Scheme and Syllabus of B.E. Mechanical Engineering 3rd to 8th Semester Examination 2017-18

PANJAB UNIVERSITY
CHANDIGARH

Vision and Mission of Department of Mechanical Engineering

Vision

To contribute to global development by producing knowledgeable, innovative, smart and ethical professionals who are technically sound in the field of mechanical engineering.

Mission

- Enable students to develop technical skills in the field of Mechanical Engineering.
- Develop new courses with case studies from modern industries.
- Involve students with faculty in various research activities.
- Promote the students to follow an ethical code of conduct while performing any task.
- Create an environment for open ended problem solving and learning.
- Promote students to always work in teams for competitive events of national or international importance.

Program Educational Objectives (PEO's)

- To prepare employable students by imbibing technical skills to the students in the field of Mechanical Engineering both theoretically and practically.
- To enable student participation in multidisciplinary events and empower the students for higher education.
- Enable students to generate, innovate and solve problems which require interdisciplinary knowledge with modern and classical engineering tools.

Program Outcomes (PO's)

- An ability to apply knowledge of mathematics, science, and engineering,
- An ability to design and conduct experiments, as well as to analyze and interpret data,
- an ability to design a system, component, or process to meet the desired needs within realistic constraints, such as, economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability,
- An ability to function in multidisciplinary teams,
- An ability to identify, formulate, and solve engineering problems,
- An understanding of professional and ethical responsibility,
- An ability to communicate effectively,
- The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context,
- A recognition of the need for and an ability to engage in life-long learning,
- A knowledge of contemporary issues, and
- An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Summary of Scheme

Semester	Contact Hours	Credits
Semester 1	29	21
Semester 2	29/28	20
Semester 3	33	27
Semester 4	34	29
Semester 5	33	28
Semester 6	34	28
Semester 7	31	25
Semester 8	32	24
Total	255	202

Scheme of Examination and Syllabi for
B.E. (Mechanical Engineering)
3rd to 8th Semester for Academic Year 2017-2018

Year: Second **Semester: Third**

S. No.	Subject Code	Subject Name	Scheme of Teaching			Scheme of Examination			
			L-T-P	Contact hrs/week	Credits	Theory			Practical*
						Internal Assessment	University Exam	Total	
1	MEC-301	Applied Thermodynamics-I	3-1-0	4	4	50	50	100	-
2	MEC-351	Applied Thermodynamics-I Lab	0-0-2	2	1	-	-	-	50
3	MEC-302	Mechanics of Materials-I	3-1-0	4	4	50	50	100	-
4	MEC-352	Mechanics of Materials-I Lab	0-0-2	2	1	--	-		50
5	MEC-303	Theory of Machines-I	3-1-0	4	4	50	50	100	-
6	MEC-353	Theory of Machines-I Lab	0-0-2	2	1	-	-	-	50
7	MEC-304	Machine Drawing	1-0-0	1	1	50	--	50	-
8	MEC-354	Machine Drawing Lab	0-0-4	4	2	-	--	-	100
9	MEC-305	Manufacturing Processes	3-1-0	4	4	50	50	100	-
10	MEC-355	Manufacturing Processes Lab	0-0-2	2	1	-	-		50
11	AS 301	Math-3	3-1-0	4	4	50	50	100	-
Total				33	27	300	250	550	300

* Practical marks are for continuous and end semester evaluation

Year: Second **Semester: Fourth**

S. No.	Subject Code	Subject Name	Scheme of Teaching			Scheme of Examination			
			L-T-P	Contact hrs/week	Credits	Theory			Practical*
						Internal Assessment	University Exam	Total	
1	MEC-401	Applied Thermodynamics-II	3-1-0	4	4	50	50	100	-
2	MEC-451	Applied Thermodynamics-II Lab	0-0-2	2	1	-	-	-	50
3	MEC-402	Mechanics of Materials-II	3-1-0	4	4	50	50	100	-
4	MEC-452	Mechanics of Materials-II Lab	0-0-2	2	1	--	-		50
5	MEC-403	Theory of Machines-II	3-1-0	4	4	50	50	100	-
6	MEC-453	Theory of Machines-II Lab	0-0-2	2	1	-	-	-	50
7	MEC-404	Numerical Analysis	3-1-0	4	4	50	50	100	--
8	MEC-405	Manufacturing Technology- I	3-1-0	4	4	50	50	100	--
9	MEC-455	Manufacturing Technology- I Lab	0-0-2	2	1	-	-	-	50
10	MEC-406	Fluid Mechanics	3-1-0	4	4	50	50	100	
11	MEC-456	Fluid Mechanics Lab	0-0-2	2	1	-	-	-	50
Total				34	29	300	300	600	250

There will be four weeks vocational training after 4th Semester either in the College or in the Factories approved by the Principal / Head of the Department.

* **Practical marks** are for continuous and end semester evaluation and **vocational training marks** are of mid semester evaluation and end semester evaluation

Year: Third **Semester: Fifth**

S. No.	Subject Code	Subject Name	Scheme of Teaching			Scheme of Examination			
			L-T-P	Contact hrs/week	Credits	Theory			Practical*
						Internal Assessment	University Exam	Total	
1	MEC-501	Design of Machine Elements-I	3-0-0	3	3	50	50	100	-
2	MEC-551	Design of Machine Elements-I Practice	0-0-2	2	1	-	-	-	50
3	MEC-502	CAD/CAM (Computer Aided Design & Manufacturing)	3-1-0	4	4	50	50	100	-
4	MEC-552	CAD/ CAM Lab	0-0-2	2	1	-	-	-	50
5	MEC-503	Robotics	3-1-0	4	4	50	50	50	-
6	MEC-553	Robotics Lab	0-0-2	2	1	-	-	-	50
7	MEC-504	Mechanical Measurement	3-0-0	3	3	50	50	50	-
8	MEC-554	Mechanical Measurement Lab	0-0-2	2	1	-	-	-	50
9	MEC-505	Manufacturing Technology- II	3-0-0	3	3	50	50	50	-
10	MEC-555	Manufacturing Technology- II Lab	0-0-2	2	1	-	-	-	50
11	MEC-506	Fluid Machinery	3-1-0	4	4	50	50	50	-
12	MEC-556	Fluid Machinery Lab	0-0-2	2	1	-	-	-	50
13	MEC-557	Vocational Training-1 (After 4th Semester)			1	---	---		50
Subjects offered by Design Innovation Centre(DIC) (OPTIONAL)									
	CS 506	Principles of Designing.	0-0-3	3	0	---	---	---	
Total				33	28	300	300	600	350

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Year: Third **Semester: Sixth**

S. No.	Subject Code	Subject Name	Scheme of Teaching			Scheme of Examination			
			L-T-P	Contact hrs/week	Credits	Theory			Practical*
						Internal Assessment	University Exam	Total	
1	MEC-601	Design of Machine Elements-II	3-0-0	3	3	50	50	100	-
2	MEC-651	Design of Machine Elements-II Practice	0-0-2	2	1	-	-	-	50
3	MEC-602	Finite Element Methods	3-1-0	4	4	50	50	100	-
4	MEC-652	Finite Element Methods Lab	0-0-2	2	1	-	-	-	50
5	MEC-603	Mechanical Vibrations	3-1-0	4	4	50	50	100	-
6	MEC-653	Mechanical Vibrations Lab	0-0-2	2	1	-	-	-	50
7	MEC-604	Heat Transfer	3-1-0	4	4	50	50	100	-
8	MEC-654	Heat Transfer Lab	0-0-2	2	1	-	-	-	50
9	MEC-605	Materials and Heat Treatment	3-0-0	3	3	50	50	100	-
10	MEC-655	Materials and Heat Treatment Lab	0-0-2	2	1	-	-	-	50
11	MEC-606	Non Conventional Manufacturing	3-1-0	4	4	50	50	100	-
12	MEC-656	Non Conventional Manufacturing Lab	0-0-2	2	1	-	-	-	50
Total				34	28	300	300	600	300

There will be four weeks Vocational Training in the manufacturing concerns after 6th semester

* **Practical marks** are for continuous and end semester evaluation and **vocational training marks** are of mid semester evaluation and end semester evaluation

Year: Fourth **Semester: Seventh**

S. No.	Subject Code	Subject Name	Scheme of Teaching			Scheme of Examination			
			L-T-P	Contact hrs/week	Credits	Theory			Practical*
						Internal Assessment	University Exam	Total	
1	MEC-701	Refrigeration and Air Conditioning	3-1-0	4	4	50	50	100	-
2	MEC-751	Refrigeration and Air Conditioning Lab	0-0-2	2	1	-	-	-	50
3	MEC-702	Automatic Controls	3-0-0	3	3	50	50	100	-
4	MEC-752	Automatic Controls Lab	0-0-2	2	1	-	-	-	50
5	MEC-703	Automobile Engineering	3-0-0	3	3	50	50	100	-
6	MEC-753	Automobile Engineering Lab	0-0-2	2	1	-	-	-	50
7	MEC-704	Total Quality Management	3-0-0	3	3	50	50	100	-
8	MEC-754	Total Quality Management Lab	0-0-2	2	1	-	-	-	50
9	MEC-705 (a-h) / HSS 701-3	Elective I	3-1-0	4	4	50	50	100	-
10	MEC-755 (a - h) /HSS 751-753	Elective I Lab	0-0-2	2	1	-	-	-	50
11	MEC-756	Minor Project	0-0-4	4	2	---	---	-	100
12	MEC-757	Vocational Training II after 6th semester			1	-	-	-	50
Total				31	25	250	250	500	400

* **Practical marks** are for continuous and end semester evaluation and **vocational training marks** are of mid semester evaluation and end semester evaluation

7th Semester :- Elective-I

1. MEC -705 (a) Thermal Plant Engineering
2. MEC- 755 (a) Thermal Plant Engineering
3. MEC -705 (b) Gas Dynamics
4. MEC -755 (b) Gas Dynamics
5. MEC- 705 (c) Renewable Energy Sources
6. MEC- 755 (c) Renewable Energy Sources
7. MEC- 705(d) Advanced Mechanics of Materials-I
8. MEC -755(d) Advanced Mechanics of Materials-I
9. MEC- 705(e) Work Study
10. MEC- 755(e) Work Study
11. MEC -705(f) Mechanical Behavior of Materials-1
12. MEC -755(f) Mechanical Behavior of Materials-1
13. MEC -705(g) Vehicle Dynamic
14. MEC- 755(g) Vehicle Dynamic
15. MEC- 705(h) Materials Design
16. MEC- 755(h) Materials Design
17. HSS -701 Financial Management
18. HSS -751 Financial Management
19. HSS 702 Business Laws
20. HSS 752 Business Laws
21. HSS 703 Human Resource Management
22. HSS 753 Human Resource Management

Year: Fourth **Semester: Eighth**

OPTION 1

S. No.	Subject Code	Subject Name	Scheme of Teaching			Scheme of Examination			
			L-T-P	Contact hrs/week	Credits	Theory			Practical*
						Internal Assessment	University Exam	Total	
1	MEC-801	Mechatronics	3-1-0	4	4	50	50	100	-
2	MEC-851	Mechatronics Lab	0-0-2	2	1	-	-	-	50
3	MEC-802	Operation Research	3-1-0	4	4	50	50	100	-
4	MEC-852	Operation Research Lab	0-0-2	2	1	-	-	-	50
5	MEC-803	Computational Fluid Dynamics	3-1-0	4	4	50	50	100	-
6	MEC-853	Computational Fluid Dynamics Lab	0-0-2	2	1	-	-	-	50
7	MEC-804 (a-m) / HSS 801	Elective-II	3-1-0	4	4	50	50	100	-
8	MEC-854 (a-m)/HSS-851	Elective-II Lab	0-0-2	2	1	-	-	-	50
4	MEC-855	Major Project	0-0-8	8	4	---	---	-	150
Total				32	24	200	200	400	350

* Practical marks are for continuous and end semester evaluation

1. The project will continue for a period of two weeks after 8th semester examinations.
2. In case of elective subject where there is no lab, project work/ seminar may be given.
3. The students who want to undergo one semester industrial training will be required to follow the rules and regulations of Industrial Training Committee.

8th Semester: - Elective-II

1. MEC -804 (a) Experimental Stress Analysis
2. MEC -854 (a) Experimental Stress Analysis
3. MEC- 804 (b) Metrology
4. MEC -854 (b) Metrology
5. MEC- 804 (c) Mechanical Handling
6. MEC- 854 (c) Mechanical Handling
7. MEC- 804 (d) Bearings and Lubrication
8. MEC- 854 (d) Bearings and Lubrication
9. MEC- 804 (e) Plastic and Rubber Technology
10. MEC- 854 (e) Plastic and Rubber Technology
11. MEC -804 (f) Advanced Fluid Machinery
12. MEC -854 (f) Advanced Fluid Machinery
13. MEC- 804 (g) Production and Operations Management
14. MEC -854 (g) Production and Operations Management
15. MEC -804 (h) Theory of elasticity & plasticity
16. MEC -854 (h) Theory of elasticity & plasticity
17. MEC- 804 (i) Advanced Mechanics of Materials -2
18. MEC -854 (i) Advanced Mechanics of Materials -2
19. MEC -804 (j) Advances in Engineering Materials
20. MEC- 854 (j) Advances in Engineering Materials
21. MEC -804(k) Mechanical Behavior of Materials-2
22. MEC -854(k) Mechanical Behavior of Materials-2
23. MEC- 804(l) Rotor Dynamics
24. MEC- 854(l) Rotor Dynamics
25. MEC-804(m) Imaging And Additive Manufacturing
26. MEC-854(m) Imaging And Additive Manufacturing
27. HSS 801 Project Management and Entrepreneurship
28. HSS 851 Project Management and Entrepreneurship

Year: Fourth **Semester: Eighth**

OPTION 2

MEC-856: INDUSTRIAL TRAINING FOR SIX (06) MONTHS DURATION.
(24 credits and 750 marks)

EIGHTH SEMESTER **OPTION 2**					
Paper Code	**Paper Title**	**Duration**	**External Assessment**	**Internal Assessment**	**Total**
MEC-856	Industrial Training	6 Months	400	350	750

* Industrial training marks are for mid semester evaluation and end semester evaluation

Course Code	MEC-301
Course Title	Applied Thermodynamics-I
Type of Course	Core
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Basic Thermodynamics
Course Objectives (CO)	**1.** Understand the applications of engineering thermodynamics in real life situations **2.** Understand basics and use of various laws of thermodynamics **3.** Understand vapour power cycles **4.** Broaden the understanding of steam generators **5.** Understanding the thermodynamics of nozzles and diffusers **6.** Understanding the basics of steam turbines **7.** Understanding the steam condensers operations and uses
Course Outcome	By the end of the course the students shall be able to 1. Understand and can apply various laws of thermodynamics. He will be able to solve the problems related to various laws of thermodynamics 2. Understand Boilers function and its uses. He will be able to do boiler trail for preparing heat balance 3. Understand function, Types, utility of steam operated devices like nozzles, impulse turbine, reaction turbine and condenser. He will be able to calculate all thermodynamic quantities like work, efficiencies etc.

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

Part A

1. Laws Of Thermodynamics:
First law of thermodynamics, Steady flow energy equation and its applications (nozzle, throttling device, turbine, compressor, heat exchanger). Limitations of first law, statements of second law by Max-Planck and Clausius, equivalence between the two statements. Reversible

and irreversible processes, Carnot's theorem. Energy analysis of a heat engine, refrigerator and heat pump, Classius Theorem, Classius Inequality and concept of Entropy, Entropy change in an Irreversible Process, Application of Entropy Principle.

(8 hrs)

2. Vapour power Cycles:

P-V, P-T, T-S, H-S diagrams of water. Dryness fraction and its measurement by calorimeter. Uses of steam tables and Mollier chart (H-S chart), Carnot cycle and its limitations Rankine steam power cycle, Ideal and actual; Mean temperature of heat addition; Effect of pressure, temperature and vacuum on Rankine Efficiency; Rankine Cycle Efficiency and methods of improving Rankine efficiency: Reheat cycle, Bleeding (feed-water-heating), Regenerative Cycle, Combined reheat-regenerative cycle.

(5 hrs)

3. Steam Generators:

Classification of steam generators, Working and constructional details of fire-tube and water-tube boilers: (Cochran, Lancashire, Babcock and Wilcox boilers); Merits and demerits of fire-tube and water-tube boilers; Modern high pressure boilers (Benson boiler, La Mont boiler) and Supercritical boilers, Advantages of forced circulation, Boiler mountings and accessories, Performance of Steam Generators : Evaporation, Equivalent Evaporation, boiler efficiency. Heat loss and boiler plant. Boiler trial and heat balance Types of draught and Calculation of chimney height.

(7 hrs)

Part B

4. Nozzles and Diffusers :

Types and utility of nozzles. Flow of steam through nozzles. Effect of friction. Nozzle efficiency. Critical pressure conditions for maximum discharge. Idea of total or stagnationenthalpy and pressure , general relationship of area velocity and pressure in nozzle flow, Supersaturated flow. Classification of diffusers, effect of friction and area change parameters affecting the performance of nozzle.

(5 hrs)

5. Impulse Steam Turbine :

Principle of operation of simple impulse turbine, General description, compounding ofimpulse turbine, pressure and velocity compounding. Velocity diagram and work done. Combination of velocity diagram. Effect of blade friction on velocity diagram. Most economical ratio of blade speed to steam speed for single stage and multi stage impulse turbine ,Blade efficiency and overall efficiency. Reheat factor and condition curve. (5 hrs)

6. Reaction Turbine :

Degree of reaction, velocity diagrams, blade efficiency and its derivation, calculation of blade eight etc. Requirement of an ideal working fluid, Methods of attachment of blades to turbine rotor, losses in steam turbine, Labyrinth packing and governing of steam turbine. Blade materials.

(5 hrs)

7. Condensers :

Utility of condenser. Elements of condensing plants. Brief description of different types of condensers. Requirement of modern condenser, Dalton's law of partial pressure applied to condenser problems, condenser and vacuum efficiencies. Cooling water calculations. Effect of air leakage. Methods of checking and preventing air infiltration. (4 hrs)

RECOMMENDED BOOKS

	NAME	**AUTHOR(S)**	**PUBLISHER**
1.	Basic and Applied	*P.K. Nag*	Tata McGraw-Hill.
	Thermodynamics		
2	Themodynamics: An	Yunus.A.Cengel and	McGraw-Hill Higher Education
	Engineering Approach	Michael.A.Boles	
3	Engineering	Gordon Rogers and Yon	Pearson Education India.
	Thermodynamics:Work and	Mayhew	
	Heat transfer		
4	Thermodynamics and Heat	R.Yadav	Central Publishers
	Engines		

Course Code	MEC-351
Course Title	Applied Thermodynamics-I lab
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Basic Thermodynamics
Course Objectives (CO)	1. Understand the applications of engineering thermodynamics in real life situations 2. Understand working and application of boilers 3. Understanding the thermodynamics of separating throttling calorimeter 4. Understanding the steam condensers operations and uses Understanding the steam condensers operations and uses
Course Outcome	1. Student will understand the principles of thermal energy. This includes the study of energy transformations and thermodynamic relationships applied to flow and non-flow processes in power and refrigeration cycles. 2. student will have analytical skills to solve and analyze a variety of steam related problems. Like boilers, condensers

Syllabus

List of Experiments

1. Study of Babcock and Wilcox boiler.
2. Study of Lancashire Boiler.
3. To Study of working, construction, mountings and accessories of various types of boilers
4. To find calorific value of a sample of fuel using Bomb calorimeter.
5. To measure the dryness fraction of steam using separating throttling calorimeter.
6. To study the working of a thermal power plant by visiting the site.
7. Study of construction and operation of various types of steam condensers.

Course Code	MEC 302
Course Title	Mechanics of Materials-1
Type of Course	Core
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Engineering/Applied Mechanics and Calculus
Course Objectives (CO)	1. Provide clear understanding of principles, assumptions, and limitations underlying the mechanics of deformable solids in equilibrium. 2. Apply above principles to engineering design based on strength, stiffness, and stability criteria.
Course Outcome	1. Given a physical situation the student should be able to develop a physical understanding of the problem. 2. The student should then be able to construct an idealized model. 3. Using equilibrium, compatibility, and force-deformation relation the student should be able to generate the solution to the problem. 4. The student should be able to analyze and design an element using the above principles.

SYLLABUS

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PART-A

1. Stress

Method of Sections, Stress, Stress Tensor, Differential Eqns. of Equilibrium; Maximum Normal Stress in Axially Loaded Bars, Stresses on Inclined Sections in Axially Loaded Bars, Shear Stresses, Analysis of Normal and Shear Stresses, Member Strength as Design Criteria, Deterministic Design of Members: Axially Loaded Bars, Probabilistic Basis for Structural Design.

(2)

2. Strain

Tension Test and Normal Strain, Stress-Strain Relationships, Hooke's Law, Poisson Ratio,

Thermal Strain and Deformation, Idealizations in Constitutive Relations, Linearly Viscoelastic Materials, Cyclic Loading: Fatigue.

(2)

3 Axial Deformation of Bars

Deformation of Statically Determinate Axially Loaded Bars, St.Venant's Principle & Stress Concentration, Tension Test, Elastic Strain Energy for Uniaxial Test, Deflections by Energy Method, Dynamic and Impact Loads; Deformation of Statically Indeterminate Axially Loaded Bars by Force and Displacement Method of Analysis, Statically Indeterminate Nonlinear Problems, Differential Equation Approach to Deflection of Bars.

(5)

4 Generalized Hooke's Law

Stress-Strain Relationship for Shear, Elastic Strain Energy for Shear Stresses; Mathematical Definition of Strain, Strain Tensor, Generalized Hooke's Law for Isotropic Materials, E, G, and ν Relationships, Dilatation and Bulk Modulus; Thin-walled Cylindrical and Spherical Pressure Vessels; Thick-walled Cylinders General Solution and Special Cases, Ideally Plastic Thick-walled Cylinder.

(3)

PART-B

5 Torsion:

Assumptions for Circular Members, Torsion Formula, Design of Circular Membersin Torsion for Strength, Stress Concentration, Angle of Twist for Circular Members, Statically Indeterminate Problems, Differential Equation Approach to Torsion Problems, Energy and Impact Loads, Shaft Couplings, Stresses and Deformation of Circular Shafts in Inelastic Range; Non-Circular Solid Bars of Any Section, Warpage of Thin-walled Open Sections; Tubular Thin-walled Members.

(3)

6 Beam Statics:

Calculation of Beam Reactions; Direct Approach to Find P, V, and M; Integration Approach to Find V and M, Differential Equation for Beam Element, Elastic Curve, Singularity Functions.

(2)

7 Beam Bending:

Symmetric Bending, Kinematic Assumptions, Elastic Flexure Formula,Moment of Inertia, Stress Concentrations, Elastic Strain Energy in Pure Bending, Inelastic Bending of Beams, Beams of Composite Cross Section, Curved Bars; Unsymmetric Bending, Bending about Both Principal Axes, Elastic and Inelastic Bending with Axial Loads; Bending of Beams with Arbitrary Cross Sections, Products of Inertia, Principal Axes of Inertia.

(4)

8 Shear Stresses in Beams:

Shear Flow, Shear Stress in Beams, Warpage of Plane SectionsDue to Shear, Limitations of Shear Stress Formula, Shear Stress in Beam Flanges, Shear Center, Combined Direct and Torsional Shear Stresses, Stresses and Deflection of Closely Coiled Helical Springs.

(3)

RECOMMENDED BOOKS

	NAME	AUTHOR(S)	PUBLISHER
1	Strength of Materials (SI Units), 3/e	G. H. Ryder	MacMillan India Ltd., 1969
2	Mechanics of Materials, 5/e	F. P. Beer, E.R. Johnston Jr.	Tata McGraw Hill Pvt. Ltd., 2009
3	Mechanics of Materials, 6/e	R. C. Hibbeler	Pearson Education India Pvt. Ltd., 2007
4	Strength of Materials,2/e	J. M. Gere, B. J. Goodno	Cengage Learning India Pvt. Ltd., 2009
5	Mechanics of Solids, 2/e	E. P. Popov	PHI India Pvt. Ltd., 2009

Course Code	MEC-352
Course Title	Mechanics of Materials-1 Lab
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Engineering/Applied Mechanics and Calculus
Course Objectives (CO)	1. The experiments aims at providing practical knowledge of the theory material covered in the Mechanics of Materials class.
Course Outcome	1. Students will be able to relate the mathematical models developed in theory tophysical models. 2. In addition the student will learn about how to carry out experiments, collect data, errors, and report generation.

Syllabus

List of Experiments

1. Study Universal Testing Machine and perform Tension, Compression, Bending, and Shear test.
2. Study Torsion testing machine and perform torsion test.
3. Study of Izod and Charpy apparatus and perform impact test.
4. Study hardness of various materials with Brinell, Vickers, Pyramid, and Rockwell hardness
5. tests.
6. Study Spring testing machine and perform test on helical spring to determine Shear Modulus.
7. Study Beam bending apparatus and perform beam bending test to determine Young's Modulus.
8. Study Fatigue behavior and perform Fatigue test.

Course Code	MEC-303
Course Title	Theory of Machines-I
Type of Course	Core
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Theory of Machines-I
Course Objectives (CO)	1. Know different machine elements and mechanisms. 2. Understand Kinematics and Dynamics of different machines and mechanisms. 3. Select Suitable Drives and Mechanisms for a particular application.
Course Outcome	By the end of the course the students shall be able to 1. Familiarity with common mechanisms used in machines and everyday life. 2. Ability to calculate mobility (number of degrees-of-freedom) and enumerate rigid links and types of joints within mechanisms. 3. Ability to conduct a complete (translational and rotational) mechanism position analysis.

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

1. Basic concepts

Kinematics and Dynamics of Machines, Mechanism, Pairs, Inversions of slider crank chains, Degrees of freedom, Kutzbach's equation. Grubler criterion and Numerical problems

2. Velocity and Acceleration:

Basic concepts of machines, link, Mechanism, Kinematic chain, relative motion of parts of Mechanism, displacement, velocity, acceleration diagrams of all basic mechanisms including quick return motion mechanism. Advance problems on velocity diagrams (relative velocity method, instantaneous center method). Acceleration diagram. Coriollis component. Advanced problems involving their application and torque calculation.

3: Kinematics Synthesis of Mechanism.

Movability, Number synthesis, Frudensteins's equation. Chebyshev spacing of precision points, Two and three position synthesis of Four-bar mechanism and slider crank mechanism, Overlay Method, Block's method, Transmission angle, Limit position and Least square techniques.

4: Flywheel and Turning Movement Diagrams:
Turning moment and crank effort diagrams for steam and I.C. engine, dynamics of simple horizontal and vertical engine. Fluctuation of speed, co-efficient of fluctuation of speed and energy. Simple problems on turning moment diagrams and the determination of size of a flywheel taking centrifugal stresses into consideration.

5: Force Analysis:
Equations of equilibrium, Couple, equilibrium of three force and four force systems, Free body diagrams, Forces on slider crank mechanism, quick return mechanism, four bar mechanism and slider crank mechanism with friction at turning pairs and numerical problems.

PART-B

6: Friction
Efficiency of inclined plane, Friction in V-threads, screw-jack, pivots and collars plate and cone-clutches, Power lost in friction, friction circle and the friction axis of a link.

7: Belts, Ropes and chains.
Materials, type of drive, idle pulley, intermediate or counter shaft pulley, angle and right angle drive, quarter turn drive, velocity ratio, crowning of pulley, loose and fast pulleys, stepped or cone pulleys, ratio of tensions on tight and slack sides of belt. Power transmitted by belts with consideration of creep and slip, centrifugal tension and its effect on power transmitted. Use of gravity idler, flat, V-belts and rope material, Length of belt, rope and chain drive, types of chains.

8: Brakes and Dynamometer:
Types of brakes, principle of friction brakes, band, band and block, internal expanding shoe brakes, simple Problems of these brakes, description of vacuum brake, types of dynamometer, measurement of power by Prone brake and rope brake dynamometer, belt transmission dynamometer, Heenan and Froude's Hydraulic dynamometer, Bevis- Gibson's flash light torsion dynamometer.

9: Governors.
Functions, types and characteristics of governors, Watt, Porter and Proell governors. Hartnell and Wilson-Hartnell spring loaded governors. Simple numerical problems on these governors. Sensitivity, stability,Isochronism and hunting of governors, governor effort and power controlling force curve, effect of sleeve friction.

RECOMMENDED BOOKS			
	NAME	**AUTHOR(S)**	**PUBLISHER**
1.	Theory of Machines	J. Lal&Shah	Metropoltian Book-seller &Publishers,New Delhi
2	Theory of Machines	P.L Ballaney	KhannaPublisher,Delhi
3	Theory of Machines	Shigley	McGraw Hill
4	Theory of Machines	V P Singh	DhanpatRai and Company

Course Code	MEC-353
Course Title	Theory of Machines-I Lab
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Theory of Machines-I
Course Objectives (CO)	1. This design-oriented course addresses the kinematics and dynamics of mechanisms with applications to linkage systems, reciprocating engines, and industrial machinery. 2. Conventional as well as innovative rigid-body dynamic systems are studied. Problems of kinematics and dynamics are framed in a form suited for computer analysis.
Course Outcome	This course is designed to help students achieve the following outcomes. 1. Familiarity with common mechanisms used in machines and everyday life. 2. Ability to calculate mobility (number of degrees-of-freedom) and enumerate rigid links and types of joints within mechanisms. 3. Ability to conduct a complete (translational and rotational) mechanism position analysis. (P)

List of Experiments

1. (a) Find the moment of inertia of a given body with the help of Fly-wheel.
   (b) Calculate the minimum possible periods of oscillation if the point of suspension may be moved .
2. Study and draw the sketches of difference inversions of single slider chain and double slider crank chain.
3. Find the co- efficient of friction for different belt material on a cast iron : Pulley.
4. To perform the various practical on Universal Governor Apparatus.
   (a)Determination the characteristics of sleeve position against speed for all governors.
   (b)Determination the characteristics curves of radius of rotation against controlling force for all governors.
   (c)To study the effect of varying the mass of central sleeve for porter and proell governors.
   (d)To study the effects of varying initial spring compression for Hartnell Governor.

Course Code	MEC-304
Course Title	MACHINE DRAWING
Type of Course	Core
L T P	1 0 0
Credits	1
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Engineering Drawing / Engineering Graphics
Course Objectives (CO)	1. To enable students to be able to communicate their ideas and concepts using sketches, symbols and engineering drawings. 2. To understand drawing and working of a number of machine elements. 3. To develop the technical skills necessary to create or modify the machine drawing using Computer Aided Drafting system.
Course Outcome	By the end of the course the students shall be able to 1. Ability to interpret and communicate engineering drawings having a number of symbols, standards and views. 2. Students understand the technical intricacies involved in drawing and working of screws, bolts, pipe fittings, cotter joint, knuckle joint, pulleys, brackets, couplings, bearings, engine parts, tail stock, screw jack, vices, valves etc. 3. Ability to create 3D models of engineering objects, machine drawings with different views, and an assembly of the objects that make up engineered systems, using a CAD system (e.g. AutoCAD etc.).

SYLLABUS

Note: Students should develop the understanding of study of drawing with reference to manufacturing processes, projections, assembly drawings and should be able to draw simple assembly drawings, projections and 3-D solid models of simple machine parts. The syllabus given here indicates the broad outlines and the scope of subject to be covered. Teacher concerned may take suitable examples to make the student understand the topic.

1. Introduction to AutoCAD, AutoCAD Screen and Components, File Operations, Methods of Giving Commands, Setting Units, Limits, Zoom, Drawing Lines using Mouse Clicks, Drawing Lines with Ortho Option, Absolute Coordinates, Relative Absolute Coordinates, Polar Coordinates, Relative Polar Coordinates, Polar Tracking, Drawing Polyline, Drawing Simple Geometries, Hatching, Title Block using Table, Use of OSNAPs, Basic Editing such as Copy,

Move, Mirror, Array, Scale, Stretch, Trim, Offset, Rotate, Erase, Explode, Undoing and Redoing Actions, Creating Regions and Closed Boundaries, Drawing Basic Solids using Extrude, Revolve, Boolean operations on solids, Drawing sectioned solids, Use of WCS and UCS, 3D Mirror and 3D Rotate, Assembly of solids, Creating PDF of the solid models. (5 Solid Models Min.)

2. Unilateral system of tolerance, Bilateral system of tolerance, Clearance fit, Transition fit, Interference fit, Basic hole system, Basic shaft system, Shortcomings of coordinate tolerancing, Advantages of Geometric Dimensioning and Tolerancing (GD&T), Machining symbols, Surface finish symbols
3. Free hand sketching of shafts, splined shafts, keys and keyways
4. Form of screw threads, conventional representations of single and multi start threads, bolts, nuts, studs, screw, locking devices, riveted joints and symbols, welded joints and symbols, pipe and pipe fittings and symbols.(3 Solid Models Min.)
5. Cotter joints, knuckle joints. Pulleys and brackets. (3 Solid Models Min.)
6. Flange and muff coupling. Pin type flexible coupling, Oldham coupling, Claw Coupling and Cone friction clutch. (3 Solid Models Min.)
7. Footstep bearing, Journal bearing, Ball bearing, Roller bearing, Angle Plummer block, Wall bracket (3 Solid Models Min.).
8. I.C. Engine Piston, connecting rod, Spark plug, Fuel pump, Fuel injector (3 Solid Models Min.)
9. Miscellaneous: Tail stock, Screw jack, Bench vice, Crane hook, Lever safety valve, Spring loaded safety valve

RECOMMENDED BOOKS

	NAME	**AUTHOR(S)**	**PUBLISHER**
1.	Machine Drawing	B Bhattacharyya	Oxford University Press, 2011
2.	Engineering Drawing Practice SP46: 2003	Bureau of Indian Standards	Bureau of Indian Standards
3.	Machine Drawing	R K Dhawan	S Chand, New Delhi, 2011
4.	Machine Drawing	P S Gill	KatsonPb. House, 2011
5.	Machine Drawing	K L Narayana, P Kannaiah and K Venkata Reddy	New Age International Publishers, New Delhi, 2011

Course Code	MEC-354
Course Title	MACHINE DRAWING PRACTICAL
Type of Course	Core
L T P	0 0 4
Credits	2
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	100
Course Prerequisites	Basic Thermodynamics
Course Objectives (CO)	1. To develop the technical skills necessary to successfully use a computer aided drafting system such as Auto-CAD. 2. To develop the technical skills necessary to produce assembly drawings. 3. To develop the ability to produce 3-D Solid model of engineering products using CAD system
Course Outcome	1. Ability to communicate the ideas and concepts using CAD software. 2. Ability to draw and communicate assembly drawings and sectional views. 3. Ability to develop 3-D solid models of real life mechanical systems.

List of Experiments

The candidates will be required to make minimum of 23 three-dimensional solid models covering syllabus MEC-304 using the software such as AutoCAD or Pro-E or Inventor or SolidWorks or CATIA etc. as per B.I.S. SP46-2003 for General Engg. Drawing. First angle method of Projection should be used.

Course Code	MEC-305
Course Title	Manufacturing Processes
Type of Course	Core
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Workshop Technology and Engineering Drawing
Course Objectives (CO)	1. To state the importance and need to Manufacturing processes 2. To tell them about various tool materials. 3. To make the students aware about various Manufacturing processes 4. To give them practical exposure of various Manufacturing processes 5. To tell them about applications of various Manufacturing processes
Course Outcome	By the end of the course the students shall be able to 1. The Fundamentals of Engineering Materials 2. The principle working and controlling parameters of metal forming processes and the principle working and controlling parameters of welding 3. The principle working and controlling parameters of foundry and the process of mould making

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

PART-A

1. Fundamentals of Engineering Materials:
Metal (Cast Iron, Pig Iron and Steel) and Alloys(Aluminum, Copper, Magnesium, Nickel and Steel), Non-ferrous materials (Aluminum, Cobalt, Copper, lead, Magnesium, Nickel, Tin and Zinc) and Non-Metal, Mechanical behavior, Physical properties, Manufacturing properties, Testing, Applications of Engineering Materials.

(8)

2. Metal forming

(a) Definition and classification of metal forming, type of rolling, hot rolling, rolling mills, forging, smith forging, drop forging, machining forging and press forging, defects in forging.

(b) pipe and tube manufacture, extrusion, hot spinning, drawing and cupping, piercing, cold rolling, wire drawing, rod and tube drawing, metal spinning, coining, embossing and shot peening, sheet metal working operations, piercing, blanking, bending and drawing, punch and die setup, presses.

(9)

PART-B

3. Foundry: Introduction to Casting Processes, Basic Steps in Casting Process, Expandable and permanent mould casting processes, Pattern, Types of Patterns, Pattern Allowances, Risers, Runners, Gates, Moulding Sand and its composition, Sand Preparation, Molding Methods, Core Sands and Core Making, Core Assembly, Mold Assembly, Melting and Pouring, Cooling and Solidification, Elementary and brief description of various melting furnaces, Fettling, Casting Defects and Remedies. (7)

4. Welding:

(a) Definition and classification, types of welded joints, weldabillity, Gas welding: oxy-acetylene welding, equipment, lighting up, type of flames, welding techniques, welding of cast iron, flame cutting, advantages and limitations Electric arc welding : principle, metal transfer in arc welding, straight & reverse polarity in AC & DC, relative merits & demerits, various electric arc welding processes, coding & selection of welding electrodes.

(b) TIG, MIG welding processes, electric resistance welding, spot, butt, seam, upset, projection &high frequency resistance welding, thermit welding, brazing and soldering, description of special welding techniques, choice of process for welding, defects in welding joint, their causes and remedies. (10)

Runners, Gates, Moulding Sand and its composition, Sand Preparation, Molding Methods, Core Sands and Core Making, Core Assembly, Mold Assembly, Melting and Pouring, Cooling and Solidification, Elementary and brief description of various melting furnaces, Fettling, Casting Defects and Remedies. (7)

4. Welding:

(a) Definition and classification, types of welded joints, weldabillity, Gas welding: oxy-acetylene welding, equipment, lighting up, type of flames, welding techniques, welding of cast iron, flame cutting, advantages and limitations Electric arc welding : principle, metal transfer in arc welding, straight & reverse polarity in AC & DC, relative merits & demerits, various electric arc welding processes, coding & selection of welding electrodes.

(b) TIG, MIG welding processes, electric resistance welding, spot, butt, seam, upset, projection &high frequency resistance welding, thermit welding, brazing and soldering, description of special welding techniques, choice of process for welding, defects in welding joint, their causes and remedies. (10)

RECOMMENDED BOOKS

	NAME	AUTHOR(S)	PUBLISHER
1.	Workshop Technology Vol. I & II	HazraChowdhry	Media Promotors
2	Manufacturing materials & process	Lindberg	Prentice Hall
3	Manufacturing processes	Begeman	John Wiley
4	Workshop Technology	S.K. Garg	Laxmi Publications
5	Production Technology	R K Jain	Khanna

Course Code	MEC-355
Course Title	Manufacturing Processes Lab
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	
Course Prerequisites	Workshop Technology and Engineering Drawing
Course Objectives (CO)	1. To state the importance and need to Manufacturing processes 2. To tell them about various tool materials. 3. To make the students aware about various Manufacturing processes 4. To give them practical exposure of various Manufacturing processes 5. To tell them about applications of various Manufacturing processes
Course Outcome	1. The Fundamentals of Engineering Materials 2. The principle working and controlling parameters of metal forming processes and the principle working and controlling parameters of welding 3. The principle working and controlling parameters of foundry and the process of mould making

SYLLABUS

List of Experiments

1. Experimental work pertaining to study & use of sand testing equipment
2. To prepare a mould& do casting.
3. Study of casting defects.
4. To prepare a lap joint using- electric arc welding.
5. To prepare a joint using- gas/spot welding.
6. Application of MIG/TIG welding

Course Code	AS-301
Course Title	MATH-3
Type of Course	Core
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	MATH-1(AS-101) and MATH-2 (AS-201)
Course Objectives (CO)	This course is an introduction to a broad range of mathematical techniques for solving problems that arise in Science and Engineering. The goal is to provide a basic understanding of the derivation, analysis and use of these techniques along with a detailed understanding of linear algebra in engineering applications.
Course Outcome	1. Students will be able to manipulate and understand systems of equations in multi-dimensions. Additionally, students will learn some standard techniques in linear algebra, which allow them to deal with matrices that might show up in applications like load and displacements in structures, compatibility in structures, finite element analysis (has Mechanical, Electrical, and Thermodynamic applications). 2. Successful study of this module should enhance students skills in understanding complex mathematical texts, working with abstract concepts, constructing solutions to problems logically and communicating mathematical ideas clearly.

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

Sequences and Series:
Sequences, Limits of sequences, Infinite series, series of positive terms,
Integral test, Comparison test, Ratio test, Root test. Alternating series, Absolute and Conditional Convergence, Leibnitz test. Power series: radius of convergence of power series, Taylor's and Maclaurin's Series, Formulae for remainder term in Taylor and Maclaurin series, Error estimates. (8)

Linear Algebra:

Concept of linear independence and dependence, Rank of a matrix: Row – Echelon form, System of linear equations: Condition for consistency of system of linear equations, Solution by Gauss elimination method. Inverse of a matrix: Gauss – Jordan elimination method. (7)

Eigen values, eigen vectors, Cayley – Hamilton theorem (statement only). Similarity of matrices, Basis of eigenvectors, diagonalization. (7)

PART B

Complex Functions:
Definition of a Complex Function, Concept of continuity and differentiability of a complex function, Cauchy – Riemann equations, necessary and sufficient conditions for differentiability (Statement only). Study of complex functions: Exponential function, Trigonometric functions, Hyperbolic functions, real and imaginary part of trigonometric and hyperbolic functions, Logarithmic functions of a complex variable, complex exponents.
(7)
Laurent Series of function of complex variable, Singularities and Zeros, Residues at simple poles and
Residue at a pole of any order, Residue Theorem (Statement only) and its simple applications.

Conformal Mappings, Linear Fractional Transformations
(8)

RECOMMENDED BOOKS

	NAME	**AUTHOR(S)**	**PUBLISHER**
1.	Advanced Engineering Mathematics	E. Kreyszig	John Wiley
2	Calculus	G. B. Thomas, R. L. Finney	Pearson Education
3	Advanced Engineering Mathematics	Michael D. Greenberg	Pearson Education
4	Complex Variables and Applications	R. V. Churchill, J. W. Brown	McGraw-Hill

Course Code	MEC-401
Course Title	Applied Thermodynamics –II
Type of Course	Core
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Applied Thermodynamics –I
Course Objectives (CO)	The purpose of this course is to enable the student to gain an understanding of How thermodynamic principles govern the behavior of various systems and have knowledge of methods of analysis and design of complicated thermodynamic systems.
Course Outcome	By the end of the course the students shall be able to 1. Apply the principles of thermodynamics to reacting systems and analyze the chemical equilibrium of a reacting system using the computer. 2. Describe the characteristics of the Otto, Diesel, and Brayton power cycles and the method of analysis of each cycle. 3. Analyze the Rankine cycle with various configurations to optimize the design of a power plant and use the computer to synthesize and evaluate the design.

SYLLABUS

Note for Examiner*- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

Part-A

1. Thermodynamics of I.C. Engines:

1.1 Introduction: I C Engine classification; Operation of two stroke and four stroke reciprocating I.C. Engines and rotary (Wankel) engine and their comparison. Comparison of SI and CI engines, Otto Cycle – The Ideal Cycle for SI Engines Diesel Cycle – The Ideal for CI Engines. Deviation of actual cycles from ideal cycles. Pressure- Time diagram for I.C. Engines Cycle

1.2 Combustion in SI Engines: Combustion in S.I. Engines, Combustion phenomenon, flame speed, ignition delay, effect of engine variables on Delay Period, abnormal combustion, preignition, detonation, effect of various engine parameters on detonation, effect of detonation

on engine performance and methods employed to reduce detonation. Combustion chamber design for S.I. Engines

1.3 Combustion in CI Engines: Combustion in C.I. Engines, Combustion phenomenon, Delayperiod, Diesel Knock, CI engine combustion chambers, High speed cinematography for combustion visualization- a brief note.

1.4 Fuels: rating of SI Engines fuels; cetane ratings of CI Engine fuels, Octane and Cetane numbers

1.5 Performance of IC engines: Performance curves of C.I. and S.I engines. Overall IC engine performance (engine sizing, mean effective pressure (MEP), power and torque) Effect of compression ratio and of air fuel ratio on power and efficiency of an engine: Variation of engine power with altitude, supercharging, its advantages and its applications, types of superchargers

2. Gas Turbines:

Introduction; Classification of Gas turbines: on the basis of system of operation and on the basis of combustion (at constant volume, or at constant pressure). Thermodynamics of constant pressure gas turbine cycle: calculation of net output, work ratio and thermal efficiency of ideal and actual cycles; cycle air rate, temperature ratio; effect of change in Sp. heat and mass of fuel on power and efficiency. Operating variables and their effects on thermal efficiency and work ratio Thermal refinements and their effects on gas turbine cycle .i.e. gas turbine cycle with regeneration, inter cooling and reheating; multistage compression and expansion , pressure losses in heat exchangers and combustion chambers. Comparison of gas turbine with a steam turbine and I.C. engine. Field of application of gas turbine.

3.Aircraft Propulsion using gas turbine :

Principle of propulsion thrust work and thrust power, propulsion efficiency, Overall thermal efficiency, specific fuel consumption. Intake and Propelling nozzle efficiencies. classification and comparison of ram jets, turbojets, turbo props, pulse jets and rockets Thermodynamics cycle analysis and efficiencies of propulsive devices of turbojet engine, Advantages and disadvantages of jet propulsion over other propulsion systems. Fields of application of various propulsion units.

Part-B

4. Air Compressors:

Introduction: Classification of air compressors, Use of compressed air in industry, Complete representation of compression process on p-V and T-S coordinates with detailed description of areas representing total work done and polytropic work done. (1)

4.1 Reciprocating Air Compressors:

Operation of single stage reciprocating compressors, construction, operation, work input and the best index of compression, Heat rejected to cooling medium. Isothermal, polytropic , mechanical and volumetric efficiency. Effect of various parameters on volumetric efficiency, Free air delivery, Multi stage compression and its advantages. Cylinder arrangements for multistage compressors. Work input in multistage compression, Performance curves of reciprocating compressors.(5)

4.2. Rotary Compressors:

Introduction and general classification of rotary compressors: Comparison of rotary compressors with reciprocating compressor Stagnation and static values of pressure, temperature and enthalpy etc, for flow through rotary machines.(1) 1 hr

4.2.1 Positive Displacement Rotary Compressor :

Operation of positive displacement type of rotary Compressor like Roots Blower, Screw Compressor and Vane type Blower.(2)4.2.2Centrifugal Compressors: Principle of operation, components of a centrifugal compressor. Complete thermodynamics analysis of centrifugal compressor stage, polytropic, isentropic and Isothermal efficiencies; work done and pressure rise. Velocity vector diagrams for centrifugal compressors and power 5 hrs calculation, preguide vanes and prewhirl, slip factor, power input factor; degree of reaction and its derivation, energy transfer in backward, forward and radial vanes; Pressure coefficient as a function of Slip Factor, efficiency and out coming velocity profile from the impeller Non-dimensional parameters for plotting compressor characteristics; Surging and choking in centrifugal compressor Field of application of centrifugal compressor.(5)

4.2.3Axial Flow compressors:

Components of axial flow compressor and their arrangement, Principle of operation, velocity vector diagrams, thermodynamics analysis and power calculation; Factors affecting stage pressure rise work done factor; Degree of reaction and blade Efficiency and their derivation; 5 hrs Isentropic, polytropic and isothermal efficiencies Surging, choking and stalling in axial flow compressors. Characteristic curves for axial flow compressors, Flow parameters of Axial Flow Compressors like Pressure Coefficient, Flow Coefficient, Work Coefficient and Temperature rise coefficient, specific speed etc Comparison of Axial Flow Compressors with Centrifugal Compressors. Field of application of Axial Flow Compressors(5)

RECOMMENDED BOOKS

	NAME	**AUTHOR(S)**	**PUBLISHER**
1.	Thermodynamics and Heat Engines	R.Yadav	Central Publishers
2	Gas Turbine	V Ganesan	Tata McGraw-Hill

3	Gas Turbine Theory	Cohan H. and Rogers and Sarvanamuttoo	Longmans
4	Fundamentals of compressible flow with aircraft and rocket	S. M. Yahya	New Age International
5	Themodynamics: An Engineering Approach	Yunus.A.Cengel and Michael.A.Boles	McGraw-Hill Higher Education
6	Applied Thermodynamics for Engineering Technologists	T. D. Eastop and A. McConkey	Prentice Hall

Course Code	MEC-451
Course Title	Applied Thermodynamics-II Lab
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Applied Thermodynamics
Course Objectives (CO)	The experiments aims at providing practical knowledge in thermodynamics and to implement practical engineering problem.
Course Outcome	1. Understand the working ofIC Engines 2. Implement practical knowledge to improve the efficiency of IC Engines.

List of Experiments

1. Study of constructional details, cooling system, Lubrication system and Fuel Flow system of
   following Engines;
   Two stroke and four stroke Diesel engine.
   Four stroke Petrol Engine.
2. To find the mechanical and thermal efficiency of a Diesel Engine.
3. To draw the valve timing diagram for a Diesel Engine
4. Determination of B.H.P. at various loads (pump being given fixed setting not to be changed by (governor) for a Diesel Engine/Semi Diesel Engine. Graphical representation of B.H.P. and torque with speed and its interpretation.
5. Trial of a Diesel Engine/Semi Diesel Engine. Determination of B.H.P., fuel consumption ,I.H.P. and mechanical efficiency at various loads (speed parameters constant). Discussion on variation of thermal efficiency and specific fuel consumption with B.H.P.
6. To estimate the indicated power, friction power and mechanical efficiency of a multi cylinder petrol engine when running at constant speed under constant settings of a carburetor (Morse test).
7. To obtain a power consumption curve, thermal and mechanical efficiency curve for the four stroke diesel engine when tested over a range of power from no load to full load. Also to draw up the heat balance sheet for this range of output of power.
8. Study of multi cylinder diesel engine.
9. To determine dryness fraction of steam using separating and throttling calorimeters.

Course Code	MEC-402
Course Title	Mechanics of Materials-2
Type of Course	Core
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Engineering/Applied Mechanics and Calculus
Course Objectives (CO)	1. Provide clear understanding of principles, assumptions, and limitations underlying the mechanics of deformable solids in equilibrium. 2. Apply above principles to engineering design based on strength, stiffness, and stability criteria.
Course Outcome	1. Given a physical situation the student should be able to develop a physical understanding of the problem. 2. The student should be able to construct an idealized model. 3. Using equilibrium, compatibility, and force-deformation relation the student should be able to generate the solution to the problem. 4. The student should be able to analyze and design an element using the above principles.

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

PART-A

1.Stress and Strain Transformation:

Transformation of Stresses, Principal Stresses, Max. Shear Stresses, and Mohr's Circle in 2D Problems, Principal Stresses and Mohr's Circle for a General State of Stress; Transformation of Strain and Mohr's Circle for 2D Problems, Strain Rosettes. (3)

2.Yield and Fracture Criteria:

Maximum Shear-stress Theory, Maximum Distortion Energy Theory, Maximum Normal-stress Theory, Comparison of Fracture and Yield Criteria.
(2)

3.Elastic Stress Analysis:

Analysis of State of Stress in Some Basic Cases, Experimental Methods of Stress Analysis; Design for Strength of Axially Loaded Bars, Torsion Members, Prismatic Beams, Non-prismatic Beams, and Complex Members.
(3)

4.Beam Deflection:

Moment-curvature Relationship, Governing Differential Equation, Boundary Conditions, Direct Integration, Singularity Functions, Moment-area Method, Deflection by Superposition, Deflection by Unsymmetric Bending, Energy Method for Deflection and Impact, Statically Indeterminate Beams, Inelastic Bending of Beams
(3)

PART B

5. Columns:

Instability, Criteria for Stability of Equilibrium, Euler Load for Columns withDifferent End Restraints, Limitations of Euler Formula, Generalized Euler Formula, Eccentric Loads and Secant Formula, Beam Columns, Differential Equation for Beam Columns; Design of Columns loaded Concentrically and Eccentrically, Lateral Stability of Beams.
(3)

6 Strain Energy and Virtual Work:

Elastic Strain Energy and External Work, Displacements by Conservation of Energy; Virtual Work Principle, Virtual Forces for Deflections, Virtual Force Equations for Elastic Systems, Indeterminate Problems, Virtual Displacements for Equilibrium, Discrete Systems; Strain Energy and Complementary Strain Energy, Castigliano's Theorems, Indeterminate Systems, Buckling Loads. (4)

7. Elastic Analyses of Systems:

Force Method, Flexibility Coefficients, Displacement Method, Stiffness Coefficients.
(2)

8 Plastic Limit Analysis: Plastic Limit Analysis, Beams, Frames.
(2)

RECOMMENDED BOOKS

	NAME	AUTHOR(S)	PUBLISHER
1	Strength of Materials (SI Units), 3/e	G. H. Ryder	MacMillan India Ltd., 1969
2	Mechanics of Materials, 5/e	F. P. Beer, E.R. Johnston Jr.	Tata McGraw Hill Pvt. Ltd., 2009
3	Mechanics of Materials, 6/e	R. C. Hibbeler	Pearson Education India Pvt. Ltd., 2007
4	Strength of Materials,2/e	J. M. Gere, B. J. Goodno	Cengage Learning India Pvt. Ltd., 2009
5	Mechanics of Solids, 2/e	E. P. Popov	PHI India Pvt. Ltd., 2009

Course Code	MEC-452
Course Title	Mechanics of Materials-2 Laboratory
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Engineering/Applied Mechanics and Calculus
Course Objectives (CO)	The experiments aims at providing practical knowledge of the theory material covered in the Mechanics of Materials class.
Course Outcome	Students will be able to relate the mathematical models developed in theory to physical models. In addition the student will learn about how to carry out experiments, collect data, errors, and report generation.

SYLLABUS

List of Experiments

1. Study of Buckling Test
2. Study time dependent deformation with Creep test.
3. Study of wood testing machine and performance of various tests on it.
4. Experiment to find shear centre for unsymmetrical sections.
5. Experiment to determine stress distribution in thin cylindrical pressure vessels.
6. Strain Gage Demonstration
7. Photo-elasticity Demonstration

Course Code	MEC-403
Course Title	**THEORY OF MACHINES-II**
Type of Course	Core
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Theory of Machines-I
Course Objectives (CO)	To educate students on different gear and gear train mechanisms To introduce functioning of various types of cams To give knowledge about balancing and inertia forces of various engine parts
Course Outcome	1. Students will be able to design gears and understand transmission of forces 2. Students will be able to design different types of cam mechanism 3. Students will be able to understand the inertia forces involved during engine force and power transmissions 4. Students can generate various mechanisms related to lower pairs and solve engine problems related to balancing of rotating and reciprocating parts

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

Part-A

1. Inertia Forces in Mechanism

Determination of Forces and couples for a link, inertia of reciprocating parts, dynamically equivalent system. Analytical and graphical methods, inertia force analysis of basic engine 5 mechanism (crank, connecting rod and piston etc). Torque required to overcome inertia and gravitational force of a four bar linkage.

Lower Pairs: -

Universal Joint: - single and double, calculation of maximum torque, Oldham's Coupling, steering mechanism including. AcKermann's and Davis steering mechanism. Mechanisms with lower pairs, pantograph, exact and approximate straight line motion, engine indicator, elliptical 4 trammel.
Elementary knowledge of Kinematic synthesis of linkage by graphical and analytical methods.

Gyroscope:-
Definition, axis of spin, axis of precession gyroscope, gyroscopic couple, Gyroscope effect on 5 the momentum of ships and vehicle, ship stabilization, stability of automobile and locomotive taking a turn.

2. Cams
Types of cams and followers, definition – basic circle & least radius, angle of ascent, dwell, 7 descent & action. Displacement, velocity and acceleration diagrams for the followers with uniform velocity motion, simple harmonic motion, uniform acceleration and retardation, determination of maximum velocity, acceleration and retardation, analysis of follower motion for pre-specified cam profiles (tangent cams and convex cams).

Part-B

3. Balancing
Classification , need for balancing, balancing for simple and multiple masses, static and dynamic balancing – Primary and secondary balancing for reciprocating masses, inside and 7 outside the cylinder locomotive balancing, swaying couple and variation of tractive effort, partial balancing of locomotive, balancing of the coupled locomotives and its advantages multicylinder in the line engines (primary and secondary balancing conditions and their applications), balancing of V-engines balancing machines (Static balancing M/c: dynamic balancing M/c, universal balancing M/c), introduction of balancing of the flexible rotors.

4. Gears
Toothed gears are their uses, types of toothed gears (spur gears, internal spur gears, spur &rack, bevel gears, helical gears, double helical gears, spiral gears, worm gears) definitions, pitch circle diameter, pitch surface, pitch point, circular pitch, diametric pitch, module pitch, addendum, dedendum, clearance addendum circle, outside diameter, internal diameter, dedendum circle, root diameter ,base. Base circle diameter, face and flank of tooth, fillet, angle of obliquity or pressure angle, path of contact, arc of contact, arc of approach, condition for correct gearing, forms of teeth, cycloid and its teeth variants epicycloids and hypocycloid, involute methods of drawing in involute and cycloidal curves, interference in involute gears and methods of its removal, comparison of involute and cycloidal gear systems.

5. Gear Trains
Types of gear trains single and compound epicyclic gear trains, Problems involving their applications, estimation of velocity ratio of worm and worm wheel, helical and spiral gears (Determination of No. teeth, spiral angle and efficiency).

RECOMMENDED BOOKS			
	NAME	**AUTHOR(S)**	**PUBLISHER**

1.	Mechanism and Machine Theory	Ambekar A.G	Prentice-Hall of India,2007
2	Theory of Machines	S S Rattan	Tata McGraw
3	Theory of Machines	Shigley	Tata McGraw Hill

Course Code	MEC-453
Course Title	**THEORY OF MACHINES-II lab**
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Theory of Machines-I
Course Objectives (CO)	1. To educate students on different gear and gear train mechanisms 2. To introduce functioning of various types of cams 3. To give knowledge about balancing and inertia forces of various engine parts
Course Outcome	1. Students will be able to design gears and understand transmission of forces 2. Students will be able to design different types of cam mechanism 3. Students will be able to understand the inertia forces involved during engine force and power transmissions 4. Students can generate various mechanisms related to lower pairs and solve engine problems related to balancing of rotating and reciprocating parts

List of Experiments

1. Balance experimentally the given known force by introducing two weight (forces) parallel to the given force in two different planes and verify the result by analytical method.

2.Study the dynamic balancing machine & balance of a given body i.e. rotor by different methods.

3.Study the working and construction of the two types of steering gears. Draw neat sketches of each type and measure the angle in Ackerman's steering gear fined in different vehicles. Find the ratio of intersection of two arms from the front axle to the base of the vehicle.

4.Study the different types of mechanisms for tracing out the approximate straight line.

5.Find out the pressure distribution graph analytically & practically around a simple Journal bearing under variable load conditions on the shaft.

6. Balance as far as possible the known unbalance due to reciprocating parts by introducing two revolving weights in two different planes. Find out experimentally the fraction of the reciprocating pans which should be balanced so that the residual unbalance force may be least.

7.Find out experimentally the viscosity of the given fluid under varying conditions of temperature and pressure and draw the graphs - Viscosity Vs' temp. and Viscosity Vs pressure.

8.Study the electrical dynamometer and find out the maximum torque of the given m/c.

9.Study the whirling speed apparatus and calculate the critical speed of the given System.

10.Find out the Co-efficient of friction between two given materials with the concept of vibration that is the effect of C. & frequency on co-efficient of friction.

11.To study the model of an Epicyclical gear train and to determine the speed ratio.

12.To study the various tooth profiles and to generate the involute profile on a blank.

Course Code	**MEC-404**
Course Title	**Numerical Analysis**
Type of Course	Core
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	
Course Objectives (CO)	4. This course is an introduction to a broad range of numerical methods for solving mathematical problems that arise in Science and Engineering. The goal is to provide a basic understanding of the derivation, analysis and use of these numerical methods along with arudi mentary understanding of finite precision arithmetic
Course Outcome	1. Choose and apply the appropriate numerical techniques to solve engineering problems when no closed-form, analytical solution exists. 2. In addition to this, the students can interpret the results and assess accuracy. Identification and selection of machine for a specific application. 3. The students will be able to write their own MATLAB programs to implement these numerical methods to solve engineering problems.

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

SECTION-A

Error analysis:

Relative error, Absolute error, Round-off error, Truncation error, significant digits and numerical instability.(Scope as in Section 1.3, Chapter 1 of Reference 1).

(4 Hours)

Transcendental and polynomial equations:

Bisection method, Iteration Method based on first degree equation: Secant method, Regula-falsi method and Newton – Raphson methods, Rate of convergence of Secant method, Regula-Falsi method and Newton-Raphson Method. Bairestow's method to find quadratic factor of a polynomial (Scope as in corresponding topics in Section 2.3, 2.5, 2.9 of Chapter 2 of Reference 1)

(8 Hours**)**

Interpolation:
Polynomial interpolation: Finite differences, Lagrange and Newton interpolation (Forward, Backward and Divided difference methods), inverse interpolation, Hermite interpolation (Scope as in corresponding topics in Section 4.1-4.3, 4.5 of Chapter 4 of Reference 1)

(10 Hours)

SECTION-B

Solution of Linear Systems:
Gauss elimination method, Gauss-Seidel method, Cholesky's Decomposition. Matrix inversion: Gauss-Jordan method. Eigen value problem: Bounds on Eigen values (Gerschgorin and Brauer theorems), Householder's method for symmetric matrices, Power method (Scope as in corresponding topics in Section 3.2, 3.4, 3.6, 3.9, 3.11 of Chapter 3 of Reference 1).

(10 Hours**)**

Numerical Integration:
Trapezoidal Rule, Simpson's 1/3 and 1/8 rule, Romberg integration, Newton – Coates formulae (Scope as in corresponding topics in Section 5.7, 5.8 of Chapter 5 of Reference 1).

(5Hours**)**

Numerical solutions of ordinary differential equations:
Taylor's series, Euler and Runge –Kutta methods. Finite difference methods for boundary value problems (Scope as in corresponding topics in Section 6.4 of Chapter 6 of Reference 1).
(**5**Hours**)**

Functional approximation:
Chebyshev polynomials, Economization of power series, least square approximation (Scope as in corresponding topics in Section 4.9 of Chapter 4 of Reference 1).

(**3**Hours**)**

TEXT BOOKS			
S. No.	**NAME**	**AUTHOR(S)**	**PUBLISHER**
1	Numerical Methods for Scientific and Engineering Computation	M. K. Jain, S. R. K. Iyenger,R. K. Jain	New Age International Publishers
RECOMMENDED BOOKS			
1	Introduction Methods of Numerical Analysis	S. S. Sastry	Prentice Hall.
2	Computer Oriented Numerical Methods	V. Rajaraman	Prentice Hall.

Course Code	**MEC-405**
Course Title	**Manufacturing Technology-I**
Type of Course	Core
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Manufacturing Processes
Course Objectives (CO)	1. The primary objective of this course is to help the student gain the knowledge about traditional manufacturing machine like lathe, drilling, milling, grinding and welding machines. 2. To understand various tools and tool signature used on these machines.
Course Outcome	1. Identify the different components and operations of traditional machines. 2. Select and apply different manufacturing processes to machine a component.

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

SECTION-A

Metal cutting & Tool life

Basic tool geometry, single point tool nomenclature, chips-various types and their characteristics, mechanism of chip formation, theoretical and experimental determination of shear angle, orthogonal and oblique metal cutting, metal cutting theories, relationship of velocities, forces and power consumption.

Effect of operating parameters life tool geometry, cutting speed, feed depth of out, coolant, materials etc on forces temp. Tool life, surface finish etc., tool life relationship, tailor equation of tool life, tool material and mechanism.

(6Hours**)**

Centre Lathe and Special Purpose Lathes

Centre lathe, constructional features, cutting tool geometry, various operations, taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes – automats– single spindle, Swiss type, automatic screw type, multi

spindle - Turret Indexing mechanism, Bar feed mechanism.

(4Hours**)**

Shaping & Planning:

Principle, description & functions of lathe, specifications, work holding devices, tools & operations. Working principle of shaper, planer and slotter, Specification of shaper, planer and slotting machine Quick return mechanism, types of tools Speed and feed used in above processes. Commonly used cutting tool materials. **(5**Hours**)**

Milling &Drilling :

Milling; principle, types of milling machines, specifications of milling machine, Introduction to indexing, Multipoint cutting tool, Types of milling cutters. Principles, Classification of drilling machine, Different operations on drilling machine, Speed and feed in drilling.

(4Hours**)**

SECTION-B

Grinding:

Types of grinding machines.Shapes of grinding wheels.Various elements of grindingwheel.Codification and selection of grinding wheel.Balancing of wheel.Wheel dressing, loading and truing.

(6Hours**)**

Boring:

Principle of boring, classification of boring machine Specification of boring machine,boring tools, boring bars & boring heads, alignment of bores & its importance.

Broaching:

Broach, Nomenclature, cutting action of broach, Broaching operations and applications.

(7Hours**)**

Thread Manufacturing:

Screw threads: classification of threads, Elements of screw threads, specification, forms and error of screw threads; Processes of making threads, using die heads, Thread milling, thread grinding, tread tapping, Automatic screw machine.

(5Hours**)**

TEXT BOOKS			
S. No.	**NAME**	**AUTHOR(S)**	**PUBLISHER**
1	Tool Design	Cole, C. B	American Technical Society Pub
RECOMMENDED BOOKS			
1	Tool Design	Donaldson	McGraw Hill, New York
2	A Textbook of production Engineering	P.C. Sharma	S. Chand Publication

Course Code	MEC-455
Course Title	Manufacturing Technology-I lab
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Manufacturing Process
Course Objectives (CO)	1. The objective of this course is to help the student gain the knowledge and skills about traditional manufacturing machine like lathe, drilling, milling, grinding and welding machines. 2. To understand various tools and tool signature used on these machines.
Course Outcome	By the end of the course the students shall be able to 1. Identify the different components and operations of traditional machines. 2. Select and apply different manufacturing processes to machine a component.

Syllabus

List of Experiments

1. To prepare a job on lathe machine- involves turning, grooving, drilling, boring & threading operation.
2. To prepare a job on shaper machine.
3. To prepare a job on milling machine.
4. To prepare a job on drill machine- involves drilling, counter sunk & reaming operation.
5. To prepare a job involves-Grinding and thread manufacturing operation.
6. Application of sheet metal fabrication techniques.

Course Code	**MEC-406**
Course Title	**Fluid Mechanics**
Type of Course	Core
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Thermodynamics
Course Objectives (CO)	1. To understand the structure and the properties of the fluid. 2. To understand the behavior of fluids at rest or in motion and the complexities involved in solving the fluid flow problems. 3. To solve different type of problems related to fluid flow in pipes and do the prototype study of different type of machines
Course Outcome	1. Explain the concept of fluid, stability of bodies in fluid and different types of fluid flows. 2. Use Bernoulli's theorem to solve basic problems involving pressure losses through pipes and pipe bends and its application 3. Explain the importance of Dimensional Analysis techniques and dimensionless parameters in fluid mechanics; Reynolds number; Mach number. 4. Lean the concept of potential flow, viscous flow considering viscous forces

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

SECTION-A

Fluid statics:

Brief History of Fluid Mechanics, Fluid & Their properties, Viscosity, Pressure measurement, Basic equation of fluid statics, absolute and gauge pressures, Pressure measuring devices: manometers, forces on submerged surfaces, stability of floating and submerged bodies.

Fluid kimematics:

Flow Kinematics, Concepts of streamline, streaklineetc, Velocity, Acceleration, , circulation, vorticity and rotation, Irrotational flow, velocity potential, stream function, Continuity Equation.

Fluid dynamics:
Euler's equation, Reynolds transport theorem, momentum and energy equation, Bernoulli's equation and its application: venturimeter, orifice, mouth pieces, weirs and notches, linear momentum equation and its applications, moment of momentum equation, Dimensional homogeneity, dimensionless parameters, similitude and model studies.

SECTION-B

Viscous flow:
Equation of motion for laminar flow through pipes: Hagen Poiseuille formula, Flow between parallel flat plates, couette flow, Plane Poiseuille flow, Flow through pipes, minor and major losses, Transition from laminar to turbulent, Reynolds experiment, Eddy viscosity, Mixing length concept.

Boundary layer concepts:
Introduction to boundary layer and its characteristics, Momentum equation foe boundary layer by Von Karman , Laminar boundary layer, Turbulent boundary layer, Total drag due to laminar and turbulent layers, boundary layer separation and its control .

Compressible flow:
Compressibility, Mach number, Areal velocity relation, isentropic relations, 1-D compressible flow, Normal Shock.Introduction to wind tunnels.

TEXT BOOKS			
S. No.	**NAME**	**AUTHOR(S)**	**PUBLISHER**
1	Fluid Mechanics	Frank M White	Tata McGraw Hill
2	Introduction to Fluid Mechanics	James A Fay	PHI Learning, Eastern Economy Edition.
RECOMMENDED BOOKS			
1	Fluid Mechanics	Yunus A Cengel, John M. Cimbala	Tata McGraw Hill
2	Fluid Mechanics	V. L. Streeter,	Tata McGraw-Hill Education
3	Fluid Mechanics and Its Applications	V. K. Gupta et.al.	Wiley Eastern, New Delhi

Course Code	MEC-456
Course Title	Fluid Mechanics lab
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50

Syllabus

List of Experiments

1. To verify Bernoulli's theorem.

2. To calibrate a venturimeter and to determine its coefficient of discharge.

3.To calibrate an orifice meter and study the variation of the coefficient of discharge with the Reynolds number

4.To study the flow over V- notch (weir) and Rectangular notch and to find their coefficient of discharge.

5. To determine the metacentric height of a ship model.

5. To determine the friction coefficients for pipes of different diameters.

8. To determine the head loss in a pipe line due to sudden expansion/ sudden contraction/ bend.

9. To determine the velocity distribution for pipeline flow with a pitot static probe.

10. Experimental evaluation of free and forced vortex flow.

Course Code	**MEC-501**
Course Title	**Design of Machine Elements-I**
Type of Course	Core
L T P	3 0 0
Credits	3
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Applied Mathematics, Engineering Mechanics, Mechanics of Materials
Course Objectives (CO)	1. Develop the ability to analyze and evaluate the different loads and stresses acting on a machine element. 2. Understand the various failure modes of the element. 3. Apply the basic principles of mechanics to design the machine element which can meet the desired needs.
Course Outcome	1. Ability to design and analyze both permanent joints (riveted, welded, etc.) and temporary joints (Bolts, keys, cotter, knuckle)under concentric and eccentric loading conditions. 2. Ability to analyze and design keys, power transmission shafts (carrying various elements like pulleys, gears etc) and couplings. 3. Ability to design and analyze power screws & screw jack. 4. Ability to design and analyze machine elements like flywheel , levers , pipes and pipe joints..

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.****Use of design data book is not allowed.***

SECTION-A

Introduction:

Scope and meaning of design with special reference to machine design, design process, codes and standards, economic aspects of design, safety aspects of design. Stress and strength, Design factors and Factors of safety, Concept of tearing, bearing, shearing, crushing, bending ,torsion ,deflection and stiffness. Basic criteria of selection of

material, mechanical properties of materials,Failures resulting from static loading, stress concentration, methods of avoiding stress concentration, Introduction to fatigue in metals, mechanism of fatigue failure, S-N diagram, endurance limit, Fatigue strength, Endurance limit modifying factors ,Fatigue stress concentration factor and notch sensitivity, characterizing fluctuating stresses, Failure Loci under variable loading.

(4Hours**)**

Design of fasteners:

Riveted Joints: Types of failures of riveted joints, strength and efficiency of a riveted joint, design of butt and lap joints of a boiler, design of Lozenge joint, design of eccentrically loaded riveted joints.

Welded Joints: Types of welded joints, strength of a welded joint, design of welded joints for various loading conditions in torsion, shear or direct loads, design of eccentrically loaded welded joints

Threaded Joints: Thread standards and definitions, Basic types of screw fastening, Bolt strength, Statically loaded tension joints-Preload, Design of eccentrically loaded bolted joints.

Design of spigot and socket cotter joint, gib and cotter joint and knuckle joint.

(6Hours**)**

Design of shafts and axles:

Design of solid and hollow shafts for transmission of torque, bending moments and axial forces, Design of shaft for rigidity, critical speed.

(5Hours**)**

Design of keys and couplings:

Types of keys, effect of keyway on strength of shaft, design of keys under different loading conditions. Types of couplings, design of sleeve coupling, clamp coupling, flange coupling and pin type flexible coupling.

(5Hours**)**

SECTION-B

Design of Levers:

First, second and third types of levers, Design of hand lever, foot lever, bell crank lever, safety valve lever.

(5Hours**)**

Power Screws:

Various types of threads used in power screw drives, conditions for self-locking and overhauling, efficiency of power screw drives, stresses developed in screws, design procedure for power screw drives like screw jack etc.

(6Hours**)**

Pipes and Pipe Joints:

Design of pipes, design of circular, oval and square flanged pipe joints.

(4Hours**)**

Pipes and Pipe Joints:

Design of pipes, design of circular, oval and square flanged pipe joints.

(5Hours**)**

TEXT BOOKS			
S. No.	**NAME**	**AUTHOR(S)**	**PUBLISHER**
1	Design of Machine Members	Vallance and Doughtie	McGraw Hill, New York
2	Mechanical Engineering Design	Shigley and Mishke	Tata McGraw Hill, New Delhi,
RECOMMENDED BOOKS			
1	Machine Design	P.C.Sharma&D.K.Aggarwal	S.K.Kataria and Sons, New Delhi
2	Machine Design: An integrated Approach	Robert L. Norton	Pearson Education
3	Design of Machine Elements	Bhandari	Tata McGraw Hill, New Delhi,

Course Code	MEC-551
Course Title	Design Of Machine Elements-I Practice
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Engineering Mechanics , Mechanics of Materials, Engineering Drawing
Course Objectives (CO)	1. The Design assignments aim at providing application of the basic principles of mechanics to design the various machine elements considering the static and dynamic strength parameters.
Course Outcome	1. Apply different theories of failure to design machine elements like permanent joints (riveted, welded, etc.) , detachable joints (bolts, keys, cotter, knuckle etc.),shafts, couplings, levers, pipe joints, IC engine parts(cylinder, piston and connecting rod) and power screws. 2. Prepare a working drawing of the machine element showing dimensions, tolerances, surface finish grades and special production requirements like heat treatment etc.

Syllabus

Design assignments to be given so as to cover the syllabus outlined in MEC 501

Course Code	**MEC-502**
Course Title	**Computer Aided Design & Manufacturing**
Type of Course	Core
L T P	3 0 0
Credits	3
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Manufacturing Technology
Course Objectives (CO)	1. To introduce the student to the basic concepts of computer-aided design (CAD) and computer-aided manufacturing (CAM). 2. To expose the student to contemporary computer design tools for mechanical engineers. 3. To prepare the student to be an effective user of a CAD/CAM system.
Course Outcome	1. Understand the role of CAD/CAM in modern design and manufacturing. 2. Knowledge about the concept of Geometric modeling and understanding of various geometrical transformations. 3. Knowledge about the representations and manipulations of various curves, surfaces and solids. 4. Understand the concepts of the NC, CNC and DNC machines and able to select the appropriate code for performing particular tasks in these machines.

SYLLABUS

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SECTION-A

Introduction:
The Design Process, Application of computers for design, definition of CAD, CAM and CIM, benefits of CAD, CAM, Automation and types of automation**.**

(4Hours**)**

Geometric Modeling:
Introduction & need of geometric modeling, types: wire frame, surface and solid model, coordinate systems, Geometric Modeling techniques. Use of geometric modeling.

(6Hours**)**

Transformations:
2D and 3D Transformations, coordinate system used in transformations, Homogeneous transformation, translation, rotation, scaling, reflection and shear transformation, concatenated transformations, 3D visualization.

(5Hours**)**

Curves:
curve entities, curve representation, analytic curves – lines, circles, ellipses, parabolas, hyperbolas, conics, synthetic curves, hermite cubic spline, bezier curve and B-spline curve.

(5Hours**)**

SECTION-B

Surfaces:
Surface entities, representation and analysis, analytic surface surface of revolution.

(4Hours**)**

Solids:
Solid models and representation scheme, boundary representation, constructive solid geometry, sweep representation.

(5Hours**)**

NC words:
Introduction, CNC, DNC and Adaptive Control, Classification of CNC machines, Co-ordinate Systems, Components of CNC machine, turning and machining center.

(5Hours**)**

NC part programming:
Introduction and basic terms of part programming, description of codes, G code, M code, programming for 2D and 3D jobs. Canned cycles, Loops and Subroutines programming, computer aided part programming.

(6Hours**)**

TEXT BOOKS			
S. No.	**NAME**	**AUTHOR(S)**	**PUBLISHER**
1	Mastering CAD/CAM	Ibrahim Zeid	McGraw Hill
2	Computer Aided Design & Manufacture	Zimmer &Groover	Prentice Hall of India
RECOMMENDED BOOKS			
1	Principles of Computer Aided design and Manufacturing	FaridAmirouche	Prentice Hall of India
2	CNC programming	B S Pabla	New Age Publishers
3	Computer Aided Manufacturing	Rao	Tata McGraw Hill Publishing

Course Code	MEC-552
Course Title	**CAD/CAM Lab**
Type of Course	Core
LTP and Credits	0,0,2 and 1 credits
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Manufacturing Technology
Course Objectives(CO)	1. To introduce the student to the basic concepts of computer-aided design (CAD) and computer-aided manufacturing (CAM). 2. To expose the student to contemporary computer design tools for mechanical engineers. 3. To prepare the student to be an effective user of a CAD/CAM system.
Course Outcomes	1. Understanding of various geometrical transformations. 2. Representations and manipulations of various curves, surfaces and solids. 3. Knowledge about the modelling of various mechanical parts in CAD software. 4. Understanding the basic part programming and computer aided part programming

Syllabus

List of Experiments

1. Write code to generate a circle, an ellipse and a tabulated cylinder.
2. Implement simple programmes for the graphics representation of
   a) Various transformation, ,
   b) Cubic & splines curves/Surfaces.
3. CAD Modeling
   1. Simple machine parts and components construction using Inventor/ pro E/ other 3D modeling package
   2. Mechanical assembly of the parts.
4. Part programming using G and M codes and NC code generations.

Course Code	**MEC-503**
Course Title	**Robotics**
Type of Course	Core
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Robotics
Course Objectives (CO)	1. This course focuses on the design, modeling, fabrication, and control of miniature mobile robot and micro/nano-manipulation systems for graduate and upper level undergraduate students. 2. It provides an overview of the state-of-the-art micro- and nanoscale sensors, actuators, manipulators, energy sources, robot design, and control methods.
Course Outcome	By studying this course, students will 1. Familiar with the history, concept development and key components of robotics technologies. 2. Understand basic mathematic manipulations of spatial coordinate representation and transformation. 3. Understand and able to solve basic robot forward and inverse kinematics problems.

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

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SECTION-A

Fundamentals of Robot

Robot degrees of freedom, robot parts: base, end effectors, drives, joints, classification, characteristics and applications of Robots.

(4Hours**)**

Spatial Descriptions and Transformations

Robot kinematics, Inverse of transformation matrices, Conventions for affixing frames to

Links.

(6Hours**)**

Inverse Manipulator Kinematics
Solvability, Algebraic versus Geometric solutions, reduction to polynomial solution, Pieper's solution, Examples of inverse manipulator kinematics.

(6Hours**)**

Jacobians: Velocities and Static forces
Differential relationships, Jacobians, Differential motions of a robot and its hand frame.

(6Hours**)**

SECTION-B

Manipulator Dynamics
Dynamic equations for multiple degree of freedom robots, Langrangian mechanics, effective moment of inertia.

(6Hours**)**

Trajectory Planning
Joint space vs. Cartesian-space descriptions, Joint space trajectories, Cartesian spacetrajectories.

(6Hours**)**

Sensors & Manipulator Mechanism Design
Robot sensors: proximity, range, force, tactile, visual, auditory sensors. Kinematicconfiguration, actuation schemes, stiffness and deflections, position sensing, forcesensing.

(6Hours**)**

Robot Programming
Methods of robot programming, Types of Programming, Robot programmingLanguages.

(4Hours**)**

TEXT BOOKS			
S. No.	**NAME**	**AUTHOR(S)**	**PUBLISHER**
1	Introduction to Robotics	J. J. Craig	Addison Wesley Publishing Co
RECOMMENDED BOOKS			
1	Robotic Engineering	Richard D. Klafter	Negini Prentice-Hall
2	Fundamentals of Robotics	Robert J. Schlling	PHI

Course Code	MEC-553
Course Title	Robotics lab
Type of Course	Core
LTP and Credits	0,0,2 and 1 credits
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Robotics
Course Objectives(CO)	1. This course will explore design and control of biologically inspired robots. 2. To know the locomotion principles of many robotic platforms like pick and place, mobile robots , legged robots
Course Outcomes	By studying this course, students will 1. understand and able to solve basic robot forward and inverse kinematics problems. 2. understand and able to solve basic robotic dynamics, path planning and control problems 3. able to undertake practical robotics experiments that demonstrate the above skills.

Syllabus

List of Experiments

1. Study of different types of robots based on configuration and application.
2. Study of different type of robotics links and joints.
3. Study of components of robots with drive system and end effectors.
4. Determination of maximum and minimum position of links.
5. Verification of transformation (Position and orientation) with respect to gripper and
   world coordinate system.
6. Estimation of accuracy, repeatability and resolution..
7. Robot programming exercises on Pick and place , Painting, welding, polishing, gluing, stacking and drilling.

Course Code	**MEC-504**
Course Title	**Mechanical Measurement**
Type of Course	Core
L T P	3 0 0
Credits	3
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Applied Mathematics, Basic Fluid Flow and Strength of Materials
Course Objectives (CO)	1. To educate students on different measurement systems and on common types of errors 2. To introduce different types of sensors, transducers and strain gauges used for measurement. 3. To give knowledge about thermocouples, thermometers and flow meters used for measurements 4. To introduce measuring equipment's used for linear and angular measurements. 5. To familiarize students with micro and nano scale measurements
Course Outcome	1. Students will be able to design sensors and transducers used for stress analysis. 2. Students will be able to design measuring equipment's for the measurement of temperature and flow measurements. 3. Students will be able to calibrate instruments.

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

SECTION-A

General Concept:

Need and classification of measurements and instruments: basic and auxiliary functional elements of a measurement system; Mechanical vs. electrical/electronic instruments, primary, secondary and working standards.

(2Hours**)**

Static and Dynamic Characteristics of Instruments:

Range and span, accuracy and precision, calibration, hysteresis and dead zone, sensitivity and linearity, threshold and resolution: speed of response, lag, fidelity and dynamic error, dead time and dead zone.

Zero, first and second order systems and their response to step, ramp and sinusoidal input signals

(5Hours**)**

Error in measurements:

Sources of errors, systematic and random errors. Statistical analysis of test data.

(3Hours**)**

Functional elements:

Review of electro-mechanical sensors and transducers – variable resistance, inductance and capacitive pickups, photo cells and piezo-electric transducers, and application of these elements for measurement of position/displacement, speed/velocity/acceleration, force and liquid level etc. Resistance strain gauges, gauge factor, bonded and unbonded gauges, surface preparation and bonding techniques, signal conditioning and bridge circuits, temperature compensation, application of strain gauges for direct, bending and torsional loads.

(7Hours**)**

SECTION-B

Pressure and Flow Measurement:

Bourdon tube, diaphragm and bellows, vacuum measurement-Mecleod gauge, thermal conductivity gauge and ionization gauge; Dead weight pressure gauge tester.

Electromagnetic flow meters, ultra-sonic flow meters and hot wire anemometer: Flow visualization techniques.

(5Hours**)**

Temperature Measurement:

Thermal expansion methods- bimetallic thermometers, liquid-in-glass thermometer and filled-in-system thermometers; thermo-electric sensors-common thermo couples, reference junction considerations, special materials and configurations: metal resistance thermometers and thermistors; optical and total radiation pyrometers; calibration standards.

(5Hours**)**

Speed, Forces, Torque and Shaft Power Measurement:

Mechanical tachometers, vibration tachometer and stroboscope; proving ring, hydraulic and pneumatic load cells, torque on rotating shafts, Different types of Dynamometers: electrical and mechanical.

(4Hours**)**

Measurement Systems Applied to Micro & Nanotechnology.

Micro scale sensors, Micro-Motion-Positioning Systems, Particle Instruments and Clean – Room Technology, Magnetic Levitation Systems for Wafer Conveyors, Scanning- Probe Microscope Bibliography

(3Hours**)**

TEXT BOOKS			
S. No.	**NAME**	**AUTHOR(S)**	**PUBLISHER**
1	Measurement System: Application and Design	Doebelin E.O	McGraw Hill Publishing Company.
RECOMMENDED BOOKS			
1	Experimental Method for Engineers	Holman, J. P	McGraw Hill Publication Company
2	Mechanical Measurement and control	Kumar, D,S	Metropolitan Book Co. Pvt. Ltd., New Delhi.

Course Code	MEC-554
Course Title	Mechanical Measurement lab
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Applied Mathematics, Basic Fluid Flow and Strength of Materials
Course Objectives (CO)	1. Familiarize students with various calibration devices Basic understanding of thermocouples Provide students hands on exposure to pressure sensors and load cells
Course Outcome	1. Students will be able to understand basic functioning of transducers 2. Students will be able to learn principles of calibration

Syllabus

List of Experiments

1. Measurement of the area of an object by using a planimeter.
2. Calibration of Pressure-gauge with the help of a dead weight gauge tester.
3. Measurement of temperature using thermistor, thermocouple, resistance temperature detector.
4. Measurement of speed by photoelectric pick up, electromagnetic pick up, proximity type sensors.
5. Measurement of light intensity by LDR, photo voltaic cell, photo diode.
6. Measurement of linear displacement by linear motion potentiometer, servo potentiometer, LVDT, inductive pick up, capacitive pick up.
7. Measurement of load using load cell.
8. Measurement of strain using strain gauge.
9. Measurement of pressure using pressure cell.
10. Measurement of water level by capacitive transducer.

Course Code	**MEC-505**
Course Title	**Manufacturing Technology-II**
Type of Course	Core
L T P	3 0 0
Credits	3
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Manufacturing Processes, MT-I
Course Objectives (CO)	1. The primary objective of this course is to help the student gain the knowledge about various, manufacturing processes and materials.
Course Outcome	By the end of the course the students shall be able to 1. Identify and select a technique for the manufacturing of an industrial component. . 2. Design and select appropriate work holding jigs, fixture.

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

SECTION-A

Powder Metallurgy

Definition and classification , of metal powder, advantages and limitation, metal powder product, method of producing powders, briquetting and sintering, hot iso-static Processing , sizing and finishing operation.

(2Hours**)**

Gear Cutting

Introduction, Advantages and disadvantages, Types of gear, Forms of gear teeth, Gear teeth terminology, Methods of making gears, gear manufacturing by casting, Template methods, Gear shaper process, rack planning process, Hobbing process, Bevel gear cutting, Cutting worm and worm wheel, gear finishing.

(5Hours**)**

Press and Press work

Introduction, Types of process, Power press parts, Power press driving Mechanism, press size, Press tools, Methods of punch support, die Accessories.

(3Hours**)**

Jigs and Fixture Design

Principles of jig and fixture design, Principles of Degrees of Freedom, Method of location and clamping, Various devices for location and clamping, Indexing devices, Hydraulic and pneumatic actuation of clamping devices, Jig bushes, Use of standard parts for jig design, types of drilling jigs, Milling fixtures, Lathe fixtures, Grinding fixtures and their classification.

(6Hours**)**

SECTION-B

Die Design

Components of die design, design of die blocks, punches and strippers, methods of holding punches, sketches of stock stops. Design procedure for progressive dies, compound dies and combination dies for press tool operation, Forging die design for drop and machine forging parts.

(5Hours**)**

Manufacturing of Plastic Components:

Types of plastics; Characteristics of the forming and shaping processes; Moulding of Thermoplastics; Working principles and typical applications of Injection moulding , Plunger and screw machines, Compression moulding, Transfer moulding;; Typical industrial applications; Introduction to Blow moulding, Rotational moulding.

(6Hours**)**

Metal Finishing and Coating:

Purpose of super finishing, surface roughness. Introduction of Honing, Lapping Polishing, Buffing and super-finishing. Metal Spraying. Metal Coating; galvanizing, electro-plating and anodizing.

(3Hours**)**

Economics of metal machining & Multi edged tools:

Element of machining cost, tooling economics, machines economics and optimization. Broach tools-types materials and applications, geometry of twist drills, thrust torque and power calculation in drills, form tools-application.

(4Hours**)**

TEXT BOOKS			
S. No.	**NAME**	**AUTHOR(S)**	**PUBLISHER**
1	Principles of Manufacturing Materials and Process	Cambell.	Tata McGraw Hill
RECOMMENDED BOOKS			
1	Manufacturing Process	Chapman	& IBM Publications: Chapman

2	Manufacturing Process	P.C. Sharma	S. Chand Publication

Course Code	MEC-555
Course Title	Manufacturing Technology -II lab
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Manufacturing Processes, Mt-1
Course Objectives (CO)	The primary objective of this course is to help the student gain the knowledge about various manufacturing processes and materials.
Course Outcome	By the end of the course the students shall be able to 1. Identify and select a technique for the manufacturing of an industrial component. 2. Design and select appropriate work holding jigs, fixture.

Syllabus

List of Experiments

1. To study various processes of powder metallurgy
2. To study the different processes of gear manufacturing
3. To study the power press driving mechanism
4. To study the working principle of Jig and Fixture design
5. Explain the design procedure for progressive dies, compound dies and combinations dies.
6. To prepare a job by using the different types of molding
7. To study the different types of metal finishing processes.

Course Code	**MEC-506**
Course Title	**Fluid Machinery**
Type of Course	Core
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Basic knowledge of thermodynamics and fluid mechanics is required.
Course Objectives (CO)	The objectives of the course 1. understand the fundamental thermo- and fluid-dynamic behavior of fluid machinery, 2. give detailed descriptions of the main elements and applications of fluid machinery, 3. understand the basic blade row aerodynamics and their influence on the machinery operating conditions
Course Outcome	The students are able to 1. Explain principles of hydraulic machines and turbines 2. Estimate the performance of Impulse and Reaction turbine 3. Solve the efficiency of centrifugal and reciprocating pumps 4. Performance analysis of hydraulic machines and Identify the various hydraulic control devices.

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

SECTION-A

Principles of Hydraulic Machines & General Study of Hydro Power Plants:

Force of Jet on stationery, moving flat and curved plates, flow over radial, vanes, velocity triangles, Determination of power. Different types of runners, classification of Hydraulic Power and turbines (General description)

Impulse Turbine :
Description of Pelton impulse turbine, design of Pelton turbines such as number of jets, number of buckets, depth and width of buckets, velocity diagrams, jet ratio, power and efficiency.

Reaction Turbines:
Description of Francis, Kaplan Turbines, velocity diagrams, speed ratio, flow ratio, degree of reaction as applied to Kaplan and Francis turbines, cavitation. Governing of Turbines: Description of oil pressure governor, double regulation of impulse and reaction turbines. Draft Tube: Description, function and simple problems.

SECTION-B

Centrifugal Pumps:
Brief description and classification of Centrifugal pump (Radial flow, Axial flow, Mixed flow, Single Stage Multistage). Priming and priming devices, Velocity triangles, work done, pressure rise, various efficiencies, Minimum starting speed, impeller diameter.

Dimensional Analysis and Performance of Hydro Machines:
Derivation of equations for Reynolds, Froude Euler, Mach, and Weber numbers from ratio of forces. Buckingham Theorem and its practical applications to turbines and pumps. Derivation of various dimensionless, specific and unit quantities for turbines and pumps by application of Buckingham theorem. Characteristics curves of turbine and pumps.

Reciprocating Pumps
Slip and coefficient of discharge, Effect of acceleration on pressure in suction and delivery pipes, Air vessels (work saved by air vessel on suction and delivery pipe) Comparison with centrifugal pumps.

Hydraulic Devices :
Construction, operation and applications of simple and differential hydraulic accumulator, intensifier, fluid coupling and torque converter, Air lift and jet pumps; gear pump, vane and piston pumps, Hydraulic Rams

TEXT BOOKS			
S. No.	**NAME**	**AUTHOR(S)**	**PUBLISHER**
1	Fluid Mechanics and Fluid Power Engineering	D. S. Kumar	Katson Pub. House, Ludhiana,
RECOMMENDED BOOKS			
1	Fluid Machinery The Technology of Fluid Power	Willam W. Reves	Prentice Hall of India, New Delhi

2	Hydraulic & Fluid Mechanics	J. Lal	Metropolitan Book Co New Delhi, DhanpatRai& Sons
3	Fluid Machinery The Technology of Fluid Power	Willam W. Reves	Prentice Hall of India, New Delhi.

Course Code	**:**	**MEC-556**
Course Title	**:**	**Fluid Machinery Lab**
Type of Course	**: Core/Optional**	Core
LTP and Credits	**:**	0 0 2 and 1
Course Assessment Methods **Continuous Assessment** (Practical Performance, report writing and Viva voce)		50Marks

Syllabus

List of Experiments

1. Determination of various efficiencies of Hydraulic Ram.
2. To draw characteristics of Francis turbine.
3. To study the constructional features of reciprocating pump and to perform test on it for determination of pump performance.
4. To draw the characteristics of Pelton Turbine.
5. To draw the various characteristics of Centrifugal pump.
6. Determine the effect of vane shape and vane angle on the performance of centrifugal fan

MEC-557: VOCATIONAL TRAINING-I after 4th Semester

Each student shall attend 4 weeks training after 4th semester in Mechanical Industry, National/International level technical institute/research organization.

Course Code	**CS-506**
Course Title	**Principle of Designing**
Type of Course	ELECTIVE
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Objectives (CO)	1. Conceptualisation and development of innovative, commercially important and socially sound decisions related to engineering products, processes and systems. 2. To train students to translate academic developments in electronics, computational, materials and energy engineering to real life applications of interest to industry for accelerated start of career.
Course Outcome	On completion of this course, a student must be able to 1. Develop and design engineering products that are commercially and socially viable. 2.Develop real-time applications using engineering design.

Syllabus

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

SECTION-A

Introduction to designing

Fundamentals of engineering designs and applications; social, economic, sustainability, environmental and aesthetic rationales in design engineering, design decisions related to competitiveness of products, processes, services and systems. Impact of product design on business and market, product portfolio development through continuity in designing.

Managing technologies and innovations

Technology road mapping, market and trend analyses for design decisions, managing technology and innovations, protecting designs by intellectual property rights, IPR gap analysis, creative thinking, technology sharing and transfer, founding start up companies, raising seed funding, challenges of conceiving, creating and growing a new venture.

Design process

Principles, tools and strategies for conceptualising the need and presenting designs - product specifications, digital tools, analog drawings, design modelling: mathematical modeling, simulation using computers, and creation of 2D and 3D scale models. Engineering fundamentals related to mechanical, electrical, electronic and computational concepts in designing; environmental, sustainability, life cycle analysis, upstream manufacturing economics and downstream assembly, distribution, recyclability, robustness, maintenance and safety aspects in design development; functional prototypes, iterations, validation of product concept, product development .

SECTION-B

Materials in Engineering Designs

Mechanical and structural properties of materials, application related needs, stress analysis and fracture, heat transfer, conductivity, transparency, surface properties etc. Nanomaterials, transparent ceramics, polymers, biocompatible materials, composites for biomechanical applications. Case studies through examples and minor projects on designing materials for dental restorative applications, energy harvesting technologies and transparent ceramics.

Computational Designs

Theory and applications of computational design and manufacturing methods, use of tools like, computer aided design, computer aided engineering, computer aided manufacturing, Digital image capture and reconstruction, additive and subtractive manufacturing using CAD CAM, milling and 3D approaches. Examples by case studies and minor projects for designing prosthetics and orthosis.

Challenges of Energy in Engineering Designs

Energy source, quality, costing, storage, utilisation, conservation and sustainability in engineering designs. Examples by case studies and minor projects on small energy capture, storage and management technologies.

Smart Systems in Engineering Designs

Smart system technologies, real time sensing and communication, embedded intelligence, designing for internet of things, data acquisition and hardware interfacing and robotics. Case studies and minor projects related to devices for visually and hearing challenged individuals, traffic sensing and information analysis.

Suggested Books

1. Michael Luchs, Scott Swan, Abbie Griffin, 2015. Design Thinking. 405 pages, John Wiley & Sons, Inc (ISBN 978-1-118-97180-2)
2. Geoffrey Boothroyd, Peter Dewhurst and Winston A Knight, 2011. Product Design for Manufacture and Assembly. CRC Press.
3. Nigel Cross, 2008. Engineering Design Methods: Strategies for Product Design. Wiley & Sons (ISBN 978-0-470-51926-4)
4. Richard G Budynas and J Keith Nisbett, 2010. Mechanical Engineering Design. . Mc Graw Hill (ISBN 978-0-07-352928-8).

Course Code	MEC 601
Course Title	DESIGN OF MACHINE ELEMENTS-II
Type of Course Core/Optional	Core
L T P	3-0-0
Credits	3
Course Assessment Methods End semester Assessment (University Exam) Continuous Assessment (Sessional)	 50 marks 50 marks
Course Prerequisites	Applied Mathematics, Engineering Mechanics, Mechanics of Materials
Course Objectives(CO)	Student will be able to: 1.Develop the ability to analyze and evaluate the different loads and stresses acting on a machine element. 2.Understand the various failure modes of the element. 3.Apply the basic principles of mechanics to design the machine element which can meet the desired needs.
Course Outcomes	1.Ability to design and analyze different types of flexible drives (belt drive, rope drive and chain drive) and rigid drives (spur gear, helical gear, bevel gear and worm gear drive) 2.Acquaintance with the working of sliding and rolling contact bearings& ability to design them. 3.Familiarity with different types of springs and spring terminology &ability to design and analyze coil springs (compression, tension, torsion) 4.Ability to design &analyze different types of clutches and brakes I.C engine parts like piston, cylinder and connecting rod.

Syllabus

- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part. Use of design data book compiled by PSG college of Engg. & Tech., Coimbatore or Design Data hand book by K Mahadevan and Reddy(CBS Publisher) is allowed in Examination.

PART-A

1 Introduction:
Types of mechanical drives and their applications. Factors influencing the choice of a mechanical drive.

2 Belt and Rope Drives:
Types of belt drives, design of flat belt drive, design of V-belt drive including selection of V-belt, design of wire rope drive including selection of rope, design of pulleys for a flat belt drive.

3 Chain Drives:
Design of chain drive including selection of chain.

4 Gear Drives:
Design details of spur, helical and bevel gear drives, design of worm and worm wheel drive.

5 Bearings:
Classification of bearings, types of sliding contact bearings, properties requirements of sliding contact bearing materials, hydrodynamic lubricated bearings, terms used in hydrodynamic journal bearings, bearing characteristic number, bearing modulus, coefficient of friction, Sommerfield number and critical pressure for journal bearings, heat generated in a journal bearing, design of journal bearings, bearing caps and bolts, design of foot-step bearings. Types of rolling contact bearings, materials of ball and roller bearings, basic static load rating, static equivalent load, life of a bearing, basic dynamic load rating, dynamic equivalent load, dynamic load rating under variable loads, selection of radial ball bearings, lubrication of ball and roller bearings. Comparison of sliding contact bearings and rolling contact bearings.

PART-B

6 Springs:
Types of springs, materials for helical springs, terms used in helical springs, end connections for compression helical springs and tension helical springs, design of helical springs of circular wire based upon stress, deflection, eccentric loading, buckling, surge, energy stored and fatigue loading, design of helical springs of non-circular wire based upon stress and deflection, design of spring based systems having springs in series, parallel and concentric or composite arrangements, design of helical torsion springs, design of flat spiral springs. Materials for leaf springs, nipping in spring leaves, design of leaf springs.

7 Clutches:
Types of clutches, design of plate clutch under uniform pressure case and uniform wear case, design of cone clutch under uniform pressure case and uniform wear case, design of centrifugal clutch

8 Brakes:
Types of brakes, design of single shoe brake, double shoe brake, pivoted shoe brake, simple band brake, differential band brake, band and shoe brake, concept of self-energizing and self-locking brakes, design of internal expanding shoe brakes.

9 I.C. Engine Parts:

Design of Piston, cylinder and connecting rod.

Recommended books			
S.NO.	**NAME**	**AUTHOR(S)**	**PUBLISHER**
1	Design of Machine Members	Vallance and Doughtie	McGraw Hill, New York
2	Mechanical Engineering Design	Shigley and Mishke	Tata McGraw Hill, New Delhi,
3	Machine Design	P.C.Sharma&D.K.Aggarwal	S.K.Kataria and Sons, New Delhi
4	Machine Design: An integrated Approach	Robert L. Norton	Pearson Education
5	Design of Machine Elements	Bhandari	Tata McGraw Hill, New Delhi,

Course Code	MEC-651
Course Title	Design Of Machine Elements-II Practice
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Engineering Mechanics , Mechanics of Materials, Engineering Drawing
Course Objectives (CO)	1. The Design assignments aim at providing application of the basic of mechanics to design the various machine elements considering the static and dynamic strength parameters.
Course Outcome	Students will be able to 1. Apply different theories of failure to design machine elements likedifferent mechanical drives(Belt Chain and Rope Drives, Gear Drives),bearings, flywheel, Clutches, Brakes, Springs. 2. Prepare a working drawing of the machine element showing dimensions, tolerances, surface finish grades and special production requirements like heat treatment etc.

Syllabus

List of Experiments

1.Design of flat belt drive.
2.Design of V-belt drive.
3.Design of rope drive.
4.Design of pulleys.
5.Design of chain drive.
6.Design of spur gear drive.
7.Design of helical gear drive.
8.Design of bevel gear drive.
9.Design of worm and worm wheel drive.
10.Design of journal bearings.
11.Exercise on selection of rolling bearings.
12.Design of flywheels.
13. Design of clutches.
14.Design of brakes.
15.Design of helical springs.
16.Design of leaf springs

Course Code	MEC- 602
Course Title	FINITE ELEMENT METHODS
Type of Course	Core
L-T-P	3-0-0
Credits	3
Course Assessment Methods End semester Assessment (University Exam) Continuous Assessment (Sessional**)**	 50 marks 50 marks
Course Prerequisites	Strength of Materials/Mechanics of Materials
Course Objectives(CO)	1. This course aims at providing fundamental knowledge in finite element analysis. 2. The course will present systematic approaches for the derivation of various finite elements and solution of the discritized governing equations. 3. Practical aspects of finite elements analysis such as mesh generation will also be presented.
Course Outcomes	1. Understand the basic theory behind the finite element method. 2. Develop finite element formulations for 1-D, 2-D and axi-symmetric elements and solve them after applying various boundary conditions. 3. Understand the use of basic finite elements for structural applications using truss, beam, frame and plate elements. 4. Knowledge about the use of finite element methods to solve dynamic problems.

Syllabus

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

PART-A

1 Introduction:

Background of continuum mechanics and FE methods; Range of applications of FE methods; stresses; equilibrium; boundary conditions; strain-displacement relations; stress-strain relations;

temperature effects; Principle of virtual work; Principle of minimum potential energy; Galerkin's method; Saint Venant's principle; Von Mises stress; Overview of the software used for FE methods; Advantages and disadvantages of FE methods; Future of FE methods. (6)

2 Discretization of the domain:
Types of elements; location of nodes; number of elements; simplification offered by physical configuration of body; node numbering scheme. (4)

3 One & Two Dimensional Problems:
Introduction; Coordinates and shape functions; Potential energy approach; Galerkin Approach; Assembly of the global stiffness matrix and load vector; FE equations and treatment of boundary conditions; Quadratic shape functions; Two dimensional problems using constant strain triangles. Quadrilateral elements. (6)

4 Axisymmetric solids subjected to axisymmetric loadings:
Axisymmetric formulation; FE modeling using triangular element; problem modeling and boundary conditions. (4)

PART-B

5 Static Analysis:
Plane and three dimensional Trusses; Assembly of global matrix for the banded and skyline solutions; Beams and frames under various boundary conditions. (6)

6 Dynamic Analysis:
Formulation for solid body with distributed mass; Element mass matrices; Evaluation of eigenvalues and eigenvectors; Guyan reduction; Rigid body modes. (5)

7 Preprocessing and Postprocessing:
Preprocessing; Mesh generation; Postprocessing; Deformed configuration and mode shape, Convergence Requirements, Mesh Refinement, Error : Sources and Detection. (5)

8 Finite Elements in Design:
FE based optimal design; Design parameterization; Structural optimization; Topology optimization; Approximation techniques; Design sensitivity analysis. (4)

Recommended books			
S.NO.	**NAME**	**AUTHOR(S)**	**PUBLISHER**
1	Introduction to Finite Elements in	Chandrupatla and Belegundu	Prentice Hall of India ,2011

	Engineering		
2	The Finite Element Method for Engineers	K. H. Huebner et al	John Wiley & Sons, 2008
3	Finite Element Procedures	Bathe	Prentice Hall of India, 2006
4	Fundamentals of Finite Element Analysis	David V Hutton	McGraw-Hill, 2005

Course Code	MEC-652
Course Title	Finite Element Methods lab
Type of Course	Core
LTP and Credits	0,0,2 and 1 credits
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50 marks
Course Prerequisites	Strength of Materials/Mechanics of Materials
Course Objectives(CO)	The experiments aim at providing practical knowledge in finite element methods and to solve practical engineering problem using any FEM software.
Course Outcomes	1. Understand the working of FEM software 2. The solution of practical engineering problems and its analysis using the software.

Syllabus

List of Experiments

1. Introduction to use of Matlab for FE related programming.
2. To understand the concept of discretization by discretization of circle to n sides.
3. Plot and understand various shape functions used in Finite Element analysis using Matlab.
4. Finite element method for truss analysis using Matlab.
5. Introduction to modeling and analysis in any existing general purpose finite element (FE) analysis software.
6. FE modeling and analysis (Stress and deflection) of a rectangular beam having a concentrated load under simply supported conditions.
7. FE modeling and analysis (Stress and deflection) of a rectangular beam having a uniformly distributed load over its entire length, under simply supported conditions.
8. Using FE software for modeling and analysis (Eigen values and mode shapes) of thin rectangular plate under one edge fixed type conditions.

Course Code	MEC- 603
Course Title	Mechanical Vibration
Type of Course	Core
L-T-P	3-0-0
Credits	3
Course Assessment Methods End semester Assessment (University Exam) Continuous Assessment (Sessional**)**	 50 marks 50 marks
Course Prerequisites	MOM1, MOM2, TOM1, TOM2
Course Objectives(CO)	1. To state the importance Mechanical Vibrations 2. To make the students aware about various modeling techniques helpful in imitating a Mechanical system. 3. To give them practical exposure of Elements of a Vibrating system 4. To tell them about applications of Elements of a Vibrating system 5. To make students learn the harmful effects of vibrations and techniques required to make system safe from its ill effects.
Course Outcomes	1. The principle and working of Elements of a Vibrating system 2. Formulation of Workable model of a Vibrating system 3. Formulations and solution of equations of motion for various types of vibrating systems 4. Methods to bring reduction in the levels of vibration in system to which they are harmful by learning to design vibration controlling Mechanical systems

SYLLABUS

Note for Examiner*- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

Part A

1. Fundamentals of Vibration 5

Free vibration, Forced vibration, Simple harmonic motion, Combination of two simple harmonic motions, Fourier analysis, Fourier integral.

2. Single degree of freedom system-free vibration 5

Natural frequency, Equivalent systems, Energy method (average energy principle, principle of conservation of energy, principle of virtual work, maximum energy principle), Response to an initial disturbance, Phase plane method, Duhamel's integral.

3. Single degree of freedom system-damped vibrations 3

Damping models (viscous damping, structural damping, and coulomb damping), Over-damped case, critically damped case, under-damped system, Logarithmic decrement.

4. Single degree of freedom system-forced vibrations 5

Harmonic excitation, Mechanical impedance (analysis of system with structural damping, analysis of system with elastically coupled viscous damper), System identification from frequency response, Support motion (solution for absolute/relative motion of the system, seismometer, accelerometer), Bending critical speeds of simple shafts, Vibration isolation (viscous damper and elastically coupled viscous damper).

Part-B

5. Two degrees of freedom systems 4

Free vibration of spring coupled systems, Two degrees of freedom mass coupled systems, Bending vibrations of two degrees of freedom systems, Forced vibration of an undamped two degrees of freedom system, Undamped vibration absorbers, Vibration isolation.

6. Multi degree of freedom methods **6**

Close coupled systems (eigen value problem up to four degree of freedom system using Graeffe's method), Far coupled systems, Orthogonality of mode shapes, Modal analysis (Undamped analysis, damped systems), Forced vibration (modal analysis, forced vibration by matrix inversion).

7. Numerical methods 4

Dunkerley's lower bound approximation, Rayleigh's upper bound approximation, Holzer method (fixed-free systems, free-free systems, branched systems), Method of matrix iteration.

8. Continuous systems 6

Systems governed by wave equation (stretched string, axial vibrations of a bar, torsional vibration of a circular rod), Free vibration of beams.

Books suggested:

1. Mechanical Vibrations : G K Grover, Nem Chand & Bros., Roorkee,1996.

2. Theory and Practice of mechanical vibrations : J S Rao& K Gupta, New age International (Pvt) Ltd., N Delhi, 2006, Ed.1 .

3. Mechanical Vibratios : V P Singh, DhanpatRai& Sons, Delhi, 3rd edition, 2006.

Course Code	MEC-653
Course Title	Mechanical Vibration Lab
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	MOM lab, TOM
Course Objectives (CO)	1. To state the importance Mechanical Vibrations 2. To make the students aware about various modeling techniques helpful in imitating a Mechanical system. 3. To give them practical exposure of Elements of a Vibrating system 4. To tell them about applications of Elements of a Vibrating system 5. To make students learn the harmful effects of vibrations and techniques required to make system safe from its ill effects.
Course Outcome	Students will be able to learn about 1. The principle and working of Elements of a Vibrating system 2. Hands on experience about working of various vibratory systems

Syllabus

List of Experiments

1. To determine the mass moment of inertia of a body by Trifilar suspension.
2. To determine damping ratio of a vibrating body by rap test.
3. To determine damping ratio of a damper by forced vibration.
4. Investigate node and antinode position for a cantilever.
5. Find first three natural frequencies of a body from it's time response. (using FFT algorithm of Matlab)
6. .Experimentally find out different harmonic frequencies present in vibrations of an IC engine.
7. Use instrumented impact hammer to find transfer function between two given points of a structure.

Course Code	MEC- 604
Course Title	HEAT TRANSFER
Type of Course Core/Optional	Core
L-T-P	3-1-0
Credits	4
Course Assessment Methods End semester Assessment (University Exam) Continuous Assessment (Sessional)	 50 marks 50 marks
Course Prerequisites	Thermodynamics, Fluid mechanics, partial differential equation
Course Objectives(CO)	1. To understand the basic concepts and different methods of Heat transfer. 2. To understand the basic concepts of conduction. 3. To understand the cross-sections of fins and their application in temperature measurement 4. To understand the principles of convection. 5. To understand the basic concepts of Heat Exchangers and its types. 6. To understand the principles of radiation and Phase change Heat transfer
Course Outcomes	1. Each student will be able to apply conservation of mass and energy to a control volume or control surface. Each student understands and can analysis conduction heat transfer in case of Cartesian, cylindrical and spherical problems and is able to solve them. 2. Each student will be able to analyze extended surfaces . 3. Each student understands the physical phenomena associated with convection, and will be able to solve convection heat transfer problems. Each student will be able to use empirical correlations to analyze external and internal, forced and free convection problems. 4. Each student understands the physical mechanisms involved in radiation heat transfer. Each student will be able to calculate total, hemispherical radiative properties of real surfaces from their spectral, directional counterparts.

Syllabus

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

PART-A

1 Basic Concepts

Difference between the subject of Heat Transfer and its parent subject "THERMODYNAMICS" Different methods of heat transfer – Conduction, Convection, and Radiation. 2

2 Conduction

Fourier's law of heat conduction, coefficient of thermal conductivity, effect of temperature and pressure on thermal conductivity of solids, liquids and gases and its measurement. Definition and explanation of the term Thermal Diffusivity. Three-dimensional most general conduction equation in rectangular, cylindrical and spherical co-ordinates involving internal heat generation and under unsteady state conditions. Derivation of equations for simple one dimensional steady state heat conduction without heat generation from three-dimensional equations through walls, cylinders and spherical shells (simple and composite).Electrical analogy of the heat transfer phenomena in the cases discussed above. Equivalent areas, shape actors. Critical thickness of insulating layers on electric wire and pipes carrying hot fluids. Influence of variable thermal conductivity on conduction through simple cases of wall, cylinder and sphere.

System with Heat Sources: Internal generation cases along with some practical cases of heat conduction, heat conduction through piston crown and case of nuclear fuel rod with cladding. Introduction to unsteady heat transfer 8

3 Extended Surfaces

Straight rod type of fins of uniform cross-section: (e.g. of circular and rectangular cross-section). Circumferential fins of rectangular cross- section provided on the circumference of a cylinder. Fins effectiveness and fins efficiency for straight rod fins of rectangular and circular cross-section. Application of fins in temperature measurement of flow through pipes and determination of error in its measurement. 6

PART-B

4 Convection

Introduction, Processes, Newton's law of cooling, theory of dimensional analysis as applied to free and forced convective heat transfer. Analytical formulae of heat transfer in laminar and turbulent flow, flow over vertical and horizontal tubes and plates. Hydrodynamic and

Thermal boundary layers over a flat plate, Blasius solution for hydrodynamic and Thermal boundary layer (No. Derivation) 6

5 Heat Exchanger

Classification of heat exchangers, Overall coefficient of heat transfer, effect of scale formation, Log mean temperature difference for parallel and counter flow heat exchangers, Heat Exchanger effectiveness, Calculation of number and length of tubes in a heat exchange by effectiveness-NTU method. 5

6 Heat Transfer with change of phase

Boiling, Boiling Regimes ,Bubble Growth and Nucleate Boiling, forced convection boiling ,Theory accounting for the increased values of h.t.c. during nucleate phase of boiling of liquids ; different phase of flow boiling (theory only).

Condensation and its classification, laminar film wise condensation on a flat vertical plate and its mathematical analysis, drop-wise condensation. 5

7 Radiation

Process of heat flow, definition of emissivity, Absorptivity, reflectivity and transmissivity.Concept of black and grey bodies, Plank's law of monochromatic radiation.Kirchoffs law and Stefan Boltzman'slaw ,Interchange factor, Lambert's Cosine and the geometric factor, Intensity of Radiation ,radiation density ,irradiation, radiosity and radiation shields.

Derivation formula for radiation exchange between two bodies using the definition of radiosity and irradiation and its application to cases of radiation exchange between three bodies, simplification of the formula for its application to simple bodies like two parallel surfaces. 8

Recommended books			
S.NO.	**NAME**	**AUTHOR(S)**	**PUBLISHER**
1	Heat and Mass Transfer	Incropera& Dewitt,	John Willy & Sons.
2	Heat Transfer	J.P. Holman,	Tata McGraw Hill.
3	Heat and Mass Transfer	R .C. Sachdeva,	New Age Publications
4	Engineering Heat Transfer	Gupta &Prakash	New Chand & Bros Roorkee.

Course Code	MEC-654
Course Title	Heat Transfer Lab
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	MOM lab, TOM
Course Objectives (CO)	1. To understand the experimental overview of conduction, and conduction related practicals, practical significance of thermal conductivity 2. To understand the experimental overview of convection, and convection related practicals, practical significance of heat transfer coefficient 3. To understand the experimental overview of radiation , and radiation related practicals, calculation Stefan Baltzmann coefficient , emissivity of surfaces.
Course Outcome	1. Students will have the ability to calculate the experimental values of heat transfer coefficient and overall heat transfer coefficient in case of convection and will have a good knowledge of convection related apparatus 2. Students will have the ability to calculate the experimental values of Stefan Boltzmann constant and emissivity of plates in case of radiation and will have a good knowledge of radiation related apparatus

Syllabus

List of Experiments

1. To find the thermal conductivity of metal rod.
2. To determine heat transfer coefficient in natural convection.
3. To determine heat transfer coefficient in forced convection for air flowing in a tube.
4. To determine heat transfer coefficient in drop wise and film wise condensation.
5. To determine the emissivity of a given plate at different temperatures.
6. To study and compare temperature distribution, heat transfer rate, overall heat transfer coefficient in parallel flow and counter flow heat exchanger.
7. To determine Overall Heat Transfer coefficient in Shell and tube heat exchanger.

8. To determine the Stefan Boltzmann's constant in radiation heat transfer process.
9. To determine the emissivity of a given plate at different temperatures.

Course Code	MEC- 605
Course Title	Material and Heat treatment
Type of Course Core/Optional	Core
L-T-P	3-1-0
Credits	4
Course Assessment Methods End semester Assessment (University Exam) Continuous Assessment (Sessional)	 50 marks 50 marks
Course Objectives(CO)	1. This course aims at the fundamental science and engineering principles relevant to materials. 2. The course will present systematic approaches for the various defects in materials, phase transformations and heat treatment processes.
Course Outcomes	Students will be able to 1. Understand the fundamental science and engineering principles relevant to materials. 2. Understand the relationship between no/microstructure, characterization, properties and processing and design of materials.

SYLLABUS

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PART-A

1. Structure of crystalline solids

Fundamental concepts of unit cell space lattice, Bravais space lattices, unit cells for cubic structure & HCP, study of stacking of layers of atoms in cubic structure & HCP, calculations of radius, Coordination Number and Atomic Packing Factor for different cubic structures, Crystal directions and planes, Miller indices. (6)

2. Crystal Imperfections

Point Imperfections, Line, Surface and volume imperfections- their types and Significance. (3)

3. Engineering Materials

Classification of materials; Types, properties and application of CI, Carbon Steels, Alloy Steel, IS code for designation of steels, Stainless Steel, High Speed Steel- properties and

applications. (7)

4. Phase Transformations (3)

Types of Phase transformation; Stages of phase transformation, Homogeneous nucleation and heterogeneous nucleation, Crystal growth.

PART-B

5. Solid solutions, Phase diagrams: (9)

Solid solutions, Types. Phase diagrams: Basic terms, phase rule, cooling curves, construction of phase diagrams, interpretation of equilibriums diagrams, Types of phase diagrams, Lever rule. Detailed study of Iron-Carbon equilibrium diagram and explanation of various connected terms, TTT diagram, and CCT diagram.

6. Heat Treatment Process (4)

Heat treatment processes for steel – Annealing, Normalizing, Spheroidizing, Hardening, Tempering, Austempering and Martempering.

7. Case Hardening and Surface Hardening (4)

Introduction, Fundamentals of case hardening, Carburizing methods, Nitriding, Carbo-nitriding, Cyaniding, Surface hadening methods, Measurement of case depth.

Recommended books			
S.NO.	**NAME**	**AUTHOR(S)**	**PUBLISHER**
1	Introduction to Material Science for Engineering	James F.Shackel ford	Jersy,6th edition
2	Physical Metallurgy	V.Raghavan, ,	PHI,New Delhi, 2nd edition
3	Principles & Practices Materials Science & Engineering	William D.Callister	Jr.Wiley India Pvt. Ltd

Course Code	MEC-655
Course Title	**Materials And Heat Treatment** Lab
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	MOM lab, TOM
Course Objectives (CO)	1. The experiments aim at providing practical knowledge of materials and their properties. 2. To possess knowledge of the significance of research, the value of continued learning and environmental/social issues surrounding materials.
Course Outcome	1. The students will able to apply core concepts in Materials Science to solve engineering problems.. 2. The students will able to design and conduct experiments and can analyze the experimental data for research.

Syllabus

List of Experiments

1. Study of different engineering materials and their mechanical properties.
2. To study microstructure of following materials:-

Hypo-eutectoid steel and Hyper-eutectoid steel

Hypo-eutectic and Hyper eutectic steel

Grey and White Cast iron

3. Study of microstructure and hardness of steel at different rate of cooling.
4. Heat treatment: Annealing, Normalizing, Hardening and Tempering of steel. Hardness studies of heat-treated samples.
5. Study of metallurgical microscope. Metallographic preparation of metals and alloys.
6. Hardness testing of metals on Vickers scale

7. Interpretation of microstructures.
8. Evaluation of mechanical properties of metallic materials by conducting following tests: Hardness test(Vicker, Brinell and Rockwell Test)

Charpy Impact test

Tension Tests

Fatigue test

9. Study of testing machines.
10. Means of determining crystal structures (X-ray and Electron Diffraction method)
11. Specimen preparation and microstructure studies using Metallurgical and Scanning electron microscope.

Tension Tests

Fatigue test

12. Study of testing machines.
13. Means of determining crystal structures (X-ray and Electron Diffraction method)
14. Specimen preparation and microstructure studies using Metallurgical and Scanning electron microscope.

Course Code	MEC- 606
Course Title	Non Conventional Manufacturing
Type of Course Core/Optional	Core
L-T-P	3-1-0
Credits	4
Course Prerequisites	Manufacturing Processes and Manufacturing Technology
Course Assessment Methods End semester Assessment (University Exam) Continuous Assessment (Sessional)	 50 marks 50 marks
Course Objectives(CO)	1. To state the importance and need to develop the nontraditional machining methods. 2. To make the students aware about nontraditional machining methods 3. To give them practical exposure of nontraditional machining methods 4. To tell them about applications of various non conventional machining processes
Course Outcomes	Students will be able to 1. The principle and working of nontraditional machining methods 2. The principle working and controlling parameters of EDM,LBM, IBM 3. The principle working and controlling parameters of AJM, WJM and AWJM 4. The principle working and controlling parameters of Chemical and electro chemical machining 5. The principle working and controlling parameters of USM

SYLLABUS

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PART-A

1.Introduction:

Classification, Advantages & limitations of non conventional machining, Hybrid Machining, Ultrasonic machining (USM)-Principle of operation, process details, applications and advantages, limitations of USM. (5)

2.Abrasive and Water Jet Machining:

Basic principle, mechanism of material removal, working principle of Abrasive jet machining (AJM), water jet machining (WJM), merits & demerits, application. (6)

3.Chemical Machining (CM):

Working principle, process characteristics, procedures, advantages& disadvantages of chemical machining. (6)

PART-B

4.Electrochemical Processes:

Fundamentals, details of machining setup, materials and selection of tools, applications, Concept of others processes like ECG, Electrochemical deburring etc. (7)

5.Thermal Metal Removal Processes:

Working principles, Mechanism of material removal, process parameters, advantages & limitations, applications of processes like electric discharge machining(EDM), Electron Beam Machining (EBM), Ion Beam Machining (IBM) Plasma Arc Machining (PAM), Laser Beam Machinig (LBM) (9)

Recommended books			
S.NO.	**NAME**	**AUTHOR(S)**	**PUBLISHER**
1	Advanced Machining Processes	V K Jain	Allied
2	Non Convectional Machining	, Benedict ,	McH
3	Non Convectional Machining	M. Adhithan	John Wiley
4.	Non Convectional Machining,"	P.K.Mishra	Narosa

Course Code	MEC-656
Course Title	Non Conventional Manufacturing Lab
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Manufacturing Processes and Manufacturing
Course Objectives (CO)	1. To state the importance and need to develop the nontraditional machining 2. To make the students aware about nontraditional machining methods 3. To give them practical exposure of nontraditional machining methods 4. To tell them about applications of various non conventional machining processes.
Course Outcome	1. The principle and working of nontraditional machining methods 2. The principle working and controlling parameters of EDM,LBM, IBM 3. The principle working and controlling parameters of AJM, WJM and AWJM 4. The principle working and controlling parameters of Chemical and electro chemical machining 5. The principle working and controlling parameters of USM

Syllabus

List of Experiments

1. To study the various Non Conventional Manufacturing processes and compare with the conventional manufacturing processes.

2. To study and perform the experiments of abrasive and water jet machining
3. To study the chemical machining
4. To study the working principle of electric discharge machine.
5. To explain the construction features of EDM.
6. To prepare a simple job on EDM
7. To study the laser beam machining and ion beam machining
8. To study the surface roughness of various materials

Course Code	MEC- 701
Course Title	**REFRIGERATION & AIR CONDITIONING**
Type of Course Core/Optional	Core
L-T-P	3-1-0
Credits	4
Course Assessment Methods End semester Assessment (University Exam) Continuous Assessment (Sessional)	 50 marks 50 marks
Course Prerequisites	Applied Thermodynamics-I and Thermodynamics-II,
Course Objectives(CO)	1. To understand the basic concepts and different cycles of refrigeration. 2. To understand the working and analysis of commonly used refrigeration cycles. 3. To understand about various properties and usage of refrigerants available and their selection for various application in refrigeration and air conditioning. 4. To understand psychrometry principles and various air conditioning processes. 5. To understand the concepts of load calculation for air conditioning of different types of buildings 6. To understand the working and principles of various refrigeration and air conditioning equipment.
Course Outcomes	1. Understand various cycles used in RAC. 2. Understand various refrigerants available. 3. Understand various air conditioning methods for different environment 4. Understand different equipment used in RAC. 5. Understand designing air conditioning systems for different applications

SYLLABUS

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PART – A

1**. Basic Concept**

Natural and Mechanical refrigeration; Application of Refrigeration; Units of refrigeration and Coefficient of performance; Refrigeration effect, cooling capacity and COP of a refrigerator; heating effect, heating capacity and COP as heat pump; Reversed Carnot cycle and its limitations

4

3. Bell Coleman Cycle and Aircraft Refrigeration

Bell Coleman Cycle and its analysis; optimum COP and pressure ratio, necessity of air craft refrigeration - air cycle refrigeration systems and their comparison

5

3. Vapour Compression Refrigeration Cycle and Refrigeration

Vapour compression cycle on P-V, P-H and T-S diagrams; Deviation of actual cycle from theoretical cycle; Compressor capacity and volumetric efficiency, Analysis of theoretical and actualvapour compression cycles; Effect of suction pressure, discharge pressure, sub-cooling, super heating and pressure drop in valves on performance and cooling capacity. Compound compression with single and multiple expansion valves, water inter-cooling and flash inter- cooling; multiple load systems with single and multiple expansion valves

4. Vapour Absorption Refrigeration Cycle (No Mathematical Analysis)

Principle of absorption system; components of the system; Desirable properties of absorption system refrigerant and absorbent; Aqua - ammonia absorption refrigeration system; Lithium Bromide - water absorption system; Theory of mixtures; temperature concentration and 4 enthalpy concentration diagrams; comparison between absorption and compression systems; Electrolux refrigeration system.

PART-B

5. Refrigerants

Classification and nomenclature of refrigerants; Desirable thermodynamic, chemical and physical properties of refrigerants; comparative study of commonly used refrigerants and their 4 fields of application; Azeotropes; Effect of moisture and oil miscibility; Refrigerants dyingagents and antifreeze solution; leak detection and charging of refrigerants; environmental aspects of conventional refrigerants; Eco-friendly refrigerants and action plan to reduce ecological hazards.

6. Air Conditioning Concept, Psychometric Processes and Applications;

5

Psychometric properties of air; Dry bulb, wet bulb and dew point temperatures; Relative and specific humidity; degree of saturation adiabatic saturation temperature, enthalpy of air and watervapours; psychometric chart. Human requirement of comforts; effective temperature and comfort charts; Industrial and comfort air conditioning. Sensible heating and cooling, cooling with dehumidification; Heating with dehumidification; by-pass factor; chemical dehumidification; adiabatic mixing, air washer.

7. Calculations for Air –Conditioning Load: 5

Sources of heat load; sensible and latent heat load; sensible heat factor; apparatus dew point temperature; Rate and state of supply - air for air- conditioning of different types of premises.

8. Refrigeration and Air Conditioning Equipment
3

Brief description of compressors, condensers, evaporators and expansion devices; Cooling towers; Ducts; dampers; grills; air filters; fans; room air conditioners; split units; Package and central air conditioning plants.

RECOMMENDED BOOKS

	NAME	**AUTHOR(S)**	**PUBLISHER**
1.	Refrigeration and Conditioning	CP Arora	Tata McGraw Hill
2.	Refrigeration and Conditioning	Manohar Prasad	Wiley Eastern Limited
3.	Refrigeration and Conditioning	Jordan and Priester	Prentice Hall of India
4.	Refrigeration and Conditioning	WF Stoecker	McGraw Hill
5.	A course on Ref. & Air Conditioning	Arora, Domkunder	DhanpatRai& sons
6.	Basic Ref. and Air Conditioning	P. N. Ananthanarayanan	Tata McGraw Hill

Course Code	MEC-751
Course Title	**Refrigeration & Air Conditioning** Lab
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Applied Thermodynamics-I and Thermodynamics-II, Heat & Mass Transfer
Course Objectives (CO)	1. To understand the basic concepts and different cycles of refrigeration. 2. To understand the working and analysis of commonly used refrigeration cycles. 3. To understand about various properties and usage of refrigerants available and their selection for various application in refrigeration and air conditioning. 4. To understand psychrometry principles and various air conditioning processes. 5. To understand the concepts of load calculation for air conditioning of different types of buildings. 6. To understand the working and principles of various refrigeration and air conditioning equipment.
Course Outcome	1. Understand various cycles used in RAC 2. Understand various refrigerants available 3. Understand various air conditioning methods for different environment 4. Understand different equipment used in RAC 5. Understand designing air conditioning systems for different applications

Syllabus

List of Experiments

1. Study of various elements of a mechanical refrigerator system through cut sections models / actual apparatus
2. Study and performance of domestic refrigerator,
3. Study the performance of and Electrolux refrigerator.
4. Study and performance of an Ice plant test rig. 5. 5.
5. Calculation/ Estimation of cooling load for large building
6. Visit to a central Air conditioning plant for study of processes for winter and summer air conditioning
7. Study and performance of window type room air conditioner Study of Cooling Tower.
8. Study and performance of Air Washer Test bench.

Course Code	MEC- 702
Course Title	**Automatic controls**
Type of Course Core/Optional	Core
L-T-P	3-1-0
Credits	4
Course Assessment Methods End semester Assessment (University Exam) Continuous Assessment (Sessional)	 50 marks 50 marks
Course Prerequisites	Theory of machines, thermodynamics,
Course Objectives(CO)	To learn how to control a mechanical system : pneumatic, hydraulic, thermal etc.
Course Outcomes	Ability to draw schematic of a system, write equations of motion and then control the system using classical control.

SYLLABUS

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Part-A

1. Introduction

Introduction, Types of control systems, Open or closed loop systems, Analog or Digital control systems, Regulators and servomechanism, Sequence control, typical block diagram, Performance analysis.

(4)

2. Representation of processes and control elements

Mathematical modeling, Block diagram representation, Representation of systems or processes, Liquid, gas and thermal systems, Mechanical rotating systems, Geared systems, Hydraulic

servomotor, Electric motors, Control valve, Comparison elements, Potentiometer-type comparator, Synchro-control transformer type error detector.

(5)

3. Representation of feedback control systems

Block diagram and transfer function representation, Signal flow graphs, Mason's formula.
(3)

4. Types of controllers

Types of control action, Proportional, Integral, Derivative, On-off, Hydraulic controllers, Pneumatic controllers, Electronic controllers.

(5)

Part-B

5. Transient and steady state response

Time domain representation, Laplace transform representation, Systems with proportional control, Transient response due to reference input, Steady state response, Response to load input, Proportional cum derivative control, Reference input, Load input, Proportional cum integral control, Reference input, Load input.

(5)

6. Stability of control systems

Characteristic equation, Routh's equation, Nyquist criterion.

(3)

7. State space analysis of control systems

Generalised state equations, Techniques for deriving system state equations, Transfer function from state equations.

(4)

8. Introduction to virtual instrumentation

Graphical programming, Concept of sub-VI, Data acquisition and control using Labview software, Simulation of proportional, derivative, integral control actions.

(6)

RECOMMENDED BOOKS

	NAME	AUTHOR(S)	PUBLISHER
1.	Theory and applications of Automatic Controls	B C Nakra	New age international
2.	Automatic control systems	Benjamin C Kuo, Farid Golnaraqhi	John Willey and sons
3.	Digital control and state variable methods	M Gopal	Tata McGraw-Hill Education

Course Code	MEC-752
Course Title	**Automatic Control** Lab
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Theory of machines, thermodynamics
Course Objectives (CO)	1. To learn how to control a mechanical system : pneumatic, hydraulic, thermal etc.
Course Outcome	1. Ability to draw schematic of a system, write equations of motion and then control thesystem using classical control.

Syllabus

List of Experiments

1. Perform two mode (P + I) controls on a temperature/flow control trainer.
2. Perform two mode (P + D) controls on a temperature/flow control trainer.
3. Perform three mode (P + I + D) controls on a temperature/flow control trainer.
4. Tune the temperature/flow control trainer using Zeigler-Nichols method.
5. Simulate first order system and second order systems on Labview software.
6. Acquire data from an analog sensor using PC and Labview software.
7. Control vibrations of a cantilevered beam using negative velocity feedback.

Course Code	**MEC 703**
Course Title	**AUTOMOBILE ENGINEERING**
Type of Course	Core
L T P	3 0 0
Credits	3
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Applied Thermodynamics-I and Thermodynamics-II
Course Objectives (CO)	1. To understand the basic concepts about automobile and performance parameters. 2. To understand the working of engine and its sub-systems. 3. To understand about function, necessity and working of various types of clutches. Selection for different application. 4. To understand power transmission from engine to tyres. Conversions at different stages, understanding working of different sub-systems in transmission to understand the power flow. 5. To understand working of various control systems like suspension, steering and brakes. 6. To understand the environmental impacts and study various means of emission control from automobile.
Course Outcome	1.Basic understanding about working of automobile 2.Understanding, importance of various sub-systems in performance of automobile 3.Understand importance of control in automobile 4.Environmental friendly automobiles

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

PART-A

Introduction
Components of automobile, basic structure, classification of automobile, body styles, frame and frameless construction, power for propulsion, traction and tractive effort, relation between engine revolution and vehicle speed, road performance curves, calculation of equivalent weight, gear ratio for maximum acceleration. (5)

Automobile Engine
Engine Types, Piston, Piston rings, valves, cooling system, lubrication system, turbocharger, supercharger, fuel supply system for petrol and diesel engine, throttle body and multi point fuel injection system , battery coil ignition system.
(6)

Clutches
Requirements of clutches, types of clutches, working of single plate, multiplate and centrifugal clutch, clutch operation, clutch plate, fluid flywheel
(4)

Transmission
Functions of transmission, necessity, types of transmission, sliding mesh, constant mesh, synchromesh, selector mechanism, transfer box, automatic transmission, torque converter, overdrive, propeller shaft, universal joint, final drive, differential, rear axle
(8)

PART-B

Suspension
Basic classifications, types of suspension systems, leaf springs, shock absorbers, independent suspension, types of front wheel, independent suspension system, air suspension.
(5)

Front axle and steering
Front axle, wheel alignment, steering geometry, under-steer and over-steer, steering linkage, steering gears, steering ratio, reversibility, power steering.
(4)

Brake wheels and tyres
Brake efficiency and stooping distance, fading of brakes, wheel skidding, types of brakes, drum and disk brakes, hydraulic and pneumatic brakes, servo brakes, antilock braking system, types of wheels, wheel dimensions, types of tyres, cross ply, radial ply and belted-bias type, tyre designation.
(4)

Emission control
Automotive air pollution, emission control, crank case emission, evaporative emission control, exhaust emission control, catalytic converter.
(4)

Recommended Books

	NAME	**AUTHOR(S)**	**PUBLISHER**
1.	Automotive Mechanics	W.H.Crouse, D. L. Anglin	Tata McGraw Hill
2	Automotive Engines.	Dempsey, P.	

3	Automotive Mechanics	J. Heitner	East West Press
4	Problems in Automobile Mechanics	N.K.Giri	Khanna Publishers, Delhi
5	Automobile Engineering, Vol. I & II.	Kripal Singh	Standard Publication, Delhi

Course Code	MEC-753
Course Title	**Automobile Engineering Lab**
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Theory of machines, thermodynamics
Course Objectives (CO)	1. To understand working of various control systems like suspension, steering and brakes. 2. To understand the basic concepts about automobile and performance parameters. 3. To understand the working of engine and its sub-systems 4. To understand about function, necessity and working of various types of clutches. Selection for different application. 5. To understand power transmission from engine to tyres. Conversions at different stages, understanding working of different sub-systems in transmission to understand the power flow. 6. To understand the environmental impacts and study various means of emission control from automobile.
Course Outcome	1. Understanding, importance of various sub-systems in performance of automobile 2. Basic understanding about working of automobile 3. Environmental friendly automobiles 4. Understand importance of control in automobile

Syllabus

List of Experiments

1. Study of various tools and working of various systems/components from an actual automobile/working model.
2. Removing the car tyres, repairing the tubes - their testing and fitting back.
3. Valve re-facing and valve seat grinding and checking the seat for leakage.
4. Checking of the cooling system, water pump, radiator, thermostat valve and its faults.

5. Checking of cylinders for wear and finding out the next possible over-size of the Piston replacing rings and studying methods of replacing piston after re-boring.

6. Overhauling the fuel pumps, cleaning the jets and testing on the engine.

7. Overhauling of the distributor, setting C.B. Points and spark plug gaps and study of the complete ignition circuit.
8. Study of Vehicle steering system and measuring steering geometry angles.
9. Replacing of car battery and casting of plate connectors, cell connectors etc.
10. Overhauling of breaking system, adjusting the brake shoes, bleeding the system and testing.
11. Engine trouble shooting.

Course Code	**MEC 704**
Course Title	**TOTAL QUALITY MANAGEMENT**
Type of Course	CORE
L T P	3 0 0
Credits	3
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	PRODUCTION MANAGEMENT, OPERATIONS RESEARCH
Course Objectives (CO)	• To state the importance Total Quality Management. • To make the students aware Principles of TQM and Strategies of TQM implementations • To give them Understanding about Statistical Process Control • To tell them about applications of TQM tools • To make students Quality Systems
Course Outcome	1. The principles of TQM 2. Implementations of TQM 3. Application of TQM tools

SYLLABUS

Note for Examiner*- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

Part A

INTRODUCTION : 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.

(6)

TQM PRINCIPLES : 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 – PDSA cycle – 5S – Kaizen – supplier partnership – Partnering – Sourcing – Supplier selection – Supplier rating – Relationship development – Performance measures – Basic concepts – Strategy – Performance measure.

(9)

Part B

STATISTICAL PROCESS CONTROL (SPC): 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.

(6)

TQM TOOLS: Benchmarking – Reasons to benchmark – Benchmarking process – QualityFunction Deployment (QFD) – House of quality – QFD process – Benefits – Taguchi quality loss function-– Total Productive Maintenance (TPM) – Concept – Improvement needs – FMEA – Stages of FMEA.

(5)

QUALITY SYSTEMS : Need for ISO 9000 and other quality systems – ISO 9000:2000 quality system – Elements – Implementation of quality system – Documentation – Quality auditing – TS 16949 – ISO 14000 – Concept – Requirements and benefits.

(6)

Books Suggested

	NAME	**AUTHOR(S)**	**PUBLISHER**
1.	Total Quality Management	Dale H.Besterfiled	Pearson Education
2	Total Quality Management	Feigenbaum.A.V	McGraw-Hill
3	Management and Control of Quality	James R.Evans& William M.Lidsay	South-Western (Thomson Learning)
4	Narayana V. and Sreenivasan, N.S	Quality Management – Concepts and Tasks	NewAge International 1996

Course Code	MEC-754
Course Title	**Total Quality Management** Lab
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Management, Production Operations Research
Course Objectives (CO)	1. To state the importance Total Quality Management. 2. To make the students aware Principles of TQM and Strategies of TQM implementations 3. To give them Understanding about Statistical Process Control. 4. To tell them about applications of TQM tools. 5. To make students Quality Systems
Course Outcome	Students will be able to learn about 1. Application of TQM tools 2. Implementations of TQM 3. The principles of TQM

Syllabus

List of Experiments

1. TQM case study in Healthcare.

2. TQM case study in Logistics.

3. TQM case study in Teaching.

4. TQM case study of Stock exchange.

5. TQM implementation issues : A case study

6. TQM case study of Tourism Industry.

MEC 756: MINOR PROJECT

L	T	P
0	0	4

MEC-757: VOCATIONAL TRAINING-II after 6th Semester

Course Code	**MEC-705(a)**
Course Title	**Thermal Plant Engineering**
Type of Course	ELECTIVE
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Thermodynamics and Heat transfer
Course Objectives (CO)	• This course will provide an introduction to various types of power plants. • This course also aims at providing knowledge about steams generators, heat balance in steams power plants, construction and operations of steams power plant
Course Outcome	1. Understand various power plants, their constructions and working 2. Solve real life problems related to steam generation, gas turbine problems, and economics for different power plants. 3. Understand the harmful aspects involved with nuclear and thermal power plants.

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

Part-A

1. Steam Power Plant

(a) Introductory: Generation of electricity and sources of energy, thermodynamic cycles, and selection of power plants on thermodynamic economical and operating considerations. Future trends in power industry. Power sources of the future.

(4)

(b)Stem Generators: Principle construction and operation of high pressure boilers. Design trend in water tube boilers. Supercritical pressure systems. Steam generation for special applications. Generator selection, maintenance and operation. Boiler furnaces.

(4)

(c**) Feed Water heating and Steam Turbines:** Cycles with finite number of heaters, analysis of optimum rise in ideal cycle efficiency. Types of heater arrangements, Equations for single heater arrangement and series of heaters. Losses in various types of heater arrangements.

(3)

(**d) Fuels and Firings:** - How fuel burns? Types of fuel and their characteristics. Coal handling and coal storage, methods of coal firing, stoker fired and pulverized fuel feeding systems, pulverized and different types of stokers. Ash handling and ash disposal. Burning and feeding of oil and gas. Selecting fuel for new plants. Combustion control.

(3)

(e) **Water Treatment:** Quality of water needed by the plant. Types of impurities. PH value, Clarification of water and filter designs. Water Treatment. DE aerators and aerators. Handling and feeding chemicals. Feed water regulation. Condenser cooling water systems.

(3)

(f) Miscellaneous Construction and operation of economizers, air pre-heaters steam separators. Schematic layout of a modern coil oil fed steam power station. Heat balance of steam power station. Steam station cost. Load curves. Site selection

(3)

2. Diesel Power Plants :- Diesel plant elements, arrangements of diesel plant, diesel engine fuel injection system, air intake system, engine lubrication and engine cooling systems, superchargers. Method of starting and stopping the engines. Advantages and disadvantages of using diesel power plant, Economics of diesel plant over stem and hydro-electric plant.

(4)

Part-B

3. Gas Turbine Power Plants: - Elements of gas turbine plants, principle and performance of simple gas turbine plant, thermal refinement of gas turbine cycle. Combination gas turbine cycles. Gas turbine cycle calculations. Economics of gas turbine plant compared with steam power plant.

(4)

4. Nuclear Power Plants: - Atomic structure, energy levels, binding energy. Radio-activity, decay laws, half-lives, nuclear reaction. The fission chain reaction (Controlled and Uncontrolled). Maintenance of chain reaction, heat removal, reactor fuels and materials**.** Some common types of power reactors. Pressurized water reactor, boiling water reactor and gas cooled reactor. Reactor system safety provisions. Fusion reaction, site selection. Economics of nuclear power plants. Air pollution. Power Plant and the air pollution. Units of radiation dose. Control of internal and external hazards.

Books Suggested

	NAME	AUTHOR(S)	PUBLISHER
1.	Power Plant Engineering	T. Morse	Van Nostrand Reinhold
2	Power Station Engineering & Economy	Skrotzkiand.	McGraw-Hill; 2nd edition
3	Power Generation System	Editors of Power (McGraw Hill)	McGraw-Hill
4	Steam Power Plants	Potter	McGraw-Hill
5	Steam Power Stations	Gaffert	McGraw-Hill
6	Nuclear Power Plants	Taylor	
7	Nuclear Power Plants Engineering	M.M. El-Wakel	McGraw-Hill
8	Power Plant Engineering	Dr. Mahesh Verma	Metropolitan Book Company
9	Electric Power Plants	Domkundwar	DhanpatRai publications
7	Nuclear Power Plants Engineering	M.M. El-Wakel	McGraw-Hill

Course Code	MEC-755(a)
Course Title	**Thermal Plant Engineering** Lab
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Thermodynamics and Heat transfer
Course Objectives (CO)	The experiments aim at providing knowledge about working of various power plants and their heat balancing.
Course Outcome	Students will be able to : Related and compare the various power plants and understand the different ways by which electricity is generated.

Syllabus

List of Experiments

1. Heat Balance of a boiler.
2. Heat Balance of a Steam Engine.
3. Heat Balance of a Steam Turbine
4. Testing of a Steam Power Plant.
5. Heat balance of a Diesel Engine.
6. Testing of a Diesel Power Plant.

Course Code	**MEC-705(b)**
Course Title	Gas Dynamics
Type of Course	Optional
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Thermodynamics and Fluid Mechanics
Course Objectives (CO)	1. Present course provides an insight into basic concepts of gas dynamics and fundamental equations of one dimensional flow 2. This course present various methods and tools for describing fluid motion in theoretical and practical aspect 3. Students will be also introduced to flow through ducts, nozzles and diffuser
Course Outcome	1. Solve basic gas dynamics problem with good understanding of theory and practical aspect 2. Understand practical approach regarding the flow in ducts with heating and cooling arrangement, flow through nozzles and diffusers 3 Learn about various standard flow equations like Bernoulli's equation, Navier-Stocks equations.

SYLLABUS

Note for Examiner- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

PART – A

1. Basic concepts of Gas Dynamics and Gas Properties:

Definition: Units and dimensions. The concepts of a continuum, properties of the continuum. Methods of describing fluid motion, Lagrangian method. Eulerian Method. The integral form of the equations of Conservations of Mass, momentum and energy as applied to control volumes, applications to the steady flow of inviscid compressible fluids.

(4)

2. Fundamental Equation Study of One Dimension Flow:

Continuity equation the momentum equation the dynamic equation and Euler's equation. Bernoulli's equation, thrust function, steady flow energy equation

(3)

3. Isentropic Flow:

Introduction, Acoustic velocity. Mach number, Mach line and mach angle. Classification of flows, Kerman's rules of supersonic flow, flow parameter, critical condition stagnation values.

(4)

4. Flow in Ducts with Heating or Cooling:-

Stagnation temp. Change governing equation , Rayleigh lines, choking due to friction.

(4)

5. Flow in Constant- Area Ducts with friction:

Friction loss, the friction parameter, Fannolines, effect of the increase of the inlet Mach number and duct length. Chocking due to friction. Isothermal flow through long ducts

(3)

Part-B

6. Normal Shock Waves:

Formation of shock waves, weak waves, compression waves. Governing relation of the Normal shock, Pressure, Temperature, Density, Mack number across the shock.

(3)

7. Oblique through Nozzles:

Oblique shock equation, shock geometry, shock polars.

(3)

8. Flow through Nozzles:

The Converging diverging nozzle, area ratio for complete expansion, effect of varying back pressure on nozzle flow. Under-expansion and over-expansion in nozzle flow. Losses nozzle.

(4)

9. Flow through diffusers

Classification of diffusers, internal compression subsonic diffusers, velocity gradient, effect of friction and area change, the conical internal-compression Subsonic diffusers, external compression subsonic diffusers, supersonic diffusers, Normal shock supersonic diffusers, the converging diverging supersonic diffusers.

(4)

10. Introduction to Multimedia Flow:

The equation of continuity, the momentum equation, Bernoulli's equation, the energy equation, Navier- Stocks Equation, Potential Flow.

(3)

Books Suggested

	NAME	**AUTHOR(S)**	**PUBLISHER**
1.	Thermodynamics of Com. Fluid flow	Shapiro	John Wiley & Sons

Course Code	MEC-755(b)
Course Title	**Gas Dynamics** Lab
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Fluid Mechanics
Course Objectives (CO)	The experiments aims at study methods of measuring compressible flows, dynamic flows.
Course Outcome	Students will be able to: Measure flows for different types of flows practically. Visualize and understand flow around different bodie

Syllabus

1. To Study the different methods of measuring the flow in case of Compressible flows.

   Pressure

   Velocity

   Temperature

   Density

   Flow direction

2. To study different methods of dynamic flow measurement techniques.
3. Study of low speed wind tunnel.
4. To study to make tunnel and visualize flow around different bodies shapes.
5. To determine the pressure and velocity variation along the length of a diffuser.
6. To study the formation of a wave phenomenon with the help of a water table.

   Study of shock tube.

Course Code	**MEC 705 (c)**
Course Title	**Renewable Energy Sources**
Type of Course	Optional
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Basic knowledge in Fluid Mechanics, Heat Transfer
Course Objectives (CO)	**8.** Introduction to various types of renewable energy resources. **9.** Describing main components and important characteristics of various renewable energy systems. **10.** To outline utilization of different renewable energy sources in a wide variety of ways.
Course Outcome	1. Describe the primary renewable energy resources and technologies. 2. Comprehensive understanding of current and possible future role of various renewable energy sources. 3. Access and decide the appropriate renewable energy as an alternate for conventional power in any engineering field

SYLLABUS

Note for Examiner- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

Section -A

Introduction to Renewable Energy Sources:- **(3)**

Introduction to Non-convectional/Renewable Energy Sources &Technologies, their importance for Sustainable Development and Environmental Protection.

Solar Radiations: - **(4)**

Measurement and Prediction of Solar Radiation; Instruments for solar radiation; Characteristics of solar spectra including Wave length Distribution; Radiation Properties and spectral Characteristics Materials; Selective Surfaces & Basis of solar Collectors.

Solar Thermal system: - **(5)**

Solar Collection Devices; their analysis; Solar Collector Characteristics; solar Pond; application of solar energy to space heating etc.

4. Biomass: (2)

Biomass as an energy Sources, Energy Plantation; conversion technologies- thermal, chemicaland biological; Photosynthesis, Biomass generation, Classification of Biomass plants.

5. Biogas: (4)

Principles of Bioconversion; Types of Bioreactors – Batch, Continuous, Plug-flow, Stirred Sewage, Industrial Wastes, Agriculture Wastes, Animal and Human Wastes; Landfill Refuse, Properties and Uses of Biogas.

Part B

6. Biofuels (4)

Bioconversion Techniques- Direct Combustion, Pyrolysis, Flash Pyrolysis Fermentation and gasification; Utilization of Industrial Wastes such as Bagasse; Combustion systems; Gasification; Sizing: Beneficiation of Fuels, Thermodynamics & Kinematics of gasification; Types of Gasifiers-Downdraft, Updraft, Cross flow, fluidized. Combustion Characteristics of Biofuels; Utilization in Conventional Engines and Power Generation including Cogeneration.

7. Wind Energy: (2)

Basic Principles; Basic components of a Wind Energy Conversion System, Classification of Wind Energy Conversion System, Their types, Application of Wind Energy, Environmental aspects, Wind Energy Development in India.

8. Tides

Origin & Nature of Tides, Tidal Heads & Duration; Principles of Tidal Energy, Conversion, Site Selection – Single & Multiple Bay System; Cycles & Load Factors; Regulation and Control of Tidal Power Generations. (2)

9. OTEC (Ocean Thermal Energy Conversion): (3)

Temperature & Tropical oceans: Principles of OTEC Systems; Site Selection; Power Cycles; Selection of Working Fluids; Pumps & Turbines; Heat Exchanger Criteria; Bio fueling; Secondary Applications such as Fresh Water Production; Mani culture, etc; Power Transmission & System Efficiency.

10. Geothermal Energy: (5)

Nature of Geothermal Resources; Location & Potential Assessment; Classification & Characteristics of Geothermal Resources- Hot Rock, Hot Water& Steam, Chemical& Physical Properties of Geothermal Brines: Control of scale Deposition, Drilling, Logging& Cycles; Refrigeration, Operation for Geothermal Wells; principles of power production System & Cycles; Refrigeration, Two-phase Flow Turbines; Thermal Phase Flow Turbines; Thermal Utilization & Mineral Recovery; Ecological & Safety Consideration.

	NAME	**AUTHOR(S)**	**PUBLISHER**
1.	Solar Energy: Principles of Thermal Collection and Storage	S.P. Sukhatme	Tata McGraw Hill, New Delhi
2	Solar energy : Fundamentals and application	H.P. Garg and Jai Parkash	Tata McGraw Hill, New Delhi
3	Energy Conversion	Chang	Prentice Hall of India
4	Direct Energy Conversion	Soo	Prentice Hall
5	Fuel cells	Bockeries and Srinivasan	McGraw Hill
6	Solar Engineering of Thermal Process	Duffic and Beckman	John Wiley.

Course Code	MEC 755 (c)
Course Title	Renewable Energy Sources
Type of Course	Elective-1(optional)
LTP and Credits	L-0, T-0, P-2, Credits-1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50 Marks
Course Objectives(CO) :	To study important characteristics of various kinds of renewable energy sources and their operating principle.
Course Outcome :	On completion of the course, the student will be able to : Describe the working principle of various types of renewable energy resources and technologies and other characteristics parameters of different types of renewable energy sources.

Syllabus

List of Experiments

1. Study of Solar Radiation.
2. Study of PV Panel & determination of its Characteristics.
3. Study of Operating Characteristics of PV Lighting and Pumping System.
4. Study of Solar Collectors, Solar Cookers, Solar Stills, Solar Concentrators, and Solar Space Heating and Water heating Systems.
5. Study of Thermo-physical Characteristics of Biomass Plants/ Biogas Plants.
6. Study of the operation and Determination of operating Characteristics of a Biomass Converter/ Gasifier

Course Code	**MEC-705 (d)**
Course Title	**Advanced Mechanics of Materials-I**
Type of Course	Optional
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Strength of materials, Material Science, Applied Mechanics
Course Objectives (CO)	The study of various theories of stress& their application on various mechanical systems. Knowledge about the inelastic & elastic behavior of various materials & their application in mechanical systems Knowledge about the application of torsion to various materials
Course Outcome	Know about stress -strain temperature effects on materials Get knowledge about various theories of stress and strain. Knowledge about the application of energy methods, elastic & inelastic behavior of various materials

SYLLABUS

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Part-A.

Introduction – Review of Elementary Mechanics of Materials, Methods of Analysis Stress-Strain Relationships, Failure and Limit on Design.

(3)

Theories of Stress and Strain – Definition of Stress at a Point, Stress Notation, Symmetry of the Stress Matrix and Stress on an Arbitrarily oriented Plane, Transformation of Stress, Differential Equation of Motion of a Deformable Body,

Deformation of a Deformable Body, Strain Theory, Small-Displacement Theory, Strain Measurement and Strain Rosettes.

(4)

Linear Stress-Strain-Temperature Relationships – First Law of Thermodynamics, Hooke's Law: Anisotropic Elasticity, Hooke's Law: Isotropic Elasticity, Equations of Thermoelasticity for Isotropic Materials, Hooke's Law: Orthotropic Elasticity.

(5)

Inelastic Material Behavior – Limitations on the use of Uniaxial Stress-Strain data, Nonlinear Material Response, Yield Criteria, Yielding of Ductile Metals, Alternative, Yield Criteria, General Yielding.

(4)

Part-B

Application of energy methods: Principle of Stationary Potential Energy,Castigliano's Theorem on Deflections, Castigliano's Theorem on Deflections for Linear Load-Deflection Relationships, Deflections of Statically Determinate Structures, Statically Indeterminate Structures.

(4)

Torsion – Torsion of a Prismatic Bar of Circular Cross Section, Saint-Venant's Semi-inverse Method, Linear Elastic Solution, Prandtl Elastic Membrane (Soap Film) Analogy, Narrow Rectangular Sections, Torsion of Rectangular Cross Section Members, Hollow Thin-Wall Torsion Members and Multiply Connected Sections, Thin-Wall Torsion Members with Restrained Ends, Numerical Solution of the Torsion Problem, Inelastic Torsion: Circular Cross Sections, Fully Plastic Torsion: General Cross Sections.

(5)

Elastic and Inelastic Stability of Columns – Introduction to Column Buckling, Deflection Response to Columns to Compressive Loads, Euler formula for Columns with Pinned Ends, Euler Buckling of Columns with Linearly Elastic End Constraints,

Local Buckling of Columns, Inelastic Buckling of Columns.

(4)

Thick Walled Cylinder - Basic Relationships, Stress Components at Sections Far fromEnds for a Cylinder with Closed ends, Stress Components and Radial Displacement for Constant Temperature, Criteria of Failure, Fully Plastic Pressure and Autofrettage, Cylinder Solution for Temperature Change Only, Rotating Disks of Constant

Books Suggested

	NAME	**AUTHOR(S)**	**PUBLISHER**
1.	Advanced Mechanics of Materials, 6/e	Arthur P. Boresi and Richard J. Schmidt	Wiley, 2002
2	Advanced Mechanics of Materials andApplied Elasticity, 5/e	Ansel C. Ugural and Saul K. Fenster	Prentice Hall, 2011
3	Advanced Strength and Applied Stress Analysis, 2/e	Budynas	McGraw Hill, 1998
4	Strength of Materials vol. 1 & 2, 3/e	S. Timoshenko	CBS Publishers,1986

Course Code	MEC-755(d)
Course Title	**Advanced Mechanics of Materials-I Lab**
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Mechanics Strength of materials, Material Science, Applied
Course Objectives (CO)	The experiments aims at 1. Finding stress & strain relationships within elastic limit & the study of various theories of failure 2. The study of bending, torsion & buckling of bars and deformation of frames & trusses
Course Outcome	The student will be able to 1. Determine the stress strain relationships within elastic limit. 2. Get knowledge about various theories of failure and deformation in bars, frames & trusses.

Syllabus

List of Experiments

1. Hooke's Law
2. Failure Theories
3. Bending of Bars
4. Torsion of Bars
5. Buckling of Bars
6. Deformation of Frames and Trusses

Course Code	**MEC 705 (e)**
Course Title	**Work Study**
Type of Course	Optional
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Manufacturing Processes, Mechanical Measurements
Course Objectives (CO)	1. To provide basic understanding about the concept and significance of work study in an organization. 2. To develop understanding about various techniques of motion study and time study. 3. To enable students to assess worker rating, determine allowances and evaluate standard time for jobs. 4. To provide knowledge about various wages and wage-incentives schemes.
Course Outcome	1. Demonstrate an understanding of the fundamental concepts of work study. 2. Analyze the existing methods of working for a particular job using flow diagrams and process charts and develop an improved method following principles of motion economy. 3. Apply different types of work measurement techniques to analyze work content and decide appropriate allowances for the jobs under analysis so as to establish time standard. 4. Calculate the rate of wage and incentive for the employees of an organization.

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

SECTION-A

Methods Engineering:Introduction to methods engineering, history in general definition, objects.

(2)

General procedure for method study, formulation of the problem, analysis of problem and use of aids like flow diagram, procedure diagram, operation process chart, multiple activity chart, trip frequency chart and diagram, left hand and right hand charge, principles of motion economy.

(10)

Search for alternatives including principles of motion economy and other aids to be used in search phase. Evaluation of alternatives.

(3)

Implementation, follow up and feedback, resistance to charge and acceptance of new Solution. Special problem-complete investigation of the problem from motion study point of view.

(3)

SECTION-B

Work Measurement: Introduction to work measurement, work measurement equipment and procedure. Various methods of reading stop watches, operator's performance, various rating methods.

(4)

Relation between observed time, normal time and standard time. Calculation of Standard time for various problems.

(4)

Work Sampling: Application of work sampling, work sampling procedure. Design of work sampling plan. Pre-determined time systems: work factor, M.T.M System. Synthesis of elemental time application.

(5)

Wage and Wage Incentives: Wages and wage incentives, types of incentives, requirements of good incentive schemes, wage-incentives schemes, group incentives.

(5)

RECOMMENDED BOOKS			
S. No.	**NAME**	**AUTHOR(S)**	**PUBLISHER**

1	Methods Engineering	Brans	Mc-Graw Hills, N. York
2	Motion and Time Study	Mundell	Prentice Hall of India, N. Delhi
3	Work Study	S. Dalela	Standard Publishers, Delhi
4	Work Study	O.P. Khanna	DhanpatRai& Sons, Delhi

Course Code	MEC-755(e)
Course Title	Work Study **Lab**
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Measurements ,Manufacturing Processes, Mechanical
Course Objectives (CO)	1. To enable students to solve practical problems related to college workshop, Hostel Mess, College Library etc. 2. This course aims at providing the practical knowledge to students regarding time- tested successful tools that industrial engineers use to improve operations & activities in actual industrial situations.
Course Outcome	1) The students will be able to apply the tools and techniques of time study, motion study etc. in real life industrial environment. 2) The student can apply the motion study techniques to wide range of applications from Mechanical Engineering and can solve various practical engineering problems related to the field.

Syllabus

List of Experiments

1. Work study report of college workshop.
2. Work study report of Hostel Mess.
3. Work study report of college Library.
4. Operation Process Chart.
5. Flow process Chart.
6. Standard time calculation.

Course Code	**MEC 705 (f)**
Course Title	**Mechanical Behavior of Materials-1**
Type of Course	Optional
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Strength of Materials/Mechanics of Materials
Course Objectives (CO)	1. This course aims at providing the knowledge of mechanical behaviour of materials 2. The course will present systematic approach for finding the deformation and yielding of materials 3. The course also provides knowledge for surveying of Engineering materials and the mechanical testing
Course Outcome	1) Understand the type of material failure which helps in design and material selection 2) Understand the structure and deformation of the materials and able to calculate the yield and fracture point of materials under complex stresses 3) Surveying/select the engineering material

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

SECTION-A

1. **Introduction:** Type of Material Failure, Design and Material Selection, Technological Challenge, Economic Importance of Fracture.

(2)

2. **Structure and Deformation of Materials:** Bonding of Solids, Structure in Crystalline Materials, Elastic Deformation and Theoretical Strength, Inelastic Deformation.

(3)

3. **Survey of Engineering Materials:** Alloying and Processing of Metals, Irons and Steels, Nonferrous Metals, Polymers, Ceramics and Glasses, Composite Materials, Material Selection for Engineering Components.

(3)

4. **Mechanical Testing:** Tension Test, Engineering and True Stress-Strain, Tensile Behavior, Compression Test, Hardness Test, Impact Test, Bending and Torsion Tests.

(4)

SECTION-B

5. **Stress Strain Relationships and Behavior:** Models for Deformation Behavior, Elastic Deformation, Anisotropic Materials.

(3)

6. **Review of Complex and Principal States of Stress and Strain:** Plane Stress, Principal Stresses, Max. Shear Stress, 3D State of Stress, Stresses on Octahedral Planes, Complex State of Strain.

(4)

7. **Yielding and Fracture under Combined Stresses:** General Form of Failure Criteria, Max. Normal Stress Criteria Max. Shear Stress Criteria, Octahedral Shear Stress Criteria, Coulomb-Mohr Criteria.

(4)

RECOMMENDED BOOKS			
S. No.	**NAME**	**AUTHOR(S)**	**PUBLISHER**
1	Mechanical Behavior of Materials (3E)	Norman Dowling	Pearson Publishers
2	Mechanical Behavior of Materials (2e)	Andre Meyers	Cambridge University Press
3	Mechanical Behavior of Materials	Bowman	John Wiley & Sons

4	Mechanical Behavior of Materials	Courtney	Waveland Publishers

Course Code	MEC-755(f)
Course Title	Mechanical Behaviors of Materials–I **Lab**
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Strength of Materials/Mechanics of Materials
Course Objectives (CO)	The experiments aims at providing knowledge in mechanical behavior of materials and to calculate the yield and fracture point of materials under complex stresses
Course Outcome	Students will be able to 3. Understand the type of material failure which helps in design and material selection 4. Understand the structure and deformation of the materials and able to calculate the yield and fracture point of materials under complex stresses Surveying/select the engineering materia

Syllabus

List of Experiments

Demonstration and studies concerning the topics in theory

Course Code	**MEC 705 (g)**
Course Title	**Vehicle Dynamics**
Type of Course	Elective
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Theory of machines I & II
Course Objectives (CO)	4. Provide an introduction to multi-body dynamics. 5. Enable students to model and analyse the stability and dynamics of ground vehicles.
Course Outcome	5. Create a analytical model of a ground vehicle. 6. Solve the mathematical model of the vehicle and find time response of the vehicle. 7. Perform vehicle dynamics simulation so as to determine stability of a vehicle.

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

SECTION-A

1. Introduction:

Overview, What is Vehicle Dynamics? , Classical methods, Analytical process, Computational methods, Computer based tools, Commercial computer packages, Benchmarking exercises.

2. Kinematics and Dynamics of Rigid Bodies:

Introduction, Theory of Vectors, Geometry analysis, Velocity analysis, Acceleration analysis, Static force and moment definition, Dynamics of a particle, Linear momentum of a rigid body, Angular momentum, Moments of inertia, Parallel axes theorem, Principal axes, Equations of motion.

3. One-Dimensional Vehicle Dynamics:

Forward Vehicle Dynamics, Parked Car on a level Road, Parked Car on an Inclined Road, Accelerating Car on a Level Road , Accelerating Car on an Inclined Road, Parked Car on a

Banked Road, Optimal Drive and Brake Force Distribution, Vehicles on a Crest and Dip.

4. Driveline Dynamics:

Engine Dynamics, Driveline and Efficiency, Gearbox and clutch Dynamics, Gearbox Design, Geometric Ratio Gearbox Design, Progressive Ratio Gearbox Design.

SECTION-B

5. Applied Vehicle Kinematics:

Rotation About Global Cartesian Axes, Successive Rotation About Global Cartesian Axes, Rotation About Local Cartesian Axes, Successive Rotation About Local Cartesian Axes, Euler Angles, General Transformation, Angular Velocity, Time Derivative and Coordinate Frames, Rigid Body Velocity, Angular Acceleration, Rigid Body Acceleration, Axis-angle Rotation, Screw Motion

6. Applied Vehicle Dynamics

Force and Moment, Rigid Body Translational Dynamics, Rigid Body Rotational Dynamics, Mass Moment of Inertia Matrix, Lagrange's Form of Newton's Equations of Motion, Lagrangian Mechanics.

7. Vehicle Planar Dynamics

Vehicle Coordinate Frame, Rigid Vehicle Newton-Euler Dynamics, Force System Acting on a Rigid Vehicle, Tire Force and Body Force Systems, Tire Lateral Force, Two-wheel Model and Body Force Components, Two-wheel Rigid Vehicle Dynamics, Steady-State Turning, Linearized Model for a Two-Wheel Vehicle, Time Response.

8. Vehicle Roll Dynamics

Vehicle Coordinate and DOF, Equations of Motion, Vehicle Force System, Tire and Body Force Systems, Tire Lateral Force, Body Force Components on a Two-wheel Model, Two-wheel Rigid Vehicle Dynamics, Steady-State Motion, Time Response.

RECOMMENDED BOOKS			
S. No.	**NAME**	**AUTHOR(S)**	**PUBLISHER**
1	Vehicle Dynamics, Theory and Application	Reza N Jazar	Springer, 2008
2	Fundamentals of Vehicle Dynamics	Thomson D. Gillespie	Society of Automotive Engineers, 1992
3	Vehicle Dynamics and Control	Rajesh Rajamani	Second Edition, Springer, 2012

Course code	MEC755(g)
Course title	Vehicle Dynamics lab
Type of course	Elective
LTP and credits	0-0-2 and 1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50 marks
Pre-requisite	Theory of machines I & II
Course Objective	Provide an hands-on experience to students in simulating dynamics of ground vehicles.
Course Outcome	At the end of the course the student would be able to 1. Create a analytical model of a ground vehicle in MATLAB. 2. Solve the mathematical model of the vehicle and find time response of the vehicle using MATLAB. 3. Perform vehicle dynamics simulation so as to determine stability of a vehicle using MATLAB.

Syllabus

List of Experiments

1. Perform numerical simulation in MATLAB, of forward vehicle dynamics.
2. Perform numerical simulation in MATLAB, of lateral vehicle dynamics.
3. Numerical simulation of high-speed turning of vehicle in MATLAB.
4. Stability analysis of a Vehicle while maneuvering in MATLAB.
5. Steering dynamic force analysis in MATLAB for a front wheel drive vehicle.

Course Code	**MEC 705 (h)**
Course Title	**Materials Design**
Type of Course	Optional
L T P	3 1 0
Credits	3
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 --- 50
Course Prerequisites	Mechanics of Materials, Materials and Heat Treatment
Course Objectives (CO)	1. To introduce applications of composite materials 2. To educate students about various material characterization techniques 3. To familiarize students on the effects of using nano-materials in composites 4. To educate students about the uses of modelling in micro and nano scale characterization
Course Outcome	1. Evaluate the uses and applications of different types of materials and composites 2. Analyze and characterize variety of materials for different types of applications 3. Model structures comprising of different types of materials 4. Learn various techniques for composite fabrication

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each*

and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

1. Basic Introduction to various types of engineering, dental and bio-materials: Types of engineering materials, properties, glass transition temperatures, mechanical properties, characterization of polymers and ceramic material (6)

2. Introduction to fabrication techniques and methodologies for different types of composite materials: Processing of plastics, extrusion, blow moulding, compression moulding, mechanical behaviour of ceramics, solvent mixing, melt blending, types of composite materials, laminates, dispersion, particle and fibre strengthening of composites (13)

Part - B

3. Simulation and Finite Element modelling techniques for characterization (10)

4. Material analysis and testing techniques: Electron Microscopy, Raman and IR spectroscopy, interpretation of various spectra, crack identification and propagation, Weibull equation and dsitribution (5)

5. Material applications for engineering, dental and surface coatings: use of ceramics in body implants, material requirements for biocompatibility, ceramic compounds and their biomedical applications (6)

RECOMMENDED BOOKS			
S. No.	**NAME**	**AUTHOR(S)**	**PUBLISHER**
1	Mechanical Behavior of Materials(3E)	Norman Dowling	Pearson Publishers
2	Mechanical Behavior of Materials	Bowman	John Wiley & Sons
3	Mechanical Behavior of Engineering Materials	Roesler, Harders, Baeker	Springer

Course Code	MEC- 755(h)
Course Title	**Materials Design Lab**
Type of Course Core/Optional	Optional
LTP and Credits	0 0 2, credit 1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50 marks
Course Objectives(CO)	1. Introduction to visual characterization techniques 2. Familiarization of composite fabrication methods
Course Outcomes	1. Learn characterization techniques of materials 2. Understand mechanical characterization methodologies of composite materials 3. Fabricate various types of composite materials

Syllabus

List of Experiments

1. Characterize materials using Scanning and Transmission Electron .Microscopy(SEM/TEM).
2. Use ultra-sonication, melt blending and extrusion methods for composite fabrication
3. Dynamic Mechanical Analysis(DMA) to study hardness, modulus and thermal analysis of composite materials.
4. Finite Element Analysis(FEA) of composite materials.
5. Use rapid prototyping to develop models.

Course Code	**HSS -701**
Course Title	**Financial Management**
Type of Course	Elective
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	
Course Objectives (CO)	The main aim of this course is to make students learn different financial decisions i.e. investing, financing and dividend, required to be taken by a company and provide knowledge about the functioning of the financial system (financial markets, financial institutions, financial services and financial instruments) of the country.
Course Outcome	1. The students will learn to make best combination of financial decisions by considering risk and return trade-off. 2 .The students will identify how business can gain maximum through the financial system. 3. The students will understand how to manage funds effectively so as to maximize returns.

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

SECTION-A

Introduction to Financial Management

Concept of Finance, Terminology Related to Finance, Financial Decisions, Factors Affecting Financial Decisions, Risk-Return Trade-Off (3 hours)

Financial System

Concept and Role of Financial System in Indian Economy (2 hours)

Financial Markets and Instruments **(8 hours)**

Concept and Relevance of Money Market and Capital Market

Money Market Instruments: Call Money, Treasury Bills, Commercial Papers, Certificate of Deposits
Capital Market Instruments: Equity Shares, Preference Shares and Debentures
Hypothetical Trading in Financial Markets

Financial Services **(7 hours)**

Nature and Functions of Financial Services: Merchant Banking, Mutual Funds, Factoring, Forfaiting, Credit Rating
Case Study on Financial Services

SECTION-B

Financial Institutions **(6 hours)**

Nature and Functions of Financial Institutions: Reserve Bank of India (RBI), Securities and Exchange Board of India (SEBI), Discount and Finance House of India (DFHI)

Long Term Investment Decisions **(7 hours)**

Capital Budgeting: Concept, Importance, Factors
Techniques/Methods with Numerical Applications (Pay Back Period, Accounting Rate of Return, Net Present Value, Internal Rate of Return and Profitability Index), Case Study

Short Term Investment Decisions **(5 hours)**

Working Capital: Nature, Type and Factors Affecting the Requirement of Working Capital, Case Study

Financing Decisions **(5 hours)**

Capital Structure: Essentials and Approaches of Capital Structure
Sources of Finance (long-term and short-term), Financial Leverage: Concept and Numerical Application, Case Study

Dividend Decisions **(2 hours)**

Types of Dividend, Dividend Policy: Nature and Factors Affecting Dividend Policy,Case Study

Suggested Books:		
S.No.	***Name of Book/ Authors/ Publisher***	***Year of Publication/ Reprint***
1	"Financial Management", Shah P., 2nd Edition, Pubs: Dreamtech Press	2009
2	"Financial Markets and Services", Gordon E. and Natarajan K., 3rd Edition, Pubs: Himalaya Publishing House.	2006
3	"Financial Management: Theory and Practice", Chandra P., 8th Edition, Pubs: McGraw Hill Education (India).	2012
4	"Financial Management", Pandey I.M., 10th Edition, Pubs: Vikas Publishing House Pvt. Ltd., Noida.	2010
5	"Cases in Financial Management", Pandey I.M. and Bhat R., 3rd Edition, Pubs: McGraw Hill Education (India).	2012
6	"Financial Institutions and Markets: Structure, Growth and Innovations", Bhole L.M. and Mahakud J., 5th Edition, Pubs: McGraw Hill Education (India).	2009

Course Code	**HSS 751**
Course Title	**Financial Management Practical**
Type of Course	Elective
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50

Syllabus

Seminars and case studies from theory.

Course Code	**HSS -702**
Course Title	**Business Environment and Business Laws**
Type of Course	Elective
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	
Course Objectives (CO)	The main aim of this course is to make students understand different types of environment influencing business decisions and to provide knowledge about different laws that needs to be followed for initiating and managing business.
Course Outcome	
	The students will learn how companies follow corporate governance and social responsibility practices along with fulfilling economic objectives.
	The students will gain knowledge about application and implementation of various business laws in practice.

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

SECTION-A

Introduction to Business **(5 hours)**

Scope and Characteristics of Business, Classification of Business Activities

Forms of Ownership of Business: Sole Proprietorship, Partnership and Company

Business Environment **(10 hours)**

Internal Environment: Concept and Elements (Value System, Vision Mission Objectives, Management Structure, Human Resources, Company Image etc.)

SWOT Analysis: Concept and Case Study

External Environment: Micro Environment (Suppliers, Customers, Competitors, Market Intermediaries etc.) and Macro Environment – PESTEL Analysis (Political, Economic, Social, Technological, Ecological and Legal), Case Study on Impact of Environment on Business

Globalization **(5 hours)**
Concept, Pros and Cons of Globalization, Impact of Global Environment on Business Globalization of Company – Case Study

SECTION-B

Corporate Social Responsibility **(5 hours)**
Concept, Social Responsibility towards different stakeholders, Rationale for CSR CSR – Case Studies

Corporate Governance **(5 hours)**
Concept, Elements and Essentials of Good Governance

Contract Law **(5 hours)**
Concept, Types and Essentials Elements of Contract

Partnership Law **(5 hours)**
Nature of Partnership, Provisions of Partnership Act, Issues Related to Partnership Firm, Hypothetical Formation of a Partnership Firm

Company Law **(5 hours)**
Nature of Company, Provisions of Company Act, Issues Related to Incorporation of Company, Hypothetical Formation of a Company

Suggested Books:		
S.No.	***Name of Book/ Authors/ Publisher***	***Year of Publication/ Reprint***
1	"Business Environment: Text and Cases", Cherunilam F., 22nd Edition, Pubs: Himalaya Publications.	2013
2	"Legal Aspects of Business", Pathak A., 5th Edition, Pubs: McGraw Hill Education.	2013
3	"Essential of Business Environment: Text, Cases and Exercises", Aswathappa K., 11th Edition, Pubs: Himalaya Publication.	2011
4	"Business Law Including Company Law", Gulshan S.S. and Kapoor G.K., 15th Edition, Pubs: New Age International (p) Ltd.	2011
5	"Business Law and Corporate Laws", Tulsian P.C., 1st Edition, Pubs: Sultan Chand Publishing.	2011
6	"Fundamentals of Business Organization & Management", Bhushan Y.K., 19th Edition, Pubs: Sultan Chand & Sons.	2013
7	"Corporate Governance: Principles, Policies and Practices", Fernando A.C., 2nd Edition, Pubs: Pearson India.	2011

Course Code	**HSS 752**
Course Title	**Business Environment and Business Laws Practical**
Type of Course	Elective
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50

Syllabus

Seminars and case studies from theory.

Course Code	**HSS 703**
Course Title	**Human Resource Management**
Type of Course	Elective
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	
Course Objectives (CO)	1. The main aim of this course is to provide an overview of HRM, keeping the Indian business scenario in the background and to acquaint the students with the strategic role of HRM in managing an organization.
Course Outcome	1. The students will develop the ability to solve problems in area of HRM in organizations. 2. The students will become aware of latest developments in HRM practices which are essential for effective management in organization.

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

SECTION-A

Introduction to Human Resource Management **(5 hours)**
HRM: Nature, Scope, Functions, HRM Practices and Problems in India with Case Studies
Human Resource Planning (HRP) (5 hours)
Concept and Process of HRP, Factors Affecting HRP
Job Analysis and Designing **(5 hours)**
Uses and Process of Job Analysis, Job Description and Job Specification: Features and Hypothetical Formulation, Job Designing: Job Enrichment, Job Enlargement

Recruitment and Selection **(6 hours)**

Recruitment: Sources and Methods
Selection: Selection Process, Selection Tests, Types and Nature of Interviews
Role Playing and Case Study on Selection Process, Tests and Interview

SECTION-B

Induction and Internal Mobility (7 hours)
Induction Programme, Need and Scope of Internal Mobility: Transfer, Promotion, Demotion
Training and Development (8 hours)
Training: Need and Methods, Management Development: Need, Methods and Management Development Programme HRM Games for Development of Employees
Performance Appraisal and Compensation (6 hours)
Nature and Methods of Performance Appraisal, Hypothetical Performance AppraisalCompensation: Financial and Non-Financial Benefits
Employee Health and Safety (3 hours)
Concept, Issues related to Health and Safety, Workplace Health Hazards

Suggested Books:		
S.No.	***Name of Book/ Authors/ Publisher***	***Year of Publication/ Reprint***
1	"Human Resource Management: Text and Cases", Rao V.S.P., Pubs: Excel Books.	2002
2	"Human Resource Management", Dessler G. and Varkkey B., 12th Edition, Pubs: Pearson India.	2011
3	"Human Resource Management: Text and Cases", Aswathappa K., 7th Edition, Pubs: McGraw Hill Education (India).	2013
4	"Human Resource Management: Text and Cases", Gupta C.B., 14th Edition, Pubs: Sultan Chand and Sons.	2012
5	"Human Resource Management: Text and Cases", Bedi S.P.S. and Ghai R.K., Pubs: Bharti Publications.	2012
6	"Human Resource Management Applications: Cases, Exercises, Incidents and Skill Builders", Fottler M.D., McAfee R.B. and Nkomo S.M., 7th Edition, Pubs: Cengage Learning.	2013

Course Code	**HSS 753**
Course Title	**Human Resource Management Practical**
Type of Course	Elective
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50

Syllabus

Seminars and case studies from theory.

Course Code	**MEC-801**
Course Title	**Mechatronics**
Type of Course	Core
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	CAD/CAM, Robotics, Automatic Controls
Course Objectives (CO)	1. To enable the students to understand the modern mechatronics components. 2.To enable the students to understand the interdisciplinary fundamentals of mechanical engineering, electrical engineering, control systems, computer engineering and their integration. 3.This course focuses particularly on providing an overview of embedded controllers like microprocessors/microcontrollers, PLCs, sensors etc. and applications of mechatronics to observe and control various mechanical systems: thermal systems, motion systems, pneumatic systems and hydraulic systems.
Course Outcome	1. The students will be able to integrate mechanical, electronics, control and computer engineering in the design of Mechatronics systems. 2. The students will learn the basics of microcontrollers, sensors and actuators imbedded in automated machines. 3. The students will be able to apply knowledge of basic mechatronics to construct a mechatronic system

SYLLABUS

Note for Examiner- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

Part-A

Mechanical Actuation Systems: Introduction to mechatronics, Measurement system, Control systems (open & closed), elements of closed loop system Mechanical systems,

types of motion, kinematic chains, cams, gear trains, ratchet and pawl, belt and chain drives, and bearings.

(3)

Pneumatic and Hydraulic Systems: Introduction to pneumatic and hydraulic, actuation, systems, directional control, valves, pressure, control valves, cylinders, process control valves, rotary actuators.

(5)

Types of controllers: Proportional, integral, derivative, PID, Hydraulic and Pneumatic controllers.

(3)

Programmable Logic Controllers: Basic structure of PLC, introduction to ladder, programming, basic programs, industrial applications of PLC, Data acquisition system.

(4)

Part-B

Microprocessors: Introduction to micro-computer structure, 8085 pin, diagram, architecture, Instruction set and basic program, I/O interfacing, Memory, interfacing A to D and D to A conversion fundamentals.

(8)

Input/output systems: Interfacing, Input/output ports, interface requirements, peripheral interface adapters, serial communication interface and examples of interfacing.

(5)

Applications: Applications of mechatronics to observe and control various mechanical systems: thermal systems, motion systems, pneumatic systems. Hydraulic systems. Case study of PLC based / Microprocessor based timed switch, windscreen wiper motion, bathroom scale, Pick and Place Robot, Car engine management.

(8)

Recommended books

	NAME	**AUTHOR(S)**	**PUBLISHER**
1.	Mechatronics	W Bolton	Pearson Education
2	Microprocessors and Interfacing	Douglas V Hall	Tata McGraw Hill

Course Code	MEC-851
Course Title	Mechatronics Lab
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	CAD/CAM, Robotics, Automatic Controls
Course Objectives (CO)	1. To enable the students to understand the interdisciplinary fundamentals of mechanical engineering, electrical engineering, control systems, computer engineering 2. Also learn their integration and apply them in practical problems.
Course Outcome	1. The students will be able to integrate mechanical, electronics, control and computer engineering in the design of Mechatronics systems. 2. The students will be able to apply knowledge of basic mechatronics to construct a simple mechatronic system and incorporate it in a mechanical device

Syllabus

List of Experiments

1. To acquire signal from a sensor through A/D card on to a computer.
2. To send data signal from computer to some actuator through D/A card.
3. To carry out the position control of a geared DC motor using servo mechanism.
4. To carry out the microprocessor based direction and speed control of a stepper motor and to observe the effect of external load.
5. To study the DC speed control system built around a permanent magnet DC motor, an optical pick-up and a slotted disk to measure the speed of the motor for feedback control. To find the characteristics of the system when subjected to variable loading.
6. To perform the PID control of an oven.

7. To assemble a pneumatic sorting system by means of a single acting cylinder to sort a set of articles.

8. Use a pneumatic double acting cylinder to open and close the lid on a container.

Course Code	**MEC-802**
Course Title	**OPERATION RESEARCH**
Type of Course	Core
L T P	3 1 0
Credits	3
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Basic knowledge of statistics and terminology used in production/manufacturing industry.
Course Objectives (CO)	This module aims to introduce students to formulate, analyze and solve mathematical models that represent real-world problems using various techniques.
Course Outcome	1. Understand scope, objectives, phases, models & limitations of operations research. 2. Understand the theoretical working of linear programming techniques like graphical, simplex algorithm and dual simplex technique. 3. Solve specialized linear programming problems like transportation and assignment models & model a dynamic system as queuing model and computation of its important performance measures. 4. Solve network models using PERT and CPM techniques

SYLLABUS

Note for Examiner- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

Part-A

1. Definition and Characteristics of O.R., Scientific decision making approach in O.R., Methodology of O.R., Need, Applications &limitation of O.R (2)

2. Definition of Models, Classification of models, Construction of models, Approximations in O.R. models (2)

3. Allocation Models
Analysis of industrial situations to find characteristics like key decision, objective, possible alternatives & restrictions – Three categories of allocations type situations to be considered. General mathematical formulation for linear programming, feasible and optimal solutions. (4)

4. Graphical and simplex techniques to solve linear models, Modification of minimization situations so as to be solvable by simplex method. Duality and degeneracy in simplex method, Dual simplex method, application and limitations of linear optimization models. (11)

Part-B

5. Transportation models, methods for finding starting solution, Stepping Stone and u-v method of finding optimal solution, Unbalanced and Degenerate transportation models, Hungarian method to find optimal solution in assignment models, Unbalanced assignment problem and Restrictions on Assignments. (8)

6. Cyclic shortest route models, Travelling salesman problem and Branch and Bound method to solve it. (2)

7. Queuing theory, various types of queuing situations and their solutions. (5)

8. PERT & CPM
Network situations where PERT & CPM can be applied, planning, scheduling & Control, work–breakdown structure.

(a) PERT NETWORKS : Events and activities, constructions of network, forward & Backward planning, Fulkerson's rule, optimistic, pessimistic & most likely time Estimates, frequency distribution, mean, variance and standard deviation, expected time , earliest expected time and latest occurrence time, definitions of slack and critical path.

(b) CPM NETWORKS : Similarity and difference of CPM & PERT, construction of network , earliest event time , latest occurrence time, float, total float, free float, independent float , Critical Path in network (9)

Recommended books

	NAME	**AUTHOR(S)**	**PUBLISHER**
1.	Operations Research – An Introduction	A.H.Taha	Macmillan Co,
2	Operations Research	P.K.Gupta and D.S.Hira	S.Chand
3	Quantitative Techniques in Management	N.D.Vohra	Tata McGraw Hill
4	Executive Decisions and Operations Research	W.D.Miller and M.K.Starr	

Course Code	MEC-852
Course Title	Operation Research Lab
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Basic knowledge of statistics and terminology used in production/manufacturing industry.
Course Objectives (CO)	This module aims to introduce students to formulate, analyze and solve mathematical models that represent real-world problems using various techniques. .
Course Outcome	At the end of the course, students will have the skills 1. To formulate a real-world problem as a mathematical model. 2. Solve case studies using various allocation and network models.

Syllabus

List of Experiments

Projects and case studies concerning the topics in theory.

Course Code	**MEC-803**
Course Title	**COMPUTATIONAL FLUID DYNAMICS**
Type of Course	Core
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Fluid mechanics, numerical analysis
Course Objectives (CO)	To solve fluid and heat-transfer problems using computational techniques
Course Outcome	Ability to solve fluid and heat-transfer problems using numerical computation.

Syllabus

Note for Examiner- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

Part-A

1. **Introduction**

   History of CFD; Comparison of the three basic approaches in engineering problem solving – Analytical History of CFD; Comparison of the three basic approaches in engineering problem solving – AnalyticalHistory of CFD; Comparison of the three basic approaches in engineering problem solving – Analytical.

2. **Conservation Laws and Equations**

   Models of flow, Conservations laws of fluid motions: Mass conservation, Momentum Equation, energy equations Navier-Stokes Equations; Difference between conservative forms and non-conservative forms.

3. **Partial Differential Equations PDE**

   Classifications of quasi linear PDE, impact on physical and computational fluid dynamics Physical Boundary Condition and well posed problems

Part-B

4. **Discretization of PDE I:**

   Finite Difference Method: Representation of PDE by Forward, Rear and Central Difference , Truncations Error, Difference Equations; Explicit and Implicit Approach:, Error and Analysis of stability

5. **Discretization of PDE II:**

   Finite volume Method: finite volume method for 1D, 2D,and 3D steady state diffusions problems, Properties of Discretization schemes; Central Difference scheme, the upwind Differencing Scheme Quadratic upwind differencing scheme (Quick).

6. **Solutions for Pressure Velocity Algorithms**

   The staggered grid, SIMLPE Algorithm, SIMPLER Algorithm; worked Examples for SIMPLE algorithm , Thomas Algorithms for solving tri-diagonal Matrix TDMA, Applications two 1D heat transfer problems

Recommended Books

	NAME	**AUTHOR(S)**	**PUBLISHER**
1.	Numerical Heat Transfer and Fluid Flow	Suhas V. Patankar	Taylor & Francis
2	Computational Fluid Dynamics	J. Anderson Publisher	McGraw Hill
3	Computational Fluid Dynamics by Bose	T. K., Wiley	New York
4	Computational Fluid flow and Heat Transfer	K. Muralidhar& T. Sundaranjan	Narosa Publications

Course Code	MEC-853
Course Title	Computational Fluid Dynamics **Lab**
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Fluid mechanics, numerical analysis
Course Objectives (CO)	To solve fluid and heat-transfer problems using computational techniques
Course Outcome	Ability to solve fluid and heat-transfer problems using numerical computation.

Syllabus

List of Experiments

1. Two dimensional heat conduction in a rectangular geometry.
2. To solve the temperature distribution for a fin.
3. To solve two dimensional incompressible viscous flow in a lid driven cavity.
4. Temperature distribution for a heated plate subjected to insulated boundary condition on one side.
5. Temperature distribution for a heated plate subjected to fixed boundary conditions

Course Code	**MEC 804 (a)**
Course Title	**Experimental Stress Analysis**
Type of Course	Optional
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Strength of Materials/Mechanics of Materials
Course Objectives (CO)	1. This course aims at providing the knowledge calculation of stress analysis 2. The course will present systematic approach for the concept of elasticity along with 2D and 3d photo elasticity 3. The course also provides knowledge of Birefringent Coatings and Strain gauges
Course Outcome	1. Understand the concept of elasticity, 2d and 3d photo elasticity 2. Calculate the stresses in the materials through strain gauges 3. Understand the concept of Birefringent and Brittle Coatings

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

SECTION-A

1. **Basic Elasticity:** Laws of stress transformation, principle stress and principle and principle planes, Cauchy's stress quards. Strain analysis, strain equation of transformation, principle strain, Cauchy's strain quadric, stress-strain relationship.

(4)

2. **Two Dimensional Photo elasticity:** Stress optic law, optics of Polaris cope, plane and circular Polaris copes, dark and light field arrangement, fringe multiplication, fringe sharp ending, compensation techniques, commonly employed photo elastic materials.

(3)

3. **Three Dimensional Photo elasticity:** Neuman's strain optic relationship, stress freezing in models, materials for three dimensional photo-elasticity, shear-difference method of stress separation.

(4)

SECTION-B

4. **Birefringent Coatings:** Sensitivity, reinforcing effects and thickness of birefringent coatings.

(3)

5. **Electric Resistance Strain Gauges:** Gauges construction and installation, temperature compensation, gauge sensitiveness, gauges factor, correction for transverse strain effects. Factors affecting gauge relation. Rosettes, Rostre analysis, potentiometer and wheatstone bridge circuits for strain measurements.

(4)

6. **Brittle Coatings:** introduction, coatings stresses and failure theories, different types of crack patterns, crack detection. Composition of brittle coatings, coating cure, influence of atmospheric condition, effect of biaxial stress field.

(4)

Course Code	MEC-854(a)
Course Title	**Experimental Stress Analysis Lab**
Type of Course	Core
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Strength of Materials/Mechanics of Materials
Course Objectives (CO)	The experiments aims at providing knowledge in mechanical behavior of materials and to calculate the yield and fracture point of materials under complex stresses
Course Outcome	Students will be able to 1. Understand the concept of elasticity, 2d and 3d photo elasticity 2. Calculate the stresses in the materials through strain gauges

Syllabus

List of Experiments

Demonstrations and studies concerning the topics in theory.

Course Code	**MEC 804 (b)**
Course Title	**Metrology**
Type of Course	Optional
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Physics, Machine drawing
Course Objectives (CO)	1. To understand the basic standards & principles of measurement. 2. To study various types of measuring instruments & techniques. 3. To learn about various methods of measuring mechanical parameters.
Course Outcome	1) Understand the fundamentals of measurement standards. 2) Know about the various methods of measurement& purpose of critical dimensioning in manufacturing. 3) Apply knowledge of metrology in industries.

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

SECTION-A

Standards of Measurements: Line Standards, imperial standard yard, standard meter, sub-standards and standards; end bars, slip gauges, angular slip gauges, wave length standard.

(4)

Measuring Principles: Principle for mechanical measuring instruments – Lever methods, vernier method, screw & screw nut method. Compound gearing method, Helical strip method. Principles of optical measuring instruments, Reflection, Refraction Interference, Optical prism, Lenses, optical systems. Principle of electrical measuring instruments, Transformation of energy, Variation of electric parameters – Principle of pneumatic measuring instruments. Construction details of measuring instrument. Abbe principle, graduation lines and scale division, pivot & bearings. Measuring accuracy – dimensional & geometrical accuracy.Types of error, compound error, random error.

(6)

Interchangeability: Concept and need of interchangeability, Systems of tolerances, System offits, Design of limit gauges. Standardization, Design Standardization and Manufacturing standardization.

(3)

Linear and angular Measurement: Use of slip gauges, Dial indicators., Mechanical opticaland electrical comparators, Pneumatic gauges, Measuring machines, sine bars & angle, gauges, levels, clinometers, auto-collimator, taper gauges.

(4)

SECTION-B

Straightness, Fitness and Squareness testing:
Straight edges, surface plates, straightnesstesting, straight edge methods, levels or auto-collimator method. Flatness testing – level or auto-collimator method, optical flatness, squareness testing, indicator method, auto-collimator methods, engineer's squares.

(5)

Screw Thread Measurement: Errors in threads, screw thread gauges, measurement of element of of the external and internal threads, thread caliper gauges.

(3)

Spur Gear Measurement:
Geometry of spur gear, measurement of spur gear parameters.Ram out, pitch, lead, backlash, tooth thickness, composite elements.

(4)

Surface Finish Measurement:
Definitions of spur gear, measurement of surface, finish talysurf, profilometer, recorder, compariscope, microscope interference methods.

(3)

Miscellaneous: Acceptance tests for a lathe, Alignment of bearings.

(2)

RECOMMENDED BOOKS			
S. No.	**NAME**	**AUTHOR(S)**	**PUBLISHER**
1	Engineering Metrology	K.J. Hume	Macdonald, 1963

2	The Essence of Measurement	Alan S. Morris	Prentice Hall of India, 1997
3	Engineering Metrology	I C Gupta	DhanpatRai

Course Code	MEC-854(b)
Course Title	**Metrology Lab**
Type of Course	Optional
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Physics
Course Objectives (CO)	The experiments aims at 1. Providing knowledge about the use of various measuring instruments. 2. Providing fundamental knowledge of measurement & its use in industries
Course Outcome	The students will be able to 1. Conduct experiments with the help of various measuring instruments 2. Learn about the use of engineering tools for measurement, which will provide solutions to problems.

Syllabus

List of Experiments

1. To measure a gap gauge with slip gauges.
2. To measure the height of a circular spigot.
3. To calibrate a micrometer
4. To measure a plug screw gauge.
5. To check a straight edge.
6. To check a engineer's square
7. To measure the angle of a taper plug gauge with sine bar.

8. To check a form gauge by projection including the construction of the projection drawing.
9. To check a sine bar.
10. To measure the pitch error of a screw gauge (plug of ring).
11. To measure the form and angle of a plug screw gauge by optical method.
12. To set and calibrate an Engineer's block level.
13. To calibrate a dial gauge.
14. To compare two slip gauges using an optical flat.
15. To test the flatness of the surface plate using a block level.

Course Code	**MEC 804 (c)**
Course Title	**Mechanical Handling**
Type of Course	Optional
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Industrial Engineering
Course Objectives (CO)	1. Knowledge about the process of material handling & factors affecting it. 2. Knowledge about the problems related to material handling & production control of material handling. 3. Knowledge about the various types of material handling equipments.
Course Outcome	1. Know about the flow process of material handling & factors of material handling. 2. Use the various material handling devices in industries or on project sites. 3. To improve the scheduling of machines & minimize the movement of material.

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

SECTION-A

1. **Importance of Material Handling:** Principles of material handling, analysis of material handling problem, operation chart and flow process chart, flow diagrams.

(3)

2. **Material Handling factors:** Material, containers, frequency and duration, distance, speed, environment, labour and equipments.

(3)

3. **Factory Planning and Material Handling:** Plant location, factory handling, the layout as key material, handling problems.

(4)

4. **Production Control and material Handling:** Types of Production control, materials control production planning, production scheduling, production dispatching and follow up as related to materials handlings.

(3)

5. **Conveyors:** Belt carrier, chain and cable, roller, screw vibrating and reciprocating pneumatic tubes, load transferring machines, air operated & Hydraulic devices.

(4)

SECTION-B

6. **Cranes, Elevators and Hosits:** Fixed cranes and derricks, traveling cranes, portable crane elevators, hoist, winchescable ways.

(3)

7. Industrial trucks, railways, cars, dump trucks, overhead track age system.

(3)

8. **Pollets and Containers:** Enclosed tight, open top and platform coil supports, strapping, industrial packing etc.

(4)

9. **Mechanical Handling Equipment Used on Project Sites:** Shovels, Draglines, clamshell cranes, bulldozers, scrappers and motor graders, concrete mixture etc.

(4)

RECOMMENDED BOOKS			
S. No.	**NAME**	**AUTHOR(S)**	**PUBLISHER**

1	Construction equipment and its planning and application	Mahesh Verma	Metropolitan Book Co., 1975
2	Big Machines	Karen Wallace	DK Pub., 2000

Course Code	MEC-854(c)
Course Title	**Mechanical Handling Lab**
Type of Course	Optional
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Industrial Engineering
Course Objectives (CO)	Industrial Engineering The experiments 1. Aims at providing knowledge about the process of mechanical handling. 2. Will provide knowledge about the transmission & control system of crane and bulldozer.
Course Outcome	Students will be able to 1. Understand the process of mechanical handling. 2. Know about the transmission, control system of crane & bulldozer.

Syllabus

List of Experiments

1. To draw flow process chart for mechanical handling.
2. To prepare a plant location report for setting up a small scale industry.
3. To study different conveyors systems.
4. To study the hoisting system of a crane.
5. To study the transmission and revolving system of a crane.
6. To study transmission system of a bulldozer.
7. To study control system of a bulldozer
8. To study a dump truck.

Course Code	**MEC 804 (d)**
Course Title	**Bearings And Lubrication**
Type of Course	Optional
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	
Course Objectives (CO)	1. To understand about Friction and lubrication. 2. To know about Selection of Bearings and Requirements. 3. To get the knowledge different types of Sliding Bearings and Rolling Bearings.
Course Outcome	1. Learn about different types of friction, laws of friction. 2. Get knowledge about lubrication and different types of lubricants used. 3. Know about journal bearings, wick- oiled bearings, pressure fed bearings, externally pressurized bearings, deep groove bearings, filling notch bearings, angular-contact ball bearings, magneto bearings, self-aligning ball bearings, miniature ball bearings double row ball bearings, duplex bearings, ball thrust bearings, tapered thrust bearings, needle bearings, and their principle of operation.

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

SECTION-A

Friction and Lubrication:- Laws of dry sliding friction, characteristics of hydro dynamically lubricated surface Boundary region of lubrication, lubrication oil Vs grease oil lubrication, selection and its application. Sealing devices. Greases, oils in greases including the study of consistency, mechanical stability, bleeding and evaporation properties, synthetic grease, grease selection, specification and application.

(6)

Selection of Bearings and Requirements:- Types of bearings available, slider type bearings, roller element bearings, principle for selection of bearings, mechanical requirements, environmental condition and economical.

(4)

Sliding Bearings:- Types of journal bearings, wick- oiled bearings, pressure fed bearings, externally pressurized bearings, types of thrust bearings, pivoted shoe bearings, spring supported flexible plate thrust bearings, step thrust bearing, externally pressurized bearings, pocket thrust bearings.

(5)

SECTION-B

Viscosity, effect of temp. and pressure on viscosity. The Hagen-poiseuillie Law, Petroff's equation, hydrodynamic bearings theory. Reynolds's equation in two dimensions and limitation of the theory. The plane slider bearings, load capacity, slider bearings, load capacity, slider bearings friction, pivot-equation. The full journal bearings, load capacity, journal bearings friction, non-dimensional charts and simple numerical.

(9)

Reynolds's equation in three dimensions, effect of end flow on load factor, Kingsbury's electrical-analogy, leakage factor. Design aspects of simple journal bearings, multiple journal Barings, pressure bearings and non-pressure bearings.

Rolling Bearing:- Elementary study of deep groove bearings, filling notch bearings, angular-contact ball bearings, magneto bearings, self-aligning ball bearings, miniature ball bearings double row ball bearings, duplex bearings, ball thrust bearings, tapered thrust bearings, needle bearings, principle of operation, stribeck's equation for load capacity.

(6)

RECOMMENDED BOOKS			
S. No.	**NAME**	**AUTHOR(S)**	**PUBLISHER**
1	Bearings Design & Applications	D.F. Wilcock, and E.R.	McGraw Hill Book Co., N. York.
2	Analysis and Lubrication of Bearings	M.C. Shaw and Fred Mecks	McGraw Hill Book Co., N. York.

Course Code	MEC-854(d)
Course Title	**Bearing and Lubrication Lab**
Type of Course	Optional
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Industrial Engineering
Course Objectives (CO)	To give the practical exposure to the students to apply there theoretical knowledge on apparatus to perform experiments and correlate the theoretical aspect with the practical results
Course Outcome	The student will able to perform these experiments and can use for there for their project work and for research work and in industry in future.

Syllabus

List of Experiments

1. To find pressure distribution around a simple journal bearings under varying loads on driven shaft.
2. Projects and case studies concerning the topics in theory.

Course Code	**MEC 804 (e)**
Course Title	**Plastic and Rubber Technology**
Type of Course	Core
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Engineering Materials
Course Objectives (CO)	• Prepare the students to meet the fundamental expectations of the Rubber and Plastics industry • Enhance the technical knowledge with respect to the current scene through collaboration with industries and research organization • Emphasize Product Design aspects to enable students to be innovators in the field of Rubber and Plastics Technology
Course Outcome	1. Graduate will demonstrate strong basics in mathematics, science and technology 2. Graduate will demonstrate the ability to design and conduct experiments, as well as to analyze and interpret data 3. Graduate will demonstrate the ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability

SYLLABUS

Note for Examiner*- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

SECTION-A

1. Introduction, type and properties of plastic.

(2)

2. Design Considerations for plastic components.

(3)

3. Moulding of plastic components – Compression, transfer, injection and Blow Moulding Extension.

(3)

4. Machining & joining of plastics – General Machining properties, machining operations Methods of joining plastics.

(4)

5. Reinforced Plastics – Nature & Processing methods.

(2)

SECTION-B

6. Common failures and defects in plastic materials: Defects arising during moulding and extension. Mechanical, Chemical, Electrical and thermal failures in plastic.

(3)

7. Testing of plastics – Mechanical testing of plastics. Preparation of test specimen and Procedure of testing the following properties:
8.
    a. Tensile strength, elongation and modulus.
    b. Compressive, shear, cross- braking, bursting and bearing strength.
    c. Flexural properties.
    d. Impact strength, plastic yield.
    e. Creep.
    f. Hardness.
    g. Abrasion.
    h. Tear Strength and fatigue.
    i. Viscosity, Plasticity and flow.
    j. Resilience, stiffness and damping.
    k. Friction.
    l. Adhesion and bond strength.
    m. Ageing (4)

- Engineering Application of Plastics.
-

(2)

- Rubbers: Introduction, Elastic and plastic properties of vulcanized rubber, artificial rubbers. Engineering application of rubber.

(5)

- Methods of processing and testing of rubbers.

(5)

RECOMMENDED BOOKS			
S. No.	**NAME**	**AUTHOR(S)**	**PUBLISHER**
1	Construction equipment and its planning and application	Mahesh Verma	Metropolitan Book Co., 1975
2	Big Machines	Karen Wallace	DK Pub., 2000
3	Plastic Mould Engg. VoI I	Laszlo Sons	Pergaman press.
4	Plastics tooling and machining handbook	----	American Society – Tool & Mfg. Engrs. 1965
5	Fundamental Tools of Plastics	Hennery M. Rikardorn	McGraw Hill Book Co.
6	Properties and Testing of Plastic Materials	A.E. lever and J. Rhys	Temple Press London

Course Code	MEC-854(e)
Course Title	Plastic and Rubber Technology **Lab**
Type of Course	Optional
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Applied Thermodynamics
Course Objectives (CO)	The experiments aims at providing practical knowledge in rubber and Plastics and to implement practical engineering problem.
Course Outcome	Students will be able to 1. Understand the Behavior of rubber and plastics in various operating conditions 2. Implement of this in practical.

Syllabus

List of Experiments

1. To perform the shear test on plastics and draw stress- strain curve.
2. To perform compression test on plastics.
3. To perform shear test on plastics.
4. To perform Bending test on plastics.
5. To perform Impact test on plastics.
6. To perform creep test at room temp on plastics.
7. To perform hardness test on plastics.
8. To perform torsion test on plastics.

Course Code	**MEC-804 (f)**
Course Title	**ADVANCED FLUID MACHINERY**
Type of Course	Optional
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Fluid Mechanics, Fluid Machinery
Course Objectives (CO)	This course aims at providing knowledge in one and two dimensional theory in hydrodynamic machines, radial and axial flow machines. The course will present systematic approaches for the influence of fluid friction and hydrodynamic theory in turbo machinery.
Course Outcome	Students will be able to understand the governing theories for problems involving design and operating conditions. Apply knowledge of mathematics, science, and engineering in solving various problems in advanced fluid machinery.

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

SECTION-A

1. One Dimensional Theory:
Euler's theory – Relation between velocity diagrams and direction of vanes, Variation in design and operating conditions of hydrodynamics machines.

(10 hours)

2. Two Dimensional Theory of Radial and Axial Flow machines: -
Irrotational flow through stationery radial flow vane systems – laws of relative motions in radial flow runners. Stodola's correction – Exact solution and comparison with approximate solution – Pressures and forces in rotating systems.
.

(10 hours)

SECTION-B

3**.** Three dimensional problems in turbo machinery and its two dimensional solutions.

4. Influence of fluid friction in turbo machinery and limitations of present theory of turbo machinery.

5. Hydrodynamic theory of cavitations in turbo machinery.

(10hours)

RECOMMENDED BOOKS			
	NAME	**AUTHOR(S)**	**PUBLISHER**
1	Fluid Mechanics of turbo machinery VoI. 1	G.F. Wisloconus.	McGraw-Hill

Course Code	MEC-854(f)
Course Title	**Advanced Fluid Machinery Lab**
Type of Course	Optional
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Fluid Mechanics, Fluid Machinery
Course Objectives (CO)	4. To explain the principles, operation and application of turbines and pumps. 5. To analyze the experimental data for research.
Course Outcome	1. Students will be able to understand the principles, operation and application of turbines and pumps 2. The students will able to design, conduct and analyze the experimental data for research.

Syllabus

More detailed experiments of hydraulic machines (Pelton, Francis, Kaplan and Centrifugal Pumps) – Drawing Mushhel curves in above cases.

Course Code	**MEC-804 (g)**
Course Title	Production and Operations Management
Type of Course	Optional
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Total Quality Management, Manufacturing Processes,
Course Objectives (CO)	To enable the student to understand the product and process design, inventory management, plant layout. To enable the students to understand the various SQC techniques, control charts, inventory costs.
Course Outcome	4. The students will be able to apply the various control charts and SQC techniques. 5. The students will learn the basics of product and process design, Plant layout, inventory management etc. 6. The students will be able to make a plant layout, SQC charts and Control charts and able to apply the knowledge of these in real industrial situations.

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

SECTION-A

6. Introduction

Production and Operations functions, scope and objectives, role of operation management in productive systems, Manufacturing Vs Service operations, meeting global challenges.

7. Product and process Design

Need, characteristics of phases of product life cycle, Product Development process, product designvs process design, classification of a production process. Methodology for process design.

8. Capacity planning

Definition and basic concepts, Long term and short term capacity strategies, Aggregate planning - strategies and guidelines, capacity planning models and linear programming.

(10 hours)

9. Facility location and layout

Facility location and procedure, principles and types of layouts, layout planning, CRAFT, Line balancing.

SECTION-B

10. Demand forecasting

Introduction, forecasting methods, time series components, forecasting errors and economics of forecasting.

11. Operation scheduling

Scheduling concept and its need, factors effecting scheduling, Job Shop scheduling, sequencing, batch scheduling.

7. Inventory control

Introduction and need of the inventory control, various inventory costs, basic EOQ model, selective inventory controls-ABC, FSN, VED. Fixed order quantity and fixed order interval system. Material requirement planning.

8. Quality Management

Concept of Quality, quality cost, inspection, type of inspection, statistical quality control, control charts, concept of TQM & ISO Certification.

(10hours)

RECOMMENDED BOOKS			
	NAME	**AUTHOR(S)**	**PUBLISHER**
1	Production and operation management	Adam EE, RJ Ebert	Prentice Hall
2	Production and operation management	James Dilworth	McGraw Hill
3	Production and operation management	SN Chary	Tata McGraw Hill

Course Code	MEC-854(g)
Course Title	Production and Operations Management **Lab**
Type of Course	Optional
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Total Quality Management, Manufacturing Processes, Manufacturing Technology
Course Objectives (CO)	To improve the presentation skills and communication skills of the students. To enable the students to share their innovative ideas, views etc. relating to the various SQC techniques, control charts, inventory costs etc
Course Outcome	4. The students will be able to communicate effectively with each other and become capable to work in a team. 5. The students will be able to share their views, innovative ideas etc. 6. To improve the group discussion skills among the students.

Syllabus

The students are required to presents seminars on various advance topics relating to the subject.

Course Code	**MEC-804 (h)**
Course Title	Theory of Elasticity and Plasticity
Type of Course	Optional
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	MOM-I, MOM-II
Course Objectives (CO)	This course aims at providing fundamental and practical knowledge in theory of elasticity and plasticity. The underlying objective is to understand the mechanical behavior of elastic media. The course will present systematic approaches for tackling issues related to stress and strain occurring in elastic and plastic material.
Course Outcome	1) The student will understand the indicial notation. 2) The student will learn an approach to tackle a basic problem in elasticity and plasticity.

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

SECTION-A

1. Basic Elasticity: Three dimensional stress and strain systems. Principal stresses, principal strains and principal planes. Mohr's circle for 3 – dimensional stress and strain systems.

2. Two dimensional Elasticity: - Stress functions, plane stress and plane strain methods.

3. Torsion: - Torsion of circular and elliptical bars – elastic analysis.

4. Introduction to Plasticity: - Idealized stress-strain systems, approximate equation for stress strain curves (Ramberg-Osgood, Ludwig,s and karunes equation), Bauschinger effect-yield locus, yield surface.

SECTION-B

5. Yield Criteria and Flow Rules: - Tresca theory & Von-Mises yield criterion, their geometrical representation, experimental evidence for the criteria.

6. Slip Line Yield Theory: - Two Dimensional plasticity, slip lines, basic equations, Hencky's first theorem, Geiringer's Velocity equation. Applications of slip line field theory to plane strain problems.

7. Load Bounding: - The lower bound theorem, the upper bound theorem and their corollaries. Applications of load bounding to plane strain problems.

(10hours)

RECOMMENDED BOOKS			
	NAME	**AUTHOR(S)**	**PUBLISHER**
1	Theory of Elasticity:	Timosenko and Goodier	McGraw Hill Book Co. 1951.
2	Plasticity for Engineers:	Johnson & Mellor	Ellis Horwood Limited, 1983
3	Fundamentals of Theory of Plasticity:	L.M. Kachanov	Courier Dover Publications, 2003
4	Elasticity in Engineering:	Ernest E. Sechler,	Dover Publications Inc., 1968
5	Applied Elasticity:	C.T. Wang,	McGraw Hill Book Co. 1953.

Course Code	MEC-854(h)
Course Title	Theory of Elasticity and Plasticity **Lab**
Type of Course	Optional
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	MOM-I, MOM-II
Course Objectives (CO)	1. This course aims at providing fundamental and practical knowledge in theory of elasticity and plasticity. 2. The underlying objective is to understand the mechanical behavior of elastic media 3. The course will present systematic approaches for tackling issues related to stress and strain occurring in elastic and plastic material.
Course Outcome	1. The student will understand the indicial notation. 2. The student will learn an approach to tackle a basic problem in elasticity and plasticity.

Syllabus

List of Experiments

1. Measurement of strains with the help of electrical strain gauges.
2. Measurement of principal strains and calculation of principle stresses in a tension member under uni-axial loading and comparison of the results with those obtained from theory.
3. Plotting of flow curve for a member subjected to uni – axial tension and fitting the suitable stress - strain relation **.**
4. Experimental verification of yield criteria.

Course Code	**MEC 804 (i)**
Course Title	**Advanced Mechanics of Materials-II**
Type of Course	Optional
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Strength of Materials, Material Science
Course Objectives (CO)	1. This course aims at providing fundamental knowledge about study of bending & shear forces in straight, curved & thin walled beams. 2. The course will provide knowledge about stresses & strains in flat plates. 3. The course will provide knowledge about stress concentration, Fracture Mechanics, Fatigue, Creep, and Contact Stresses.
Course Outcome	1. Calculate the bending & shear forces in straight, curved & thin walled beams. 2. Understand how to find out various stresses-strain relationships for flat plates. 3. Know about various factors affecting stress concentration, Fracture Mechanics, Fatigue, Creep, and Contact Stresses. Also able to find out reasons & calculations of various parameters for the same.

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

SECTION-A

1. **Bending of Straight Beams** – Fundamentals of Beam Bending, Bending Stresses in Beams subjected to Non-Symmetrical Bending, Deflection of Straight Beams Subjected to Non-Symmetrical Bending, Effect of Inclined Loads, Fully Plastic Load for Non-Symmetrical

Bending. (4)

2. **Shear Center for Thin-Wall Beam Cross Sections:** Approximations for Shear in Thin-Wall Beam Cross Sections, Shear Flow in Thin-Wall Beam Cross Sections, Shear Center for a Channel Section, Shear Center of Composite Beams Formed from Stringers and Thin Webs, Shear Center of Box Beams. **(3)**

3. **Curved Beams:** Introduction, Circumferential Stresses in a Curved Beam, Radial Stresses in Curved Beams, Correction of Circumferential Stresses on Curved Beams having I, T, or Similar Cross Sections, Deflection of Curved Beams, Statically Indeterminate Curved Beams: Closed Ring subjected to a Concentrated Load, Fully Plastic Loads for Curved Beams. (4)
4. **Beams on Elastic Foundations:** General Theory, Infinite Beam Subjected to a Concentrated Load, Infinite Beam Subjected to a Distributed Load, Semi-infinite Beam Subjected to Loads at its End, Semi-infinite Beam with Concentrated Load Near its End. Short Beams, Thin-Wall Circular Cylinders. (3)

5. **Flat Plates:** Introduction, Stress Resultants in a Flat Plate, Kinematics: Strain Displacement Relationships for Plates, Equilibrium Equations for Small-Displacement Theory of Flat Plates, Stress-Strain-Temperature Relationships for Isotropic Elastic Plates, Strain Energy of a Plate, Boundary Conditions for Plates, Solution of Rectangular Plate Problems, Solution of Circular Plate Problem. (4)

SECTION-B

6. **Stress Concentrations:** Nature of a Stress Concentration Problem and Stress Concentration Factor, Stress Concentration Factors: Theory of Elasticity, Stress Concentration Factors: Combined Loads, Stress Concentration Factors: Experimental Techniques, Effective Stress Concentration Factors, Effective Stress Concentration Factors: Inelastic Strains. (4)

7. **Fracture Mechanics:** Failure Criteria and Fracture, Stationary Crack, Crack Propagation and Stress Intensity Factor, Fracture: Other Factors. (3)

8. **Fatigue: Progressive Fracture:** Fracture Resulting from Cyclic Loading, Effective Stress Concentration Factors: Repeated Loads, Effective Stress Concentration Factors: Other Influences, Low Cycle Fatigue and the epsilon-N Relation. (3)

9. **Creep:** Time Dependent Deformation – Definition of Creep and Creep Curve, The Tension Creep Test for Metals, One-Dimensional Creep Formulas for Metals Subjected to Contact Stress and Elevated Temperature, One-Dimensional Creep of Metals Subjected to Variable Stress and Temperature, Creep under Multiaxial States of Stress, Flow Rule for Creep of Metals Subjected to Multiaxial State of Stress, Creep in Nonmetals. (4)

10. **Contact Stresses:** Introduction, The Problem of Determining Contact Stresses,Geometry of Contact Surface, Principal Stresses, Methods of Computing Contact Stresses, Deflection of Bodies in Point Contact, Stress for Two Bodies in Line Contact: Loads Normal to Contact Area, Stress for Two Bodies in Line Contact: Loads Normal and Tangent to Contact Area. (4)

RECOMMENDED BOOKS			
S. No.	**NAME**	**AUTHOR(S)**	**PUBLISHER**
1	Bearings Design & Applications	D.F. Wilcock, and E.R.	McGraw Hill Book Co., N. York.
2	Analysis and Lubrication of Bearings	M.C. Shaw and Fred Mecks	McGraw Hill Book Co., N. York.

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Course Code	MEC-854(i)
Course Title	**Advanced Mechanics of Materials-II Lab**
Type of Course	Optional
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Strength of Materials, Material Science
Course Objectives (CO)	The experiments aims at 1. Determining deformations in various types of beams 2. Finding stress & strain in thick cylinder.
Course Outcome	The students will be able to 1. Calculate the deformations in various types of beam. 2. Determine the stress & strain in thick cylinder.

Syllabus

List of Experiments:

1. Deformation of Straight Beams
2. Deformation of Curved Beams
3. Unsymmetrical Bending
4. Stress and Strain in Thick Cylinder (Strain Gauge)
5. Photoelasticity Demonstration

Course Code	**MEC 804 (j)**
Course Title	**Advances In Engineering Materials**
Type of Course	Optional
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Industrial Engineering
Course Objectives (CO)	1. To understand the importance of Selection of materials and Material Characterization. 2. To know about Thermal Analysis Techniques like DTA/DSC/TGA for material characterization. 3. To get the knowledge of surface characterization techniques like Optical microscopy, Scanning Electron Microscopy, Scanning Tunneling Microscopy, Transmission Electron Microscopy. 4. To learn about Synthetic materials, Nano materials & Smart materials.
Course Outcome	1. Understand how to select materials for a particular requirement and on what basis. 2. Learn about material characterization and various techniques used for material characterization. 3. Know about latest materials like synthetic materials, nano materials and smart materials.

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

SECTION-A

Selection of materials: Service requirement, Structure-Property correlations and reappraisal of the role of crystal structure and structural defects on properties. (4)

Material Characterization:- Stereographic Projections, X-ray diffraction, crystal structure and phase identification, residual stress measurement and other applications. (3)

ThermalAnalysisTechniques: Outline of thermal analysis, technique, description of DTA/DSC/TGA techniques and instrumentation, applications, and case studies (5)

Optical microscopy: light optics, microscope components, possibilities, and limitations. (2)

Scanning Electron Microscopy: Optics and performance of a SEM, Image interpretation**,** crystallographic information in a SEM, analytical microscopy (2)

Scanning Tunneling Microscopy: Construction and operation, Image interpretation (2)

Transmission Electron Microscopy: Construction and operation of a TEM, Electron Diffraction and image interpretation (2)

SECTION-B

Synthetic materials: Classifications and structure of polymers, class transition temperature, mechanical properties of polymers. Artificial and synthetic materials. (5)

Nano materials: Classification, the structure, methods of their production, their properties and their sphere of applications. (3)

Smart materials: Shape Memory Alloys, Varistors and Intelligent materials for bio-medicaluses including poly-acrylates, ABS plastics, polvmatha acrylates, nylon and teflon. Applications and development of these materials. (6)

RECOMMENDED BOOKS			
S. No.	**NAME**	**AUTHOR(S)**	**PUBLISHER**
1	Callister's Materials Science and Engineering	William D. Callister, Jr.,	Wiley India Pvt. Ltd.
2	Engineering Material Technology	James A. Jacobs & Thomas F. Kilduff.	Prentice Hall.
3	Foundations of Materials Science and Engineering	William F. Smith.	McGraw Hill.
4	Materials characterization techniques	Sam Zhang; L Li; Ashok Kumar,	Boca Raton, CRC Press

Course Code	MEC-854(j)

Course Title	**Advances In Engineering Materials Lab**
Type of Course	Optional
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Strength of Materials, Material Science
Course Objectives (CO)	To give the practical exposure to the students to apply there theoretical knowledge on apparatus to perform experiments and correlate the theoretical aspect with the practical results
Course Outcome	The student will able to use these equipments for there for their project work and for research work and in industry in future .

Syllabus

Study of experiments related to SEM/TEM/XRD/IR Lab facilities

Course Code	**MEC 804 (k)**
Course Title	**Mechanical Behavior of Materials-2**
Type of Course	Optional
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Strength of Materials/Mechanics of Materials
Course Objectives (CO)	**11.** This course aims at providing the knowledge of mechanical behaviour of materials **12.** The course will present systematic approach for finding the Fracture and fatigue in the materials **13.** The course also provides knowledge of plastic deformation and models of materials along with creep and damping concept.
Course Outcome	7. Understand the fracture and fatigue of material which helps in design and materialselection 8. Calculate the fatigue in materilas of notched members through stress approach 9. Understand the concept plastic deformation and models of materials along with creep and damping concept

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

SECTION-A

1. **Fracture of Cracked Members:** Application of K to Design and Analysis, Fracture Toughness, Plastic Zone Size, Fracture Toughness Testing, Fracture Mechanics Beyond Linear Elasticity. (3)

2. **Fatigue of Materials (Stress Based Approach):** Cyclic Loading, Fatigue Testing, Physical Nature of Fatigue Damage, S-N Curves, Mean Stresses, Multi-axial Stresses, Variable Amplitude Loading. (3)

3. **Fatigue of Materials of Notched Members (Stress Based Approach):** Notch Effects, Notch Sensitivity, Notch Effects for - Long, Intermediate, and Short Lives, Combined Effects of Notches and Mean Stress, Designing to Avoid Fatigue Failure. (3)

4. **Fatigue Crack Growth:** Testing of Fatigue Crack Growth, Effect of S_{min}/S_{max}on Crack Growth, Life Estimates for Constant and Variable Amplitude Loading, Design Considerations, Plasticity Aspects, Environmental Crack Growth. (3)

SECTION-B

5. **Plastic Deformation and Models for Materials:** Stress-Strain Curves, 3D Stress-Strain Relationships, Unloading and Cyclic Loading Behavior from Rheological Models, Cyclic Stress-Strain Behavior for Real Materials. (3)

6. **Stress-Strain Analysis of Plastically Deforming Members:** Plasticity in Bending, Residual Stresses and Strains for Bending, Plasticity of Circular Shafts in Torsion, Notched Members, Cyclic Loding. (3)

7. **Fatigue of Materials (Strain Based Approach):** Strain-N Curves, Mean and Multi- axial Stress Effects, Life Estimates for Structural Components. (3)

8. **Creep and Damping:** Creep Testing, Physical Mechanism for Creep, Time-Temperature Parameters and Life Estimates, Creep Failure under Varying Stress, Stress-Strain-Time Relationships, Creep Deformation under Varying Stress, Creep under Multi-axial Stress, Component Stress-Strain Analysis, Energy Dissipation. (3)

RECOMMENDED BOOKS			
S. No.	**NAME**	**AUTHOR(S)**	**PUBLISHER**
1	Mechanical Behavior of Materials (3E)	Norman Dowling	Pearson Publishers
2	Mechanical Behavior of Materials (2e)	Andre Meyers	Cambridge University Press
3	Mechanical Behavior of Materials	Bowman	John Wiley & Sons
4	Mechanical Behavior of Materials	Courtney	Waveland Publishers

Course Code	MEC-854(k)
Course Title	**Mechanics of Material-II Lab**
Type of Course	Optional
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50
Course Prerequisites	Strength of Materials,
Course Objectives (CO)	The experiments aims at providing knowledge in mechanical behavior of materials and to calculate calculate the yield and fracture point of materials under complex stresses
Course Outcome	Students will be able to 1. Understand the type of material failure which helps in design and material selection 2. Understand the structure and deformation of the materials and able to calculate the yield and fracture point of materials under complex stresses 3. Surveying/select the engineering material

Syllabus

Demonstrations and studies concerning the topics in theory.

Course Code	**MEC 804 (L)**
Course Title	**Rotor Dynamics**
Type of Course	Elective
L T P	3 1 0
Credits	0
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	Theory of machines I & II
Course Objectives (CO)	7. Provide an introduction to dynamics of rotating machinery. 8. Enable students to model and analyze the stability and dynamics of rotors.
Course Outcome	7. Create an analytical model of a rotor. 8. Solve the mathematical model of the lateral dynamics of a rotor and find modes, modal shapes and time response. 9. Perform complete rotor dynamics simulation so as to determine stability of a rotor bearing system.

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

1. Introduction
Linear rotor-dynamics, Equation of motion, Rotating systems, Complex coordinates, Free vibration, Forced response, Nonlinear rotor-dynamics, Non-stationary rotor-dynamics, Time domain versus frequency domain.

2. Jeffcott rotor
Undamped Jeffcott rotor, Complex coordinates in rotordynamics, Jeffcott rotor with shaft bow, Jeffcott rotor with viscous damping, Jeffcott rotor with structural damping, Jeffcott rotor with non-synchronous damping, Effect of the compliance of the bearings, Rotating coordinates, Stability in the supercritical field, Drag torque at constant speed.

3. Model with four degrees of freedom: Gyroscopic effect
Generalized coordinates and equations of motion, Uncoupled gyroscopic system, Free whirling of the coupled, undamped system, Response to unbalance and shaft bow, Frequency response,

Unbalance response: modal computation, Modal uncoupling of gyroscopic systems.

4. Discrete multi-degrees-of-freedom rotors

The finite element method, Defining Generalized Co-ordinates, Axial Deflection in a Bar, Lateral Deflection of a Beam, Developing General Element Matrices, Assembling Global Matrices, Real versus complex coordinates, Fixed versus rotating coordinates, Complex state-space equations, Static solution, Critical-speed computation, Computation of the unbalance response, Plotting the Campbell diagram and the roots locus, Reduction of the number of degrees of freedom.

5. Anisotropy of rotors or supports

Isotropic rotors on anisotropic supports, Jeffcott rotor on non-isotropic supports, Effect of damping, System with many degrees of freedom, Non-isotropic rotors on isotropic supports, Non-isotropic Jeffcott rotor, Effect of damping, Response to a static force, Anisotropic rotors with many degrees of freedom.

6. Free Lateral Response of Complex Systems

Co-ordinate systems, Disk elements, Shaft Elements, Bearings, Seals and Rotor-Stator Interactions, Hydrodynamic Journal Bearings, Hydrostatic Journal Bearings, Rolling Element Bearings, Magnetic Bearings, Rigid Bearings, Seals, Alford's Force, Modeling Foundations and Stators, Assembly of the Full Equations of Motion, Speed Dependence of the System Matrices, Free Response of Complex Systems, Features of Eigenvalues and Eigenvectors.

7. Asymmetric Rotors and Other Sources of Instability

Introduction, Rotating Co-ordinate Systems, Rotor Asymmetry with Isotropic Supports - Simple Rotors, Stability of Asymmetric Rotors, The Effect of External Damping on the Asymmetric Rotor, Unbalance Response, Response to Sinusoidal Excitation in the Stationary Frame, Response to General Excitation in the Stationary Frame, Asymmetric Rotors Supported by Anisotropic Bearing -Simple Rotors, Internal Rotor Damping - Simple Rotors, Rotor Asymmetry with Isotropic Supports – Complex Rotors.

8. Dynamics of controlled rotors

Open-loop equations of motion, Real coordinates, Complex coordinates, Closed-loop equations of motion, Ideal proportional control, Ideal PID control, Dynamics of the control system, Rigid rotor on magnetic linearized bearings, Equations of motion, Symmetrical system, Nonsymmetrical system, Geometric re-colocation, Modal control of rotors.

RECOMMENDED BOOKS

S. No.	NAME	AUTHOR(S)	PUBLISHER
1	Dynamics of Rotating Systems	Giancarlo Genta	Springer, 2005
2	Rotor Dynamics: Modeling and Analysis	M.I. Friswell, J.E.T. Penny, S.D. Garvey and A.W. Lees	Cambridge University Press, Cambridge, 2010
3	Rotordynamics	A. Muszynska	CRC Press, 2005
4	Machinery Vibration and Rotor Dynamics	J.M.Vance et al.	Wiley, 2010

Course code	MEC854(l)
Course title	Rotor Dynamics
Type of course	Elective
LTP and credits	0-0-2 and 1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50 marks
Pre-requisite	Theory of machines I & II
Course Objective	1. Provide an introduction to dynamics of rotating machinery. 2. Enable students to model and analyze the stability and dynamics of rotors.
Course Outcome	At the end of the course the student would be able to 1. Create an analytical model of a rotor in MATLAB. 2. Solve the mathematical model of the lateral dynamics of a rotor and find modes, modal shapes and time response using MATLAB. 3. Perform complete rotor dynamics simulation so as to determine stability of a rotor bearing system using MATLAB.

Syllabus

List of Experiments:

3. Plot of Campbell diagram for a Jeffcott rotor using MATLAB.
4. Eigen value analysis of rotor with gyroscopic effects using MATLAB.
5. Evaluating time response of rotor subjected to unbalance using MATLAB.
6. FFT plot of the time series data using MATLAB.
7. Response of asymmetric rotors using MATLAB.

Course Code	**MEC-804 (m)**
Course Title	**IMAGING AND ADDITIVE MANUFACTURING**
Type of Course	Optional
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	
Course Objectives (CO)	To understand the complete process of image capturing and developing complex high precision structures through additive manufacturing.
Course Outcome	After the successful completion of this course students will be able to 7. Understand Image processing fundamentals 8. Design and Implement 2 D and 3 D models Generate and evaluate Prototype

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

SECTION-A

1. Introduction to Image Processing

2. Medical Image Processing Concepts- Analysis, Visualization, Enhancement and Segmentation

3. 2D and 3D Transformations of geometry.

SECTION-B

9. Design of Surfaces and Solids

10. Rapid Prototyping

6. 3D Scanning and Printing

(10hours)

RECOMMENDED BOOKS			
	NAME	**AUTHOR(S)**	**PUBLISHER**
1	Digital Image Processing	Gonzalez and woods	Prentice Hall
2	Handbook of Medical Image Processing and Analysis	Isaac Bankman	Academic Press
3	Geometric Modeling	Michael E. Mortenson	Wiley, NY
4	Computer Aided Engineering Design	Anupam Saxena, Birendra Sahay	Springer

Course code	MEC854(m)
Course title	**Imaging And Additive Manufacturing Lab**
Type of course	Optional
LTP and credits	0-0-2 and 1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50 marks
Pre-requisite	Theory of machines I & II
Course Objective	To understand the complete process of image capturing and developing complex high precision structures through additive manufacturing
Course Outcome	After the successful completion of this course students will be able to 11. Understand Image processing fundamentals 12. Design and Implement 2 D and 3 D models 13. Generate and evaluate Prototype

Syllabus

List of Experiments:

3. Implement basic Image Processing Operations
4. Perform Registration, Enhancement and Segmentation on medical images
5. Perform 2D and 3D Transformations of geometry
6. Design of Surfaces and Solids
7. Construct Rapid Prototypes
8. Perform 3D Scanning and Printing

Course Code	**HSS 801**
Course Title	**Entrepreneurship and Project Management**
Type of Course	Core
L T P	3 1 0
Credits	4
Course Assessment Methods End Semester Assessment (University Exam.) Continuous Assessment (Sessional, Assignments, Quiz)	 50 50
Course Prerequisites	
Course Objectives (CO)	The main aim of this course is to make prospective engineers familiar with the concept of entrepreneurship and MSMEs and to provide knowledge about different aspects to be considered while formulating the business plan for a new entrepreneurial venture. This course also intends to create awareness among students about financial and marketing functions that is required for a new venture.
Course Outcome	1. The students will be able to apply engineering knowledge effectively in the field of entrepreneurship development. 2. The students can make effective use of entrepreneurial knowledge to start and manage their venture. 3. The students will learn to check the feasibility of a new project to maintain its long run sustainability.

SYLLABUS

Note for Examiner- *Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.*

SECTION-A

Introduction to Entrepreneurship

Concept of Entrepreneurship, Characteristics and Functions of Entrepreneur
Forms of Ownership of Business, Factors Affecting Entrepreneurship

Case Studies of Entrepreneurs (8 hours)

Women Entrepreneurship

Nature of Women Entrepreneurship, Problems of Women Entrepreneurs, Institutional Initiatives for Promotion of Women Entrepreneurs (4 hours)

Micro, Small and Medium Enterprises (MSMEs)

Concept of MSMEs, Schemes of MSMEs

Functions of Entrepreneurial Development Programmes (EDPs)

(3 hours)

Project Identification

Idea Generation, Project Life Cycle, Concept of SWOT Analysis

SWOT Analysis of Selected Project (3 hours)

SECTION-B

Project Planning and Formulation

Elements of Project Formulation: Product, Technical (Location, Scale, Technology, Production Process, Layout, Manpower, Resources), Market, Finance and Economic Aspects

Feasibility Analysis: Financial Viability and Profitability, and Socio-Economic Desirability

(12 hours)

Project Report

Formulation of Business Plan and Project Report, Hypothetical Example of a Real-Life Project (4 hours)

Finance and Marketing Function

Concept of Finance, Finance Related Terminologies, Sources of Finance, Cost Estimations

Marketing Mix: Product, Place, Price, Promotion, People, Process and Physical Evidence

Marketing Segmentation Targeting and Positioning (8 hours)

Discussions on Additional Reading (any one of the following in the semester)

- The New Age Entrepreneurs
- The $100 Startup: Fire your Boss, Do what you Love and Work Better to Live More
- A Guide to Entrepreneurship
- Dhandha: How Gujaratis Do Business
- Rokda: How Baniyas Do Business
- Take Me Home
- Business Families of Ludhiana

(3 hours)

TEXT BOOKS			
S. No.	**NAME**	**AUTHOR(S)**	**PUBLISHER**
1	"Dynamics of Entrepreneurial Development & Management"	Desai V	5th Edition, Himalaya Publishing House
2	"Projects: Planning, Analysis, Selection, Financing, Implementation and Review"	Chandra P.	8th Edition, McGraw-Hill Education (India), 2014
RECOMMENDED BOOKS			

1	"Entrepreneur's Toolkit"	Harvard Business School.	Harvard University Press, 2004
2	"Entrepreneurship"	Hisrich R.D., Peters M.P. and Shepherd D.A.	McGraw Hill Education, 2006.
3	"Essentials of Project Management"	Ramakrishna K	PHI Learning
4	"Entrepreneurship"	Roy R.	2nd Edition, Oxford University Press, 2011
5	"Entrepreneurship Development in India"	Gupta C.B. and Srinivasan N.P.	Sultan Chand and Sons, 2013

Course Code	**HSS 851**
Course Title	**Entrepreneurship and Project Management Practical**
Type of Course	Elective
L T P	0 0 2
Credits	1
Course Assessment Methods Continuous Assessment (Practical Performance, report writing and Viva voce)	50

Syllabus

Seminars and case studies from theory.

OPTION II

MEC856: INDUSTRIAL TRAINING FOR SIX (06) MONTHS DURATION