspects.

UNIT 1 INTRODUCTION**9 Hrs.**

Historical Background- Basic Concepts of FEM - Mathematical Modeling of field problems in Engineering - Governing Equations - Discrete and continuous models - Boundary, Initial and Eigen Value problems-Residual Methods- Variational Formulation of Boundary Value Problems - Ritz Method .

UNIT 2 ONE-DIMENSIONAL PROBLEMS**9 Hrs.**

One Dimensional Second Order Equations - Discretization - Element types- Linear and Higher order Elements - Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices- Solution of problems from solid mechanics and heat transfer-Bar, Beam Elements - Applications to Heat Transfer.

UNIT 3 TWO DIMENSIONAL PROBLEMS**9 Hrs.**

Basic Boundary Value Problems in Two Dimensions - Triangular, quadrilateral, higher order elements - Triangular elements - Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems - Torsion of Non circular shafts -Quadrilateral elements - Higher Order Elements.

UNIT 4 SOLUTION TO PLANE ELASTICITY PROBLEMS**9 Hrs.**

Introduction to Theory of Elasticity - Plane Stress - Plane Strain and Axisymmetric Formulation - Body forces and temperature effects - Stress calculations - Plate and shell elements.

UNIT 5 ISO PARAMETRIC FORMULATION**9 Hrs.**

Natural Co-ordinate System - Lagrangian Interpolation Polynomials - Iso-parametric Elements - Formulation -Numerical Intergration - 1D -2D Triangular elements - rectangular elements - Introduction to Analysis Software-- h & p elements- Errors and Types

Max.45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Understand the basics of matrix manipulations required for Finite Element Analysis.
- CO2 - Apply finite element formulations to solve one dimensional Problems.
- CO3 - Apply finite element formulations to solve two dimensional scalar Problems.
- CO4 - Apply finite element method to solve two dimensional Vector problems.
- CO5 - Apply finite element method to solve problems on iso parametric element.
- CO6 - Analyze the importance of ethical issues pertaining to the effective utilization of FEA in Mechanical engineering.

TEXT / REFERENCE BOOKS

1. Reddy. J.N., "An Introduction to the Finite Element Method", 3rd Edition, Tata McGraw-Hill, 2010.
2. Seshu, P, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.
3. Chandrupatla & Belagundu, "Introduction to Finite Elements in Engineering", 4th Edition, Prentice Hall College Div, 1997.
4. Rao, S.S., "The Finite Element Method in Engineering", 4th Edition, Butterworth Heinemann, 2005.
5. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and Applications of Finite Element Analysis", 4th Edition, Wiley Student Edition, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 marks each - No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice; each carrying 16 marks**80 Marks**

SMEA3001	ADDITIVE MANUFACTURING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To explore the technology used in additive manufacturing.
- To understand the importance of additive manufacturing in advance manufacturing process.
- To acquire knowledge, techniques and skills to select relevant additive manufacturing process.
- To explore the potential of additive manufacturing in different industrial sectors.
- To apply 3D printing technology for additive manufacturing.

UNIT 1 INTRODUCTION**9 Hrs.**

Overview, Basic principle need and advantages of additive manufacturing, Procedure of product development in additive manufacturing, Classification of additive manufacturing processes, Materials used in additive manufacturing, Challenges in Additive Manufacturing.

UNIT 2 ADDITIVE MANUFACTURING PROCESSES**9 Hrs.**

Z-Corporation 3D-printing, Stereolithography apparatus (SLA), Fused deposition modeling (FDM), Laminated Object Manufacturing (LOM), Selective deposition lamination (SDL), Ultrasonic consolidation, Selective laser sintering (SLS), Laser engineered net shaping (LENS), Electron beam free form fabrication (EBFFF), Electron beam melting (EBM), Plasma transferred arc additive manufacturing (PTAAM), Tungsten inert gas additive manufacturing (TIGAM), Metal inert gas additive manufacturing (MIGAM).

UNIT 3 ADDITIVE MANUFACTURING MACHINES AND SYSTEMS**9 Hrs.**

Axes, Linear motion guide ways, Ball screws, Motors, Bearings, Encoders/ Glass scales, Process Chamber, Safety interlocks, Sensors. Introduction to NC/CNC/DNC machine tools, CNC programming and introduction, Hardware Interpolators, Software Interpolators, Recent developments of CNC systems for additive manufacturing.

UNIT 4 PRE-PROCESSING IN ADDITIVE MANUFACTURING**9 Hrs.**

Preparation of 3D-CAD model, Reverse engineering, Reconstruction of 3D-CAD model using reverse engineering, Part orientation and support generation, STL Conversion, STL error diagnostics, Slicing and Generation of codes for tool path, Surface preparation of materials.

UNIT 5 POST-PROCESSING IN ADDITIVE MANUFACTURING**9 Hrs.**

Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non-thermal and thermal techniques, Brief information on characterization techniques used in additive manufacturing, Applications of additive manufacturing in rapid prototyping, rapid manufacturing, rapid tooling, repairing and coating.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Define the various process used in Additive Manufacturing.
- CO2 - Analyze and select suitable process and materials used in Additive Manufacturing.
- CO3 - Identify, analyze and solve problems related to Additive Manufacturing.
- CO4 - Apply knowledge of additive manufacturing for various real-life applications.
- CO5 - Apply technique of CAD and reverse engineering for geometry transformation in Additive Manufacturing.
- CO6 - Understand the basic concept of additive manufacturing application.

TEXT / REFERENCE BOOKS

- Gibson, I, Rosen, D W., and Stucker, B., Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010.
- Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", 3rd Edition, World Scientific Publishers, 2010.
- Chee Kai Chua, Kah Fai Leong, 3D Printing and Additive Manufacturing: Principles and Applications: 4th Edition of Rapid Prototyping, World Scientific Publishers, 2014.
- Gebhardt A., "Rapid prototyping", Hanser Gardener Publications, 2003. Kenneth G. Budinski & Michael K. Budinski, "Engineering Materials: Properties and Selection", 9th Edition, Pearson, 2009, 792 pages.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 marks each - No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice, each carrying 16 marks**80 Marks**

SMEA3005	NON DESTRUCTIVE TESTING AND TECHNIQUES	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To enable the student to understand the modern NDT techniques.
- To present the underlying principles and alternatives for destructive testing procedures.
- To provide the student with the opportunity for hands-on experience for diverse domains of application.

UNIT 1 INTRODUCTION AND VISUAL INSPECTION METHODS**9 Hrs.**

Scope and advantages of NDT. Comparison of NDT with DT. Some common NDT methods used since ages, Terminology. Flaws and Defects, Visual inspection-Unaided, Equipment used for visual inspection. Ringing test chalk test (oil whitening test). Attractive uses of above tests in detecting surface cracks, bond strength and surface defects.

UNIT 2 LIQUID PENETRANT TESTING AND MAGNETIC PARTICLE TESTING**9 Hrs.**

Die penetrate test (liquid penetrate inspection), Principle, scope. Equipment & techniques, Tests stations, Advantages, types of penetrant and developers. Illustrative examples - Heavy castings of large size, frame of jet engine, porosity testing of nickel alloys, leak testing. Magnetic particle Inspection - Scope, principle, Ferro Magnetic and Non-ferro magnetic materials, equipment & testing. Advantages, limitations Interpretation of results. DC and AC magnetization, Skin Effect, use of dye and wet powders for magna glow testing, different methods to generate magnetic fields, Applications and demonstration.

UNIT 3 RADIOGRAPHIC METHODS**9 Hrs.**

X-ray radiography principle, equipment and methodology. Applicability, types of radiations limitations. Interpretation of Radiographs, limitations of gamma-ray radiography -principle, equipment. Attenuation of electromagnetic radiations, source of radioactive materials and technique. Photo electric effect, Rayleigh's scattering (coherent scattering), Compton's scattering (Incoherent scattering). Pair production, Beam geometry, scattering factor. Precautions against radiation hazards. Xero-Radiography, Digital Radiography, Gamma ray Radiography, Safety in X- ray and Gamma ray radiography. Advantages of gammaray radiography over X-ray radiography.

UNIT 4 ULTRASONIC TESTING AND ACOUSTIC EMISSION TESTING**9 Hrs.**

Introduction, Principle of operation, Piezoelectricity. Ultrasonic probes, CRO techniques, advantages, Limitation & typical applications. Applications in inspection of castings, forgings, Extruded steel parts, bars, pipes, rails and dimensions measurements. Acoustic Emission Technique - Introduction, Types of AE signal, AE wave propagation, Source location, Kaiser effect, AE transducers, Principle, AE parameters, AE instrumentation, Advantages& Limitations, Applications and demonstration.

UNIT 5 EDDY CURRENT TESTING AND THERMOGRAPHY**9 Hrs.**

Eddy current Testing - Principle, properties of eddy currents, Eddy current sensing elements, probes, Instrumentation, Types of arrangement, Advantages and Limitations and applications. Thermography - Introduction, Principle, Contact and Non-Contact inspection methods, Active and Passive methods, Liquid Crystal - Concept, example, advantages and limitations. Electromagnetic spectrum, infrared thermography- approaches, IR detectors, Applications and demonstration.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Recall the basic concepts of NDT.
- CO2 - Interpret the quality of the components.
- CO3 - Design the precautions against the radiation hazards.
- CO4 - Apply the knowledge on Interpretation of results.
- CO5 - Analyze products as production team member.
- CO6 - Apply the knowledge on Electromagnetic spectrum.

TEXT / REFERENCE BOOKS

1. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
2. Research Techniques in NDT Vol.3, R.S. Shah, Academic 2002.
3. Paul E Mix, "Introduction to non-destructive testing: a training guide", Wiley, 2nd Edition New Jersey, 2005.
4. Ravi Prakash, "Non-Destructive Testing Techniques", New Age International Publishers, 1st Revised Edition, 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 marks each - No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice, each carrying 16 marks**80 Marks**

SMEA3012	INDUSTRIAL ROBOTICS AND EXPERT SYSTEMS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Understand the basics of robotics and Automation Systems.
- Learn the robot cell design, Robot Configuration and robot programming.
- Understand the application of artificial intelligence and expert systems in robotics.

UNIT 1 INTRODUCTION AND ROBOTIC KINEMATICS**9 Hrs.**

Definition need and scope of industrial robots- Coordinate Systems Classification of Robot- Robot anatomy - work volume - Precision movement - End effectors - sensors. Robot kinematics - Basics about plane rotation - rotation matrix - Direct and inverse kinematics - Robot trajectories-Control of robot manipulators - Robot dynamics - Methods for orientation and location of objects. Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load.

UNIT 2 ROBOT DRIVES AND CONTROL**9 Hrs.**

Controlling the robot motion - Position and velocity sensing devices - Design of drive systems - Hydraulic and Pneumatic drives - D.C. Servo Motors, Stepper Motors, A.C. Servo Motors Linear and rotary actuators and control valves -Electro hydraulic servo valves, electric drives - Motors -Selection of Drives- designing of end effectors - Vacuum, magnetic and air operated grippers.

UNIT 3 ROBOT PATH PLANNING AND IMAGE PROCESSING**9 Hrs.**

Introduction-Path planning overview- Road map path planning- Cell decomposition path planning-Potential field path planning-Obstacle avoidance- Robotic vision system - Image Gripping - Image processing and analysis - Image segmentation - Pattern recognition - Training of vision system.

UNIT 4 ROBOT CELL DESIGN AND FIELD ROBOTS**9 Hrs.**

Robot work cell design and control - Safety in Robotics - Robot cell layouts - Multiple robots and machine interference - Robot cycle time analysis - Ariel robots- Collision avoidance-Robots for agriculture, mining, exploration, underwater, civilian and military applications, nuclear applications, Space applications.

UNIT 5 ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS**9 Hrs.**

Methods of robot programming - characteristics of task level languages lead through programming methods-Motion interpolation. Artificial intelligence - Basics - Goals of artificial Intelligence - AI techniques - problems representation in AI- Problem reduction and solution techniques - Application of AI. Elements of Knowledge Representation -Logic, Production Systems, Semantic Networks, Expert Systems Knowledge Building Environment Systems (KBES)-Humanoids.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Recall fundamental Concepts of Robots and Kinematics.
- CO2 - Implement Drives concepts in End effectors.
- CO3 - Analyze and design Path planning and Image processing.
- CO4 - Design robot work cell for automation industries.
- CO5 - Apply the knowledge about robot programming methods.
- CO6 - Apply the concepts of AI and expert systems.

TEXT / REFERENCE BOOKS

1. K.S.Fu, R.CGonzalez and C.S.G. Lee, Robotics control, Sensing, Vision and intelligence", McGraw Hill,1994.
2. Kozyrey, Yu, "Industrial Robotics", MIR Publishers Moscow, 1998.
3. Richard.D.,Klafter, Thomas.A, Chmielewski, Machine Negin "Robotics Engineering-An Integrated Approach", PrenticeHall of India, 1984.
4. Deb, S.R. "Robotics Technology and Flexible Automation", Tata McGraw Hill, 1994.
5. Mikell,P.Groover, Mitchell Weis, Roger N.Nagel, Nicholas Odrey "Industrial Robotics Technology, Programming and Applications", McGraw Hill, Int., 1986.
6. Timothy Jordonidesetal,"Expert Systems and Robotics", Springer-Verlag, New York, May 1991.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 marks each - No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice, each carrying 16 marks**80 Marks**

SMEA4003	INDUSTRY 4.0 FOR DESIGN AND MANUFACTURING	L	T	P	Credits	Total Marks
		2	-	0	2	100

COURSE OBJECTIVES

- To enable students understand the fundamentals and the contributing technologies of Industry 4.0.
- To make the students evaluate the suitability of Industry 4.0 technologies for the design and Manufacturing sectors.
- To help the students implement the Industry 4.0 technologies to diverse applications.

UNIT 1 CONTRIBUTING TECHNOLOGIES**8 hrs**

Brief introduction to the industrial revolutions. Contributing technologies to Industry 4.0: Additive manufacturing, Digital twin, Internet of things, Smart sensors, AR and VR, Artificial intelligence, Cloud computing, Block chain, Big data and analytics. Challenges and opportunities.

UNIT 2 ADVANCED CAD TECHNOLOGIES**8 hrs**

Introduction to CAD. Enabling technologies: Digital twin, AR/VR, AI. Cloud computing, Touch/Voice/Motion enabled CAD, Customized CAD, Cloud based CAD, Digital twin and live simulation.

UNIT 3 SMART MANUFACTURING SYSTEMS**8 hrs**

Enabling technologies: AI, Cloud computing, Robotics, IoT. Digital manufacturing: CNC, Cloud based manufacturing, IoT based manufacturing, Advanced CNC programming. Additive manufacturing. Micro electro mechanical systems. Robotics: Robotic automation, Collaborative robots, Autonomous robots, Swarm robots, and Modular robots.

UNIT 4 SMART FACTORY ENABLERS**8 hrs**

Enabling technologies. Smart energy: Improving energy efficiency with data, Smart grids. Clean energy. Smart logistics. Smart Inspection. Smart decision making.

UNIT 5 AUTOMOMOUS VEHICLES**8 hrs**

Introduction: Traditional mobility versus autonomous driving, Levels of automation, and challenges. Enabling technologies. Self-propelled vehicles, Drones, Unmanned aerial vehicles, Space crafts

UNIT 6 CASE STUDIES**5 hrs**

Case studies related to Industry 4.0 applications, such as, transportation, energy, infrastructure, manufacturing, and product design sectors.

Max. 45 Hrs.**COURSE OUTCOMES**

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

CO1: Justify how the digitalization technologies are advantageous to the design and manufacturing industries.

CO2: Use the advanced CAD technologies to create the CAD models.

CO3: Use the smart manufacturing technologies to produce the components and products.

CO4: Recommend the enabling technologies to make various factory operations smarter.

CO5: Choose the suitable sensors and technologies to the future autonomous vehicles, drones and space crafts.

CO6: Prepare a report with the challenges faced currently, the enabling technologies to become smarter, and the steps needed for the effective implementation for the given case study.

TEXT / REFERENCE BOOKS

1. Flavio Craveiro, Jose Pinto Duarte, Helena Bartolo and Paulo Jorge Bartolo, "Additive manufacturing as an enabling technology for digital construction: A perspective on Construction 4.0", Automation in Construction, Vol. 103, pp. 251- 267, 2019.
2. Klaus Schwab, "Fourth Industrial Revolution", Random House USA Inc, New York, USA, 2017.
3. Oliver Grunow, "Smart Factory and Industry 4.0. The current state of Application Technologies", Studylab Publications, 2016
4. Alasdair Gilchrist, "Industry 4.0: Industrial Internet of Things", Apress, 2016
5. Sang C. Suh, U. John Tanik, John N Carbone, Abdullah Eroglu, "Applied Cyber-Physical Systems", Springer Publications, New York, 2013.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 11 Questions of 2 marks each - No choice**22 Marks**

Questions from each unit with internal choice, each carrying 13 marks

78 Marks

SMEA3021	QUALITY CONTROL AND RELIABILITY ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

(Use of approved statistical table permitted in the examination)

COURSE OBJECTIVES:

- To understand process control and acceptance sampling procedure and their application.
- To learn the concept of reliability.

UNIT I INTRODUCTION AND PROCESS CONTROL FOR VARIABLES

9Hrs

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality control: Quality cost-Variation in process causes of variation –Theory of control chart- uses of control chart – Control chart for variables – X chart, R chart and chart - process capability – process capability studies and simple problems. Six sigma concepts

UNIT II PROCESS CONTROL FOR ATTRIBUTES

9Hrs

Control chart for attributes –control chart for non conforming– p chart and np chart – control chart for nonconformities– C and U charts, State of control and process out of control identification in charts, pattern study.

UNIT III ACCEPTANCE SAMPLING

9hrs

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

UNIT IV LIFE TESTING – RELIABILITY

9Hrs

Life testing – Objective – failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate – Weibull model, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability – simple problems. Acceptance sampling based on reliability test – O.C Curves.

UNIT V QUALITY AND RELIABILITY

9Hrs

Reliability improvements – techniques- use of Pareto analysis – design for reliability – redundancy unit and standby redundancy – Optimization in reliability – Product design – Product analysis – Product development – Product life cycles.

Course Outcomes:

Max. 45 Hours

On completion of the course, student will be able to

CO1: Apply the concept of SQC in process control for reliable component production

CO2: Perform statistical analysis using control charts

CO3: Apply sampling techniques for non conformities

CO4: Evaluate the quality of components by failure analysis

CO5: Design for reliability of component parts

CO6: Develop product analysis for new product development

TEXT BOOKS/ REFERENCES

1. Douglas.C. Montgomery, " Introduction to Statistical quality control", 4th edition, John Wiley 2001.
2. Srinath. L.S., "Reliability Engineering", Affiliated East west press, 1991.
3. John.S. Oakland. "Statistical process control", 5th edition, Elsevier, 2005
4. Connor, P.D.T.O., "Practical Reliability Engineering", John Wiley, 1993
5. Grant, Eugene .L "Statistical Quality Control", McGraw-Hill, 1996
6. Monohar Mahajan, "Statistical Quality Control", Dhanpat Rai & Sons, 2001.
7. Sharma S.C., "Inspection Quality Control and Reliability", Khanna Publishers, 1998.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration : 3 Hrs.****PART A:** 10 questions of 2 marks each - No choice**20 Marks****PART B :** 2 questions from each unit of internal choice; each carrying 16 marks**80 Marks**

SMEA3020	DESIGN OF HEAT EXCHANGERS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To learn the thermal and stress analysis on various parts of the heat exchangers
- To analyze the sizing and rating of the heat exchangers for various applications

UNIT I INTRODUCTION

9 Hrs.

Types of heat exchangers, shell and tube heat exchangers — regenerators and recuperators
 - Temperature distribution and its implications - Parts description, Classification as per Tubular Exchanger Manufacturers Association (TEMA)

UNIT II PROCESS DESIGN OF HEAT EXCHANGERS

9 Hrs.

Heat transfer correlations, Overall heat transfer coefficient, analysis of heat exchangers — LMTD and effectiveness method. Sizing of finned tube heat exchangers, U tube heat exchangers, Design of shell and tube heat exchangers, fouling factors, pressure drop calculations.

UNIT III STRESS ANALYSIS

9 Hrs.

Stress in tubes – header sheets and pressure vessels – thermal stresses, shear stresses
 - types of failures, buckling of tubes, flow induced vibration.

UNIT IV COMPACT AND PLATE HEAT EXCHANGERS

9 Hrs.

Types- Merits and Demerits- Design of compact heat exchangers, plate heat exchangers, performance influencing parameters, limitations.

UNIT V CONDENSERS AND COOLING TOWERS

9 Hrs.

Design of surface and evaporative condensers — cooling tower — performance characteristics.

Course Outcomes:

Max. 45 Hours On

completion of the course, student will be able to

CO1: Classify Heat Exchangers based on TEMA.

CO2: Perform Heat transfer analysis by LMTD and NTU

Methods. CO3: Calculate stresses in heat exchanger tubes.

CO4: Design compact heat exchangers according to applications

CO5: Evaluate the performance characteristics of heat exchanger types

CO6: Design condensers and cooling towers according to need and applications..

TEXT BOOKS/ REFERENCES BOOKS

1. SadikKakac and Hongtan Liu, "Heat Exchangers Selection", Rating and Thermal Design, CRC Press, 2002.
2. Shah, R. K., Dušan P. Sekulić, "Fundamentals of heat exchanger design", John Wiley & Sons, 2003.
3. Robert W. Serth, "Process heat transfer principles and applications", Academic press, Elsevier, 2007.
4. Sarit Kumar Das, "Process heat transfer", Alpha Science International, 2005
5. John E. Hesselgreaves, "Compact heat exchangers: selection, design, and operation", Elsevier science Ltd, 2001.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration : 3 Hrs.

PART A: 10 questions of 2 marks each - No choice

20 Marks

PART B : 2 questions from each unit of internal choice; each carrying 16 marks

80 Marks

PROGRAMME: B.E.

STRUCTURE ENGINEERING CURRICULUM

SEMESTER 1

Sl.No.	COURSE CODE	COURSE TITLE	L	T	P	Total Hrs.	Credits
THEORY							
1	SCH1101	Environmental Science and Engineering	3	0	0	45	3
2	SMT1101	Engineering Mathematics - I	3	1	0	60	4
3	SPH1101	Physics of Engineering Materials	3	0	0	45	3
4	SCY1101	Engineering Chemistry	3	0	0	45	3
5	SME1101	Engineering Mechanics	3	1	0	60	4
6	SME1102	Fundamentals of Mechanical Engineering	3	0	0	45	3
PRACTICAL							
7	SPH4051	Engineering Physics Lab	0	0	2	15	1
8	SCY4051	Engineering Chemistry Lab	0	0	2	15	1
9	SME4051	Engineering Graphics - I	1	0	2	30	2

TOTAL CREDITS

SEMESTER 2

Sl.No.	COURSE CODE	COURSE TITLE	L	T	P	Total Hrs.	Credits
THEORY							
1	SHS1101	English for Science and Technology	3	0	0	45	3
2	SMT1105	Engineering Mathematics - II	3	1	0	60	4
3	SCH1101	Environmental Science and Engineering	3	0	0	45	3
4	SPH1102/ SPH1103/ SPH1104	Physics for Electronic Devices / Engineering Physics / Applied Biophysics	3	0	0	45	3
5	SCY1102/ SCY1103/ SCY1104/ SCY1105	Chemistry of Electronic Materials / Chemistry of Industrial Materials / Bio-organic Chemistry / Physical Chemistry	3	0	0	45	3
6	SCS1102	Fundamentals of Programming	3	0	0	45	3
7	SEE1103	Electrical Engineering	3	0	0	45	3
PRACTICAL							
8	SCS4101	Programming in C Lab	0	0	4	30	2
9	SME4052	Engineering Graphics - II	1	0	2	30	2

TOTAL CREDITS

L - LECTURE HOURS, T - TUTORIAL HOURS, P - PRACTICAL HOURS, C - CREDITS

SEMESTER 3

SI.No.	COURSE CODE	COURSE TITLE	L	T	P	Total Hrs	Credits
THEORY							
1	SMT1201	Engineering Mathematics - III	3	1	0	60	4
2	SME1201	Engineering Thermodynamics	2	1	0	45	3
3	SME1202	Fluid Mechanics and Machinery	3	1	0	60	4
4	SME1203	Kinematics of Machines	3	1	0	60	4
5	SME1204	Strength of Materials	3	1	0	60	4
6	SPR1201	Material Technology	3	0	0	45	3
PRACTICAL							
7	SME4054	Fluid Mechanics and Machinery Lab	0	0	4	30	2
8	SME4055	Machine Drawing Practice	1	0	2	30	2
TOTAL CREDITS							

SEMESTER 4

SI.No.	COURSE CODE	COURSE TITLE	L	T	P	Total Hrs	Credits
THEORY							
1	SMT1204/ SMT1206/ SMT1207/ SMT1208/ SMT1209	Engineering Mathematics - IV / Number Theory and Linear Algebra / Graph Theory / Applied Statistics / Foundations of Mathematics	3	1	0	60	4
2	SME1205	CAD / CAM	3	0	0	45	3
3	SME1206	Dynamics of Machinery	3	1	0	60	4
4	SME1207	Thermal Engineering	3	1	0	60	4
5	SPR1202	Engineering Metrology	3	0	0	45	3
6	SPR1207	Manufacturing Technology - I	3	0	0	45	3
PRACTICAL							
7	SME4056	Material Testing Lab	0	0	4	30	2
8	SPR4051	Manufacturing Process Lab - I	0	0	4	30	2
9	S15PT1	Professional Training - 1	0	0	1 0	30	5
TOTAL CREDITS							

SEMESTER 5

SI.No.	COURSE CODE	COURSE TITLE	L	T	P	Total Hrs	Credits
THEORY							
1	SME1301	Design of Machine Elements	3	1	0	60	4
2	SME1302	Fluid Power Systems	3	0	0	45	3
3	SME1303	Gas Dynamics and Jet Propulsion	2	1	0	45	3
4	SME1304	Power Plant Engineering	3	0	0	45	3
5	SPR1301	Manufacturing Technology - II	3	0	0	45	3
6	SPR1304	Industrial Mechatronics	3	0	0	45	3
PRACTICAL							
7	SME4058	Mechatronics Lab	0	0	4	30	2
8	SPR4052	Manufacturing Processes Lab - II	0	0	4	30	2
TOTAL CREDITS							

SEMESTER 6

SI.No.	COURSE CODE	COURSE TITLE	L	T	P	Total Hrs.	Credits
THEORY							
1	SME1307	Design of Transmission Systems	3	1	0	60	4
2	SME1309	Heat and Mass Transfer	3	1	0	60	4
3	SME1310	Product Design	3	0	0	45	3
4	SPR1306	Production Planning and Control	3	0	0	45	3
5	SPR1307	Resource Management Techniques	2	1	0	45	3
6		Elective - 1	3	0	0	45	3
PRACTICAL							
7	SME4059	Metrology and Dynamics Lab	0	0	4	30	2
8	SME4060	Thermal Engineering Lab	0	0	4	30	2
9	S15 PT2	Professional Training - 2	0	0	10	30	5
TOTAL CREDITS							

SEMESTER 7

SI.No.	COURSE CODE	COURSE TITLE	L	T	P	Total Hrs	Credits
THEORY							
1	SPR1402	Total Quality Management	3	0	0	45	3
2	SAU1401	Automobile Engineering	3	0	0	45	3
3		Elective - 2	3	0	0	45	3
4		Elective - 3	3	0	0	45	3
5	SPR1307	Manufacturing Technology - II	3	0	0	45	3
6	SPR1304	Resource Management Techniques	2	1	0	45	3
PRACTICAL							
7	SME4061	Heat Transfer Lab	0	0	4	30	2
8	SPR4054	CAD / CAM Lab	0	0	4	30	2
TOTAL CREDITS							

SEMESTER 8

SI.No.	COURSE CODE	COURSE TITLE	L	T	P	Total Hrs	Credits
THEORY							
1	SBA1101	Principles of Management and Professional Ethics	3	0	0	45	3
2	SPR1403	Modern Manufacturing Processes	3	0	0	45	3
3		Elective - 4	3	0	0	45	3
4	S15 PROJ	Project Work (Phase - 1 & 2)	0	0	30		15
TOTAL CREDITS							
TOTAL CREDITS FOR THE PROGRAMME							

ELECTIVE COURSES (GROUP A)

SI.No.	COURSE CODE	COURSE TITLE	L	T	P	Total Hrs	Credits
1	SME1306	Theory of Vibrations	3	0	0	45	3
2	SME1308	Finite Element Analysis	3	0	0	45	3
3	SME1601	Advanced Internal Combustion Engineering	3	0	0	45	3
4	SME1602	Wind and Solar Energy	3	0	0	45	3
5	SME1607	Computational Fluid Dynamics	3	0	0	45	3
6	SME1609	Cryogenic Engineering	3	0	0	45	3
7	SME1611	Design of Machine Tool Structure	3	0	0	45	3
8	SME1612	Waste Heat Utilization and Management	3	0	0	45	3
9	SME1613	Energy Engineering and Management	3	0	0	45	3
10	SME1614	Experimental stress analysis	2	0	0	45	3
11	SME1616	Industrial Tribology	3	0	0	45	3
12	SME1617	Non Conventional Energy systems	3	0	0	45	3
13	SME1618	Refrigeration and Air Conditioning	3	0	0	45	3
14	SME1620	Theory of Elasticity	3	0	0	45	3

ELECTIVE COURSES (GROUP B)

SI.No.	COURSE CODE	COURSE TITLE	L	T	P	Total Hrs.	Credits
1	SPR1602	Artificial Intelligence and Expert Systems	3	0	0	45	3
2	SPR1604	Design for Manufacture and Assembly	3	0	0	45	3
3	SPR1605	Flexible Manufacturing Systems	3	0	0	45	3
4	SPR1606	Industrial Robotics and Expert systems	3	0	0	45	3
5	SPR1607	Industrial Safety Engineering	3	0	0	45	3
6	SPR1609	Material handling and Storage systems	3	0	0	45	3
7	SPR1611	<u>Non Destructive</u> Testing and Techniques	3	0	0	45	3
8	SPR1612	Six Sigma Methods and Applications	3	0	0	45	3
9	SPR1615	Production and operations Management	3	0	0	45	3
10	SPR1616	Rapid Prototyping	3	0	0	45	3
11	SPR1617	Supply Chain Management	3	0	0	45	3
12	SPR1619	Precision Engineering	3	0	0	45	3

SME1101	ENGINEERING MECHANICS (For Mech, Mech & Prod, Aero & Auto)	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

- To make the students understand Force system, statics, dynamics and friction.

UNIT 1 BASICS & STATICS OF PARTICLES**12 Hrs.**

Introduction - Units and Dimensions - Laws of Mechanics - Vectors - Vectorial representation of forces and moments - Vector operations, Coplanar forces resolution and composition of forces - equilibrium of a particle - Free body diagram - forces in space - equilibrium of a particle in space - equivalent systems of forces - principle of transmissibility - Single equivalent force.

UNIT 2 EQUILIBRIUM OF RIGID BODIES**12 Hrs.**

Types of supports and their reactions - requirements of stable equilibrium - Moments and Couples - Varignon's theorem - Equilibrium of Rigid bodies in two dimensions - Equilibrium of Rigid bodies in three dimensions - Virtual work

UNIT3 PROPERTIES OF SURFACES AND SOLIDS**12 Hrs.**

Determination of Areas - First moment of Area and the centroid - simple problems involving composite figures. Second moment of plane area - Parallel axis theorems and perpendicular axis theorems - Polar moment of Inertia - Principal moments of Inertia of plane areas - Principle axes of inertia - relation to area moments of Inertia. Second moment of plane area of sections like C,I,T,Z etc. - Basic Concept of Mass moment of Inertia

UNIT 4 FRICTION**12 Hrs.**

Frictional Force - Laws of Coulomb friction - Cone of friction- Angle of repose- Simple contact friction - Screw - Wedge - Ladder - Rolling resistance - Belt friction.

UNIT 5 KINETICS OF RIGID BODIES AND DYNAMICS OF PARTICLES**12 Hrs.**

Work, Kinetic Energy, Potential Energy, Power, Impulse, Momentum, Impact - Combination problems. **Displacement, Velocity and acceleration their relationship - Relative motion - Curvilinear motion** - Newton's Law - D'Alembert's Principle, Work Energy Equation - Impulse and Momentum - Impact of elastic bodies. Translation and rotation of rigid bodies- General plane motion.

Max. 60 Hours**TEXT / REFERENCE BOOKS**

- Irving H Shames, "Engineering Mechanics - Statics and Dynamics" 3rd edition, Prentice Hall of India pvt ltd 1993.
- Beer & Johnston, "Vector Mechanics for engineers - Vol I &II", 8th Edition,2005
- Timoshanko and Young, "Engineering Mechanics",4th Edition, Tata McGrawhill 2005.
- McLean, "Engineering Mechanics" 3rd Edition, Schaum Series 1995

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks : 80****Exam Duration : 3 Hrs.****PART A : 2 Questions from each unit, each carrying 2 marks****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 12 marks****60 Marks**

SME1102	FUNDAMENTALS OF MECHANICAL ENGINEERING (For Mech, Mech & Prod & Auto)	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To study product life cycle concept and implications
- To provide basic knowledge on manufacturing process and production process
- To enable the students to understand the IC engines and Power plants

UNIT 1 PRODUCT CYCLE**9 Hrs.**

Need for new product development - Globalization - Product life cycle - Technology development cycle - Forward cycle - Forward engineering - Design process - Materials Used in Engineering and their Applications Metals - Ferrous and Non-Ferrous, Nonmetallic materials, Material selection criteria Design considerations Steps in Design, designing to codes and standards sequential engineering - simultaneous engineering - concurrent engineering - Reverse engineering - Re engineering.

UNIT 2 MANUFACTURING PROCESS**9 Hrs.**

Introduction to manufacturing processes and Their Applications: Sheet metal forming, Sheet metal cutting, Fabrication, Metal joining processes. Principles of welding - fundamentals of arc welding, gas welding and gas cutting - brazing and soldering. Foundry - tools - patterns - moulding process - types - green sand moulding and dry sand molding, castings - sand casting - die casting - defects and remedies Forging - forging tools - open-die forging, closed-die forging, coining, nosing, upsetting, heading, - smithy tools

UNIT 3 PRODUCTION PROCESS (MACHINE TOOLS)**9 Hrs.**

Metal machining process: Lathe -Specifications - Main components and their functions-Lathe operations. Machining Concept - Drilling, Milling, Turning, Grinding and surface Finishing. Operations. Study of Pillar drilling machine, boring, milling, shaping, planning, broaching, grinding. Introduction to NC and CNC machines, Grinding machine, Power saw, Milling Machine.

UNIT 4 I.C.ENGINES**9 Hrs.**

Working principle of S.I. and C.I.engines - four stroke and two stroke cycles - comparison of four stroke and two stroke engines, Ignition systems -single jet carburetor-spark plug-cooling systems- lubrication systems - fuel pump and fuel injector, function of piston, piston rings, cylinder, connecting rod and crankshaft. Steam Engine(Qualitative treatment only)

UNIT 5 POWER PLANT**9 Hrs.**

Layout - components and working of Steam, Hydrel, Diesel, Nuclear and Gas turbine Power Plants - comparison and selection of sites, High pressure and Super Critical Boilers - Fluidised Bed Boilers

Max. 45 Hours**TEXT / REFERENCE BOOKS**

1. George E.Dieter, Linda C.Schmidt, "Engineering Design", McGraw-Hill International Edition, 4th Edition, 2009, ISBN 978-007-127189-9
2. Hajra-Chaudhari " Workshop Technology
3. Ganesan V, "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2011.
4. Arora S.C and Domkundwar S, "A Course in Power Plant Engineering", Dhanpat Rai, 2001.
5. Cagan, Jonathan; Vogel, Craig M.; Creating Breakthrough Products: Innovation from Product Planning to Program Approval, Publisher: Financial Times Prentice Hall; 2002
6. Collier J.G., and Hewitt G.F, "Introduction to Nuclear power", Hemisphere publishing, New York, 1987.
7. John B Heywood, "Internal Combustion Engine Fundamentals", Tata McGraw-Hill, 2011.

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks : 80****Exam Duration : 3 Hrs.****PART A : 2 Questions from each unit, each carrying 2 marks****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 12 marks****60 Marks**

SME1201	ENGINEERING THERMODYNAMICS (For Mech, Mech & Prod, Aero & Auto)	L	T	P	Credits	Total Marks
		2	1	0	3	100

(Use of Steam table with mollier chart, compressibility chart, psychrometric chart are permitted in the END SEMESTER EXAM.)

COURSE OBJECTIVES

- To understand the Basic concepts of thermodynamics
- To analyze the behavior and performance of various thermal concepts.

UNIT 1 BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS

9 Hrs.

Basic concepts - concept of continuum, macroscopic approach, thermodynamic systems - closed, open and isolated. Thermodynamic Equilibrium, Property, state, path and process, quasi-static process, work, modes of work, Zeroth law of thermodynamics- concept of temperature and heat. Concept of ideal and real gases. First law of thermodynamics - application to closed and open systems, internal energy, specific heat capacities, enthalpy, steady flow process with reference to various thermal equipments.

UNIT 2 SECOND LAW OF THERMODYNAMICS AND ENTROPY

9 Hrs.

Second law of thermodynamics - Kelvin's and Clausius statements of second law. Reversibility and irreversibility. Heat Engine, Refrigerator, Heat pump, Carnot theorem, Carnot cycle, reversed carnot cycle, efficiency, COP. Thermodynamic temperature scale, Clausius inequality, concept of entropy, entropy of ideal gas, principle of increase of entropy, Available and Unavailable energy, Helmholtz and Gibbs function-Availability of non-flow and steady flow systems-Irreversibility and second law efficiency.

UNIT 3 PROPERTIES OF PURE SUBSTANCES

9 Hrs.

Properties of pure substances - Thermodynamic properties of pure substances in solid, liquid and vapour phases, phase rule, P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces, thermodynamic properties of steam. **Dryness fraction and its determination by separating and throttling calorimeter. Calculations of workdone and heat transfer in non-flow and flow processes. Ideal and actual Rankine cycles.** Cycle Improvement Methods - Reheat and Regenerative cycles-Binary Vapour cycles.

UNIT 4 IDEAL AND REAL GASES, GAS MIXTURES AND THERMODYNAMIC RELATIONS

9 Hrs.

Gas mixtures - Properties of ideal and real gases - Equations of state - Avagadro's law- Vanderwaal's equation of state - compressibility factor - compressibility chart - Dalton's law of partial pressure - Exact differentials - T-ds relations - Maxwell's relations - Clausius Clapeyron equations - Joule - Thomson coefficient.

UNIT 5 FUELS AND COMBUSTION

9 Hrs.

Types of fuel, Combustion equations, Stoichiometric air, Excess air, Air-fuel ratio by volume & weight. Calorific value - HCV & LCV. Bomb and Boy's gas calorimeter, Proximate and ultimate analysis of fuel-mass basis and volume basis, analysis of exhaust and flue gases.

Max. 45 Hours

TEXT / REFERENCE BOOKS

- Nag.P.K., "Engineering Thermodynamics", 4th Edition, Tata McGraw-Hill, New Delhi, 2008
- Lynn D Russell, George A, Adebisi "Engineering Thermodynamics", 6th Edition, Indian Edition, Oxford University Press, New Delhi, 2008.
- Yunus A Cengel and Michael Boles, "Thermodynamics An Engineering Approach", 6th Edition, McGraw Hill, 2008
- Arora C.P., "Thermodynamics", 2nd Edition, Tata McGraw-Hill, New Delhi, 2003.
- Venwylen and Sontag, "Classical Thermodynamics", Wiley Eastern, 1987
- Holman.J.P., "Thermodynamics", 3rd Ed. McGraw-Hill, 1995.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 80

Exam Duration : 3 Hrs

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks

SME1202	FLUID MECHANICS AND MACHINERY (For Mech, Mech & Prod & Auto)	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVES

- To understand fluid properties, flow characteristics and basic governing equations-mass, momentum, energy.
- To understand types of flow and boundary layer concept.

UNIT 1 FLUID PROPERTIES**12 Hrs.**

Fluid Properties: Density -Specific Weight -Specific Gravity-viscosity -surface tension -capillarity - Vapour pressure-compressibility. Fluid Static : Hydrostatic Law-Pressure Variation in static fluid- Hydrostatic force on a submerged plane surfaces - Location of hydrostatic force. Manometers - Simple U tube and differential manometers - Buoyancy -Meta-centric height - determination of stability of floating bodies and submerged bodies.

UNIT 2 EQUATIONS OF MOTION**12 Hrs.**

Basic equations of motion: Types of fluid flow-Concept of Control Volume- Control Volume Analysis of mass, momentum and energy. Differential equations of continuity and momentum - Euler's and Bernoulli's Equation and its applications. Flow Measurement: Orifice meter, Venturi meter, Piezometer, Pitot Tube.

UNIT 3 LAMINAR AND TURBULENT FLOW**12 Hrs.**

Flow through orifices: Classification - Hydraulic co-efficient - Flow through rectangular orifice, Notches and weirs.Laminar and Turbulent flow - Reynolds experiment - Major and minor losses in pipes - Darcy weisbach's equation, chezy's formula - friction factor- moody diagram - pipes in series and pipes in parallel - total energy line - hydraulic gradient line -Equivalent pipe Introduction to viscous flow of incompressible fluids - Concept of Boundary Layer- Types of boundary layer thickness.-Flow over bodies-Drag and Lift.

UNIT 4 PUMPS**12 Hrs.**

Impact of jets - Theory of roto-dynamic machines - various efficiencies-velocity components at entry and exit of the rotor- velocity triangles. Centrifugal Pumps:Definition-Operations-VelocityTriangles-Performancecurves - Cavitations-Multi-staging. Reciprocating Pumps: Operation - Slip - indicator Diagram - Separation - Air vessels.

UNIT 5 TURBINES AND DIMENSIONAL ANALYSIS**12 Hrs**

Hydraulic Turbines: Classification of hydraulic turbines-Working principle of Pelton wheel, Francis and Kaplan turbines -velocity triangles - draft tube - hydraulic turbine characteristics. Governing of turbines Dimensional Analysis: Needs and methods -Buckingham's π Theorem, Non-Dimensional Numbers, Similarities of flow. Model studies

Max.60 Hours**TEXT / REFERENCE BOOKS**

1. Bansal.R.K," Fluid Mechanics & Hydraulics Machines", 9th Edition,Laxmi Publications, 2005.
2. Douglas. J. F., Gasiorek. J. M., Swaffield. J. A., "Fluid Mechanics ELBS", 4th Edition,Prentice Hall,2000
3. Modi P. N., Seth S. M., "Hydraulics and Fluid Mechanics", Standard Book House, 1987
4. Kumar K. L., "Engineering Fluid Mechanics", 8thEdition, Eurasia Publication.2009
5. Govinda Rao N. S., "Fluid Flow Machines", 2ndEdition,Tata McGraw Hill, New Delhi, 1990
6. Yunus .A.Cengel,John. M. Cimbala "Fluid Mechanics&Fundamentals Application"3rd Reprint Edition,Tata McGraw Hill 2006.

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks : 80****Exam Duration : 3 Hrs.****PART A : 2 Questions from each unit, each carrying 2 marks****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 12 marks****60 Marks**

SME1203	KINEMATICS OF MACHINES (For Mech, Mech & Prod & Auto)	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

- To study the fundamentals of kinematics of mechanical systems .

UNIT 1 BASICS OF MECHANISMS**12 Hrs.**

Definitions: Links- Rigid, flexible and fluid links. Kinematic pairs - Degrees of freedom, Kutzbach criterion, Grubler's criterion (without derivation), Mechanism, structure, Mobility of Mechanism, Kinematic chains and inversions: Grashof's law - pantograph, straight line generator (peaucellier and watts mechanisms). Inversions of Four bar chain; Single slider crank chain and Double slider crank chain.

UNIT 2 KINEMATICS OF LINKAGE MECHANISMS**12 Hrs.**

Displacement, velocity and acceleration analysis of simple mechanisms - Graphical method, Klein's construction: Analysis of velocity and acceleration of single slider crank mechanism. Coriolis component of acceleration.

UNIT 3 KINEMATICS OF CAM MECHANISMS**12 Hrs.**

Types of cams, Types of followers, Terminology and definitions. Displacement diagrams- SHM, Uniform velocity, uniform acceleration and retardation and Cycloidal motion. Graphical construction of Cam profiles- Disc cam with knife-edge, roller, flat-faced followers and oscillating roller follower.

UNIT 4 GEARS AND GEAR TRAINS**12 Hrs.**

Spur Gear terminology, law of toothed gearing- involute and cycloidal tooth profiles - Path of contact, Arc of contact, Contact ratio, Interference and Methods of avoiding interference in involute gears, Back lash, Comparison of involute and cycloidal teeth. Basics of helical, bevel, worm and rack and pinion gears (Basics only). Simple gear trains, Compound gear trains for large speed reduction, Epicyclic gear trains - tabular method of finding velocity ratio.

UNIT 5 FRICTION**12 Hrs.**

Introduction - Dry friction - Plate clutches. Belt drives - Flat & V belt drives - Materials used for belts, Velocity ratio, slip, creep. Ratio of driving tensions, angle of contact, centrifugal tension, Maximum tension of belt - power of transmission.

Max.60 Hours.**TEXT / REFERENCE BOOKS**

1. Rattan.S.S, "Theory of Machines", 2nd Edition, Tata McGraw Hill Publishers, 2005
2. Ghosh A and Mallick.A.K, "Theory of Mechanisms and Machines", 3rd Edition, Affiliated East-West Pvt. Ltd., New Delhi, 2000
3. Rao J.S and Dukupati R.V, "Mechanism and Machines Theory", Wiley-Eastern Ltd., New Delhi, 2007.
4. Khurmi.R.S & Gupta.J.K, "Theory of Machines", 15th Revised Edition, Eurasia Publishing House Pvt Ltd, 1997
5. SHIGLEY J.E, "Theory of Machines and Mechanisms", 2nd Edition, McGraw Hill Inc., 1995

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks : 80****PART A : 2 Questions from each unit, each carrying 2 marks****PART B : 2 Questions from each unit with internal choice, each carrying 12 marks****Exam Duration : 3 Hrs.****20 Marks****60 Marks**

SME1204	STRENGTH OF MATERIALS (For Mechanical)	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVES

- To gain knowledge of different types of stresses, strain and deformation induced in the mechanical components due to external loads.
- To study the distribution of various stresses in the mechanical elements such as beams, shafts etc.
- To study the effect of component dimensions and shapes on the stresses and deformations.

UNIT 1 STRESS STRAIN DEFORMATION OF SOLIDS 12 Hrs.

Rigid and Deformable bodies - Strength, Stiffness and Stability - Stresses; Tensile, Compressive and Shear - Deformation of simple and compound bars under axial load - Thermal stress - Elastic constants, Strain energy and unit strain energy - Strain energy in uniaxial loads Principal stress and strain, Mohr's stress circle., Theory of failure.

UNIT 2 BEAMS - LOADS AND STRESSES 12 Hrs.

Types of beams: Supports and Loads - Shear force and Bending Moment in beams - Cantilever, Simply supported and Overhanging beams - Stresses in beams - Theory of simple bending - Stress variation along the length and in the beam section - Effect of shape of beam section on stress induced - Shear stresses in beams - Shear flow

UNIT 3 SPRINGS 12 Hrs.

Helical and Leaf Springs- deflection of springs by energy method- helical springs under axial load and under axial twist (respectively for circular and square cross sections) axial load and twisting moment acting simultaneously both for open and closed coiled springs- laminated springs. Application to close-coiled helical springs - Maximum shear stress in spring section including Wahl Factor - Deflection of helical coil springs under axial loads - Design of helical coil springs - stresses in helical coil springs under torsion loads.

UNIT 4 TORSION 12 Hrs.

Analysis of torsion of circular bars - Shear stress distribution - Bars of Solid and hollow circular section - Stepped shaft - Twist and torsion stiffness - Compound shafts - Fixed and simply supported shafts - Columns and Struts: Combined bending and direct stress, middle third and middle quarter rules. Struts with different end conditions - Euler's theory and experimental results - Ranking Garton Formulae

UNIT 5 CYLINDERS & CURVED BEAMS 12 Hrs.

Thin cylinders & spheres - Hoop and axial stresses and strain.- Volumetric strain.- Thick cylinders- Radial, axial and circumferential stresses in thick cylinders subjected to internal or external pressures - Compound cylinders. Stresses due to interference fits Curved Beams - Bending of beams with large initial curvature, position of neutral axis for rectangular - trapezoidal and circular cross section- stress in crane hooks, stress in circular rings subjected to tension or compression

Max.60 Hours.**TEXT / REFERENCE BOOKS**

1. Nash W.A, "Theory and problems in Strength of Materials", Schaum Outline Series, McGraw-Hill Book Co, New York, 1995
2. Kazimi S.M.A, "Solid Mechanics", Tata McGraw-Hill Publishing Co., New Delhi, 1981.
3. Ryder G.H, "Strength of Materials, Macmillan India Ltd", Third Edition, 2002
4. Ray Hulse, Keith Sherwin & Jack Cain, "Solid Mechanics", Palgrave ANE Books, 2004.
5. Bansal.R.K., "Strength of Materials", 4th Edition, Laxmi Publications, 2007.

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks : 80****PART A : 2 Questions from each unit, each carrying 2 marks****PART B : 2 Questions from each unit with internal choice, each carrying 12 marks****Exam Duration : 3 Hrs.****20 Marks****60 Marks**

SME1206	DYNAMICS OF MACHINERY (For Mech, Mech & Prod, Aero & Auto)	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVES

- To recognize the force-motion relationship in mechanism subjected to outside armed forces and analysis of regular mechanism.
- To understand the objectionable things of unbalance consequential from prescribe motion in Mechanism.
- To understand the effect of Dynamics of undesirable vibrations.
- To understand the principles in mechanisms used for speed control and stability control.

UNIT 1 INTRODUCTION**12 Hrs.**

Static and Dynamic Force Analysis (Demonstration of models in video show)- Theory and analysis of Compound Pendulum, Concept of equivalent length of simple pendulum, Bifilar suspension, Trifilar suspension - Inertia force and Inertia torque- Turning moment diagrams -Fly Wheels - Flywheels of punching presses. Dynamics of reciprocating engines: Two mass statically and with dynamism equivalent system, correction couple, static and dynamic force analysis of reciprocating engine mechanism (analytical method only), Crank shaft torque, Introduction to T- θ diagram.

UNIT 2 BALANCING AND FRICTION**12 Hrs.**

Tending plane, resistance of screw and nuts, pivot and collar, uniform force, uniform wear, friction circle and friction axis border friction, film lubrication Friction in journal bearing-friction circle, Balancing Of Reciprocating Masses - Balancing of Multi-cylinder inline, V-engines- Balancing a single cylinder engine- Balancing of linkages --Balancing machines-Field balancing of discs and rotors Balancing of rotating masses single and multiple - single and different planes, use analytical and graphical methods.

UNIT 3 ONE DOF FREE VIBRATION**12 Hrs.**

Introduction - vibration - measuring instruments. Free Vibration of spring mass system - oscillation of pendulums Harmonic motion, periodic motion, vibration terminology, complex method of representing harmonic vibration, Fourier series and harmonic analysis, Mathematical modeling for vibrations springs in series and parallel, differential equation of motion, solution of differential equation Transverse and torsional vibrations of two and three rotor systems, critical speeds.

UNIT 4 TWO DOF FORCED VIBRATION**12 Hrs.**

Vibration isolation and transmissibility, elementary treatment of two degree of freedom systems torsional vibrations of single rotor and two rotor systems, transverse Vibration of simply supported beam energy method, Rayleigh's and Dunkerley method. Vibration damper; Properties of vibrating system, flexibility matrix, stiffness matrix, reciprocity theorem. Disturbance caused by unbalance - Support motion -transmissibility

UNIT 5 PRECESSION AND GOVERNORS**12 Hrs.**

Gyroscopes and gyroscopic effects-Effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aero planes and ships, gyroscopic couple, (Demonstration of models in video show).

Governors: types and applications; Watt, porter and proell governors, spring loaded governors - Hartnell and Hartung with auxiliary springs. Sensitiveness, isochronisms and hunting.

Max.60 Hours**TEXT / REFERENCE BOOKS**

1. Rattan S. S, Theory of Machines, 3rd Ed., Tata McGraw Hill, 2009
2. JohnHannah and Stephens R.C., "Mechanics of Machines", Viva Low-Prices Student Edition,1999
3. Thomas. Bevan. Theory of Machines, CBS Publishers and Distributors, 1984
4. Khurmi, R.S., "Theory of Machines", 14th Edition, S Chand Publications, 2005
5. Benson H. Tongue, "Principles of Vibrations", Oxford University Press, 2nd Edition, 2007

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks : 80****Exam Duration : 3 Hrs.****PART A : 2 Questions from each unit, each carrying 2 marks****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 12 marks****60 Marks**

SME1301	DESIGN OF MACHINE ELEMENTS (For Mech & Mech & Prod)	L	T	P	Credits	Total Marks
		3	1	0	4	100

(Use of PSG Design Data Book is permitted in the End Semester Examination)

COURSE OBJECTIVES

- To understand the various procedures involved in the Design Process based on strength requirements.
- To understand the design steps involved in evaluating the dimensions of a component to satisfy functional operation.
- To learn standard practices and standard data by using design data book and catalogues

UNIT 1 STATIC STRESSES AND VARIABLE STRESSES IN MACHINE COMPONENTS 12 Hrs.

Introduction to the design process-factors influencing machine design, selection of materials based on mechanical properties-Preferred Numbers-Direct, Bending and torsional stress equations-Impact and shock loading-calculation of principle stresses for various load combinations, eccentric loading-Factor of safety-theories of failure-Design based on strength and stiffness-stress concentration-Design for variable loading S-N curve-Endurance limit-Gerber's Parabola, Goodman's line, Soderberg's Line.

UNIT 2 DESIGN OF SHAFTS AND COUPLINGS 12 Hrs.

Design of solid and hollow shafts based on strength, rigidity and critical speed- Keys- different types of keys- Design Keys, failures of keys-Couplings - Flange coupling- Bush-pin type flexible coupling

UNIT 3 TEMPORARY AND PERMANENT JOINTS 12 Hrs.

Threaded fasteners- Forms of screw threads, nomenclature, thread series, designation, stress in screwed threads, Bolted joints including eccentric loading- Design of knuckle and cotter joints- Welded joints- Welding process, merits and demerits of welded joints, Types of welded joints, weld symbols, Strength of parallel and fillet weld, strength of a welded joint, eccentrically loaded welded joints.

UNIT 4 DESIGN OF SPRINGS 12 Hrs.

Functions of springs-applications- spring materials-Design of helical, Belleville springs (disc) and torsional springs under constant loads and varying loads - Leaf springs

UNIT 5 DESIGN OF BEARINGS AND FLYWHEELS 12 Hrs.

Design of bearings - Sliding contact bearing - Cubic mean load - Design of journal bearings- McKees equation - Lubrication in journal bearings - Calculation of bearing dimensions. Introduction - rolling contact bearing (antifriction bearing). Types of fly wheels- Design of flywheels involving stresses in rim and arm.

Max.60 Hours

TEXT / REFERENCE BOOKS

1. Juvinall R.C, and Marshek K.M, "Fundamentals of Machine Component Design", John Wiley & Sons, 2002.
2. Bhandari V.B, "Design of Machine Elements", Tata McGraw-Hill Book Co, 2003.
3. Norton R.L, "Design of Machinery", Tata McGraw-Hill Book Co, 2004.
4. Spotts M.F, Shoup T.E., "Design and Machine Elements" Pearson Education, 2004.
5. Kannaiah, P., Machine Design, 2/e, Scitech Publication Pvt. Ltd., 2009.
6. Shigley, J.E and Mischke, C. R. Mechanical Engineering Design, 6/e, Tata McGraw Hill, 2005.
7. Sundararajamoorthy, T.V. and Shanmugam, N., Machine Design, Anuradha Agencies, 2003.

END SEMESTER EXAM QUESTION PAPER PATTERN:

Max. Marks : 80

Exam Duration : 3 Hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 Marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 Marks

SME1303	GAS DYNAMICS AND JET PROPULSION (For Mechanical)	L	T	P	Credits	Total Marks
		2	1	0	3	100

(Use of Gas tables is permitted in the End Semester Examination)

COURSE OBJECTIVES

- To understand the concepts of compressible and Incompressible fluids
- To understand Mach number variation on area ratio
- To understand the flow characteristics through constant area duct
- To study about the Shock waves

UNIT 1 COMPRESSIBLE FLUID FLOW - FUNDAMENTALS

9 Hrs.

Introductory concepts of compressible flow, Energy and momentum equations for compressible fluid flows, various regions of flow, reference velocities, stagnation state, velocity of sound, critical states, Mach number, critical mach number, types of waves, mach cone, mach angle, effect of mach number on compressibility.

UNIT 2 FLOW THROUGH VARIABLE AREA DUCTS

9 Hrs.

Isentropic flow through variable area duct, T-S and h-s diagrams for nozzle and diffuser flows, area ratio as a function of Mach number, Mass flow rate through nozzles and diffusers, effect of friction in flow through nozzles.

UNIT 3 FLOW THROUGH CONSTANT AREA DUCTS

9 Hrs.

Flow in constant area duct with friction (Fanno Flow) - Fanno curves, and Fanno Flow equations, variation of flow properties, variation of Mach number with duct length. Flow in constant area duct with heat transfer (Rayleighflow), Rayleigh line and Rayleigh flow equations, variation of flow properties, maximum heat transfer.

UNIT 4 NORMAL SHOCK AND OBLIQUE SHOCKS

9 Hrs.

Governing equations, variation of flow parameters like static pressure, static temperature, density, stagnation pressure and entropy across normal shock and oblique shocks. Normal shocks - stationary and moving, applications. Prandtl Meyer equation, impossibility of shock in sub-sonic flows, flow in convergent and divergent nozzles with shock, normal shock in Fanno and Rayleigh flows. Flow with oblique shock

UNIT 5 PROPULSION

9 Hrs.

Aircraft propulsion - types of jet engines - energy flow through jet engines, study of turbo jet engine components - thrust, thrust power, propulsive and overall efficiencies, thrust augmentations in turbo jet engines, ram jet and pulse jet engines Rocket propulsion - Types of rocket engines - Liquid and solid fuel rocket engines - Introduction to Electrical and Nuclear rockets-Space Flights -Orbital and escape velocity.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Yahya S.M., "Fundamental of Compressible flow", New Age International (P) Ltd., New Delhi, 2003.
2. Cohen H., Rogers R.E.C. and Sravanamuttoo, "Gas Turbine Theory", Addison Wesley Ltd., 2001
3. Hill D. and Peterson C., "Mechanics & Thermodynamics of Propulsion ", Addison Wesley, 1992.
4. Ganesan V., "Gas Turbines", Tata McGraw Hill Publishing Company, New Delhi. 1999.
5. Sutton G.P., "Rocket Propulsion Elements", John Wiley, New York, 1975.

END SEMESTER EXAM QUESTION PAPER PATTERN:

Max. Marks : 80

PART A : 2 Questions from each unit, each carrying 2 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

Exam Duration : 3 hrs

20 Marks

60 Marks

SME1304	POWER PLANT ENGINEERING (For Mechanical)	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the layout and working of conventional and non conventional power plants
- To understand the working power plant equipments and instruments
- To understand the economics of power plants and environmental aspects

UNIT 1 STEAM POWER PLANT**9 Hrs.**

Plant layout, types of firing systems - pulverized fuel, tilting and tangential firing system, pulverized bed combustion system. Coal handling systems - crushers - feeders, ash handling system - dust collectors id and id fans - economizers, air preheaters, super-heaters, re-heaters, Steam generators. Steam turbines, Binary cycles.

UNIT 2 POWER PLANT EQUIPMENTS AND INSTRUMENTATION**9 Hrs.**

Subcritical and supercritical boilers, boiler calculations - boiler efficiencies, equivalent evaporation, boiler power. Condensers - types - Calculation of vacuum efficiency, Feed Heaters. cooling towers - tower characteristics. Classification of plant instruments-Pressure gauges and types, Thermo-meters and types, Liquid level, gauges and types, Flow meter, pH measurement instruments, Gas Analysis, Impurity measurement instruments, Speed measuring instruments. Major Electrical Equipment in Power Plant-Layout of Electrical Equipment, Generator and Excites, Switch gear installations, Circuit breakers, Power transformers, Methods of Earthing a power system, Protective devices and control system used in power plant, Types of relays and voltage regulation.

UNIT 3 GAS TURBINE, NUCLEAR AND HYDEL POWER PLANTS**9 Hrs.**

Gas turbine plants - open and closed cycles - construction details -, reheating regeneration and intercooling, combined cycle plants and their representation in TS diagram. Nuclear energy - fission - fusion reaction, nuclear fuel, enrichment, nuclear reactor - parts and types, Pressurized Water Reactor (PWR), CANada Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants. Hydel plants - classification, selection of turbines, pumped storage system.

UNIT 4 NON CONVENTIONAL ENERGY BASED POWER PLANT**9 Hrs.**

Non conventional energy - various forms - capacity - availability and limitations. Solar energy plants - various collecting devices - solar devices, photovoltaic cells and solar ponds, wind mills - types - site selection - capacity estimation - performance evaluation, tidal power plants, fuel cells - working - types - limitations, performance evaluation. Geo thermal and biogas power plant.

UNIT 5 ECONOMICS AND ENVIRONMENTAL ASPECTS**9 Hrs.**

Load curves, fixed and operating costs, economics of load sharing and plant selection, comparison of economics of various power plants, Co-generation, types of Co-generation Systems and its economics, environmental hazards of various power plants- CO₂ SO_x, NO_x and particulate emissions and their control, land and water pollution. Waste Disposal Options for Coal and Nuclear Power Plants.

Max. 45 Hours.**TEXT / REFERENCE BOOKS**

1. Nagpal G.R., Power Plant Engineering - Khanna Publishers, 1996.
2. Domkundwar, Power Plant Engineering - Dhanpat Rai & Sons, Delhi, 1988.
3. Vopal and Stortzki, "Power Plant Engineering", PHI, 2007.
4. El Wakil M.N., "Power Plant Technology", McGraw Hill, 1985.
5. Joel Weisomon and Roy Eckart, "Modern Power Plant Engineering", PHI, 1985.
6. Rai G.D., "Non conventional sources of Energy", Khanna Publishers Delhi, 1994.

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks : 80****Exam Duration : 3Hrs.****PART A : 2 Questions from each unit, each carrying 2 marks****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 12 marks****60 Marks**

SME1307	DESIGN OF TRANSMISSION SYSTEMS (For Mech & Mech & Prod)	L	T	P	Credits	Total Marks
		3	1	0	4	100

(Use of PSG Design Data Book is permitted in the End Semester Examination.)

COURSE OBJECTIVES

- To understand the various standards and the procedures involved in various machine component
- Identify critical static and dynamic stresses in a mechanical component
- To understand of the fundamental concepts of the finite element method

UNIT 1 DESIGN OF TRANSMISSION SYSTEMS FOR FLEXIBLE DRIVES 12 Hrs.

Selection and design of - Flat belts and pulleys- V belts and pulleys -Chain and sprockets drive.

UNIT 2 DESIGN OF SPUR GEARS AND PARALLEL AXIS HELICAL GEARS 12 Hrs.

Gear Terminology-Speed ratios - Selection and design of spur gear- material selection- service factor- module calculation for endurance strength- Force analysis -Tooth stresses (fillet bending stress and contact stress) — Parallel axis Helical Gears --Forces

UNIT 3 DESIGN OF BEVEL AND WORM GEARS 12 Hrs.

Straight bevel gear: Tooth terminology- Design of pair of straight bevel gears - Tooth forces and stresses
Worm Gear: Merits and demerits- Terminology. Design of the worm and gear - Forces and stresses, efficiency

UNIT 4 DESIGN OF GEAR BOXES 12 Hrs.

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box -Constant mesh gear box. - Design of multi speed gear box.

UNIT 5 INTRODUCTION TO FINITE ELEMENT METHOD 12 Hrs.

Basic concept of FEM- steps involved in FEM, shape function, mathematical modeling of one dimensional element- stepped bar, tapered bar-simple problems. Variational formulation and approximation- the Rayleigh-Ritz method, method of weighted residuals- simple problems

Max.60 Hours

TEXT / REFERENCE BOOKS

1. Shigley J.E and.Mischke C.R, "Mechanical Engineering Design", McGraw-Hill International Editions, 1989.
2. Design of Machine Elements by V.B. Bhandari, TMH publishing Co. Ltd., New Delhi.
3. Juvinall R.C, K.M. Marshek , "Fundamentals of Machine component Design", Third Edition, John Wiley & Sons, 2002.
4. Bhandari V.B, "Design of Machine Elements", Tata McGraw-Hill Publishing Company Ltd., 1994.
5. Reddy.J.N "An Introduction to the Finite Element Method" , Mc Graw Hill, International Edition, 1993.
6. Rao. S.S, "Finite Element Method in Engineering" , Pergamum Press, 1989.
7. Chandrupatla & Belagundu, "Finite Elements in Engineering", Prentice Hall of India Private Ltd., 1997

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 80

Exam Duration : 3 hrs

PART A : 2 Questions from each unit, each carrying 2 marks

20 Marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 Marks

SME1309	HEAT AND MASS TRANSFER (For Mech & Auto)	L	T	P	Credits	Total Marks
		3	1	0	4	100

(Use of Heat and mass transfer Data Book is permitted in the END SEMESTER Examination)

COURSE OBJECTIVES

- To understand the heat transfer in steady and unsteady conditions.
- To understand the concepts of convection heat transfer by internal and external flows. To understand the concepts of boiling and condensation.
- To study about the heat transfer analysis on heat exchangers and to understand the concepts of radiation heat transfer.

UNIT 1 CONDUCTION 12 Hrs.

Basic Concepts - Mechanism of Heat Transfer - Conduction, Convection and Radiation - General Differential equation of Heat Conduction - Fourier Law of Conduction - Cartesian - Cylindrical - Polar Coordinates- One Dimensional Steady State Heat Conduction - Conduction through Plane Wall, Cylinders and Spherical systems - Composite Systems-critical thickness of insulation - Conduction with Internal Heat Generation - Systems with Variable Thermal Conductivity - Extended Surfaces- Fins--Classification - Unsteady Heat Conduction - Lumped Analysis - Infinite and Semi Infinite Solids - Heisler and Grober Charts. Finite difference method for multi dimensional heat conduction

UNIT 2 CONVECTION 12 Hrs.

Basic Concepts - Convective Heat Transfer Coefficients - Boundary Layer Concept - Forced Convection - External Flow - Flow over Plates, Cylinders Spheres and Bank of tubes - Internal Flow - Laminar and Turbulent Flow Solutions -Analogies between momentum and heat transfer-Reynolds analogy-Chilton colburn analogy(Modified Reynolds analogy)-Free Convection – Flow over Vertical Plate - Vertical Tubes - Horizontal Plate, Inclined Plate, Cylinders and Spheres.

UNIT 3 PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 12 Hrs.

Film and Drop wise Condensation - Nusselt's theory of condensation- Regimes of pool boiling and flow boiling, Nucleate Boiling - correlations in boiling and condensation. Heat Exchanger Types - Overall Heat Transfer Coefficient - Fouling Factors - Analysis - LMTD method, - NTU method. - Introduction of TEMA Standards.

UNIT 4 RADIATION 12 Hrs.

Basic Concepts, Laws of Radiation - Wiens Displacement Law – Hemispherical Emissive Power - Stefan Boltzman Law, Kirchhoff Law - Black Body Radiation - Grey body radiation - Shape Factor for Simple Geometries - Electrical Analogy -Radiation Shields-Solar radiation.

UNIT 5 MASS TRANSFER 12 Hrs.

Basic Concepts - Diffusion Mass Transfer - Fick's Law of Diffusion - Steady state Molecular Diffusion - Convective Mass Transfer - Momentum, Heat and Mass Transfer Analogy - Convective Mass Transfer Correlations.

Max.60 Hours

TEXT / REFERENCE BOOKS

1. Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata Mc Graw Hill, 2004
2. Rajput R.K., "Heat and Mass transfer", S.Chand & Co, 1983.
3. Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 1998.
4. Kothandaraman C.P., "Fundamentals of Heat and Mass Transfer", New Age International (P) Ltd., 1998
5. Sachdeva R.C., "Fundamentals of Heat and Mass Transfer", New Age International (P) Ltd., 2010
6. Ozisik N.M., "Heat Transfer", McGraw Hill Book Company, 1988.

END SEMESTER EXAM QUESTION PAPER PATTERN:

Max. Marks : 80

PART A : 2 Questions from each unit, each carrying 2 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

Exam Duration : 3 Hrs.

20 Marks

60 Marks

SME1310	PRODUCT DESIGN (For Mechanical)	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To assimilate the basic concepts of Product design
- To know the usage of computers in product design.
- To learn about the principles of Design for Manufacture and Environment.

UNIT 1 INTRODUCTION**9 Hrs.**

Definition of a product - Types of product- levels of product- New product development product-market mix- New product development (NPD) process- Idea generation methods-Creativity-Creative attitude, creative design process- Morphological analysis- analysis of interconnected decision areas, brain storming, synectics. Product life cycle- The challenges of product development- product analysis- product characteristics

UNIT 2 BASIC CONCEPTS**9 Hrs.**

Product design- definition-Design by evolution- design by innovation-design by imitation -factors affecting product design. Standards of performance and environmental factors.decision making and iteration - Morphology of design (different phases). -role of aesthetics in design. Introduction to optimization in design- economic factors in design-design for safety and reliability.

UNIT 3 ROLE OF COMPUTERS IN PRODUCT DESIGN**9 Hrs.**

Geometric Modeling - types - Wire frame surface and solid modeling - Boundary Representation, constructive solid geometry - Graphics standards - assembly modeling - use of software packages Modeling and simulation-the role of models in engineering design- Design for manufacturing, Rapid proto typing (RP) - application of RP in product design.

UNIT 4 DESIGN FOR MANUFACTURE AND ENVIRONMENT**9 Hrs.**

General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances - mGeometric tolerances - Assembly limits - Datum features - Tolerance stacks.
Design for the Environment - Introduction - Environmental objectives - Global issues - Regional and local issues - Basic DFE methods - Design guide lines.

UNIT 5 INDUSTRIAL DESIGN**9 Hrs.**

Need for industrial design-impact in design process - investigation of customer needs - conceptualization - refinement- management of the industrial design process - technology driven products - user - driven products Integrating CAE, CAD, CAM tools

Max. 45 Hours**TEXT / REFERENCE BOOKS**

1. Product Design and Development, Karl T.Ulrich and Steven D.Eppinger, Tata McGraw -Hill edition.
2. An Introduction to Engineering Design methods Vijay Gupta
3. Chitale A K and Gupta R C, "Product Design and Manufacturing", Prentice Hall of India, 2005.
4. Bralla, Design for Manufacture handbook, McGraw hill, 1999.
5. Boothroyd, G, Hartz and Nike, Product Design for Manufacture, Marcel Dekker, 1994.
6. Dickson, John. R, and Corroda Poly, Engineering Design and Design for Manufacture and Structural Approach, Field
7. Stone Publisher, USA, 1995.
8. Fixel, J. Design for the Environment McGraw hill., 1996.
9. Graedel T. Allen By. B, Design for the Environment Angle Wood Cliff, Prentice Hall. Reason Pub., 1996.
10. Kevien Otto and Kristin Wood, Product Design. Pearson Publication, 2004.

END SEMESTER EXAM QUESTION PAPER PATTERN:**Max. Marks : 80****Exam Duration : 3 Hrs.****PART A : 2 Questions from each unit, each carrying 2 marks****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 12 marks****60 Marks**

SME1308	FINITE ELEMENT ANALYSIS (For Mech & Mech&Prod , Aero & Auto)	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Understand the capabilities of FEM and its importance in Engineering.
- To introduce the concepts of Mathematical Modeling of Engineering Problems.

UNIT 1 1D FINITE ELEMENT METHOD**9 Hrs.**

Historical Background -Basic concept of FEM- steps involved in FEA - Variational Formulation of Boundary value problem - Rayleigh Ritz Method - Weighted Residual methods-Finite Element Modeling - Element Equations - Shape functions -Bar, Beam Elements - stepped bar, tapered bar-simple problems

UNIT 2 2D FINITE ELEMENT METHOD**10 Hrs.**

Basic Boundary Value Problems in 2 Dimensions - Triangular, quadrilateral, higher order elements - Poisson and Laplace Equations - Weak Formulation - Elements Matrices and Vectors -.Natural Co-ordinate System - Lagrangian Interpolation Polynomials - Iso-parametric Elements - Formulation -Numerical Integration -2D Triangular elements - rectangular elements - Illustrative Examples.

UNIT 3 SOLUTION TO PLANE ELASTICITY PROBLEMS**8 Hrs.**

Introduction to Theory of Elasticity - Plane Stress - Plane Strain and Axisymmetric Formulation - Principle of virtual work - Element matrices using energy approach.

UNIT 4 APPLICATIONS IN HEAT TRANSFER & FLUID MECHANICS**9 Hrs.**

One dimensional heat transfer element - application to one-dimensional heat transfer problems- scalar variable problems in 2-Dimensions - Applications to heat transfer in 2- Dimension - Application to problems in fluid mechanics in 2-D.

UNIT 5 SPECIAL TOPICS**9 Hrs.**

Vibrational problems - equations of motion based on weak form -longitudinal vibration of bars - transverse vibration of beams Mesh Generation-Errors in the finite element method - various measures of errors- accuracy of the solution- Eigen value Problems - h & p elements- Applications of FEM software to solve simple problems, types of solver - a brief.

Max. 45 Hours**TEXT / REFERENCE BOOKS**

1. J.N Reddy. "An Introduction to the Finite Element Method", Mc Graw Hill, International Edition, 1993.
2. Seshu, P, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.
3. Segerlind L.J, "Applied Finite Element Analysis", John Wiley, 1984.
4. Rao. S.S, "Finite Element Method in Engineering", Pergamon Press, 1989.
5. Chandrupatla & Belagundu, "Finite Elements in Engineering", Prentice Hall of India Private Ltd., 1997.
6. Cook, Robert Davis et al, "Concepts and Applications of Finite Element Analysis", Wiley, John & Sons, 1999.
7. George R Buchanan, "Schaum's Outline of Finite Element Analysis", McGraw Hill Company, 1994.
8. Taylor.C and Hughes.J.B. "Finite Element Programming of the Navier Stoke equation" Pineridge Press Limited, UK 1981

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks : 80****Exam Duration : 3 Hrs****PART A : 2 Questions from each unit, each carrying 2 marks****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 12 marks****60 Marks**

SME1601	ADVANCED INTERNAL COMBUSTION ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To Provide an overview of the underlying principle of operation of IC Engines and their subsystem components.
- To provide Knowledge on modern engine technologies

UNIT 1 INTRODUCTION TO I.C ENGINES**9 Hrs.**

Classification of I.C Engines-Thermodynamics of Air Standard Otto and Diesel Cycles – Working of 4 Stroke and 2 stroke –S.I and C.I engines– Comparison of S.I and C.I Engines-I.C engine fuels,types,Combustion of fuels- Rating of fuels – composition of petrol and diesel fuels - importance Of valve and port timing.

UNIT 2 SI ENGINES**9 Hrs.**

Air Fuel ratio requirements-Carburetion-types of Automobile carburetor-working principle, injection system in SI Engines. Combustion in SI Engines-Combustion Chambers, Factors controlling combustion chamber design, stages of combustion-Factors affecting Flame propagation, Knock in SI engines, variables affecting Knocking.

UNIT 3 CI ENGINES**9 Hrs.**

Diesel Fuel injection system, MPFI&CRDI, Function of components, jerk type pump, Distributor pump. Mechanical and pneumatic Governor, Fuel injector, Types of nozzle, importance of swirl, squish, Turbulence air motion, Combustion in CI Engines-Combustion Chambers, Factors controlling combustion chamber design. Stages of combustion, Factors affecting ignition delay, knock in CI Engines, variables affecting knocking

UNIT 4 IGNITION, COOLING AND LUBRICATION SYSTEM**9 Hrs.**

Types of ignition systems, inlet and exhaust manifold arrangements, engine Cooling System: Cooling requirement, Air cooling, Type of liquid cooling system, Advantage and disadvantage of air cooling and water cooling system, Antifreeze mixture. Lubrication System: Function of lubricating system, Properties of lubricating oil, Wet sump, Dry sump and mist lubrication system.

UNIT 5 RECENT TRENDS**9 Hrs.**

Introduction to Modern engine technologies- Lean Burn Engine, Stratified Charge Engine, Surface Ignition Engine-Measurement Techniques. Four Valve and Overhead cam Engines, Electronic Engine Management, Common Rail Direct Injection Diesel Engine, Gasoline Direct Injection Engine, Data Acquisition System –pressure pick up, charge amplifier PC for Combustion and Heat release analysis in Engines.

Max. 45 Hours**TEXT / REFERENCES BOOKS**

1. Ramalingam. K.K., "Internal Combustion Engine Fundamentals", Scitech Publications, 2002.
2. Ganesan, "Internal Combustion Engines", II Edition, TMH, 2002.
3. John Heywood – Internal Combustion engines, McGraw Hill, 1988.
4. R .B .Mathur and R.P Sharma. – Internal Combustion engines, Dhanpat Rai and Sons, 1994. 5. Internal Combustion engines, Maleev.V.L, McGraw Hill

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks : 80****Exam Duration : 3 Hrs.****PART A : 2 Questions from each unit, each carrying 2 marks****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 12 marks****60 Marks**

SME1602	WIND AND SOLAR ENERGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the fundamentals of wind and solar energy and its conversion system
- To study the various types of wind machines and to analyze its performance
- To study the radiation principles with respective solar energy estimation To discuss about solar thermal technologies and its applications
- To learn about PV technology principles and techniques of various solar cells

UNIT 1 WIND ENERGY FUNDAMENTALS & WIND MEASUREMENTS**9 Hrs.**

Introduction: Scope of wind power potential in India. Wind Energy Basics, Wind Speeds and scales, Terrain, Roughness, Wind Mechanics, Power Content, Classification of wind turbines, Atmospheric Boundary Layers, Turbulence. Instrumentation for wind measurements, Wind data analysis, tabulation, Wind resource estimation, Betz's Limit, Turbulence Analysis.

UNIT 2 WIND MACHINES**9 Hrs.**

Types of wind machines, analysis of aerodynamic forces acting on blade, performance, generating systems, energy storage – Applications.

UNIT 3 SOLAR RADIATION AND COLLECTORS**9 Hrs.**

Solar angles – Sun path diagrams – Radiation – extra terrestrial characteristics - measurement and estimation on horizontal and tilted surfaces - flat plate collector thermal analysis - testing methods- evacuated tubular collectors - concentrator collectors – classification - design and performance parameters - tracking systems - compound parabolic concentrators - parabolic trough concentrators - concentrators with point focus - Heliostats – performance of the collectors.

UNIT 4 SOLAR THERMAL TECHNOLOGIES**9 Hrs.**

Principle of working, types, design and operation of Solar heating and cooling systems – Thermal Energy storage systems – Solar Desalination – Solar cooker : domestic, community – Solar pond – Solar drying.

UNIT 5 SOLAR PHOTO VOLTAIC SYSTEM DESIGN AND APPLICATIONS**9 Hrs.**

Semiconductor – properties - energy levels - basic equations of semiconductor devices physics. Solar cells - p-n junction - Solar cell array system analysis and performance prediction - solar cell array design concepts - PV system design - design process and optimization - detailed array design - variation of efficiency with band-gap and temperature - efficiency measurements - high efficiency cells – Solar thermo-photovoltaic - System installation - operation and maintenance - field experience - PV market analysis and economics of SPV systems.

Max. 45 Hours**TEXT / REFERENCE BOOKS**

1. Rai G.D., Non Conventional Sources of energy, Khanna publications, 4th Edn., 1999.
2. Garg H.P. and Prakash J., Solar energy, Fundamentals and application, 2006.
3. David M.Eggleston and Stoddard S., Wind turbine Engineering designing, – Van Nustrand, 1987.
4. Putnam, C Palmer, Power from wind., Van Nustrand, 1984.
5. Le Couriers D., Wind power plants. Theory and design, Permagon press, 1982.
6. Sukhatme S P, J K Nayak, Solar Energy – Principle of Thermal Storage and collection, Tata McGraw Hil, 2008.
7. Freris, L .L. Wind Energy Conversion Systems, Prentice Hall, 1990.
8. Wind and Solar Power Systems, Mukund. R. Patel, 2nd Edition, Taylor & Francis, 2001
9. Wind energy Handbook, Edited by T. Burton, D. Sharpe, N. Jenkins and E. Bossanyi, John Wiley & Sons, 2001
10. Rao S. & Parulekar B.B, "Energy Technology", 4th edition, Khanna publishers, 2005.

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks : 80****Exam Duration : 3 Hrs.****PART A : 2 Questions from each unit, each carrying 2 marks****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 12 marks****60 Marks**

SME1607	COMPUTATIONAL FLUID DYNAMICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To understand the fluid flow characteristics and its applications

UNIT 1 INTRODUCTION**8 Hrs.**

Historical Background-One dimensional Computations -Finite Difference Methods-Finite Element Methods - Finite Volume Methods Neumann Boundary Conditions Dirichlet Boundary Conditions -Governing Equations- Classification of Partial Differential Equations- Introduction to Navier-Stokes System of Equations. Comparison of numerical, analytical and experimental.

UNIT 2 FINITE DIFFERENCE METHODS AND SOLUTIONS**9 Hrs.**

Simple Methods -General Methods -Higher Order Derivatives- Multidimensional Finite Difference Formulas - Mixed Derivatives –Non uniform Mesh- Higher Order Accuracy Schemes- Accuracy of Finite Difference Solutions- Elliptic Equations- Parabolic Equations- Hyperbolic Equations- Burgers' Equation- Coordinate Transformation for Arbitrary Geometries

UNIT 3 INCOMPRESSIBLE VISCOUS FLOWS AND COMPRESSIBLE FLOWS**10 Hrs.**

Artificial Compressibility Method - Pressure Correction Methods -Semi-Implicit Method for Pressure-Linked Equations -Pressure Implicit with Splitting of Operators -Marker-and-Cell (MAC) Method -Vortex Methods -Potential Equation-Euler Equations-Central Schemes with Combined Space and Independent Space-Explicit Schemes-Implicit Schemes-PISO Scheme for Compressible Flows-Finite Difference Volume Equations

UNIT 4 STRUCTURED AND UNSTRUCTURED GRID GENERATION**9 Hrs.**

Algebraic Methods- PDE Mapping Methods- Unidirectional Interpolation- Multidirectional Interpolation- Domain Vertex Method- Transfinite Interpolation Methods (TFI)- PDE Mapping Methods- Control Functions- Hyperbolic Grid Generator- Multiblock Structured Grid Generation- Delaunay-Voronoi Methods- Advancing Front Methods- Three-Dimensional Applications- DVM in 3D- AFM i 3-D..

UNIT 5 COMPUTING TECHNIQUES AND APPLICATION**9 Hrs.**

Domain Decomposition Methods- Multigrid Methods- Parallel Processing- Turbulence Models- Zero-Equation Models- One-Equation Models -Two-Equation Models -Second Order Closure Models (Reynolds Stress Models) - Algebraic Reynolds Stress Models -Compressibility Effects- Direct Numerical Simulation- RANS- LES

Max. 45 Hours**TEXT / REFERENCE BOOKS**

- Chung T.J Computational fluid dynamics, second edition –Cambridge University press USA ISBN 978-0-521-76969-3
- Suhas V Patankar, "Numerical Heat Transfer and Fluid Flow", Taylor and Francis ISBN 0-89116-522-3
- Principles of Computational Fluid Dynamics by P. Wesseling. ISBN 978-3-642-05145-6
- Shaw C T, "Using Computational Fluid Dynamics" Prentice Hall, 1992.
- Anderson.J.D.Jr. "Computational Fluid Dynamics: An Introduction", 3rd Edition, ISBN: 978-3-540- 85055-7, 2009

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks : 80****Exam Duration : 3 Hrs.****PART A : 2 Questions from each unit, each carrying 2 marks****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 12 marks****60 Marks**

SME1609	CRYOGENIC ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To enrich the students in the field of Cryogenic Engineering, Applications, Various Refrigeration processes, Equipments, Instruments, gas separation and Purification processes.

UNIT 1 INTRODUCTION**9 Hrs.**

Cryogenic Engineering – Properties of cryogenic fluids – Oxygen, Nitrogen, Argon, Neon, Fluorine, Helium. Hydrogen, Properties of Solids – Mechanical, Thermal, and Electrical-Super conductivity, Cryogenic applications

UNIT 2 CRYOGENIC REFRIGERATION AND GAS LIQUEFACTION**9 Hrs.**

Principle – Joule Thomson Expansion, Cascade processes, Ortho para hydrogen conversion, cold gas refrigerators, Linde-Hampson cycles, Claude and cascaded systems, magnetic cooling, Stirling Cycle, Pulse Tube refrigeration..

UNIT 3 CRYOGENIC EQUIPMENTS AND REQUIREMENTS**9 Hrs.**

Cryogenics- Heat Exchangers, Compressors, Expanders, Effect of various parameters in performance and system optimization. Insulation and Storage equipments for cryogenic fluids, industrial storage and transfer of cryogenic fluids

UNIT 4 GAS SEPARATION AND PURIFICATION**9 Hrs.**

Ideal gas, Mixture characteristics – composition diagrams – gas separation – Principle of Rectification, Flash Calculation Rectification column analysis – air separation, gas purification.

UNIT 5 CRYOGENIC INSTRUMENTATION AND VACUUM TECHNOLOGY**9 Hrs.**

Properties and characteristics of instrumentation, Strain Displacement, Pressure, flow, Liquid level, Density and temperature measurement in cryogenic range. Need of Vacuum in Cryogenics – Vacuum Fundamentals – Conductance and Electrical Analogy – Pumping speed and Pump down time – Classification of vacuum Pumps – Types of Vacuum Pumps – Mechanical Pumps, Roots Pump, Diffusion Pumps, Turbo molecular Pumps, Cryo Pump, Getter Pumps, Pump Selection and Operating range of each type, Vacuum gauges and measurement range.

Max. 45 Hours**TEXT / REFERENCE BOOKS**

- Randal F. Barron, Cryogenic Systems, Mc Graw Hill, 1985
- , Cryogenic Engineering, Van Nostrand Co. Inc. 1985.
- Klaus D. Timmerhaus, Richard Palmer Reed, Cryogenic Engineering: 50 years of progress, Springer, 2007.
- Hastlden, C., "Cryogenic Fundamentals", Academic Press, 2001.
- Walker, "Cryocoolers", Plenum Press, 2000.
- Mikulin, Y., "Theory and Design of Cryogenic Systems", MIR Publishers, 2002

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks : 80****Exam Duration : 3 Hrs.****PART A : 2 Questions from each unit, each carrying 2 marks****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 12 marks****60 Marks**

SME1611	DESIGN OF MACHINE TOOL STRUCTURE	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To learn about machine tool structures and design of machine tool structures

UNIT 1 INTRODUCTION**9 Hrs.**

Classification of machining processes, machine tools – machine tool construction – factors – performance criteria – trends in modern machine tool– calculation of cutting forces and power requirements for turning, milling, boring and grinding – force distribution on different parts of drilling, milling and grinding machine tools.

UNIT 2 STRENGTH AND RIGIDITY OF MACHINE TOOL STRUCTURES**9 Hrs.**

Basic principles of design – comparison of materials used in machine tool construction – dependence of process capability on rigidity – static compliance – design of lathe beds – materials – typical construction – torsional modulus of rectangular and box sections – methods of increasing rigidities.

UNIT 3 SLIDEWAYS**9 Hrs.**

Slide ways – types – materials – constructions – clearance adjustments – Hydrostatically lubricated slide ways – slide way design – pressure distribution – antifriction ways – design – construction.

UNIT 4 SPINDLES AND SPINDLE SUPPORTS**9 Hrs.**

Spindle units – materials – spindle design – spindle bearings – types of materials – constructions.

UNIT 5 MACHINE TOOL DYNAMICS**9 Hrs.**

Dynamic system – elastic system – working processes – vibration in machine tools – self excited vibration and dynamic stability – basic principles of chatter – effects of vibration – vibration elimination – damping – isolation of vibration – dynamic absorber with damping.

Max. 45 Hours**TEXT / REFERENCE BOOKS**

1. Manfred week, "Hand Book of machine tools – vol1, vol 2, vol.3 John Wiley & Sons, 1984.
2. Acherkan.N, "Machine Tool Design", vol 3, MIR publishers, 1978
3. Metha N.K, "Machine Tool Design and Numerical control", Tata McGraw Hill publishing company, 1996
4. Sen G.C. and A.Battacharya, "Principles of machine tools", New central book agency, 1999
5. Yoshimi Lto, Modular Design for Machine tools, McGraw Hill, 2008
6. Joshi P.H. Machine Tools Hand book, McGraw Hill, 2007

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks : 80****Exam Duration: 3 Hrs.****PART A : 2 Questions from each unit, each carrying 2 marks****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 12 marks****60 Marks**

SME1612	WASTE HEAT UTILIZATION AND MANAGEMENT	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To study the waste heat recovery systems for the effective utilization of energy

UNIT 1 COGENERATION**9 Hrs.**

Introduction, Principles of Thermodynamics, Combined Cycles, Topping, Bottoming, Organic Rankine Cycles, Advantages of Cogeneration Technology

UNIT 2 APPLICATION & TECHNO ECONOMICS OF COGENERATION**9 Hrs.**

Cogeneration Application in various process industries. Sizing of waste heat boilers, Performance calculations, Part load characteristics selection of Cogeneration Technologies, Financial considerations, operating cost and Investments, Costs of Cogeneration

UNIT 3 WASTE HEAT RECOVERY**9 Hrs.**

Introduction - Principles of Thermodynamics and Second Law, Sources of waste heat and its potential applications, Waste heat survey and measurements, Data collection, Limitations and affecting factors Heat recovery equipment and systems

UNIT 4 WASTE HEAT RECOVERY SYSTEMS & WASTE HEAT BOILERS**9 Hrs.**

Waste heat recovery systems: Recuperators, Regenerators, Economizers: Waste heat boilers: Classification, Location, Service Conditions, Design Considerations, Unfired combined Cycle, Supplementary fired combined cycle, fired combined cycle, Thermic fluid heaters

UNIT 5 APPLICATIONS & TECHNO ECONOMICS OF WASTE HEAT RECOVERY SYSTEMS**9 Hrs.**

Applications in industries, selection of waste heat recovery technologies - financial considerations - operations and investment costs of waste heat recovery

Max. 45 Hours**TEXT / REFERENCE BOOKS**

- Charles H. Butler, Cogeneration, McGraw Hill Book Co., 1984.
- Horlock JH, Cogeneration - Heat and Power, Thermodynamics and Economics, Oxford, 1987.
- Institute of Fuel, London, Waste Heat Recovery, Chapman & Hall Publishers, London, 1963.
- Sengupta Subrata, Lee SS EDS, Waste Heat Utilization and Management, Hemisphere, Washington, 1983.
- De Nevers, Noel., Air Pollution Control Engineering, McGrawHill, New York, 1995.

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks : 80****Exam Duration : 3 Hrs.****PART A : 2 Questions from each unit, each carrying 2 marks****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 12 marks****60 Marks**

SME1613	ENERGY ENGINEERING AND MANAGEMENT	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To provide Knowledge on energy management and methodology

UNIT 1 GENERAL ASPECT OF ENERGY MANAGEMENT AND AUDIT 9 Hrs.

Energy energy and various forms – energy management and audit – material and energy balance – energy action planning – energy monitoring and targeting scenario – energy conservation act – Basic

UNIT 2 ENERGY AUDIT METHODOLOGY & RECENT TRENDS 9 Hrs.

Current Practices, Integration of two or more systems, Switching of Energy Sources, Economics of implementation of energy optimisation projects, it's constraints, barriers and limitations, Report-writing, preparations and presentations of energy audit reports, Post monitoring of energy conservation projects, MIS , impact of renewable energy on energy audit recommendations.

UNIT 3 ENERGY EFFICIENCY IN THERMAL UTILITIES 9 Hrs.

Boilers- steam System-Furnaces-Insulation and Refractories-FBC Boilers-Waste heat recovery-Heat Exchanger

UNIT 4 ENERGY PERFORMANCE ASSESSMENT IN UTILITIES 9 Hrs.

Fans and blowers – pumps – compressors - HVAC – Electric motor and variable speed drives – cogeneration – thermal power plant

UNIT 5 FINANCIAL ANALYSIS 9 Hrs.

Introduction-fixed and variable cost-interest charges-simple payback period-discounted cash flow method-factors affecting analysis - Life Cycle Costing –ESCO concept

Max. 45 Hours

TEXT / REFERENCES BOOKS

1. Paul W.O., Callaghan, Energy Management, Mc Graw Hill Book Company, New Delhi,1993
2. Jose Goldemberry, Thomas B Johanson, Amulya K.N. Reddy & Robert H. Williams, Energy for a Sustainable World, Wiley EasternLtd., 1990
3. Murphy W.R., Energy Management, Butter Worths, London, 1982
4. Dryden. I.G.C., "The Efficient Use of Energy" Buterworths, London, 1982
5. Ray, D.A., Industrial Energy Conservation, Permagon Press, 1980
6. Witte L.C, Schmidt P.S., Brown D.R. Industrial Energy Management and Utilization (Hemisphere Publication, Washington, 1988)
7. Manager Training Manual (4 Volumes) by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 80

Exam Duration : 3 Hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 Marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 Marks

SME1614	EXPERIMENTAL STRESS ANALYSIS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To understand the different methods of stress analysis methods

UNIT 1 OVERVIEW OF EXPERIMENTAL STRESS ANALYSIS**7 Hrs.**

Introduction to ESA– Advantages– Methods –Simplification of problems – Selection of Experimental Techniques.

UNIT 2 STRAIN MEASUREMENT**10 Hrs.**

Introduction of strain gauges – Strain Sensitivity – Bridge Sensitivity – Rosettes strain gauge Alloys – Performance of Strain Gauge system –Strain Gauge Selection – Bonding of a Strain Gauge –Special Gauges– Recording Instruments – Static and Dynamic Recording.

UNIT 3 MOIRE METHODS**10 Hrs.**

Mechanism of formation of Moire fringe – Geometrical approach to Moire fringe analysis – Displacement field approach to Moire fringe analysis – Out of plane measurements Tardy's Method – Babinet Soleil Method.

UNIT 4 PHOTOELASTICITY METHODS**10 Hrs.**

Temporary double refraction – Stress optic law – Effects of stressed model in a plane polariscope fringe multiplication – Isochromatic fringe patterns – Isoclinic fringe pattern Compensation techniques – Calibration methods – Separation methods – Scaling model to prototype stresses –Material properties of photo elastic.

UNIT 5 BRITTLE COATING METHOD**8 Hrs.**

Introduction, Types – Test procedures– Coating stresses –Crack pattern –Crack detection– Calibration procedures –Brittle coating data analysis.

Max. 45 Hours**TEXT / REFERENCE BOOKS**

- Sadhu Singh , "Experimental Stress Analysis" Khanna Publishers, New Delhi, 1996.
- James Dalley, W.F.Riley, "Experimental mechanics ", int. Student Edition McGraw Hill, Kogakusha Ltd., 1992.
- Srinath,L.S., Raghava,M.R., Lingaiah,K. Gargasha,G.,Pant B. and Ramachandra,K– Experimental Stress Analysis, Tata McGraw Hill, New Delhi,1984
- Dove Adams, Experimental Stress Analysis, McGraw Hill, 1992.

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks : 80****Exam Duration : 3 Hrs.****PART A : 2 Questions from each unit, each carrying 2 marks****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 12 marks****60 Marks**

SME1616	INDUSTRIAL TRIBOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the basics of friction wear and lubrication.
- To learn the applications of tribology

UNIT 1 INTRODUCTORY TO FRICTION, WEAR AND LUBRICATION**8 Hrs.**

Basic Definitions of Friction Quantities-Tipping and Onset of Slip -Introductory Friction Problems -Ladder against a Wall -Speed of a Skier -Motorcycle Accident -Angle of Bank to Prevent Sliding of -an Automobile on a Curve under Wet or Dry Conditions -Friction Coefficient Required to Avoid -Sliding on an Unbanked Curve in the Road-Friction in Simple Machine Components-Wedge-Based Mechanisms-Pivots, Collars, and Disks-belts and Ropes-Screws-Shafts and Journal Bearings-Rolling Friction-Types of wear – wear measurement techniques – types of lubrication – solids and semisolids.

UNIT 2 FRICTION MEASUREMENTS AND TESTS**9 Hrs.**

Classification of Tribometers-Specimen Preparation and Cleaning-Design and Selection of Friction-Testing Methods-Static Friction -Sliding Friction -Rolling Friction -Friction Tests-Nanoscale Friction Microscale Ball-on-Flat Tests - Friction of a Fiber within a Composite-Multidirectional Tribometers Friction of Impacting Spheres - Pendulum-Based Devices - Friction Measurement Using Precision Chains - Piston Ring and Cylinder Bore Friction -Friction of Brake Linings - Tire/Road Surface Testing - Walkway Friction Testing - Metalworking - Friction of Rock - Friction of Currency - Friction Sensing and Recording

UNIT 3 FUNDAMENTALS OF SLIDING FRICTION AND ROLLING FRICTION**10 Hrs.**

Macrocontact, Microcontact and Nanocontact-Static Friction and Stick-Slip-Sliding Friction-Plowing Models - Adhesion, Junction Growth, and Shear Models -Plowing with Debris Generation -Plowing with Adhesion -Single-Layer Shear Models -Multiple-Layer Shear Models -Molecular Dynamics Models -Stimulus-Response Dynamical Friction Models -Ultralow Friction and "Superlubricity" -Selecting Friction Models -Frictional Heating.

Solid friction of materials-friction of wood, leather, and stone-friction of metals and alloys-friction of glasses and ceramics-friction of polymers-friction of carbon materials including diamond-friction of ice-friction of treated surfaces.

UNIT 4 LUBRICATION TO CONTROL FRICTION AND EFFECTS OF TRIBO-SYSTEM VARIABLES ON FRICTION**9 Hrs.**

Lubrication by Liquids and Greases -Liquid Lubrication-Composition of Liquid Lubricants -Friction Polymers-Lubricating Characteristics of Ultrathin Layers-Ionic Liquid Lubricants-Grease Lubrication-Liquid Crystal Lubricants-Lubrication by Solids-Role of Lamellar Crystal Structures- Simplified Models for Solid Lubrication-Graphite and Molybdenum Disulfide-Solid Lubrication by Powders-Engineered Self-Lubricating Materials-Effects of Surface Finish-Load and Contact Pressure-Sliding Velocity-Type of Sliding Motion-Temperature-Surface Films and Chemical Environments-Stiffness and Vibration-Combined Effects of Several Variables

UNIT 5 APPLICATIONS OF FRICTION TECHNOLOGY**9 Hrs.**

Applications in Transportation Systems-Friction in Brakes -Brake Materials -Brake Terminology and Jargon - Aircraft Brakes -Friction in Tires-Friction in Internal Combustion Engines-Friction in Bearings and Gears-Friction in Sliding Seals-Friction in Manufacturing Processes-Friction Cutting -Machining of Metals -Drawing and Rolling - Friction Welding, Friction Stir Processing, -Friction Drilling-Friction Welding -Friction Stir Welding-Friction Stir Processing and Friction Drilling-Friction of Flooring-Friction in Cables-Friction in Fasteners, Joints, and Belts -Friction in Microtribology and Nanotribology

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Peter J. Blau, Friction Science and Technology from concepts to applications-CRC PRESS –Tylor and Francis group
2. Theory and Practice of Lubrication for Engineers, Fuller, D., New York company 1998
3. Principles and Applications of Tribology, Moore, Pergamon press 1998
4. Tribology in Industries, Srivastava S., S Chand and Company limited, Delhi 2002

END SEMESTER EXAM QUESTION PAPER PATTERN

Max .Marks : 80

PART A : 2 Questions from each unit, each carrying 2 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

Exam Duration: 3 Hrs.

20 Marks

60 Marks

SME1617	NON CONVENTIONAL ENERGY SYSTEMS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To understand the basic concepts of Non conventional energy sources

UNIT 1 INTRODUCTION**9 Hrs.**

World Energy Use – Reserves of Energy Resources – Environmental Aspects of Energy Utilization – Renewable Energy Scenario in Tamilnadu, India and around the World - Potentials - Achievements / Applications – Economics of renewable energy systems

UNIT 2 SOLAR ENERGY**9 Hrs.**

Solar Radiation – Measurements of Solar Radiation - Flat Plate and Concentrating Collectors – Solar direct Thermal Applications– Solar thermal Power Generation - Fundamentals of Solar Photo Voltaic Conversion – Solar Cells – Solar PV Power Generation – Solar PV Applications.

UNIT 3 WIND ENERGY**9 Hrs.**

Wind Data and Energy Estimation – Types of Wind Energy Systems – Performance - Site Selection – Details of Wind Turbine
Generator – Safety and Environmental Aspects

UNIT 4 BIO – ENERGY**9 Hrs.**

Biomass direct combustion – Biomass gasifiers – Biogas plants – Digesters – Ethanol production – Bio diesel – Cogeneration - Biomass Applications

UNIT 5 OTHER RENEWABLE ENERGY SOURCES**9 Hrs.**

Tidal energy – Wave Energy – Open and Closed OTEC Cycles – Small Hydro-Geothermal Energy – Hydrogen and Storage - Fuel Cell Systems – Hybrid Systems, Magneto Hydro dynamometer.

Max. 45 Hours**TEXT / REFERENCE BOOKS**

- Rai G.D, Non Conventional Energy Sources, Khanna Publishers, New Delhi, 2011.
- Twidell, J.W. & Weir, A., Renewable Energy Sources, EFN Spon Ltd., UK, 2006.
- Sukhatme S.P, Solar Energy, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.
- Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K., 1996.
- Tiwari G.N, Solar Energy – Fundamentals Design, Modelling & Applications, Narosa Publishing House, New Delhi, 2002.
- Freris L.L, Wind Energy Conversion Systems, Prentice Hall, UK, 1990.
- Johnson Gary, L. Wind Energy Systems, Prentice Hall, New York, 1985
- David M. Mousdale – Introduction to Biofuels, CRC Press, Taylor & Francis Group, USA 2010
- Chetan Singh Solanki, Solar Photovoltaic's, Fundamentals, Technologies and Applications, PHI Learning Private Limited, New Delhi 2009.

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks : 80****Exam Duration : 3 Hrs****PART A : 2 Questions from each unit, each carrying 2 marks****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 12 marks****60 Marks**

SME1618	REFRIGERATION AND AIRCONDITIONING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand and discuss fundamentals of refrigeration principles and pressure/temperature relationship, heat transfer, refrigerants, gas refrigeration compression cycle, compressors, condensers, evaporators.
- To understand air conditioning systems and their design, load calculation, control and accessories. To understand Non-conventional Refrigeration Systems and Psychrometry.
- To have a thorough knowledge of the applications of refrigeration and air conditioning

UNIT 1 BASICS OF REFRIGERATION**7 Hrs.**

Refrigeration: Definition, necessity and methods; Unit of refrigeration, COP, EER ; Carnot Principle: Heat pump & Refrigerator; Air Refrigeration System: Reversed Brayton cycle– Quantitative treatment. Aircraft refrigeration system, Refrigerants: Desirable properties, Types, Selection criteria, Designation; Ozone depletion and Global warming– Qualitative treatment only.

UNIT 2 VAPOUR COMPRESSION REFRIGERATION**12 Hrs.**

Vapour compression refrigeration (VCR): Simple and actual VCR cycle; T-s and p-h representation, Effect of Sub cooling and superheating – Quantitative treatment. Two stage compression; flash chamber, Intercooler; Compound VCR systems: Necessity, merits; Multiple Evaporator Systems; Compressors: single and multistage, Hermetic, Screw, Vane and Centrifugal compressors;

Condensers and evaporators; Expansion devices– Qualitative treatment only.

UNIT 3 VAPOUR ABSORPTION REFRIGERATION**10 Hrs.**

Vapour absorption refrigeration (VAR): importance, Principle of Operation of Ammonia-Water, Lithium Bromide-Water VAR systems: Comparison of VCR and VAR systems, merits over VCR system; Electrolux System, Steam ejector system; Introduction to adsorption system; Thermoelectric, Vortex tube and pulse tube refrigeration; Descriptive study of Low temperature refrigeration, Cascade system; Liquefaction of hydrogen and helium. Joule Thomson effect; Applications of cryogenics – Qualitative treatment only.

UNIT 4 PSYCHROMETRICS AND AIR CONDITIONING**8 Hrs.**

Psychrometrics: Psychrometry; Psychrometric properties, charts, processes and relations; Gibbs-Dalton's law; Adiabatic mixing of two streams; Human comfort, factors affecting comfort, Comfort chart; Ventilation requirement; Comfort air conditioning ; Air conditioning loads, load estimation; Solar radiation, infiltration and ventilation; Air washer; BPF, ADP temperature; RSHF, GSHF, ERSHF – Quantitative treatment. Summer, winter and central air conditioning systems – Qualitative treatment only.

UNIT 5 ACCESSORIES OF REFRIGERATION AND AIR CONDITIONING SYSTEMS**8 Hrs.**

Cooling towers, types; Ducts, types, various types of losses of fluid flow in ducts, Methods of duct design, arrangement system. Air distribution system, Fans and blowers, filters; sources of noise in AC equipments and methods to control noise; Refrigeration and air conditioning controls: pressure, humidity, temperature sensors; safety controls; actuators; Study of Ice manufacturing plant, cold storage, food freezing, building Air conditioning, Automotive, Railway and Marine air conditioning– Qualitative treatment only.

Max. 45 Hours**TEXT / REFERENCE BOOKS**

1. Refrigeration and Air conditioning by Manohar Prasad- New Age International Second edition, 2003
2. Refrigeration and Air Conditioning, C. P. Arora, Tata McGraw-Hill Education, Third edition, 2010
3. Principles of Refrigeration, Roy J. Dossat, Pearson Education, Fourth edition, 2009
4. Basic Refrigeration and Air Conditioning, P. N. Ananthanarayanan, TMH, Third edition, 2006
5. Refrigeration and Air conditioning, W.F. Stoeker, Tata McGraw-Hill

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks : 80****PART A : 2 Questions from each unit, each carrying 2 marks****PART B : 2 Questions from each unit with internal choice, each carrying 12 marks****Exam Duration : 3 Hrs.****20 Marks****60 Marks**

SME1620	THEORY OF ELASTICITY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To understand the basics of Theory of Elasticity and its principles

UNIT 1 INTRODUCTION**9 Hrs.**

Definition, notations and sign conventions for stress and strain – Stress - strain relations, Strain-displacement relations- Elastic constants. Coordinates and Tensors Transformation. Stress in Cartesian Coordinates. Principal Stresses and Principal Coordinates. Stress Ellipsoid.

UNIT 2 BASIC EQUATIONS OF ELASTICITY**9 Hrs.**

Generalized Hooke's Law. Relationships between Elastic Moduli. Boundary-Value Problems in Elasticity. Navier's Equations. Beltrami-Michell's Equations. Saint-Venant's Principle.

UNIT 3 2D PROBLEMS OF ELASTICITY**10 Hrs.**

Plane stress and plain strain problems - Airy's stress function in polar and Cartesian coordinates. Biharmonic equations – 2-D problems – Cantilever and simply supported beams. Thick-Walled Cylindrical Pressure Vessel (Lame's problem). Pure Bending of a Curved Beam in polar coordinates.

UNIT 4 3D PROBLEMS OF ELASTICITY**9 Hrs.**

Bar Stretched by its Own Weight. Torsion of a Circular Shaft. Bending of a Prismatic Bar. Thermo elasticity- General Approach- Plane Thermoplastic Problem in Polar Coordinates.

UNIT 5 TORSION**8 Hrs.**

Torsion of a uniform circular shaft. Torsion of Elliptical and Triangular sections Bars. Torsion of Hollow Bars. Prandtl's theory-Membrane analogy.

Max. 45 Hours**TEXT / REFERENCE BOOKS**

1. Timoshenko S.P. and J.N. Goodier, Theory of Elasticity, McGraw-Hill, 1985.
2. Sechler E, "Elasticity in Engineering" John Wiley & Sons Inc., New York, 1980.
3. Ugural, A.C and Fenster, S.K, Advanced Strength and Applied Elasticity, Prentice hall, 2003
4. Wang, C.T. Applied elasticity, McGraw Hill 1993
5. Enrico Volterra and Caines, J.H, Advanced strength of Materials, Prentice Hall, 1991.

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks : 80****Exam Duration : 3 Hrs.****PART A : 2 Questions from each unit, each carrying 2 marks****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 12 marks****60 Marks**

SME5102	ADVANCED THERMODYNAMICS	L	T	P	C	Max.marks
		4	0	0	4	100

COURSE OBJECTIVES:

- To achieve an understanding of basic principle and scope of thermodynamics.
- To predict the availability and irreversibility associated with the thermodynamic processes.
- To analyze the properties of ideal and real gas mixtures and to understand the basic concepts of combustions.

UNIT 1: REVIEW OF THERMODYNAMIC LAWS AND COROLLARIES**12Hrs**

Transient flow analysis, Second law thermodynamics, Entropy, Availability and unavailability, Thermodynamic potential, Maxwell relations, Specific heat relations, Mayer's relation. Evaluation of thermodynamic properties of working substance

UNIT 2: P.V.T SURFACE**12Hrs**

Equation of state. Real gas behavior, Vander Waal's equation, Generalization compressibility factor. Energy properties of real gases. Vapour pressure, Clausius, Clapeyron equation. Throttling, Joule Thompson coefficient. Non reactive mixtures of perfect gases. Governing laws, Evaluation of properties, Psychometric mixture properties and psychometric chart, Air conditioning processes, cooling towers. Real gas mixture.

UNIT 3: COMBUSTION**12Hrs**

Combustion Reactions, Enthalpy of formation. Entropy of formation, Reference levels of tables. Energy of formation, Heat reaction, Adiabatic flame temperature generated product, Enthalpies, Equilibrium. Chemical equilibrium of ideal gases, Effect of non reacting gases equilibrium in multiple reactions, The vent hoff's equation. The chemical potential and phase equilibrium. The Gibbs phase rule.

UNIT 4: POWER CYCLES**12Hrs**

Review binary vapour cycle, co generation and combined cycles, Second law analysis of cycles. Refrigeration cycles. Thermodynamics of irreversible processes. Introduction to Phenomenological laws, Onsaga Reciprocity relation, Applicability of the Phenomenological relations, Heat flux and entropy production, Thermodynamic phenomena, Thermo electric circuits.

UNIT 5: DIRECT ENERGY CONVERSION**12Hrs**

Introduction to fuel cells, Thermo electric energy, Thermoionic power generation, Thermodynamic devices Magnetohydrodynamic generations, Photovoltaic cells, Thermoacoustic refrigeration systems.

Max. 60 Hours**COURSE OUTCOME**

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

- CO1: Develop the analytical methods to carry out the thermodynamic analysis using equations of potentials, availability, and exergy.
- CO2: Analyze the ideal & real gas behaviour and the properties of ideal and real gas mixtures.
- CO3: Compute enthalpy of reaction, enthalpy of combustion and Apply the knowledge of adiabatic flame temperature in the design of combustion devices.
- CO4: Predict the condition of systems and Analyze them by the criteria of equilibrium [Understand
- CO5: Analyze vapour power cycle and refrigeration cycle and optimize their performance
- CO6: Apply the knowledge of direct energy conversion of fuel cells, thermo electric energy, thermionic power generation, thermodynamic devices magnetohydrodynamic generations and photovoltaic cells.

TEXT/REFERENCE BOOKS:

1. Rogers and Mayhew, Engineering Thermodynamics, 4th Edition, Addison Wesley 1999.
2. P.L.Dhar, Engineering Thermodynamics, Elsevier. (A Division of Reed Elsevier India Pvt. Limited), 2008
3. Sonntag, R. E., and G. J. Van Wylen: Introduction to Thermodynamics—Classic and Statistical, 3rd edition, John Wiley & Sons, New York, 1991
4. Doolittle-Messe., Thermodynamics for Engineers, John Wiley & Sons, New York, 1995
5. Holman.J.P. Thermodynamics, 3rd Edition, McGraw-Hill, 1995.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 80

Part A: 6 Questions of 5 marks each uniformly distributed among all units – No Choice

Part B: 2 Questions from each unit of internal choice, each carrying 10 marks.

Exam Duration: 3 hrs.

30 marks

50 marks

SME5103	ADVANCED HEAT TRANSFER	L	T	P	C	Max.marks
		4	0	0	4	100

COURSE OBJECTIVES:

To develop the ability to use the heat transfer concepts for various applications like finned systems, turbulence flows, high speed flows.

To perform the thermal analysis and sizing of heat exchangers and to learn the heat transfer coefficient for compact heat exchangers.

To achieve an understanding of the basic concepts of phase change processes and mass transfer.

UNIT I: CONDUCTION AND RADIATION HEAT TRANSFER**12Hrs**

One dimensional energy equations and boundary condition - two and three-dimensional heat conduction equations - extended surface heat transfer - conduction with moving boundaries - radiation in gases and vapour. Gas radiation and radiation heat transfer in enclosures containing absorbing and emitting media – interaction of radiation with conduction and convection, shape factor algebra.

UNIT 2: TURBULENT NATURAL/ FORCED CONVECTIVE HEAT TRANSFER**12Hrs**

Momentum and energy equations - turbulent boundary layer heat transfer - mixing length concept - turbulence model – $k-\epsilon$ model - analogy between heat and momentum transfer – Reynolds & Colburn analogies, Prandtl mixing length, turbulent flow in a tube - high speed flows, Natural convection over vertical surfaces, bank of tubes, Natural convection in enclosures, Rayleigh-Bernard convection cells, mixed convection

UNIT 3: PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGER**12Hrs**

Condensation- film condensation, dropwise condensation over walls and bank of tubes - boiling – pool and flow boiling - heat exchanger – ϵ -NTU approach and design procedure - compact heat exchangers.

UNIT 4: NUMERICAL METHODS IN HEAT TRANSFER**12Hrs**

Finite difference formulation of steady and transient heat conduction problems – discretization schemes – explicit - Crank Nicolson and fully implicit schemes - control volume formulation – steady one-dimensional convection and diffusion problems - calculation of the flow field – SIMPLE/SIMPLER Algorithms.

UNIT 5: MASS TRANSFER AND ENGINE HEAT TRANSFER CORRELATION**12Hrs**

Mass transfer - vaporization of droplets - combined heat and mass transfers - heat transfer correlations in various applications like I.C. engines - compressors and turbines.

Max. 60 Hours

Course Outcomes:

On completion of the course, student will be able to

CO1: Understand the various mechanisms of heat transfer that characterize a given system.

CO2: Combine thermodynamics and fluid mechanics principles to analyse heat convection processes CO3: Understand the various mechanisms phase change heat transfer and heat exchanger

CO4: Formulate and build up mathematical model, apply analytical and numerical methods to solve problems. CO5: Understand combined heat and mass transfers

CO6: Develop heat transfer correlations in various applications

TEXT/REFERENCE BOOKS:

1. Yunus A. Cengel, Heat Transfer A Practical Approach, Tata Mc Graw Hill, 2004.
2. Frank P. Incropera and David P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley & Sons, 1998.
3. Ozisik N.M., Heat Transfer, McGraw Hill Book Company, 1988.
4. Holman J.P., Heat Transfer, McGraw Hill Book Company, 1989
5. Rajput R.K., Heat and Mass transfer, S.Chand & Co, 1983.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 80

Part A: 6 Questions of 5 marks each uniformly distributed among all units – No Choice

Part B: 2 Questions from each unit of internal choice, each carrying 10 marks.

Exam Duration: 3 hrs.

30 marks

50 marks

SME5104	FUELS, COMBUSTION AND EMISSION CONTROL	L	T	P	C	Max.marks
		4	0	0	4	100

COURSE OBJECTIVES:

To provide information on various types of fuels, their property and characterization and understand the thermodynamics and kinetics of combustion.

To identify the nature and extent of the problem of pollutant formation and Control in internal combustion engines.

UNIT 1: CHARACTERIZATION

12Hrs

Fuels - Types and Characteristics of Fuels - Determination of Properties of Fuels - Fuels Analysis - Proximate and Ultimate Analysis - Moisture Determination - Calorific Value - Gross & Net Calorific Values - Calorimetry - DuLong's Formula for CV Estimation - Flue gas Analysis - Orsat Apparatus - Fuel & Ash Storage & Handling - Spontaneous Ignition Temperatures.

UNIT 2: SOLID FUELS & LIQUID FUELS

12Hrs

Types - Coal Family - Properties - Calorific Value - ROM, DMMF, DAF and Bone Dry Basis - Ranking - Bulk & Apparent Density - Storage - Washability - Coking & Caking Coals - Renewable Solid Fuels - Biomass - Wood Waste - Agro Fuels - Manufactured Solid Fuels. Liquid Fuels Types - Sources - Petroleum Fractions - Classification - Refining - Properties of Liquid Fuels - Calorific Value, Specific Gravity, Flash & Fire Point, Octane Number, Cetane Number etc, - Alcohols - Tar Sand Oil - Liquefaction of Solid Fuels.

UNIT 3: GASEOUS FUELS

12Hrs

Classification - Composition & Properties - Estimation of Calorific Value - Gas Calorimeter. Rich & Lean Gas - Wobbe Index - Natural Gas - Dry & Wet Natural Gas - Stripped NG - Foul & Sweet NG - LPG - LNG - CNG - Methane - Producer Gas - Gasifiers - Water Gas - Town Gas - Coal Gasification - Gasification Efficiency - Non - Thermal Route - Biogas - Digesters - Reactions - Viability - Economics.

UNIT 4: COMBUSTION - STOICHIOMETRY & KINETICS

12Hrs

Stoichiometry - Mass Basis & Volume Basis - Excess Air Calculation - Fuel & Flue Gas Compositions - Calculations - Rapid Methods - Combustion Processes - Stationary Flame - Surface or Flameless Combustion - Submerged Combustion - Pulsating & Slow Combustion Explosive Combustion. Mechanism of Combustion - Ignition & Ignition Energy - Spontaneous Combustion - Flame Propagation - Solid, Liquid & Gaseous Fuels Combustion - Flame Temperature - Theoretical, Adiabatic & Actual - Ignition Limits - Limits of Inflammability.

UNIT 5: COMBUSTION - EQUIPMENTS AND EMISSION

12Hrs

Coal Burning Equipments - Types - Pulverized Coal Firing - Fluidized Bed Firing - Fixed Bed & Recycled Bed - Cyclone Firing - Spreader Stokers - Vibrating Grate Stokers - Sprinkler Stokers, Traveling Grate Stokers. Oil Burners - Vaporizing Burners, Atomizing Burners - Design of Burners. Gas Burners - Atmospheric Gas Burners - Air Aspiration Gas Burners - Burners Classification according to Flame Structures - Factors Affecting Burners & Combustion. Emissions - Emission index - Corrected concentrations - Control of emissions for premixed and non-premixed combustion.

Max. 60 Hours

Course Outcomes:

On completion of the course, student will be able to

CO1: Understand the different types of fuels

available CO2: Examine basic fuel properties and their importance

CO3: Get knowledge on different types solid fuel sources and their significance

CO4: Get knowledge on different Liquid & Gaseous fuel sources and their significance

CO5: Understand the thermodynamics of combustion and to formulate combustion

equations CO6: Recognize various combustion equipments and their working.

TEXT/REFERENCE BOOKS:

1. Samir Sarkar, Fuels & Combustion, 2nd Edition, Orient Longman, 1990.
2. Sharma SP, Mohan Chander, Fuels & Combustion, Tata McGraw Hill, 1984.
3. Bhatt, Vora Stoichiometry, 2nd Edition, Tata McGraw Hill, 1984.
4. Blokh AG, Heat Transfer in Steam Boiler Furnace, Hemisphere Publishing Corp, 1988.
5. Civil Davies, Calculations in Furnace Technology, Pergamon Press, Oxford, 1966.

**END SEMESTER EXAM QUESTION PAPER
PATTERN**

Max. Marks: 80

Exam Duration: 3 hrs.

Part A: 6 Questions of 5 marks each uniformly distributed among all units – No Choice

30 marks

Part B: 2 Questions from each unit of internal choice, each carrying 10 marks.

50 marks

SME5105	INSTRUMENTATION IN THERMAL ENGINEERING	L	T	P	C	Max.marks
		4	0	0	4	100

COURSE OBJECTIVES:

To provide knowledge on various measuring instruments.

To provide knowledge on advanced measurement techniques.

To understand the various steps involved in error analysis and uncertainty analysis.

UNIT 1: MEASUREMENT CHARACTERISTICS

12Hrs

Instrument Classification, Characteristics of Instruments – Static and dynamic, experimental error analysis, Systematic and random errors, Statistical analysis, Uncertainty, Experimental planning and selection of measuring instruments, Reliability of instruments.

UNIT 2: MICROPROCESSORS AND COMPUTERS IN MEASUREMENT

12Hrs

Data logging and acquisition – use of sensors for error reduction, elements of micro computer interfacing, intelligent instruments in use.

UNIT 3: MEASUREMENT OF PHYSICAL QUANTITIES

12Hrs

Measurement of thermo-physical properties, instruments for measuring temperature, pressure, velocity and flow rate, use of sensors for physical variables, measurement of emissivity.

UNIT 4: ADVANCED MEASUREMENT TECHNIQUES

12Hrs

Shadowgraph, Schlieren, Interferometer, Laser Doppler Anemometer, PIV (Particle Image Velocimetry), Hot wire Anemometer, heat flux sensors, Telemetry in measurement.

UNIT 5: MEASUREMENT ANALYSERS

12Hrs

Orsat apparatus, Gas Analysers, Smoke meters, gas chromatography, spectrometry. Noise pollution and its impact - oil pollution - pesticides - instrumentation for pollution control – water pollution from tanneries and other industries and their control – environment impact assessment for various projects – case studies.

Max. 60 Hours

Course Outcomes:

On completion of the course, student will be able to

CO1: Understand the operation of various thermal engineering measuring

devices CO2: Apply computerized techniques in measurement applications

CO3: Analyze the characteristics of measurements

CO4: Identify various techniques to measure different physical variables

CO5: Design and implement measuring devices for social, domestic and industrial

applications CO6: Apply the advanced measuring techniques in contemporary issues

TEXT/REFERENCE BOOKS:

1. Holman, J.P., Experimental methods for engineers, McGraw-Hill, 1988.
2. Barnery, Intelligent Instrumentation, Prentice Hall of India, 1988.
3. Prebrashensky, V., Measurements and Instrumentation in Heat Engineering, Vol. 1 and 2, MIR Publishers, 1980.
4. Raman, C.S., Sharma, G.R., Mani, V.S.V., Instrumentation Devices and Systems, Tata McGraw-Hill, New Delhi, 1983.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 80**Part A: 6 Questions of 5 marks each uniformly distributed among all units – No Choice****Part B: 2 Questions from each unit of internal choice, each carrying 10 marks.****Exam Duration: 3 hrs.****30 marks****50 marks**

SME5106	OPTIMUM UTILIZATION OF HEAT AND POWER	L	T	P	C	Max.marks
		4	0	0	4	100

COURSE OBJECTIVES:

To learn the various types of thermal storage systems and the storage materials.

To develop the ability to model and analyze the sensible and latent heat storage units. To study the various applications of thermal storage systems.

UNIT 1: CONCEPTS OF COMBINED HEAT AND POWER (CHP)**12Hrs**

Systems Basic concepts of CHP- The benefits and problems with CHP -Balance of energy demand– Types of prime movers – Economics– CHP in various sectors

UNIT 2: ENERGY SAVING METHODOLOGY**12Hrs**

Pinch Technology–significance– Selection of pinch temperature difference – Stream splitting – Process retrofit – Installation of heat pumps, heat engines - Grand composite curve.

UNIT 3: WASTE HEAT RECOVERY**12Hrs**

Insulation – Recuperative heat exchanger – Run-around coil systems – Regenerative heat exchangers – Heat pumps – Heat pipes – Waste Heat Recovery -Cogeneration Technology.

UNIT 4: COGENERATION**12Hrs**

Sources of waste heat, Cogeneration - Principles of Thermodynamics - Combined Cycles-Topping -Bottoming - Organic Rankine Cycles- Advantages of Cogeneration Technology.

UNIT 5: TECHNO ECONOMICS OF COGENERATION**12Hrs**

Application & techno economics of Cogeneration- Cogeneration - Performance calculations, Part load characteristics- financial considerations - Operating and Investments.

Max. 60 Hours

CO1: Demonstrate the concepts of combined heat and power systems

CO2: Analyze the energy saving techniques

CO3: Apply the concept of waste heat recovery in thermal systems

CO4: Apply the cogeneration principle in process industries

CO5: Estimate economic analysis of cogeneration systems

CO6: Demonstrate financial considerations in cogeneration

TEXT/REFERENCE BOOKS:

1. Charles H. Butler, Cogeneration, McGraw Hill Book Co., 1984
2. EDUCOGEN – The European Educational tool for cogeneration, Second Edition, 2001
3. Horlock JH, Cogeneration - Heat and Power, Thermodynamics and Economics, Oxford,1987.
4. Institute of Fuel, London, Waste Heat Recovery, Chapman & Hall Publishers, London, 1963.
5. Seagate Subrata, Lee SS EDS, Waste Heat Utilization and Management, Hemisphere, Washington, 1983.
6. De Nevers, Noel., Air Pollution Control Engineering, McGrawHill, New York,1995.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 80**Part A: 6 Questions of 5 marks each uniformly distributed among all units – No Choice****Part B: 2 Questions from each unit of internal choice, each carrying 10 marks.****Exam Duration: 3 hrs.****30 marks****50 marks**

SME5201	DESIGN AND OPTIMIZATION OF THERMAL SYSTEM	L	T	P	C	Max.marks
		4	0	0	4	100

COURSE OBJECTIVES

- To learn basic principles underlying piping, pumping, heat exchangers; modeling and optimization in design of thermal systems.
- To develop representational modes of real processes and systems.
- To develop concept of design optimization of thermal systems.

UNIT 1 DESIGN CONCEPTS**12 Hrs.**

Design Principles, Workable Systems, Optimal Systems, Matching of System Components, Economic Analysis, Depreciation, Gradient Present Worth factor.

UNIT 2 MATHEMATICAL MODELLING AND SYSTEM SIMULATION**12 Hrs.**

Equation Fitting, Nomography, Empirical Equation, Regression Analysis, Different Modes of Mathematical Models, Selection, and Computer Programmes for Models. System simulation - Application of successive method and Newton Raphson Method to Energy Systems.

UNIT 3 MODELLING THERMAL EQUIPMENTS**12 Hrs.**

Modelling Heat Exchangers, Evaporators, Condensers, Compressors, Pumps, Turbo machines, Distillation equipment, Absorber, generator, GAX, Simulation Studies, Information Flow Diagram, Solution Procedures

UNIT 4 SYSTEMS OPTIMIZATION**12 Hrs.**

Mathematical Representation for Optimization Problems in Energy Systems- Calculus Method - Dynamic programming – Search methods, Applications of various search methods to Energy Systems - Waste Heat Recovery System - design of energy recovery systems.

UNIT 5 COST ANALYSIS AND FORECASTING TECHNIQUES**12 Hrs.**

Cost analysis by present worth-annual cost-Evaluating potential Investments-Forecasting Techniques- Economic Factors in Energy Systems-Examples- Genetic Algorithms – using MATLAB.

Max. 60 Hours

- CO1: Analysis of Design concepts
 CO2: Demonstrate the mathematical modeling and simulation
 CO3: CModeling the thermal equipments
 CO4: Apply the EGR and catalytic convertor system to control emissions
 CO5: Estimate the heat transfer characteristic in engine system
 CO6: Modify I.C. Engines according to need and applications

TEXT / REFERENCE BOOKS

1. Stoecker W. F., Design of Thermal Systems, McGraw Hill Edition, 1989.
2. Jaluria, Y., Design and Optimisation of Thermal Systems, McGraw-Hill, 1998.
3. Bejan A., George Tsatsaronis, Michael J. Moran, Thermal Design and Optimization, Wiley, 1996.
4. Kapur J. N., Mathematical Modelling, Wiley Eastern Ltd, New York, 1989.
5. Yogesh Jaluria, Design and Optimization of Thermal Systems, CRC Press, 2007.
6. Rao S. S., Engineering Optimization Theory and Practice, New Age Publishers, 2000.

**END SEMESTER EXAM QUESTION PAPER
PATTERN**

Max. Marks: 80**Part A: 6 Questions of 5 marks each uniformly distributed among all units – No Choice****Part B: 2 Questions from each unit of internal choice, each carrying 10 marks.****Exam Duration: 3 hrs.****30 marks****50 marks**

SME5601	ADVANCED I.C ENGINES	L	T	P	C	Max.Marks
		4	0	0	4	100

COURSE OBJECTIVES:

- To study thermodynamics of I.C Engines
- To study the combustion in SI and CI engines
- To Study pollution formation and control methods in I.C engines

UNIT I INTRODUCTION**9Hrs**

Historical Review – Engine Types – Design and operating Parameters. Cycle Analysis: Thermo-chemistry of Fuel – Air mixtures, properties – Ideal Models of Engine cycles – Real Engine cycles - differences and Factors responsible for – Computer Modeling.

UNIT II GAS EXCHANGE PROCESSES**9Hrs**

Volumetric Efficiency – Flow through ports – Supercharging and Turbo charging. Charge Motion: Mean velocity and Turbulent characteristics – Swirl, Squish – Pre-chamber Engine flows.

UNIT III ENGINE COMBUSTION IN S.I ENGINES**9Hrs**

Combustion and Speed – Cyclic Variations – Ignition – Abnormal combustion Fuel factors, MPFI, SI engine testing. Combustion in CI engines: Essential Features – Types of Cycle. Pr. Data – Fuel Spray Behavior – Ignition Delay – Mixing Formation and control, Common rail fuel injection system.

UNIT IV POLLUTANT FORMATION AND CONTROL:**9Hrs**

Nature and extent of problems – Nitrogen Oxides, Carbon monoxide, unburnt Hydrocarbon and particulate – Emissions – Measurement – Exhaust Gas Treatment, Catalytic converter, SCR, Particulate Traps, Lean, NOx, Catalysts.

UNIT V ENGINE HEAT TRANSFER**9Hrs**

Importance of heat transfer, heat transfer and engine energy balance, Convective heat transfer, radiation heat transfer, Engine operating characteristics. Fuel supply systems for S.I. and C.I engines to use gaseous fuels like LPG, CNG and Hydrogen. Modern Trends in IC Engines: Lean Burning and Adiabatic concepts, Rotary Engines, Modification in I.C engines to suit Bio –fuels, HCCI and GDI concepts.

- CO1: Analysis of thermodynamic cycles for I.C.Engines
 CO2: Demonstrate the concepts of supercharging and turbo charging principle
 CO3: Comprehend knowledge on various engine parameters
 CO4: Apply the EGR and catalytic convertor system to control emissions
 CO5: Estimate the heat transfer characteristic in engine system
 CO6: Modify I.C. Engines according to need and applications

TEXT/REFERENCE BOOKS:

1. Heinz Heisler, Advanced Engine Technology, S.A.E. Publications 1995
2. Tom Denton, Automotive Electrical & Electronic systems, Edward Arnold 1995.
3. Duffy smith, Auto Fuel systems, The god heart Wilcox company Inc. Publishers 1987.
4. Gordon P.Blair, Advanced concepts of Two stroke Engines S.A.E.1990.
5. John B.Heywood, Internal combustion Engine Fundamentals, McGraw Hill Book 1990.

**END SEMESTER EXAM QUESTION PAPER
PATTERN**

Max. Marks: 80

Part A: 6 Questions of 5 marks each uniformly distributed among all units – No Choice
 Part B: 2 Questions from each unit of internal choice, each carrying 10 marks.

Exam Duration: 3 hrs.

30 marks
 50 marks

SME5602	ADVANCED REFRIGERATION AND AIR CONDITIONING	L	T	P	CREDIT
		4	0	0	4

COURSE OBJECTIVES:

To study vapour compression refrigeration system
To study the thermal comfort of air conditioning
To Study the various air conditioning systems

UNIT I VAPOUR COMPRESSION REFRIGERATION**9Hrs**

Performance of Complete vapor compression system. **Components of Vapor Compression System:** The condensing unit –Evaporators – Expansion valve – Refrigerants – Properties – ODP & GWP - Load balancing of vapor compression Unit. **Compound Compression:** Flash inter-cooling – flash chamber – Multi-evaporator & Multistage systems.

UNIT II THERMAL COMFORT**9Hrs**

Thermal comfort, Heat transfer from human body, metabolic heat generation, effect of clothing and definition of effective temperature, PMV and PPP, ASHRAE comfort chart, Infiltration and ventilation, Indoor air quality, sources of indoor pollution, methods of control for IAQ, Fresh air requirements for IAQ

UNIT III PSYCHROMETRY**9Hrs**

Composition of moist air, psychrometric properties ,Ideal adiabatic saturation temperature, Relation between WBT and thermodynamic WBT, Relation between psychrometric properties, psychrometric chart, ASHARE, psychrometric chart, psychrometric processes, Air washer ,Bypass factor, ADP, applied psychrometry -RSHF,GSHF and ESHF.

UNIT IV AIR CONDITIONING:**9Hrs**

Requirements of Comfort Air –conditioning – Thermodynamics of human body – Summer , Winter and year round air – conditioning systems. Cooling load Estimation: Occupants, equipments, infiltration, duct heat gain fan load, Fresh air load. Duct Systems- Frictional pressure drop in straight ducts, rectangular, circular cross section, equivalent diameter for rectangular ducts, pressure losses in fittings-due to sudden enlargement, contraction, duct sizing, velocity reduction method (VRM),Equal friction method (EFM), static regain method, Selection of fans, fan laws, fan characteristic curves, air distribution in rooms

UNIT V AIR CONDITIONING SYSTEMS**9Hrs**

All air system, All water system Air water system, Direct Refrigerant, Unitary system, Chilled ceiling and chilled beams, VAV,VRF, water cooled VRV. Two stage evaporating cooling, RA&C Control system-Closed & open loop control system, control based on air space temperature, outside temperature, heating and cooling medium, humidity and all parameters, Application - Super market s, restaurants, kitchen exhaust, ventilation system and official buildings

CO1: Analysis the vapour compression refrigeration cycle

CO2: Demonstrate the thermal comfort techniques in air conditioning

CO3: Apply the Psychrometric principles and properties in air conditioning

CO4: Estimate the cooling load calculations of various AC Systems

CO5: Evaluate the pressure losses in duct systems

CO6: Implementation of AC systems in various applications

TEXT/REFERENCE BOOKS:

1. Dossat R.J., Principles of refrigerations, John Wiley, 1984.
2. W.F. Stoecker, Refrigeration and Air conditioning, McGraw Hill Book Company, 1985.
3. Jorden and Priester, Refrigeration and Air Conditioning, 1985.
4. Goshnay W.B., Principles and Refrigeration, Cambridge, University Press, 1982.
5. Langley, Billy, C., 'Solid State Electronic Controls for HV ACR, pentice-Hall 1989.

**END SEMESTER EXAM QUESTION PAPER
PATTERN**

Max. Marks: 80

Part A: 6 Questions of 5 marks each uniformly distributed among all units – No Choice

Part B: 2 Questions from each unit of internal choice, each carrying 10 marks.

Exam Duration: 3 hrs.**30 marks****50 marks****B.E. / B.Tech REGULAR****BACK TO TOP****REGULATIONS 2015**

SME5603	AIRCRAFT AND SPACE PROPULSION	L	T	P	C	Max.Marks
		4	0	0	4	100

COURSE OBJECTIVES:

To study the jet propulsion system

To study the various characteristic parameters involved in

nozzle To Study the solid and liquid propellant characteristics

UNIT I PRINCIPLES OF JET PROPULSION AND ROCKETRY**9Hrs**

Fundamentals of jet propulsion, Rockets and air breathing jet engines – Classification – turbo jet, turbo fan, turbo prop, rocket (Solid and Liquid propellant rockets) and Ramjet engines. **Nozzle Theory and Characteristics Parameters:** Theory of one dimensional convergent – divergent nozzles – aerodynamic choking of nozzles and mass flow through a nozzle – nozzle exhaust velocity – thrust, thrust coefficient, A_c / A_t of a nozzle, Supersonic nozzle shape, non-adapted nozzles, summer field criteria, departure from simple analysis – characteristic parameters – 1) characteristic velocity, 2) specific impulse 3) total impulse 4) Relationship between the characteristic parameters 5) nozzle efficiency, combustion efficiency and overall efficiency.

UNIT II AERO THERMO CHEMISTRY OF THE COMBUSTION PRODUCTS**9Hrs**

Review of properties of mixture of gases – Gibbs – Dalton laws – Equivalent ratio, enthalpy changes in reactions, heat of reaction and heat of formation – calculation of adiabatic flame temperature and specific impulse – frozen and equilibrium flows.

Solid Propulsion System: Solid propellants – classification, homogeneous and heterogeneous propellants, double base propellant compositions and manufacturing methods. Composite propellant oxidizers and binders. Effect of binder on propellant properties. Burning rate and burning rate laws, factors influencing the burning rate, methods of determining burning rates.

UNIT III Propulsion System**9Hrs**

Solid propellant rocket engine – internal ballistics, equilibrium motor operation and equilibrium pressure to various parameters. Transient and pseudo equilibrium operation, end burning and burning grains, grain design. Rocket motor hardware design. Heat transfer considerations in solid rocket motor design. Ignition system, simple pyro devices **Liquid Rocket Propulsion System:** Liquid propellants – classification, Mono and Bi propellants, Cryogenic and storage propellants, ignition delay of hypergolic propellants, physical and chemical characteristics of liquid propellant. Liquid propellant rocket engine – system layout, pump and pressure feed systems, feed system components. Design of combustion chamber, characteristic length, constructional features, and chamber wall stresses. Heat transfer and cooling aspects. Uncooled engines, injectors – various types, injection patterns, injector characteristics, and atomization and drop size distribution, propellant tank design.

UNIT IV TURBO JET PROPULSION SYSTEM**9Hrs**

Gas turbine cycle analysis – layout of turbo jet engine. Turbo machinery- compressors and turbines, combustor, blade aerodynamics, engine off design performance analysis. **Flight Performance:** Forces acting on vehicle – Basic relations of motion – multi stage vehicles.

UNIT V RAMJET AND INTEGRAL ROCKET RAMJET PROPULSION SYSTEM:**9Hrs**

Fuel rich solid propellants, gross thrust, gross thrust coefficient, combustion efficiency of ramjet engine, air intakes and their classification – critical, super critical and sub-critical operation of air intakes, engine intake matching, classification and comparison of IIRR propulsion systems.

COURSE OUTCOMES

On completion of the course, students will be able to

- CO-1:** Recall basics of aero thermo dynamics
- CO-2:** Understanding the aircraft jet propulsion
- CO-3:** Understanding the supersonic combustion
- CO-4:** Recognize the functions of hypersonic propulsion
- CO-5:** Analyze the various types of flame stabilization
- CO-6:** Understand the advanced propulsion

TEXT/REFERENCE BOOKS:

- Hill and Peterson, Mechanics and Dynamics of Propulsion, 7th edition, John Wiley & Sons. 2001
- George P. Sutton, Rocket propulsion elements, 8th Edition, John Wiley & Sons, 2010
- Ganesan, Gas Turbines, Tata McGraw-Hill, 2003
- Khajuria & Dubey, Gas Turbines & Propulsive Systems, Dhanpat Rai & Sons

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 80

Exam Duration: 3 hrs.

Part A: 6 Questions of 5 marks each uniformly distributed among all units – No Choice

30 marks

Part B: 2 Questions from each unit of internal choice, each carrying 10 marks.

50 marks

SME5604	CRYOGENIC ENGINEERING	L	T	P	C	Max.Marks
		4	0	0	4	100

COURSE OBJECTIVES:

To learn the fundamentals of cryogenic Engineering, Cryogenic systems their working and applications.

UNIT –I INTRODUCTION TO CRYOGENIC SYSTEMS:

9Hrs

Mechanical Properties at low temperatures. Properties of Cryogenic Fluids. Gas Liquefaction: Minimum work for liquefaction. Methods to protect low temperature. Liquefaction systems for gases other than Neon. Hydrogen and Helium. Space technology, In-Flight air separation and collection of LOX, Gas industry, Biology, Medicine, Electronics.

UNIT II LIQUEFACTION SYSTEMS FOR NEON, HYDROGEN AND HELIUM

9Hrs

Components of Liquefaction systems. Heat exchangers. Compressors and expanders. Expansion valve, Losses in real machines.

UNIT-III GAS SEPARATION AND PURIFICATION SYSTEMS:

9Hrs

Properties of mixtures, Principles of mixtures, Principles of gas separation, Air separation systems.

UNIT-IV CRYOGENIC REFRIGERATION SYSTEMS

9Hrs

Refrigerators using solids as working media- Magnetic cooling, magnetic refrigeration systems, thermal; valves, nuclear demagnetization, Liquids, and Gases, Adsorption processes- Physical principles of adsorption, Adsorbents-various adsorbents, salient features – properties, determination of mass of adsorbents for the adsorption of gases.

UNIT-V CRYOGENIC STORAGE AND INSTRUMENTATION

9Hrs

Cryogenic fluid storage & transfer, Cryogenic storage systems, Insulation, Fluid transfer mechanisms, Cryostat, Cryo Coolers Cryogenic storage- Dewar, construction of Dewar, fluid storage and transfer, different piping methods, insulating types, vapor shielded vessels. Vacuum technology-definition, different flow regimes, need of vacuum in cryogenics, types of vacuum, pump down time, types of vacuum pumps-mechanical pump, diffusion pump, ion pump, baffles and loops, types of vacuum gauges and operating range.

CO1: Comprehend knowledge on cryogenic systems

CO2: Demonstrate the different liquefaction techniques

CO3: Apply the cryogenic systems to gas purification systems

CO4: Implementation of cryogenics in refrigeration

CO5: Demonstrate the cryogenic storage systems

CO6: Apply the instrumentation principle in cryogenics

TEXT/REFERENCE BOOKS:

1. R.F.Barren, Cryogenic Systems, Oxford University Press
2. Marshal Sitting and Von Nostrand, Cryogenic Research and Applications, Inc. New Jersey
3. R.B.Scottm Vin Nostrand, Cryogenic Engineering, Inc. New Jersey, 1959
4. O.K. White, Experimental Techniques in Low Temperature Physics, Oxford Press, 1968.
- 5.K.D. Timmerhaus & TM Flynn, Cryogenic Process Engineering, Plenum Press, 1998
6. J.G.Weisend –II, Hand Book of Cryogenic Engineering, Taylor and Francis, 1998

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 80

Part A: 6 Questions of 5 marks each uniformly distributed among all units – No Choice

Part B: 2 Questions from each unit of internal choice, each carrying 10 marks.

Exam Duration: 3 hrs.

30 marks

50 marks

SME5605	DESIGN AND ANALYSIS OF TURBO MACHINES	L	T	P	C	Max.Marks
		4	0	0	4	100

COURSE OBJECTIVES:

To learn the fundamental Theory of Turbo Machines and their classifications
To study the various Turbo machines, their working and performance

UNIT I THEORY OF TURBO MACHINES**9Hrs**

Introduction – Classification of Turbomachinery – Energy transfer between a fluid and a Rotor – Euler Turbine equation – Components of energy transfer – Internal and external losses – Efficiencies.

UNIT II TYPES OF TUBINES**9Hrs**

Impulse and Reaction turbine – degree of reaction –Utilisation factor – Speed ratio.

UNIT III FUNDAMENTALS OF FLUID FLOW**9Hrs**

Flow of fluid through rotor blades – One and two dimensional incompressible flow analysis –Calculation of velocity and pressure – Radial pressure gradient – Free vortex flow – Forced vortex flow. Two dimensional cascades – Experimental study – Correlations, Ainley, Soderberg, Howell's

UNIT IV FANS BLOWERS AND PUMPS**9Hrs**

Fans, Blowers and Pumps: Radial and axial flow – single and multistage flow through impeller –Design parameters- Selection of empirical and experimental data for design – Performance characteristics, Stability of operation.

UNIT V STEAM TURBINES**9Hrs**

Types – Design of impulse and Reaction stages – 50 percent reaction steam turbine – Blade and nozzle losses – efficiencies – Reheat factor.

CO1: Classify turbo machinery equipments

CO2: Differentiate impulse and Reaction turbines

CO3: Analyze the One and two dimensional incompressible flow analysis

CO4: Design of fans, blowers and pumps

CO5: Evaluate the performance of steam turbines

CO6:Design the impulse and reaction turbines

TEXT/REFERENCE BOOKS:

1. Dr. Yahya S.M., Turbomachines, Tata McGraw Hill, New Delhi, 1998.
2. Shepherd D.G., Principles of Turbomachines, Macmillan, London, 1968.
3. Dr. Yahya S.M., Turbines, Compressors and Fans, Tata McGraw-Hill, New Delhi, 1998.
4. Keartow W.O., Steam Turbine theory and practice, ELBS, London, 1995.
5. Jagdishlal and Church A.M., Centrifugal pumps and blowers, Metropolitan Book Company, 1988.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 80

Part A: 6 Questions of 5 marks each uniformly distributed among all units – No Choice

Part B: 2 Questions from each unit of internal choice, each carrying 10 marks.

Exam Duration: 3 hrs.

30 marks

50 marks

SME5606	DESIGN OF HEAT EXCHANGERS	L	T	P	C	Max.Marks
		4	0	0	4	100

COURSE OBJECTIVES:

To learn the Design principles of various Heat Exchangers

UNIT I CONSTRUCTIONAL DETAILS AND HEAT TRANSFER:**9Hrs**

Types - Shell and Tube Heat Exchangers – Regenerators and Recuperators - Industrial Applications Temperature Distribution and its Implications - LMTD - Effectiveness – NTU method.

UNIT II FLOW DISTRIBUTION AND STRESS ANALYSIS:**9Hrs**

Effect of Turbulence - Friction Factor - Pressure Loss – Channel Divergence Stresses in Tubes - Heater Sheets and Pressure Vessels - Thermal Stresses - Shear Stresses - Types of Failures, Flow induced vibrations.

UNIT III DESIGN ASPECTS:**9Hrs**

Heat Transfer and Pressure Loss - Flow Configuration - Effect of Baffles - Effect of Deviations from Ideality - Design of Typical Liquid - Gas-Gas-Liquid Heat Exchangers

UNIT IV CONDENSERS AND EVAPORATORS DESIGN:**9Hrs**

Design of Surface and Evaporative Condensers - Design of Shell and Tube - Plate Type Evaporators

UNIT V COOLING TOWERS:**9Hrs**

Types – counter flow – cross flow - Packings - Spray Design - Selection of Pumps - Fans and Pipes - Testing and Maintenance - Experimental Methods – Types of draft – natural and forced.

Course Outcomes:

Total 45 Hrs

On completion of the course, student will be able to–

- CO1: Remember the types of heat exchanger, advantages, disadvantages and its application.
- CO2: Understand the types of heat exchanger which will be suitable for particular application
- CO3: Apply the knowledge gained from this into industrial applications
- CO4: Analyze the difference between the various heat exchangers which will be suitable for corresponding application
- CO5: Evaluate the better heat exchanger among the available heat exchanger
- CO6: Evaluate the cooling tower accessories components to increase their performance

TEXT/REFERENCE BOOKS:

1. T. Taborek, G.F. Hewitt and N.Afgan, Heat Exchangers, Theory and Practice, McGraw Hill Book Company, 1980
2. Walker, Industrial Heat Exchangers - A Basic Guide, McGraw Hill Book Co., 1980
3. Nicholas Cheremisiouff, Cooling Tower, Ann Arbor Science Pub 1981
4. Arthur P.Fraas, Heat Exchanger Design, John Wiley & Sons, 1988
5. Kern D.Q., Process Heat transfer, Tata McGraw -Hill, New Delhi, 1999.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 80**Exam Duration: 3 hrs.**

Part A: 6 Questions of 5 marks each uniformly distributed among all units – No Choice

30 marks

Part B: 2 Questions from each unit of internal choice, each carrying 10 marks.

50 marks

SME4056	MATERIAL TESTING LAB (For Mech, Mech&Prod & Auto)	L	T	P	Credits	Total Marks
		0	0	4	2	100

SUGGESTED LIST OF EXPERIMENTS

METALLURGY LAB

1. To study the metallurgical microscope.
2. Studying the preparation of a specimen for metallographic examination
3. To study the microstructure of plain carbon steel (Low carbon steel, medium carbon steel and high speed steel).
4. To study the effect of heat treatment on plain carbon steel (Annealing, Normalizing and Hardening)
5. To study the microstructure of alloy steels (Stainless steels, Tool steels)
6. To study the microstructure of cast iron (Grey cast iron, white cast iron, malleable cast iron and spheroidal graphite cast iron)
7. To study the microstructure of light alloys (Aluminium alloy and Magnesium alloy)
8. To study the microstructure of heavy alloys (Copper alloy, Nickel alloy)
9. determine the Hardenability of steel by Jominy end quench testing.
10. To study the hardness of ferrous and non-ferrous alloys.

MATERIAL TESTING LAB

1. Hardness test on metals- Brinell, Vicker and Rockwell Hardness tests.
2. Impact test on metals-Charpy, Izod impact tests.
3. Shear test on metals-direct shear strength, single shear, double shear.
4. Deflection test on beams-load deformation characteristics, Young's modulus, Maxwell's reciprocal law verification.
5. Torsion test on beams-torque and angle of twist characteristics, shear stress, modulus of rigidity, energy.
6. Tests on helical springs-compression, tension springs-load deformation characteristics, stiffness, shear stress, modulus of rigidity, energy.
7. Compression test on given specimen on universal testing machine.
8. Tension test on metals-stress strain characteristics, ductility, resilience, toughness.

SPR1202	ENGINEERING METROLOGY (For Mech , Mech & Prod & Auto)	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the basic principles of measurements
- To learn the various linear and angular measuring equipments, their principle of operation and applications, various methods of measuring mechanical parameters

UNIT 1 INTRODUCTION TO METROLOGY**8 Hrs.**

Accuracy, precision, resolution and sensitivity of measuring instruments, classification of errors in measurements, alignment errors, evaluation and propagation of errors , Limits, fits and tolerances. Terminologies in Measurement - Care of Measuring Instruments- Reliability.

UNIT 2 LINEAR AND ANGULAR MEASUREMENTS**9 Hrs.**

Linear Measuring Instruments – Evolution – Types – Classification – gauge design – concepts of interchangeability and selective assembly – Comparators, slip gauges – Types – Angular measuring instruments – Sine bar, angle gauges, autocollimator, angle dekkor, tool maker's microscope, Bevel protractor, clinometers, spirit levels– Alignment telescope – Applications.

UNIT 3 MEASUREMENT OF POWER, PRESSURE, TEMPERATURE AND FLOW**10 Hrs.**

Power, Force and Torque – mechanical, hydraulic, pneumatic and electrical type – Pressure – low pressure measurement using McLeod gauge, thermal conductivity gauge and ionization gauges – high pressure measurement using diaphragm gauges and bulk modulus pressure gauge. Temperature – thermo couple, RTD, thermistor-electrical resistance thermometer- pyrometers. Flow – Turbine type flow meter, magnetic flow meter, ultra sonic flow meter, thermal flow meter and hot wire anemometer. : Venturimeter, Orifice meter, Rotameter, Pitot tube – Temperature: bimetallic strip.

UNIT 4 FORM MEASUREMENT**9 Hrs.**

Standard thread profiles, Measurement of major, minor and effective diameter, 3 wire method and best wire size, gear tooth profile measurement, run out and composite error measurement, gear pitch measurements. Form measurement-Straightness - Flatness, Roundness, Surface finish measurement.

UNIT 5 ADVANCES IN METROLOGY**9 Hrs.**

Interferometry – laser interferometers – types – Applications – Computer Aided Inspection-Basic concept of Co-ordinate Measuring Machines(CMM) – Types of CMM – Constructional features – Probes – laser interferometer, working principle, applications, alignment and errors; Machine Vision, elements of vision system, applications in manufacturing; introduction to atomic force microscopy (AFM), Scanning tunneling microscopy (STM), Nano metrology.

Max.45 Hours**TEXT / REFERENCE BOOKS**

1. Connie L Dotson, "Fundamentals of Dimensional Metrology", Thomson Delmer Learning, 2006.
2. Beckwith T.G. and Marangoni, "Mechanical Measurements", Addison Wesley, 2000.
3. Gupta I C, "Text Book of Engineering Metrology", Dhanpat Rai Publishers, 2003.
4. Jain R.K., "Engineering Metrology", Khanna Publishers, 1994.
5. Alsutko, Jerry.D.Faulk, Thomson, "Industrial Instrumentation", Asia Pvt Ltd., 2011
6. Sirohi, "Mechanical Measurements", New Age Publications, 2013.
7. Gupta S.C., "Engineering Metrology", Dhanpat Rai Publications, 1993.
8. Gaylor & Shotbolt, "Engineering Metrology", Mc Donald & Co Publications, 2005.
9. Hume K.J., "Engineering Metrology", ELBS, 1970.
10. Whitehouse D.J., The Handbook of Surface and Nano metrology, CRC Press, 2011.

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks : 80****Exam Duration : 3 Hrs.****PART A : 2 Questions from each unit, each carrying 2 marks****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 12 marks****60 Marks**

SME4055	MACHINE DRAWING PRACTICE (For Mech Mech&Prod & Auto)	L	T	P	Credits	Total Marks
		1	0	2	2	100

COURSE OBJECTIVE

- To make the students to visualize and interpret drawings of machine components so that the students can prepare assembly drawings from exploded views either manually and by using standard CAD packages.
- The students will be expected to make acquainted with the standard machined components.

DRAWING STANDARDS

BIS code of practice for Engineering Drawing – Machine drawing conventions – Conventional representation of common machine elements such as bolts, screws, bolts, nuts, keys, gears, bearings and springs – Abbreviations and symbols used in machine drawing – Types of sections – Half section - Full section – Partial or local section – Removed section – Revolved section.

LIMITS, FITS AND TOLERANCES

Limits – Upper limit – Lower limit – Fits – Types of fits – Clearance fit – Interference fit – Transition fit – Hole basis system – Shaft basis system – Tolerance – Tolerance grades – Use of tolerance table and specification of tolerance.

ASSEMBLY DRAWING (MANUAL AND USING CAD PACKAGES)

Preparation of assembled views given part details of components followed by practicing the same using standard CAD packages - Suggested assemblies: Sleeve and cotter joint, Universal coupling, Screw jack, Snug type plummer block, Octagon type plummer block, Swivel bearing, Tail stock, Machine vice, Steam stop valve.

TEXT / REFERENCE BOOKS

1. Gopalakrishnan, K.R., Machine Drawing, Subhas Publications, 16th Edition, 2008.
2. PSG Design Data Book.
3. Bhatt N.D., Machine Drawing, Charotar Publishing House, 44th Edition, 2009.
4. Lakshminarayanan V, Mathur M.L., Text Book on Machine Drawing with Computer Graphics, Jain Brothers, 12th Edition, 2007.
5. SP 46: Engineering Drawing Practice for schools and colleges, Bureau of Indian Standards.
6. AutoCAD – 2D and 3D CAD Reference Guide.

END SEMESTER EXAM QUESTION PAPER PATTERN

By using mini drafter: 50 marks

by using CAD: 50 marks

Note: Only after submission of all drawing sheets prescribed by staff member, the students will be allowed for university practical examination.

SME1608	COMPUTER SIMULATION OF IC ENGINES	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OUTCOMES

On completion of the course, student will be able to

CO1- Understand first and second laws of thermodynamics.

CO2- Understand the basic Heat transfer models for engines.

CO3- Apply the simulation techniques for modification of combustion chamber.

CO4- Apply the simulation techniques to develop new engines.

CO5- Apply the simulation techniques Combustion in SI engines.

CO6- Apply the simulation techniques Combustion in CI engines.

UNIT 1 SIMULATION PRINCIPLES

9 Hrs.

Simulation principles-First and second laws of thermodynamics – Estimation of properties of gas mixtures - Structure of engine models – Open and closed cycle models - Cycle studies, Chemical Reactions, First law application to combustion, Heat of combustion – Adiabatic flame temperature, Chemical Equilibrium and calculation of equilibrium composition - – Heat transfer in engines – Heat transfer models for engines.

UNIT 2 SIMULATION OF COMBUSTION IN SI ENGINES

9 Hrs.

Simulation in S I engine - Combustion in SI engines, Flame propagation and velocity, Single zone models – Multi zone models – Mass burning rate, Turbulence models – One dimensional models – Chemical kinetics modeling – Multidimensional models, Flow chart preparation.

UNIT 3 SIMULATION OF COMBUSTION IN CI ENGINES

9 Hrs.

Main difference between SI and CI engine simulation, differences between ideal and actual cycles, Combustion in CI engines Single zone models – Premixed-Diffusive models – Wiebe' model – Whitehouse way model, Two zone models - Multizone models- Meguerdichian and Watson's model, Hiroyasu's model, Lyn's model – Introduction to Multidimensional and spray modeling, Flow chart preparation.

UNIT 4 SIMULATION OF TWO STROKE ENGINES

9 Hrs.

Thermodynamics of the gas exchange process - Flows in engine manifolds – One dimensional and multidimensional models, determination of the pressure-crank angle variation, computation of performance parameters. Flow around valves and throughports Models for scavenging in two stroke engines – Isothermal and non-isothermal models, Heat Transfer and Friction. simulation for pollution estimation.

UNIT 5 SIMULATION OF GAS TURBINE COMBUSTORS

9 Hrs.

Gas Turbine Power plants – Flame stability, Combustion models for Steady Flow Simulation – Emission models. Flow chart preparation.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Ashley S. Campbell, Thermodynamic Analysis of Combustion Engines, Krieger publication co, 1985.
2. Ganesan V., Computer Simulation of Spark Ignition Engine Processes, Universities Press, 2000.
3. Ganesan V., Computer Simulation of C.I. Engine Processes, Universities Press, 2000.
4. Cohen H. Rogers GEC. – Gas Turbine Theory – Pearson Education India Fifth edition, 2001.
5. Bordon P. Blair, The Basic Design of two-Stroke engines, SAE Publications, 1990.
6. Horlock and Winterbone, The Thermodynamics and Gas Dynamics of Internal Combustion Engines, Vol. I & II, Clarendon Press, 1986.

END SEMESTER EXAM QUESTION PAPER PATTERN

SME1603	ALTERNATE FUELS & ENERGY SYSTEMS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the need of alternate fuels and energy systems.

CO2 - Understand the production method of various alternate fuels.

CO3 - Understand the different methods of using alternate fuels in engines.

CO4 - Understand the properties of different alternate fuels.

CO5 - Analyse the performance, emission and combustion characteristics of engines using alternate fuels.

CO6 - Understand the basics of electric, hybrid and fuel cell vehicles

UNIT 1 INTRODUCTION**9 Hrs.**

Need for alternate fuel, availability and properties of alternate fuels, general use of alcohols, LPG, hydrogen, ammonia, CNG and LNG, vegetable oils and biogas, merits and demerits of various alternate fuels, introduction to alternate energy sources- EV, hybrid, fuel cell and solar cars.

UNIT 2 ALCOHOLS**9 Hrs.**

Properties as engine fuel, alcohols and gasoline blends, performance in SI engine, methanol and gasoline blends, combustion characteristics in CI engines, emission characteristics, Di-Methyl Esters, Di-Ethyl Esters, properties performance analysis, performance in SI & CI Engines.

UNIT 3 NATURAL GAS, LPG, HYDROGEN AND BIOGAS**9 Hrs.**

Availability of CNG, properties, modification required to use in engines, performance and emission characteristics of CNG using LPG in SI & CI engines, performance and emission of LPG. Hydrogen; storage and handling, performance and safety aspects.

UNIT 4 VEGETABLE OILS**9 Hrs.**

Various vegetable oils for engines, Biodiesel and its characteristics esterification, performance, Combustion and emission Characteristics

UNIT 5 ELECTRIC, HYBRID, FUEL CELL AND SOLAR CARS**9 Hrs.**

Layout of an electric vehicle, advantage and limitations, specifications, system components, electronic control system, high energy and power density batteries, hybrid vehicle, fuel cell vehicles, solar powered vehicles.

Max.45Hours**TEXT / REFERENCE BOOKS**

1. Richard L. Bechfold, Alternative Fuels Guide Book - SAE International Warren dale - 1997.
2. MaheswarDayal, "Energy Today & Tomorrow", I & B Horsier India - 1982.
3. Nagpal, "Power Plant Engineering", Khanna Publishers - 1991.
4. "Alcohols as motor fuels progress in technology", Series No.19, SAE Publication USE - 1980.
5. SAE Paper Nos. 840367, 841333, 841334, 841156, Transactions, SAE, USA
6. A.Demirbas, "Biodiesel a realistic fuel alternative for Diesel engines" Springer, Verlog London limited-2008

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 80

Exam Duration : 3 Hrs.

PART A : 2 Questions from each unit, each carrying 2marks

20 Marks

PART B : 2 Questions from each unit with internal choice, each carrying 12marks

60 Marks

SME1606	COMBUSTION ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OUTCOMES

On completion of the course, student will be able to CO1- Understand various types of fuels and its ppts CO2- Understand the concept of gaseous fuels

CO3- Will able to differentiate gaseous and liquid fuels CO4- Will understand the concept of solid fuels

CO5- Student learns about fluidized bed combustion

CO6- Student understands the fundamentals in combustion of fuels.

UNIT 1 COMBUSTION OF FUELS

9 Hrs.

Fuels & Fuel Analysis-Combustion equation, Stoichiometry, theoretical & actual combustion processes. Combustion equations, excess air, air fuel ratio, equivalence ratio, exhaust gas composition, Air fuel ratio from exhaust gas composition.

UNIT 2 THERMODYNAMICS OF COMBUSTION

9 Hrs.

Enthalpy of Formation; Enthalpy of Reaction; Heating Values; First law Analysis of Reaction System and Second Laws Analysis of Reaction System, Adiabatic combustion temperature criteria for Chemical Equilibrium, Equilibrium constant for gaseous mixtures, Evaluation of equilibrium composition, chemical availability.

UNIT 3 KINETICS OF COMBUSTION

9 Hrs.

Law of Mass Action; Reaction Rate; Simple and Complex Reaction; Reaction order and Molecularity, Arrhenius Laws; Activation Energy; Chain Reaction; Steady Rate and Partial Equilibrium Approximation; Chain Explosion; Explosion Limit and Oxidation Characteristics of Hydrogen, Carbon Monoxide, Hydrocarbons.

UNIT 4 FLAMES

9 Hrs.

Remixed Flame Structure and Propagation of Flames in Homogeneous Mixtures; Relation, Properties of Hugoniot Curve, Analysis of Deflagration and Detonation Branches. Theories of Flame Propagation & Calculation of Flame Speed Measurements. Stability Limits of Laminar Flames; Flammability Limits & Quenching Distance, Burner Design, Mechanism of Flame Stabilization In Laminar & Turbulent Flows, Flame Quenching, Diffusion Flames; Comparison of Diffusion With Premixed Flame, Combustion of Gaseous Fuel, Jets Burke & Schumann Development.

UNIT 5 ENGINE COMBUSTION

9 Hrs.

Combustion in SI and CI engines, stages of combustion in SI and CI engines, Normal combustion and abnormal combustion, Emissions from premixed combustion, Emission from Non-premixed combustion, Control of emissions.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Stephen R. Turns, "An Introduction to Combustion", McGraw Hill Book Company, 1996.
2. Irwin Glassman, "Combustion", Third Edition, Academic Press, 1996.
3. Sharma S.P. and Chandramohan, "Fuels and Combustion", Tata McGraw Hill Book Co., 1984.
4. Samir Sarkar, "Fuels and Combustion", Orient Longman, 1984.
5. Kuo K.K. "Principles of Combustion", John Wiley & Sons, 1984.
6. Heywood J.B, "Internal Combustion Engine Fundamentals", Mc Graw Hill Book Co., 1988.

**END SEMESTER EXAM QUESTION PAPER
PATTERN**

Max. Marks: 80

Exam Duration : 3 Hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 Marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 Marks

B.E. - MECHANICAL ENGINEERING
REGULATIONS 2010 - CURRICULUM
SEMESTER I

Sl. No.	SUBJECT CODE	SUBJECT TITLE	L	T	P	C	Page No.
1	SMTX1001	Engineering Mathematics – I	3	1	0	4	1
2	SCHX1001	Environmental Science & Engineering	3	0	0	3	2
3	SPHX1001	Physics of Materials	3	0	0	3	3
4	SCYX1001	Engineering Chemistry	3	0	0	3	4
5	SCSX1002	Programming In C	3	0	0	3	5
6	SMEX1002	Engineering Mechanics	2	1	0	3	6
7	SMEX1001	Engineering Graphics	1	2	0	3	7

PRACTICALS

1	SPRX4002	CAD Lab – I	0	0	4	2	8
2	SCSX4002	Programming In C Lab	0	0	4	2	8

TOTAL CREDITS 26

SEMESTER II

Sl. No.	SUBJECT CODE	SUBJECT TITLE	L	T	P	C	Page No.
1	SMTX1002	Engineering Mathematics – II	3	1	0	4	9
2	SHSX1001	English for Science & Technology	3	0	0	3	10
3	SPHX1002	Applied Physics	3	0	0	3	11
4	SCYX1003	Chemistry of Industrial Materials	3	0	0	3	12
5	SCSX1003	Programming in C++	3	0	0	3	13
6	SEEX1002	Basic Electrical & Electronics Engineering	2	1	0	3	14
7	SPRX1001	Basic Mechanical Engineering & Civil3 Engineering		0	0	3	15

PRACTICALS

1	SPRX4001	Mechanical Workshop Lab	0	0	4	2	16
2	SCSX4007	Programming in C++ Lab	0	0	4	2	17

TOTAL CREDITS 26

L - Lecture hours; T - Tutorial hours; P - Practical hours; C - Credits

SEMESTER III

Sl. No.	SUBJECT CODE	SUBJECT TITLE	L	T	P	C	Page No.
1	SMTX1009	Engineering Mathematics-III	3	1	0	4	18
2	SMEX1003	Kinematics of Machines	2	1	0	3	19
3	SMEX1004	Engineering Thermodynamics	2	1	0	3	20
4	SMEX1005	Fluid Mechanics and Machinery	2	1	0	3	21
5	SMEX1006	Material Technology	3	0	0	3	22
6	SEEX1004	Electrical Technology	2	1	0	3	23
7	SMEX1007	Machine Drawing	1	2	0	3	24

PRACTICALS

1	SMEX4001	Fluid Mechanics Lab	0	0	2	1	25
2	SMEX4002	Metallurgy Lab	0	0	2	1	25
3	SEEX4001	Electrical Engineering Lab	0	0	4	2	25

TOTAL CREDITS 26**SEMESTER IV**

Sl. No.	SUBJECT CODE	SUBJECT TITLE	L	T	P	C	Page No.
1	SMTX1010	Engineering Mathematics- IV	3	1	0	4	26
2	SMEX1008	Dynamics of Machinery	3	1	0	4	27
3	SMEX1009	Thermal Engineering	3	1	0	4	28
4	SMEX1010	Strength of Materials	2	1	0	3	29
5	SPRX1042	Manufacturing Technology –I	3	0	0	3	30
6	SPRX1007	CAD / CAM	3	0	0	3	31

PRACTICALS

1	SMEX4003	Fluid Machinery Lab	0	0	2	1	32
2	SMEX4004	Material Testing Lab	0	0	2	1	32
3	SPRX4008	Machine Shop Practice Lab -I	0	0	2	1	33
4	SPRX4009	CAD Lab-II	0	0	2	1	33

TOTAL CREDITS 25

SEMESTER V

Sl. No.	SUBJECT CODE	SUBJECT TITLE	L	T	P	C	Page No.
1	SMTX 1011	Applied Numerical Methods	3	1	0	4	34
2	SECX1011	Microprocessor & Microcontroller	2	1	0	3	35
3	SMEX1014	Design of Machine Elements	2	1	0	3	36
4	SMEX1015	Gas Dynamics and Jet Propulsion	3	1	0	4	37
5	SPRX1043	Manufacturing Technology – II	2	1	0	3	38
6	SMEX1016	Power Plant Engineering	2	1	0	3	39
7	SPRX1044	Measurements & Metrology	2	1	0	3	40

PRACTICALS

1	SECX4014	Electronics & Microprocessor Lab	0	0	4	2	41
2	SPRX4006	Metrology Lab	0	0	2	1	41
3	SPRX4015	Machine Shop Practice Lab – II (Special Machines)	0	0	2	1	41

TOTAL CREDITS 27**SEMESTER VI**

Sl. No.	SUBJECT CODE	SUBJECT TITLE	L	T	P	C	Page No.
1	SMEX1017	Resource Management Techniques	3	0	0	3	42
2	SMEX1018	Heat and Mass Transfer	3	1	0	4	43
3	SMEX1019	Design of Transmission Systems	3	1	0	4	44
4	SMEX1020	Mechatronics	3	0	0	3	45
5		Elective-I	3	0	0	3	
6		Elective-II	3	0	0	3	

PRACTICALS

1	SMEX4009	Dynamics Lab	0	0	2	1	46
2	SMEX4010	Mechatronics Lab	0	0	2	1	46
3	SMEX4011	Thermal Engineering Lab - I	0	0	4	2	46

TOTAL CREDITS 24

SEMESTER VII

Sl. No.	SUBJECT CODE	SUBJECT TITLE	L	T	P	C	Page No.
1	SMEX1021	Total Quality Management	3	0	0	3	47
2	SMEX1022	Fluid Power Systems	3	0	0	3	48
3	SAUX1025	Automobile Engineering	3	0	0	3	49
4	SPRX1045	Production Planning & Control	3	0	0	3	50
5		Elective-III	3	0	0	3	
6		Elective-IV	3	0	0	3	

PRACTICALS

1	SMEX4012	Thermal Engineering Lab - II	0	0	2	1	51
2	SMEX4013	CAD Lab-III	0	0	2	1	51

TOTAL CREDITS 20**SEMESTER VIII**

Sl. No.	SUBJECT CODE	SUBJECT TITLE	L	T	P	C	Page No.
1	SBAX1001	Principles of Management & Professional Ethics	3	0	0	3	52
2	SPRX1046	Modern Manufacturing Process	3	0	0	3	53
3	SMEX1023	Wind & Solar Energy	3	0	0	3	54

PRACTICALS

1	SPRX4011	Design of Jigs & Fixtures and Press Tools Laboratory	0	0	2	1	55
2	SPRX4014	CAM Simulation Lab	0	0	2	1	56
3	S15XPROJ	Project Work and Viva Voce	0	0	30	15	56

TOTAL CREDITS 26**TOTAL CREDITS FOR THE COURSE 200**

LIST OF ELECTIVE SUBJECTS

Note: ONE SUBJECT IS TO BE CHOSEN FROM EACH GROUP

COMPULSORILY Group I – THERMAL

Sl. No.	SUBJECT CODE	SUBJECT TITLE	L	T	P	C	Page No.
1	SMEX1024	Advanced Internal Combustion Engineering	3	0	0	3	57
2	SMEX1025	Cryogenic Engineering	3	0	0	3	58
3	SMEX1026	Refrigeration and air conditioning	3	0	0	3	59
4	SMEX1027	Combustion Engineering	3	0	0	3	60
5	SMEX1031	Design of Heat Transfer Equipment	3	0	0	3	61
6	SMEX1034	Solid Waste Management	3	0	0	3	62

Group II – DESIGN

1	SMEX1032	Vibration and Noise Control	3	0	0	3	63
2	SMEX1033	Industrial Tribology	3	0	0	3	64
3	SMEX1036	Experimental stress analysis	3	0	0	3	65
4	SMEX1039	Finite Element Analysis	3	0	0	3	66
5	SMEX1038	Computational Fluid Dynamics	3	0	0	3	67

Group III – PRODUCTION

1	SMEX1029	Non Destructive Testing and Techniques	3	0	0	3	68
2	SMEX1037	Design for Manufacture	3	0	0	3	69
3	SMEX1040	Industrial Handling & Storage Systems	3	0	0	3	70
4	SMEX1041	Artificial Intelligence & Expert Systems	3	0	0	3	71
5	SPRX1019	Industrial Robotics and Expert Systems	3	0	0	3	72
6	SPRX1021	Powder Metallurgy	3	0	0	3	73
7	SPRX1022	Six Sigma Methods and Applications	3	0	0	3	74
8	SPRX1024	System Simulation & Modeling	3	0	0	3	75
9	SPRX1025	Supply Chain Management	3	0	0	3	76
10	SPRX1028	Non Traditional Machining Techniques	3	0	0	3	77
11	SPRX1029	Special Casting Processes	3	0	0	3	78

Group IV – ENERGY CONVERSION & MANAGEMENT SYSTEMS

1	SAUX 1016	Alternate Fuels And Energy Systems	3	0	0	3	79
2	SAUX 1023	Fuel Cell And Applications	3	0	0	3	80
3	SMEX1028	Cogeneration and Waste Heat Recovery Systems	3	0	0	3	81
4	SMEX1030	Bio Energy Conversion Technologies	3	0	0	3	82
5	SMEX1035	Energy Engineering and Management.	3	0	0	3	83

SMEX1014	DESIGN OF MACHINE ELEMENTS (Common to MECHANICAL and MECHANICAL & PRODUCTION)	L	T	P	Credits	Total Marks
		2	1	0	3	100

UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS**10 hrs.**

Introduction to the design process – Factors influencing machine design, selection of materials based on mechanical properties – Direct, bending and torsional stress equations – Impact and shock loading – Calculation of principle stresses for various load combinations, eccentric loading – Factor of safety – Theories of failure – Stress concentration – Design for variable fatigue loading – Soderberg, Goodman and Gerber relations

UNIT II DESIGN OF SHAFTS AND COUPLINGS**10 hrs.**

Design of solid and hollow shafts based on strength, rigidity and critical speed – Design of keys and key ways – Design of rigid and flexible couplings – Design of knuckle joint and cotter joints

UNIT III DESIGN OF FASTNERS AND WELDED JOINTS**10 hrs.**

Threaded fasteners – Design of bolted joints including eccentric loading – Design of welded joints for pressure vessels and structures.

UNIT IV DESIGN OF SPRINGS**10 hrs.**

Design of helical, leaf, belleville springs (disc) and torsional springs under constant loads and varying loads – Concentric springs

UNIT V DESIGN OF BEARINGS AND FLYWHEELS**10 hrs.**

Design of bearings – Sliding contact and rolling contact types. – Cubic mean load – Design of journal bearings – McKee's equation – Lubrication in journal bearings – Calculation of bearing dimensions – Design of flywheels involving stresses in rim and arm.

Note: (Use of P S G Design Data Book is permitted in the University examination)

TEXT / REFERENCES BOOKS:

1. Juvinall R.C., and Marshek K.M., "Fundamentals of Machine Component Design", Third Edition, John Wiley & Sons, 2002.
2. Bhandari V.B., "Design of Machine Elements", Tata McGraw-Hill Book Co, 2003.
3. Norton R.L., "Design of Machinery", Tata McGraw-Hill Book Co, 2004.
4. Orthwein W., "Machine Component Design", Jaico Publishing Co, 2003.
5. Ugural A.C., "Mechanical Design – An Integral Approach, McGraw-Hill Book Co, 2004.
6. Spotts M.F., Shoup T.E., "Design and Machine Elements" Pearson Education, 2004.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max Marks : 80

Exam Duration : 3 hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks

SMEX1019	DESIGN OF TRANSMISSION SYSTEMS (Common to Mechanical – Mechanical and Production)	L	T	P	Credits	Total Marks
		3	1	0	4	100

UNIT I DESIGN OF TRANSMISSION SYSTEMS FOR FLEXIBLE ELEMENTS**10 hrs.**

Selection and design of – Flat belts and pulleys- V belts and pulleys –Chain drives and sprockets

UNIT II DESIGN OF SPUR GEARS AND PARALLEL AXIS HELICAL GEARS**10 hrs.**

Gear Terminology-Speed ratios – Selection and design of spur gear- material selection- service factor- module calculation for endurance strength- Force analysis -Tooth stresses (fillet bending stress and contact stress) — Parallel axis Helical Gears – Equivalent number of teeth-Forces. Estimating the size of the helical gears and stresses – Dynamic effects- Fatigue strength

UNIT III DESIGN OF BEVEL AND WORM GEARS**10 hrs.**

Straight bevel gear: Tooth terminology- Design of pair of straight bevel gears – Tooth forces and stresses

Worm Gear: Merits and demerits- Terminology. Thermal capacity, Design of the worm and gear – Forces and stresses, efficiency

UNIT IV DESIGN OF GEAR BOXES**10 hrs.**

Geometric progression – Standard step ratio – Ray diagram, kinematics layout -Design of sliding mesh gear box -Constant mesh gear box. – Design of multi speed gear box.

UNIT V DESIGN OF CLUTCHES AND BRAKES**10 hrs.**

Design of plate clutches – Axial clutches-Cone clutches-Internal expanding rim clutches –Design of brakes – Internal and external shoe brakes.

Note: (Usage of P.S.G Design Data Book is permitted in the University examination)

TEXT / REFERENCES BOOKS:

1. Juvinall R.C., K.M. Marshek , "Fundamentals of Machine component Design", Third Edition, John Wiley & Sons, 2002.
2. Bhandari V.B., "Design of Machine Elements", Tata McGraw-Hill Publishing Company Ltd., 1994.
3. Maitra G.M., Prasad L.V., "Hand book of Mechanical Design", II Edition, Tata McGraw-Hill, 1985.
4. Shigley J.E. and Mischke C.R., "Mechanical Engineering Design", McGraw-Hill International Editions, 1989.
5. Norton R.L., "Design of Machinery", McGraw-Hill Book co, 2004.
6. Hamrock B.J., Jacobson B., Schmid S.R., "Fundamentals of Machine Elements", McGraw-Hill Book Co., 1999.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max Marks : 80

Exam Duration : 3 hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks

SMEX1020	MECHATRONICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I MECHATRONICS, SENSORS AND ACTUATORS**10 hrs.**

Introduction to Mechatronics Systems – Measurement Systems – Control Systems – Sensors and actuators – Performance Terminology – Sensors for Displacement, Position and Proximity-selection. Directional Control Valves – Rotary Actuators, Mechanical Actuation Systems – Cams – Gear Trains – Ratchet and pawl – Belt and Chain Drives. Electrical Actuation Systems – Mechanical Switches – Solid State Switches of Sensors

UNIT II RELAYS AND LADDER DIAGRAMS**10 hrs.**

Relays –electromechanical –reed-solid state. Ladder diagrams – sequence charts-ladder diagram design using sequence charts – Huffman method -through cascade method – single path sequencing, multi path sequencing system. Primitive flow table – row merging and merged flow table-state assignment.

UNIT III SYSTEM MODELS AND CONTROLLERS**10 hrs.**

Building blocks of Mechanical, Fluid and Thermal Systems, Rotational –Translational Systems, Hydraulic – Mechanical Systems. Continuous and discrete process Controllers – Control Mode –Step mode –Proportional Mode – Derivative Mode – Integral Mode – PID Controllers – DigitalControllers – Micro Processors Control.

UNIT IV PROGRAMMING LOGIC CONTROLLERS**10 hrs.**

Programmable Logic Controllers (PLC) – Basic Structure – Input / Output modules – Selection of PLC programming – Mnemonics – Timers, Internal relays and counters – Shift Registers –Master and Jump Controls – Data Handling – Analogs Input / Output – Simple example of PLC applications.

UNIT V DESIGN OF MECHATRONICS SYSTEM**10 hrs.**

Stages in designing Mechatronics Systems – Traditional and Mechatronic Design – Case studies of Mechatronics systems- Pick and place Robot- time delay using PLC, autonomous mobile robot- **Engine Management system- Automatic car park barrier- automatic camera.**

TEXT / REFERENCE BOOKS:

1. Bolton W., "Mechatronics", 2nd Edition, Pearson education, 3rd Indian Reprint, 2003.
2. Smaili A., and Mrad F., "Mechatronics integrated technologies for intelligent machines", Oxford university press, 2008.
3. Rajput R.K., "A Textbook of Mechatronics", S. Chand & Co, 2007
4. David. W. Pessen," Industrial Automation, Circuit Design and Components", John Wiley, 1990
5. Michael B. Hstand and David G. Alciatore, "Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 2000.
6. Bradley D.A., Dawson D., Buru N.C., and Loader A.J., "Mechatronics", Chapman and Hall, 1993.
7. Dan Neculescu, "Mechatronics", Pearson Education Asia, (Indian Reprint), 2002

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max Marks : 80

Exam Duration : 3 hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks

SMEX1021	TOTAL QUALITY MANAGEMENT	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I INTRODUCTION**10 hrs.**

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs – Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

UNIT II TQM PRINCIPLES**10 hrs.**

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDCA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, strategy, Performance Measure.

UNIT III STATISTICAL PROCESS CONTROL (SPC)**10 hrs.**

The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

UNIT IV TQM TOOLS**10 hrs.**

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

UNIT V QUALITY SYSTEMS**10 hrs.**

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 – Concept, Requirements and Benefits.

TEXT / REFERENCE BOOKS:

1. Dale H. Besterfield, et. al., Total Quality Management, Pearson Education Asia, 1999. (Indian reprint 2002).
2. James R. Evans & William M. Lindsay, The Management and Control of Quality, 5th Edition, South-Western (Thomson Learning), 2002
3. Feigenbaum A.V., "Total Quality Management, McGraw-Hill, 1991.
4. Oakland J.S. "Total Quality Management Butterworth – Heinemann Ltd., Oxford. 1989.
5. Narayana V. and Sreenivasan N.S., Quality Management – Concepts and Tasks, New Age International 1996.
6. Zeiri. "Total Quality Management for Engineers Wood Head Publishers, 1991.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max Marks : 80

Exam Duration : 3 hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

SMEX1023	WIND AND SOLAR ENERGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I WIND ENERGY**10 hrs.**

Introduction : Scope of wind power potential in India. Principles of wind energy conversion – Natural power in the wind – Forces on blades. Wind data and energy estimation , site selection. Wind energy conversion system – Classification : Advantages and disadvantages.

UNIT II WIND MACHINES**10 hrs.**

Types of wind machines, analysis of aerodynamic forces acting on blade, performance, generating systems, energy storage – Applications.

UNIT III SOLAR ENERGY**10 hrs.**

Solar radiation and its measurement – Solar constants , solar radiation at earth surface, spectral distribution of extra terrestrial radiation, variations of basic earth sun angles, solar time and equation of time, diffused radiation – Empirical equations – Computation of radiation on inclined surfaces – Solar charts.

UNIT IV SOLAR COLLECTORS**10 hrs.**

Measurement of diffused , global and direct solar radiation, solar collectors – Flat plates and parabolic collectors and comparison of collectors, selective absorber coatings.

UNIT V SOLAR ENERGY STORAGE AND APPLICATION**10 hrs.**

Solar energy storage systems, solar pond, thermo electric conversion, solar photovoltaic, solar heating and cooling, industrial process heat, desalination.

REFERENCE BOOKS:

1. Rai G.D., Non Conventional Sources of energy,. Khanna publications, 4th Edn., 1999.
2. Garg H.P. and Prakash J., Solar energy, Fundamentals and application, 2006.
3. David M.Eggleston and Stoddard S., Wind turbine Engineering designing, – Van Noustrand, 1987.
4. Putnam, C Palmer, Power from wind., Van Noustrand, 1984.
5. Le Couriers D., Wind power plants. Theory and design, Permagon press, 1982.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max Marks : 80

Exam Duration : 3 hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks

SMEX1024	ADVANCED INTERNAL COMBUSTION ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I THERMODYNAMICS OF DIESEL CYCLE**10 hrs.**

Thermodynamics of Diesel Cycle – Performance of 4 and 2 stroke engines – use of gaseous, liquid and solid fuels – composition of petrol and diesel fuels – combustion fuels – principles of spark and compression ignition – theoretical and actual air / fuel ratio, importance valve and port timing.

UNIT II COMBUSTION**10 hrs.**

Octane and Cetane number determination – carburetion – carburettor – diesel fuel pump and injection system – normal and abnormal combustion – effects and prevention in diesel and petrol engines, shape of combustion chambers in SI and CI engines – air movement in CI engines – charge stratification in SI engines.

UNIT III COOLING, LUBRICATION AND IGNITION SYSTEMS**10 hrs.**

Engine cooling and lubrication systems, spark ignition system – inlet and exhaust manifold arrangements – ideal, relative, mechanical and thermal efficiency, brake mean effective pressure and heat balance calculation and curves, torque, load – speed characteristics of multicylinder engines

UNIT IV DESIGN OF ENGINE COMPONENTS**10 hrs.**

Simple Component design of piston, cylinder, connecting rod, crankshaft, flywheel and main bearing – Functions of inlet and exhaust valves, cylinder heads, piston rings, cylinder liners, air filters, exhaust silencers, petrol fuel pump, lube oil pump, cam shaft.

UNIT V APPLICATIONS**10 hrs.**

Applications: Diesel engine in different fields – Automobile, Agriculture, Marine, industrial power plants and rail traction, petrol engine for automobile. Comparison of diesel, steam and gas turbines power plants. Fuel oil reserves and saving methods – alternate fuel and bifuel operation in engines – free piston engines and wankel rotary engines.

REFERENCE BOOKS:

1. John Heywood, Internal Combustion engines, McGraw Hill, 1988
2. Gill, Smith and Zurich, Fundamentals of IC Engines, 2011
3. Mathur R.B. and Shama R.P., Internal Combustion Engines, Dhanpat Rai and Sons, 1994
4. Ganesan V., Internal Combustion Engines, TMH 1996
5. Kothandaraman C.P. et al., A course in Thermodynamics in Heat Engines Dhanpat Rai and Sons, 2002
6. Heldt P.M., High Speed Combustion Engines, Oxford and IBH, 2008
7. Internal Combustion Engines, Maleev.V.L., McGraw Hill, 2010

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max Marks : 80

Exam Duration : 3 hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

SMEX1025	CRYOGENIC ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I INTRODUCTION**10 hrs.**

Introduction: Cryogenic Engineering – Properties of cryogenic fluids – Oxygen, Nitrogen, Argon, Neon, Fluorine, Helium. Hydrogen, Properties of Solids – Mechanical, Thermal, and Electrical-Super conductivity.

UNIT II CRYOGENIC REFRIGERATION**10 hrs.**

Cryogenic refrigeration: Principle – Joule Thomson Expansion, Cascade processes, Ortho para hydrogen conversion, cold gas refrigerators, Linde-Hampson cycles, Claude and cascaded systems, magnetic cooling, Stirling Cycle Cryocoolers.

UNIT III CRYOGENIC REQUIREMENTS**10 hrs.**

Cryogenic requirements: Cryogenics- Heat Exchangers, Compressors, Expanders, Effect of various parameters in performance and system optimization. Insulation and Storage equipment's for cryogenic fluids, industrial storage and transfer of cryogenic fluids

UNIT IV GAS SEPARATION AND PURIFICATION**10 hrs.**

Gas Separation and purification: Ideal gas, Mixture characteristics – composition diagrams – gas separation – Principle of Rectification, Flash Calculation Rectification column analysis – air separation, gas purification.

UNIT V CRYOGENIC INSTRUMENTATION:**10 hrs.**

Cryogenic Instrumentation: Properties and characteristics of instrumentation, Strain Displacement, Pressure, flow, Liquid level, Density and temperature measurement in cryogenic range.

REFERENCE BOOKS :

1. Randal F. Barron, Cryogenic Systems, Mc Graw Hill, 1985
2. Scoot, Cryogenic Engineering, Van Nostrand Co. Inc. 1985.
3. T.M Flynn, Cryogenic Engineering, Maxwell Dekker, 1997.
4. Klaus D. Timmerhaus, Richard Palmer Reed, Cryogenic Engineering: 50 years of progress, Springer, 2007.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max Marks : 80

Exam Duration : 3 hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

SMEX1026	REFRIGERATION AND AIR CONDITIONING	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I REFRIGERATION CYCLES & REFRIGERANTS**10 hrs.**

Vapour Compression Refrigeration Cycle-Simple saturated vapour compression Refrigeration cycle. Thermodynamic analysis of the above. Refrigerant Classification, Designation, Alternate Refrigerants, Global Warming Potential & Ozone Depleting Potential aspects.

UNIT II SYSTEM COMPONENTS**10 hrs.**

Refrigerant Compressors – Reciprocating Open & Hermetic type, Screw Compressors and Scroll Compressors -Construction and Operation characteristics. Evaporators – DX coil, Flooded type Chillers. – Expansion devices -Automatic Expansion Valves, Capillary Tube & Thermostatic Expansion Valves – Condensing Units and Cooling Towers.

UNIT III CYCLING CONTROLS AND SYSTEM BALANCING**10 hrs.**

Pressure and Temperature controls. Range and Differential settings – Selection and balancing of system components – Graphical method.

UNIT IV PSYCHROMETRY**10 hrs.**

Moist air behaviour, Psychrometric chart, Different Psychrometric process analysis.

UNIT V AIR CONDITIONING**10 hrs.**

Summer and Winter Airconditioning, Cooling Load Calculations, Air Distribution Patterns, Dynamic and Frictional Losses in Air Ducts, Equal Friction Method, Fan Characteristics in Duct Systems.

REFERENCE BOOKS

1. Stocker W F and Jones J W, "Refrigeration & Air Conditioning" McGraw Hill Book Company, 1985.
2. Dossat R J, "Principles of Refrigeration", John Wiley and Sons Inc., 1997.
3. Manohar Prasad, "Refrigeration and Air Conditioning ", Wiley Eastern Ltd., 2007.
4. Arora C P, "Refrigeration and Air Conditioning ", Tata McGraw Hill, 2000.
5. Jones W P, "Air Conditioning Engineering", Elsevier Butterworthy- Heine Mann, 2005.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max Marks : 80

Exam Duration : 3 hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

SMEX1034	SOLID WASTE MANAGEMENT	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I SOLID WASTE**10 hrs.**

Definitions – Sources, Types, Compositions, Properties of Solid Waste – Municipal Solid Waste – Physical, Chemical and Biological Property – Collection – Transfer Stations – Waste Minimization and Recycling of Municipal Waste

UNIT II WASTE TREATMENT**10 hrs.**

Size Reduction – Aerobic Composting – Incineration – Furnace Type & Design, Medical/ Pharmaceutical Waste Incineration – Environmental Impacts – Measures of Mitigate Environmental Effects due to Incineration

UNIT III WASTE DISPOSAL**10 hrs.**

Land Fill Method of Solid Waste Disposal – Land Fill Classification, Types, Methods & Siting Consideration – Layout & Preliminary Design of Land Fills – Composition, Characteristics generation, Movement and Control of Landfill Leachate & Gases – Environmental Monitoring System for Land Fill Gases, Waste landfill Remediation

UNIT IV HAZARDOUS WASTE MANAGEMENT**10 hrs.**

Definition & Identification of Hazardous Waste – Sources and Nature of Hazardous Waste – Impact on Environment – Hazardous Waste Control – Minimization and Recycling -Assessment of Hazardous Waste Sites – Disposal of Hazardous Waste, Underground Storage Tanks Construction, Installation & Closure, Remediation, risk assessment.

UNIT V ENERGY GENERATION FROM WASTE**10 hrs.**

Thermal conversion Technologies – Pyrolysis systems, Combustion systems, Gasification systems, Environment control systems, energy recovery systems.

Biological & chemical conversion technologies – Aerobic composting, low solids. Anaerobic digestion, high solids anaerobic digestion, Energy production from biological conversion products, other biological transformation processes. Chemical transformation processes.

REFERENCE BOOKS:

1. George Tchobanoglous, H.Theisen, S. Vigil, Integrated Solid Waste management- Engg. Principles and management issues –McGraw Hill, 1993.
2. Parker, Colin, & Roberts, Energy from Waste – An Evaluation of Conversion Technologies, Elsevier Applied Science, London, 1985.
3. Shah, L Kanti., Basics of Solid & Hazardous Waste Management Technology, Prentice Hall,
4. Manoj Datta, Waste Disposal in Engineered Landfills, Narosa Publishing House, 1997
5. Rich, Gerald et.al., Hazardous Waste Management Technology, Podvan Publishers, 1987
6. Bhide AD., Sundaresan BB, Solid Waste Management in Developing Countries, INSDOC New Delhi, 1983.

WEBSITES:

1. www.bical.net
2. www.volund.dk
3. www.iswa.org
4. www.wmrc.uiuc.edu

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max. Marks : 80

Exam Duration : 3 hrs

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

SMEX1033	INDUSTRIAL TRIBOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

(Approved hand book may be used in the Examination)

UNIT I FRICTION**10 hrs.**

Dry Friction: Dry Friction – Topography of Surfaces – Contact between surfaces – Sliding friction – Energy dissipation – Theory of molecular attraction – Fretting corrosion and prevention – Variables in dry friction – Present concept of friction – Boundary Friction – Oiliness – Variables of boundary friction – Friction characteristics of metals and non metals – Rolling friction – Sources of measurement of friction

UNIT II WEAR**10 hrs.**

Wear: Wear – Types – Mechanisms – Factors affecting wear – Adhesive wear, fatigue wear, corrosive wear and brittle fracture wear – Delamination – Wear measurement

UNIT III VISCOSITY AND FLOW**10 hrs.**

Viscosity and Flow: Fundamentals of viscosity and flow – Petroff's equation – Friction torque – Viscosity measurement, factors affecting viscosity, Principle of Hydrostatic lubrication – Hydrostatic step bearing – Multi-recess bearing – Design Problems – Different types of compensation and their effect on bearing parameters – Hydrostatic lift, simple problems – Hydrostatic squeeze films.

UNIT IV HYDRODYNAMIC LUBRICATION**10 hrs.**

Hydrodynamic lubrication: Solution of Reynold's Equation – Application to tilt pad thrust bearing – Design of hydrodynamic journal bearings – Force feed of oil flow with various types of grooves – Brief discussion on Dynamic bearing and rotor systems and Elastohydrodynamic lubrication – Brief discussion.

UNIT V LUBRICANTS AND MAINTENANCE**10 hrs.**

Lubricants and Maintenance: Lubricants – Types – Solid and liquid – Properties – Additives – Testing – Reclamation of lubricants – surface treatment – Phosphating of metal surface, Teflon Coating – Predictive maintenance – Signature analysis and Condition monitoring – Basic Principles – Instrumentation

REFERENCE BOOKS:

1. Hutchings M., Tribology, Friction and wear of Engineering Materials – Edward Arnold, London, 1992
2. Ncalc, Newncs, Tribology Hand Book Butterworths, 1975
3. Dudley D. Fuller, Theory and practice of Lubrication for Engineers – John Wiley and Sons, 1984.
4. Camaron A. Basic Lubrication Theory – Wiley Eastern Ltd, 1987
5. Majundar, Introduction of Tribology and bearings – A.H. Wheeler Co. 1986
6. Bharath Bushsan & Gupta B.K., Hand book of Tribology – Mc Graw Hill Inc., 1991

UNIVERSITY EXAM QUESTION PAPER PATTERN:

Max. Marks : 80

Exam Duration : 3 hrs

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

SMEX1036	EXPERIMENTAL STRESS ANALYSIS	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I STRESS**10 hrs.**

Stress at a point – Stress equations of Equilibrium – Laws of stress transformation – Principal stresses – Maximum Shear stress – Dimensional state of stress.

UNIT II STRAIN MEASUREMENT**10 hrs.**

Strain – Its relations to experimental determination – Properties of strain gauge systems – Electrical resistance strain gauges – Strain gauge circuits – Recording instruments – Analysis of strain gauge data.

UNIT III MOIRE METHODS**10 hrs.**

Mechanism of formation of Moire fringe – Geometrical approach to Moire fringe analysis – Displacement field approach to Moire fringe analysis – Out of plane measurements.

UNIT IV PHOTOELASTICITY METHODS**10 hrs.**

Temporary double refraction – Stress optic law – Effects of stressed model in a plane polariscope fringe multiplication – Isochromatic fringe patterns – Isoclinic fringe pattern- Compensation techniques – Calibration methods – Separation methods – Scaling model to phototype stresses – Materials

UNIT 5 BRITTLE COATING TECHNIQUE**10 hrs.**

Coating stresses and strains – Sensitivity – Materials and applications – Effect of thickness – Stress separation.

REFERENCE BOOKS:

1. Dove Adams, Experimental Stress Analysis, McGraw Hill, 1992.
2. James Dalley, W.F.Riley, " Experimental mechanics ", int. Student Edition McGraw Hill, Kogakusha Ltd., 1992.
3. Perry and Lissienner, " Strain Gauge Primer ", McGraw Hill, 1965.
4. Durelli, Photomechanics Prentice Hall, 1972.
5. Holister. G.S, "Experimental Stress Analysis", 1987

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max. Marks : 80

Exam Duration : 3 hrs

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

SMEX1039	FINITE ELEMENT ANALYSIS	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I 1D FINITE ELEMENT ANALYSIS**10 hrs.**

Historical Background – Weighted Residual Methods – Basic Concepts of FEM – Variational Formulation of B.V.P – Ritz Method – Finite Element Modeling – Element Equations – Linear and Quadratic Shape functions -Bar, Beam Elements – Applications to Heat Transfer.

UNIT II FEA OF 2D PROBLEMS**10 hrs.**

Basic Boundary Value Problems in 2 Dimensions – Triangular, quadrilateral, higher order elements – Poissons and Laplace Equations – Weak Formulation – Elements Matrices and Vectors – Application to Solid mechanics, Heat transfer, Fluid Mechanics.

UNIT III ISO PARAMETRIC FORMULATION**10 hrs.**

Natural Co-ordinate System – Lagrangian Interpolation Polynomials – Iso-parametric Elements – Formulation – Numerical Intergration – 1D -2D Triangular elements – rectangular elements – Illustrative Examples.

UNIT IV SOLUTION TO PLANE ELASTICITY PROBLEMS**10 hrs.**

Introduction to Theory of Elasticity – Plane Stress – Plane Strain and Axisymmetric Formulation – Principle of virtual work – Element matrices using energy approach.

UNIT V SPECIAL TOPICS**10 hrs.**

Dynamic Analysis – Equation of Motion – Mass Matrices – Free Vibration analysis – Natural frequencies of Longitudinal – Transverse and torsional vibration – Introduction to transient field problems. Non linear analysis. Use of software – h & p elements – special element formulation.

REFERENCE BOOKS:

1. Reddy J.N. "An Introduction to the Finite Element Method" , Mc Graw Hill, International Edition, 1993.
2. Segerlind L.J., "Applied Finite Element Analysis", John Wiley, 1984.
3. Rao S.S., "Finite Element Method in Engineering" , Pergamon Press, 1989.
4. Chandrupatla & Belagundu, "Finite Elements in Engineering", Prentice Hall of India Private Ltd., 1997.
5. Cook, Robert Davis et al, "Concepts and Applications of Finite Element Analysis" , Wiley, John & Sons, 1999.
6. George R Buchanan, "Schaum's Outline of Finite Element Analysis", McGraw Hill Company, 1994.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max. Marks : 80

Exam Duration : 3 hrs

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

SMEX1038	COMPUTATIONAL FLUID DYNAMICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I GOVERNING DIFFERENTIAL EQUATIONS**10 hrs.**

Conservation of chemical species -the energy equation – Momentum equation -Time -Averaged equations for Turbulent flow – Turbulence -Kinetic -Energy Equations -The General Differential Equation -Nature of Coordinates-Independent variables-Choice of Co-ordinates-One way and Two-way Co-ordinates.

UNIT II DISCRETIZATION METHODS**10 hrs.**

Nature of numerical methods – Methods of Deriving the Discretization Equations – Taylor Series formulation – variational Formulation-Method of weighted residuals -Control volume –Formulation.

UNIT III HEAT CONDUCTION, CONVECTION AND DIFFUSION**10 hrs.**

Steady state one-dimensional conduction – two and three dimensional conduction -Steady state one-dimensional convection and Diffusion – Discretization equations for two dimensional convection and diffusion.

UNIT IV CALCULATION OF FLOW FIELD**10 hrs.**

Representation of the pressure.- Gradient term and continuity equation – Staggered grid – Momentum equations -Pressure and velocity corrections – Pressure. – Correction equation. Introduction to Finite Element method -Solution of Steady state heat conduction by FEM – incompressible flow -Simulation by FEM.

UNIT V TURBULENCE MODELS – ALGEBRAIC MODELS**10 hrs.**

One equation Model – Two equation models – High and Low Reynolds number models – Reynolds stress models – Prediction of fluid flow and heat Transfer using Standard codes.

REFERENCE BOOKS:

1. Muralidhar K., and Sundarajan T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 1995.
2. Ghoshdastidar P.S., "Computer Simulation of flow and heat transfer", Tata McGraw Hill Publishing Company Ltd., 1998.
3. Fletcher C.A.J., "Computational Techniques for Fluid Dynamics "1" Fundamental and General Techniques, Springer-Verlag, 1987.
4. Fletcher C.A.J., "Computational Techniques for Fluid Dynamics" 2" Specific Techniques Different Flow Categories, Springer, 1987.
5. Bose T.K., "Numerical Fluid Dynamics", Narosa publishing House, 1997.
6. Muralidhar K., and Biswas "Advanced Engineering Fluid Mechanics", Narosa Publishing House, New Delhi, 1996.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max. Marks : 80

Exam Duration : 3 hrs

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

SMEX1029	NON DESTRUCTIVE TESTING AND TECHNIQUE	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I PRINCIPLES AND IMPORTANCE OF NDT**10 hrs.**

Basic concepts of NDT-Its principles and significance in boiler and pressure vessel manufacturing- Case study – Types of structures and defects for analysis-Code requirements-Quality control and inspection procedures in industrial practice

UNIT II BASIC CRACK DETECTION METHODS**10 hrs.**

Dye penetrant testing-Materials and specifications-Developers-Testing Procedure-Process capability and accuracy-Principles of magnetic particle testing- Types of equipment-Materials- Testing procedure-Process capability and accuracy.

UNIT III RADIOGRAPHIC TESTING**10 hrs.**

Production of X-rays-Types of radiation-Interaction of X-rays with matter-Absorption of X-rays-Gamma rays-Sources of gamma rays- X-rays- Radioactive decay-Artificial radio activity-Image formation-Sharpness and contrast and effects of various factors on them-Quality of film-Use of penetrometer and metal intensifying screens-Study and interpretation of radiographs-Safety precautions.

UNIT IV ULTRASONIC TESTING**10 hrs.**

Production of sound waves- Use of Transducers-Types of wave motion-Types of probes-Transmission and reflection techniques-Detection and interpretation of different types of defects-Thickness measurement.

UNIT V OTHER METHODS OF NDT**10 hrs.**

Eddy current testing-Principles and procedures-Instruments used and interpretation of readings-Acoustic emission testing-Principles and procedures-Instruments used and interpretation of readings-Non-industrial and other applications of NDT.

REFERENCE BOOKS

1. Barry Hull and Venon John, Non-Destructive Testing, ELBS, 1998.
2. Knud Boving, Non-Destructive Testing Handbook-Jaico Publications, 1998.
3. Metals Handbook-Volume 11, Non-Destructive Testing, ASME 1976.
4. Silk M.G., NDT Ultrasonic Transducers- Br. Institute of NDT, 1982.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max. Marks : 80

Exam Duration : 3 hrs

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

SMEX1015	GAS DYNAMICS AND JET PROPULSION	L	T	P	Credits	Total Marks
		3	1	0	4	100

UNIT I COMPRESSIBLE FLUID FLOW – FUNDAMENTALS**10 hrs.**

Introductory concepts of compressible flow, Energy and momentum equations for compressible fluid flows, various regions of flow, reference velocities, stagnation state, velocity of sound, critical states, Mach number, critical mach number, types of waves, mach cone, mach angle, effect of mach number on compressibility.

UNIT II FLOW THROUGH VARIABLE AREA DUCTS**10 hrs.**

Isentropic flow through variable area duct, T-S and h-s diagrams for nozzle and diffuser flows, area ratio as a function of Mach number, Mass flow rate through nozzles and diffusers, effect of friction in flow through nozzles.

UNIT III FLOW THROUGH CONSTANT AREA DUCTS**10 hrs.**

Flow in constant area duct with friction (Fanno Flow) – Fanno curves, and Fanno Flow equations, variation of flow properties, variation of Mach number with duct length. Flow in constant area duct with heat transfer (Rayleigh flow), Rayleigh line and Rayleigh flow equations, variation of flow properties, maximum heat transfer.

UNIT IV NORMAL SHOCK**10 hrs.**

Governing equations, variation of flow parameters like static pressure, static temperature, density, stagnation pressure and entropy across normal shock. Normal shocks – stationary and moving, applications. Prandtl Meyer equation, impossibility of shock in sub-sonic flows, flow in convergent and divergent nozzles with shock, normal shock in Fanno and Rayleigh flows. Flow with oblique shock (elementary treatment only).

UNIT V PROPULSION**10 hrs.**

Aircraft propulsion – types of jet engines – energy flow through jet engines, study of turbo jet engine components – thrust, thrust power, propulsive and overall efficiencies, thrust augmentations in turbo jet engines, ram jet and pulse jet engines Rocket propulsion – Types of rocket engines – Liquid and solid fuel rocket engines – Introduction to Electrical and Nuclear rockets.

TEXT / REFERENCE BOOKS:

1. Yahya S.M., "Fundamental of Compressible flow", New Age International (P) Ltd., New Delhi, 2003.
2. Cohen H., Rogers R.E.C. and Sravanamuttoo, "Gas Turbine Theory", Addison Wesley Ltd., 2001
3. Hill D. and Peterson C., "Mechanics & Thermodynamics of Propulsion", Addison Wesley, 1992.
4. Ganesan V., "Gas Turbines", Tata McGraw Hill Publishing Company, New Delhi. 1999.
5. Sutton G.P., "Rocket Propulsion Elements", John Wiley, New York, 1975.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max Marks : 80

Exam Duration : 3 hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

SMEX1016	POWER PLANT ENGINEERING	L	T	P	Credits	Total Marks
		2	1	0	3	100

UNIT I STEAM POWER PLANT**10 hrs.**

Plant layout, types of firing systems – pulverized fuel, tilting and tangential firing system, pulverized bed combustion system. Coal handling systems – crushers – feeders, ash handling system – dust collectors and id fans – economizers, air preheaters, super-heaters, re-heaters.

UNIT II BOILER CALCULATIONS AND POWER CYCLES**10 hrs.**

Subcritical and supercritical boilers, boiler calculations – boiler efficiencies, equivalent evaporation, boiler power. Condensers – types – calculation of vacuum efficiency, cooling towers – tower characteristics. Review of Rankine cycle – reheat regeneration with open and closed types of feed water heaters and their representation in TS diagram.

UNIT III GAS TURBINE, NUCLEAR AND HYDEL POWER PLANTS**10 hrs.**

Gas turbine plants – open and closed cycles – construction details –, reheating regeneration and intercooling, combined cycle plants and their representation in TS diagram. Nuclear energy – fission – fusion reaction, nuclear fuel, enrichment, nuclear reactor – parts and types, waste disposal and safety in nuclear plants. Hydel plants – classification, selection of turbines, pumped storage system.

UNIT IV NON CONVENTIONAL ENERGY BASED POWER PLANT**10 hrs.**

Non conventional energy – various forms – capacity – availability and limitations. Solar energy plants – various collecting devices – solar devices, photovoltaic cells and solar ponds, wind mills – types – site selection – capacity estimation – performance evaluation, tidal power plants, fuel cells – working – types – limitations, performance evaluation.

UNIT V ECONOMIC AND ENVIRONMENTAL ASPECTS**10 hrs.**

Load curves, fixed and operating costs, economics of load sharing and plant selection, comparison of economics of various power plants and co-generation, environmental hazards of various power plants – SO₂, NO_x and particulate emissions and their control, land and water pollution.

TEXT / REFERENCE BOOKS:

1. Nagpal G.R., Power Plant Engineering – Khanna Publishers, 1996.
2. Domkundwar, Power Plant Engineering – Dhanpat Rai & Sons, Delhi, 1988.
3. Vopal and Stortzki, "Power Plant Engineering", PHI, 2007.
4. El Wakil M.N., "Power Plant Technology", McGraw Hill, 1985.
5. Joel Weisomon and Roy Eckart, "Modern Power Plant Engineering", PHI, 1985.
6. Rai G.D., "Non conventional sources of Energy", Khanna Publishers Delhi, 1994.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max Marks : 80

Exam Duration : 3 hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

SMEX1018	HEAT AND MASS TRANSFER (Common to Mech and Aero)	L	T	P	Credits	Total Marks
		3	1	0	4	100

(Use of Heat transfer data book, steam table are permitted)

UNIT I CONDUCTION**10 hrs.**

Basic Concepts – Mechanism of Heat Transfer – Conduction, Convection and Radiation – General Differential equation of Heat Conduction – Fourier Law of Conduction – Cartesian and Cylindrical Coordinates – One Dimensional Steady State Heat Conduction – Conduction through Plane Wall, Cylinders and Spherical systems – Composite Systems-critical thickness of insulation – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Infinite and Semi Infinite Solids

UNIT II CONVECTION**10 hrs.**

Basic Concepts – Convective Heat Transfer Coefficients – Boundary Layer Concept – Forced Convection – External Flow – Flow over Plates, Cylinders Spheres and Bank of tubes – Internal Flow – Free Convection – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres.

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS**10 hrs.**

Nusselt's theory of condensation- Regimes of pool boiling and flow boiling, correlations in boiling and condensation. Heat Exchanger Types – Overall Heat Transfer Coefficient – Fouling Factors – Analysis – LMTD method, – NTU method.

UNIT IV RADIATION**10 hrs.**

Basic Concepts, Laws of Radiation – Wiens Displacement Law – Stefan Boltzman Law, Kirchoff Law – Black Body Radiation – Grey body radiation – Shape Factor – Electrical Analogy – Radiation Shields.

UNIT V MASS TRANSFER**10 hrs.**

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations.

TEXT / REFERENCE BOOKS:

1. Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata Mc Graw Hill, 2004
2. Rajput R.K., "Heat and Mass transfer", S.Chand & Co, 1983.
3. Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 1998.
4. Kothandaraman C.P., "Fundamentals of Heat and Mass Transfer", New Age International (P) Ltd., 1998
5. Sachdeva R.C., "Fundamentals of Heat and Mass Transfer", New Age International (P) Ltd., 2010
6. Ozisik N.M., "Heat Transfer", McGraw Hill Book Company, 1988.
7. Holman J.P., "Heat Transfer", McGraw Hill Book Company, 1989
8. Yadav R., "Heat and Mass Transfer", Central Publishing House, 1995.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max Marks : 80

Exam Duration : 3 hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

SMEX1022	FLUID POWER SYSTEMS	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I GENERAL INTRODUCTION**10 hrs.**

Introduction to fluid power – review of fundamental principles of fluid power – construction, operation and characteristics of gear pump, vane pump, variable displacement pump, piston pump. Fluid power actuators, linear and rotary – computation of force – flow requirement – cushioning – cylinder mountings – relative merits – selection criteria for specific applications – power pack design

UNIT II CONTROL SYSTEM COMPONENTS AND ACCESSORIES**10 hrs.**

Valves – non return valve for pressure control, direction control and flow control – servo valves and proportional control valves – valve actuation techniques – pressure, electrical and limit switches, Relief valve – brake valve – counter balance valve. Fluid power maintenance – filters – seals – reservoirs, selection of accumulators, hoses and couplings. Safety regulations as per BIS

UNIT III HYDRAULIC SYSTEMS**10 hrs.**

Fluid power symbols, hydraulic Circuits – regenerative – intensifier – metering out – bleed off. Design of circuits for specific applications – vehicle suspension systems – hydraulic press – low cost automation. Programmable logic control. Electrical control for FPCs. Temperature control in hydraulic circuits.

UNIT IV HYDRAULIC CIRCUIT**10 hrs.**

Circuits and selection of components with specification for the following applications – hydraulic or pneumatic systems for shapers – lift – hydraulic press – automatic reciprocating system – hydraulic cranes and earth moving equipments.

UNIT V PNEUMATIC SYSTEMS**10 hrs.**

Basic principles of pneumatic circuits – merits and demerits over hydraulic systems, pneumatic conditioners – filters – regulators – lubricators – mufflers – air dryers. Types of Air compressors – pneumatic actuators – control of pneumatic circuits – valves. Introduction to pneumatic logic control – pneumatic hydraulic circuits.

TEXT / REFERENCE BOOKS:

1. Anthony Esposito, Fluid Power with Applications – Prentice Hall, 1980
2. Princes M.J., and Ashby John, Power Hydraulics, Prentice Hall, 1980
3. Sullivan James P., Fluid Power Theory and Applications, Prentice Hall, 1989
4. James L Johnson, Introduction to Fluid power, Cengage Delmark Learning Edition, 2009.
5. Srinivasan, Hydraulics and Pneumatics, Tata McGraw Hill, 9th Edition, 2001
6. Shanthakumar S.R., Fluid power system, Anuradha Publications, 1996.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max Marks : 80

Exam Duration : 3 hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

SMEX1027	COMBUSTION ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I COMBUSTION OF FUELS**10 hrs.**

Combustion equations, Theoretical air, excess air, air fuel ratio, equivalence ratio, exhaust gas composition, Airfuel ratio from exhaust gas composition, heating value of fuels.

UNIT II THERMODYNAMICS OF COMBUSTION**10 hrs.**

Thermo-chemistry, First law analysis of reacting systems, Adiabatic combustion temperature, Second law analysis of reacting systems, criterion for chemical equilibrium, Equilibrium constant for gaseous mixtures, Evaluation of equilibrium composition, chemical availability

UNIT III KINETICS OF COMBUSTION**10 hrs.**

Rates of reaction, Reaction order and molecularity complex reactions, chain reactions, Arrhenius rate equation, Collection theory, activated complex theory, Explosive and general oxidative characteristics of fuels

UNIT IV FLAMES**10 hrs.**

Laminar and Turbulent flames, Premixed and Diffusion flames, Burning velocity and its determination, Factors affecting burning velocity, Quenching, Flammability and Ignition, Flame stabilization in open burners.

UNIT V ENGINE COMBUSTION**10 hrs.**

Combustion in SI and CI engines, stages of combustion in SI and CI engines, Normal combustion and Abnormal combustion, Emissions from premixed combustion, Emission from Non-premixed combustion, Control of emissions

REFERENCE BOOKS

1. Stephen R. Turns, "An Introduction to Combustion", McGraw Hill Book Company, 1996.
2. Irwin Glassman, "Combustion", Third Edition, Academic Press, 1996.
3. Sharma S.P. and Chandramohan, "Fuels and Combustion", Tata McGraw Hill Book Co., 1984.
4. Samir Sarkar, "Fuels and Combustion", Orient Longman, 1984.
5. Kuo K.K., "Principles of Combustion", John Wiley & Sons, 1984.
6. Heywood J.B., "Internal Combustion Engine Fundamentals", Mc Graw Hill Book Co., 1988.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max Marks : 80

Exam Duration : 3 hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

SMEX1031	DESIGN OF HEAT TRANSFER EQUIPMENT	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I INTRODUCTION**10 hrs.**

Double pipe heat exchangers and heat pipes: Heat pipes – structures – applications – basic relations – performance characteristics – effects of working fluid and operating temperature, wick – selection of material – pore size.

UNIT II SHELL AND TUBE HEAT EXCHANGERS**10 hrs.**

Shell and tube Heat Exchangers: Basic components – shell – tube bundles – baffles – types and geometry, Design procedure – preliminary estimation of size, pressure drop and heat transfer calculations – shell and tube sides – Kern methods – Bell – Delaware method.

UNIT III COMPACT HEAT EXCHANGERS AND GASKETTED PLATE HEAT EXCHANGERS 10 hrs.

Compact Heat Exchangers and Gasketed plate Heat Exchangers: Compact heat Exchangers – types – constructional features, heat transfer and pressure drop calculation – finned plate and tube. Gasketed – plate exchangers – constructional features – plate pack and frame – operation characteristic – flow arrangement heat transfer and pressure drop calculation, performance analysis, comparison with other type of heat exchangers.

UNIT IV CONDENSERS AND EVAPORATORS**10 hrs.**

Condensers and Evaporators: Shell and tube condensers – horizontal and vertical type – design and operation consideration, plate condensers, air cooled and direct contact types, condenser for refrigeration, evaporative condensers. Evaporators for refrigeration and air conditioning – chillers – air coolers – thermal analysis – Shah, Kandhakar and Ghngor & Wintertom correlations, std types

UNIT V COOLING TOWERS**10 hrs.**

Cooling Towers: Cooling towers-types – basic relations – heat balance & heat transfer – characteristic, effect of packing – geometry, spray design, selection of pumps, fans, testing, maintenance, environmental effect wind loads, typical installations.

REFERENCE BOOKS

1. Sadik Kakac & Hongtan Lin, Heat Exchangers – CRC Press, London, 1998
2. Arthur P Fraas, Heat Exchanger, Design – John Wiley & Sons, 1997
3. Kern D., Process Heat transfer – Tata MC Graw Hill, 1997
4. Walker, Industrial Heat Exchangers – MC Graw Hill, 1997
5. Holger Martin, Heat Exchangers – Hemisphere publishing Corporation, London, 1992

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max. Marks : 80

Exam Duration : 3 hrs

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

SMEX1032	VIBRATION AND NOISE CONTROL	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I SINGLE AND TWO DEGREES OF FREEDOM VIBRATIONS**10 hrs.**

Single and two degrees of freedom vibrations: Review of single degree of freedom systems – free, damped and forced vibrations – Linear and Torsional vibrations, seismometer, accelerometer. Two degrees of freedom systems – Vibration absorbers – Undamped and Damped- Vibration isolation.

UNIT II MULTIPLE DEGREE FREEDOM VIBRATIONS**10 hrs.**

Multi degree Freedom vibrations: Multi degree vibration systems – free vibration – close coupled and far coupled systems – Eigen Value Problem – Orthogonality of mode shapes, modal analysis, forced vibration and numerical methods – Dunkerley, Raleigh and Holzer methods

UNIT III BALANCING**10 hrs.**

Balancing: Rotor Balancing methods – Rigid and flexible rotor balancing – Analytical development – Application to balancing- Advantages and limitations of modal balancing- Influence coefficient balancing, analytical development balancing – Procedure – Advantages and limitations of unified balancing approach – Analytical development – Balancing procedure – Experimental comparison of various methods

UNIT IV VIBRATION MONITORING**10 hrs.**

Vibration Monitoring: Experimental Methods in vibration analysis – Vibration exciters, measurement devices, analyzers, condition exciters, measurement devices, condition based maintenance of machines and economics – Applications- Vibration monitoring and analysis – Case studies.

UNIT V NOISE CONTROL**10 hrs.**

Noise Control: Sound wave characteristics- levels and decibels – Directivity, source of noise, estimation of noise source and acoustics of walls- Enclosure barrier, sound absorbing materials, duct noise and mufflers.

REFERENCE BOOKS :

1. Rao J.S., & Gupta K., Theory & practice of Mechanical vibrations – John Wiley, 1999.
2. Ashok Kumar Malik, Principles of vibration control, – Affiliated East West press, 1993.
3. Timoshenko S., Young D.H. & Weaver W. Vibration problems in engineering. Fourth Edition.- John Wesley & Sons, New York 1967.
4. Grover G.K., Mechanical Vibrations – Nemchand Bros., Roorkee(U.P) 1989.
5. Mark S. Darlow, Balancing of High Speed Machinery- Springer Verlag, 1992.
6. Kewal K. Rujara, Vibrations and noise for Dhanpat Rai & Sons, 1987.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max. Marks : 80

Exam Duration : 3 hrs

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

SMEX1037	DESIGN FOR MANUFACTURE	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I DFMN APPROACH AND PROCESS**10 hrs.**

Methodologies and tools- Design axioms- Design for assembly and evaluation- Minimum part assessment by taquchi method, robustness assessment- Manufacturing process rules- Designer's tool kit, Computer Aided group process rules – Computer Aided group Technology, failure mode effective analysis- Value Analysis- Design for minimum number of parts- Development of modular design, minimising part variations- Design of parts to be multi-functional, multi-use and ease of fabrication- Poka Yoka principles.

UNIT II GEOMETRIC ANALYSIS**10 hrs.**

Process capability- Feature tolerance, geometric tolerance, surface finish, review of relations between attainable tolerance grades and difference machining processes- Analysis of tapers and screw threads- Applying probability to tolerances.

UNIT III FORM DESIGN OF CASTINGS AND WELDMENTS**10 hrs.**

Redesign of castings based on parting line considerations- Minimizing core requirements- Redesigning cast members using weldments- Use of welding symbols.

UNIT IV MECHANICAL ASSEMBLY**10 hrs.**

Selective assembly- Deciding the number of groups- Control of axial play- Examples- Grouped datum systems -Different types- Geometric analysis and applications-Design features to facilitate automated assembly.

UNIT V TRUE POSITION THEORY**10 hrs.**

Virtual size concept- Floating and fixed fasteners, projected tolerance zone- Assembly with gasket- Zero true position tolerance-, Functional gauges- Paper layout gauging- Examples. Operation sequence for typical shaft type of components- Preparation of process drawings for different operations- Tolerance- Worksheets and centrality analysis- Examples.

REFERENCE BOOKS:

1. Harry Peck, "Designing for Manufacture", Pitman Publications, 1983.
2. Matousek, "Engineering Design - A Systematic Approach", Blackie & Son Ltd., London, 1974.
3. Sports M.F., "Dimensioning and Tolerance for Quantity Production", Prentice Hall Inc., 1983.
4. Oliver R. Wade, "Tolerance Control in Design and Manufacturing", Industrial Press Inc. New York Publications, 1967
5. James G. Bralla, "Hand Book of Product Design for Manufacturing", McGraw Hill Publications, 1983.
6. Trucks H.E., "Design for Economic Production", Society of Manufacturing Engineers, michigan, 2nd edition, 1987.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max. Marks : 80

Exam Duration : 3 hrs

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

SMEX1040	INDUSTRIAL HANDLING & STORAGE SYSTEMS	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I PRINCIPLES OF MATERIAL HANDLING**10 hrs.**

Importance and scope – Planning, Operation and costing principles- Types systems – Factors influencing their choice – Analysis of the handling systems – Motion analysis, flow analysis, safety analysis and cost analysis.

UNIT II INTERPLANT MATERIAL TRANSPORTING AND HANDLING EQUIPMENT**10 hrs.**

Interplant transporting facilities – Trucks, rail sliding , hoists, cranes, and other material handling equipment at receiving yard – Principles of palletisation – Bulk materials handling.

UNIT III INTERPLANT MATERIAL HANDLING EQUIPMENT**10 hrs.**

Handling within stores – Within production area – Aisle design – Fork lift trucks, types and applications – Automated materials handling – Jib cranes – OHT cranes – Safety requirements.

UNIT IV CONVEYORS**10 hrs.**

Conveyors, general theory and principles – several types of conveyors for bulk materials and unit loads – Belt – Apron, flight conveyors, bucket and swing tray conveyors – Car and platform conveyors – Screw Conveyors , Roller conveyors – Portable conveyors and their uses – Hydraulic and Pneumatic Conveyors – Overhead conveyors – Monorails – safety requirements.

UNIT V STORAGE SYSTEMS**10 hrs.**

Stores – planning and design – Storage systems and procedures – incoming material control – Stock location – Different types and arrangement of storage racks – Order picking – Loading and shipping – Stores accounting and stock verification – Automated storage and retrieval systems.

REFERENCE BOOKS:

1. John R. Immer, Material Handling, McGraw Hill. 1986
2. Dougals M. Considine, Standard Handbook of Industrial Automation, Chapman & Hall, 1994
3. James Mac Gregon Apple, Plant Layout and Material Handling, John wiley, 1991.
4. James Mac Gregon Apple, Material Handling System Design, Ronald Press, 1963.
5. Rudenko N., Material Handling Equipment, Peace Publishers, 1965.
6. Aleksandr Onisinovich Spivakovskii, Conveyors and Related Equipments, Peace Publishers, 1992.
7. Aggarwal G.K., Materials Handling Equipment, Tata McGraw Hill Publication, 1983

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max. Marks : 80

Exam Duration : 3 hrs

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

SMEX1041	ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I INTRODUCTION**10 hrs.**

Intelligence – Definition, Types, Cognitive Aspect Approach; Measuring Intelligence – Early Efforts, Iq And Ai; Aspects Of Intelligence – Learning, Problem Solving, Creativity, Behaviour And Biology. Artificial Intelligence; Historical Background; Application Of Ai; Objection And Myths. AI Languages; Introduction To Prolog & Lisp.

UNIT II COGNITIVE PSYCHOLOGY**10 hrs.**

The Mind – Information And Cybernetics, Components For Thought; Modes Of Perception – Visual, Auditory And Other System; Memory Mechanism; Problem Solving – Planning, Search, The Gps System; Types Of Learning – Rote, Parameter, Method And Concept; Game Playing Reasoning.

UNIT III KNOWLEDGE ENGINEERING**10 hrs.**

Introduction; Role Of Knowledge Engineer; Knowledge Representation – Psychology, Production Rules, Logic And Programming, Common Sense And Fuzzy Logic; Semantic Network; Learning System.

UNIT IV VISUAL PERCEPTION**10 hrs.**

Introduction; Biology Of Vision; Computational Aspects; Towards Artificial Vision – Picture Processing – Identifying Real Objects; Vision Programmes; Factory Vision Systems, Robotics; Ai Impact; Robot Sensor; Factory Robots, Personal Robots; Robots Tomorrow.

UNIT V EXPERT SYSTEM**10 hrs.**

Introduction; Knowledge Acquisition For Expert System; Future of Expert System – System Structurssystem Structure, Inference Engines, Uncertainties, Memory Mechanisms Range Of Application; Actual Aspect System – VP Expert. Assignment, Development of Simple Expert System.

REFERENCE BOOKS:

1. Rich E., Artificial Intelligence, McGraw Hill, 2002
2. Simons G.L., Introducing Artificial Intelligence, NCC publications, 1984
3. Charniak E. and Mc Demott D., Introduction to Artificial Intelligence,th4Edition, Pearson Education Inc. and Dorling Kindersley Publishing Inc, 2009
4. Jackson J.P., Introduction to expert systems, 3rd Edition, Addison Wesley Ltd, 1999.
5. Wendy B. Ranch Hindlin, AI in business, science and Industry Applications., Vol 2., PH, 1985

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max. Marks : 80

Exam Duration : 3 hrs

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

SMEX1035	ENERGY ENGINEERING AND MANAGEMENT	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I ENERGY AND ENVIRONMENT**10 hrs.**

Energy Resources World energy consumption, green house effect, global warming, energy use patterns, scope for conservation, energy prices and policies.

UNIT II ENERGY CONSERVATION**10 hrs.**

Energy conservation scheme, energy surveying & auditing – energy cost – energy index cost – cost index, energy conservation in thermal systems, buildings, engineering & process industries, non conventional energy source schemes.

UNIT III ENERGY TECHNOLOGIES**10 hrs.**

Energy consumptions in boilers and furnaces – waste heat recovery systems – heat pumps and refrigerators, storage systems – heat exchangers

UNIT IV ENERGY MANAGEMENT**10 hrs.**

Principles of energy management – energy resource management – energy management information systems – Instrumentation and measurement – computerized energy management

UNIT V ECONOMICS AND FINANCE**10 hrs.**

Costing and cost optimization techniques – optimal target investment schedule – cost appraisal and profitability – needs and cost benefits of energy resources.

REFERENCE BOOKS:

1. Paul W.O., Callaghan, Energy Management, Mc Graw Hill Book Company, New Delhi, 1993
2. Jose Goldemerry, Thomas B Johanson, Amulya K.N. Reddy & Robert H. Williams, Energy for a Sustainable World, Wiley Eastern Ltd., 1990
3. Raikhy P.S., and Paraminder Singh, Energy Consumption in India, Deep and Deep Publications, 1990
4. Murphy W.R., Energy Management, Butter Worths, London, 1982
5. Ray, D.A., Industrial Energy Conservation, Permagon Press, 1980

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max. Marks : 80

Exam Duration : 3 hrs

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks

SMEX1028	COGENERATION AND WASTE HEAT RECOVERY SYSTEMS	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I COGENERATION**10 hrs.**

Introduction – Principles of Thermodynamics – Combined Cycles-Topping -Bottoming – Organic Rankine Cycles – Advantages of Cogeneration Technology

UNIT II APPLICATION & TECHNO ECONOMICS OF COGENERATION**10 hrs.**

Cogeneration Application in various industries like Cement, Sugar Mill, Paper Mill etc. Sizing of waste heat boilers – Performance calculations, Part load characteristics selection of Cogeneration Technologies – Financial considerations – Operation and Investments – Costs of Cogeneration.

UNIT III WASTE HEAT RECOVERY**10 hrs.**

Introduction – Principles of Thermodynamics and Second Law – sources of Waste Heat recovery – Heat engines and other Power Plants –Heat pump for waste heat recovery.

UNIT IV WASTE HEAT RECOVERY SYSTEMS, APPLICATIONS & TECHNOECONOMICS **10 hrs.**

Design of waste heat recovery system – Heat exchanger – Theory and Design, organic fluid systems – analysis & Design

UNIT V ENVIRONMENTAL CONSIDERATIONS**10 hrs.**

Environmental considerations for cogeneration and waste heat recovery – Pollution.

REFERENCE BOOKS:

1. Charles H. Butler, Cogeneration, McGraw Hill Book Co., 1984.
2. JH Horlock, Cogeneration, Heat and Power, Thermodynamics and Economics, Oxford, 1987.
3. Institute of Fuel, London, Waste Heat Recovery, Chapman & Hall Publishers, London, 1963.
4. Sengupta Subrata, Lee SS EDS, Waste Heat Utilization and Management, Hemisphere, Washington, 1983.
5. De Nevers, Noel., Air Pollution Control Engineering, McGraw-Hill, New York, 1995.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max. Marks : 80

Exam Duration : 3 hrs

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks