Details of

Programme of Study

&

Syllabus of Courses

Offered by

School of Mechanical Engineering

School of Mechanical Engineering

Program Structure of B. Tech. Four Year Full Time Degree

(Entry Batch 2018 Onwards)

1st Semester 2018-22

Sl. No.	Course Code	Course Title	L	T	S/P	C
1.	MTL1012	Engineering Mathematics-I	3	0	0	3
2	ECL1010	Basic Electronics	3	0	2	4
3		Engineering Physics	3	0	2	4
4	ECL1020	Introduction to 'C' Programming-	1	0	4	3
5	LNL1411	Communication Skills	2	0	2	3
6	MEL1001	Introduction to Mechanical Engineering **RKM**	1	0	0	1
7		Engineering Workshop	0	0	2	1
		Induction Program				
8		NSS (Non-Credit)-UGC	40 Hrs			
Total Credits						**19**

2nd Semester

Sl. No.	Course Code	Course Title	L	T	S/P	C
1	MTL1026	Engineering Mathematics-II	3	0	0	3
2	ECP 1200	Engineering Graphics	0	0	4	2
3		PYTHON-I	1	0	4	3
4	MEL1112	Materials Science and Engineering	3	0	2	4
5	MEL1012	Engineering Mechanics	3	1	0	4
6	PCL 1067	Discourse of Human Values –AICTE MC-HS	2	0	0	2
7	LMP1142	Language Lab-I-HS	0	0	2	1
Total Credits						**19**

3rdSemester

Sl. No.	Course Code	Course Title	L	T	S/P	C
1		Environmental Studies-AICTE	3	0	0	NC
2	PCL2042	Introduction to Logic-AICTE	3	0	0	3
3	MEL2015	Kinematics of Machines	3	0	0	4
4	MEL2231	Fluid Mechanics	3	0	2	4
5	MEL2014	Strength of Materials	3	1	2	5
6	MTL6066	Numerical Methods	3	1	0	4
7	MEL1211	Thermodynamics	3	0	0	3
Total Credits						**23**

4thSemester

Sl. No	Course Code	Course Title	L	T	S/P	C
1	MEL 2232	Fluid Machines	3	0	2	4
2	MEL 2212	Thermal Engineering	3	0	2	4
3	MEL 2113	Manufacturing Processes	3	0	2	4
4	MEL 2018	Dynamics of Machines	3	0	2	4
5	MEL 2017	Machine Design	3	1	0	4
6	MEL 2016	Mechanics of Materials	3	0	0	3
7		Constitutional of India- AICTE	2	0	0	2
Total Credits						**25**

5thSemester

Sl. No.	Course Code	Course Title	L	T	S/P	C
1	MEL3221	Heat and Mass Transfer	3	0	2	4
2	MEL3131	Industrial Engineering	3	0	0	3
3	MEL3019	Design of Machine Elements	3	0	0	3
4	MEL3114	Machining Processes	3	0	0	3
5	MEL3021	CAD/CAM	3	0	2	4
6		School Elective –I	3	0	0	3
7		Finite Element Analysis	3	0	0	3
		Minor Project-I –				2
Total Credits						**25**

6thSemester

Sl. No.	Course Code	Course Title	L	T	S/P	C
1		Open Elective-I	3	0	0	3
2		School Elective –II	3	0	0	3
3	MEL3121	Metrology and Measurements	3	0	2	4
4	MEL3222	Internal Combustion Engines	3	0	2	4
5	MEL3022	Mechanical Vibrations	3	1	2	4
6	MEL2133	Operations Research	3	0	0	3
7	MED 4921	Minor Project- Projects				2
		Advance CAD/CAM Lab	0	0	3	2
Total Credits						**25**

7thSemester								8thSemester						
Sl. No.	**Course Code**	**Course Title**	**L**	**T**	**S / P**	**C**		**Sl. No.**	**Course Code**	**Course Title**	**L**	**T**	**S/ P**	**C**
1	ECC 4980	Summer Internship Evaluation-				2		1	ECD 4992 / ECC 4982	(Major Project + **Open Elective-III**) (9+3) / Internship (12)				12
2		Open Elective-II	3	0	0	3								
3	ECL4170	**OFC (Compulsory)**	3	0	2	4								
4	M EL 4223	Refrigeration and Air-conditioning	3	0	2	4								
5	MEL 4031	Automobile Engineering	3	0	2	4								
6		Disaster management – AICTE-MC	2	0	0	2								
7	MEC 4913	Colloquium	0	0	2	1								
8	MED 4921	Project- Phase-I	0	0	4	2								
Total Credits						**22**		**Total Credits**						**12**

LIST OF SCHOOL ELECTIVES

School Elective –I

Course Code	**Course Title**	**L-T-P**	**Credits**
MEE 3224	Power Plant Engineering	3-0-0	3
MEE 3134	Work Study Ergonomics	3-0-0	3
MEE 3122	Computer Integrated Manufacturing Systems	3-0-0	3
MEE 3024	Concurrent Engineering	3-0-0	3
MEE 3032	Industrial Automation	3-0-0	3
MEE 3233	Gas Dynamics and Jet Propulsion	3-0-0	3
MEE 3033	Control Systems	3-0-0	3

School Elective-II

Course Code	**Course Title**	**L-T-P**	**Credits**
MEE 4234	Computational Fluid Flow and Heat Transfer	3-0-0	3
MEE 4025	Design for Manufacturing and Assembly	3-0-0	3
MEE 4034	Environmental Science and Engineering	3-0-0	3
MEE 4141	Maintenance Engineering	3-0-0	3
MEE 4026	Mechanical System Design	3-0-0	3
	THE FUTURE OF THE AUTOMOBILE		
MEE 4027	Product Design & Developments	3-0-0	3
MEE 4035	Tool Design	3-0-0	3
MEE 4143	Total Quality Management	3-0-0	3
MEE 4235	Energy Management	3-0-0	3

Open Elective

Course Code	**Course Title**	**L-T-P**	**Credits**
	Industrial Psychology	3-0-0	3
	Artificial Intelligence	3-0-0	3
MEE 3225	Fuel Combustion and Pollution	3-0-0	3
MEE 4142	Injection Moulding and Mould Design	3-0-0	3
	INTRODUCTION TO SENSORS	3-0-0	3
		3-0-0	3
		3-0-0	3
		3-0-0	3

ECP 1200			Engineering Graphics				Pre Requisites			
Version R-01							Co-requisites			
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
0	0	4	2	1 Hour	3 Hours	10	20	20	50	100

Engineering Graphics

ECP 1200 ***0-0-4=2***

Section-A

Introduction of Engineering Graphics: Drawing instruments and their uses, Orthographic Projections: Planes of projection–Projection of points in different quadrants. Orthographic Projection of Straight Line parallel to one plane and inclined to the other plane–Straight Line inclined to both the planes–True Length and inclination of lines with reference planes–Traces of line–Projection of Planes, Projection of Solids, Isometric Drawing: Types of Projection-Orthographic, Isometric, Oblique and Perspective Projections, exercises on Isometric drawings.
Section of Solids: Classification of Solids, Section plane perpendicular to one plane and parallel to other, Section plane inclined to one plane and perpendicular to other plane.
Development of Surfaces: Principle, Engineering applications and Methods of development.

Section-B

Introduction: Introduction to Computer Aided Drafting (CAD), Reasons for implementing CAD, Applications of CAD, Benefits/limitations of CAD, Hardware of CAD system, Types of CAD software. Introduction to other drafting software suchas Mechanical Desktop and Auto Cad Electrical
Introduction to Auto CAD: Starting AutoCAD, AutoCAD screen components, creating a drawing on AutoCAD, invoking different commands, Dialog boxes, Coordinate Systems, Exercises on Drawing of Line, Circle, Arc, Ellipse, Polygon, etc.
Drawing Aids and Editing Commands: Layers, Drafting Settings, Object Snaps, Function and Control keys, various Editing Commands, Editing the Objects with Grips, Grip Types.
Creating Text, Dimensions and Tolerances in AutoCAD: Creating Text, Editing Text, Styles of Dimensioning, Dimensioning System Variables, Editing/Updating Dimensions, Adding Tolerances.

Recommended Books:

1. Ellen Filkensten-AutoCAD 2006 & AutoCAD LT2006 Bible, Wiley, New York.
2. Sham Tickoo -AutoCAD 2005,Tata McGraw Hill, New Delhi.
3. George Omura - AutoCAD, Sybex Inc.
4. Bhat, N.D. and Panchal, V. M. - Engineering Drawing, Charotar Publishers, Anand.
5. Narayana, K.L. and Kannaiah, P.-Engineering Graphics, Tata McGrawHill, New Delhi.
6. Gill, P.S-Engineering Drawing, S.K Kataria & Sons, New Delhi.

MEL 1112			Material Science & Engineering				Pre Requisites			
Version R-01							Co-requisites			
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

Materials Science & Engineering

MEL 1112 **3-0-2=4**

Unit I Crystallography: Review of Crystal Structure, Space Lattice, Crystal Planes and Crystal Directions, Coordination Number, Number of Atoms Per Unit Cell, Atomic Packing Factor.

Unit II Imperfection & Deformation of Metal: Crystal Imperfections, Type of Defects and Effects on Metal Properties, Deformation of Metal. Mechanism, Yield Point Phenomena, Strain Ageing, Work Hardening, Bauschinger Effect, Season Cracking, Recovery, Re-Crystallization and Grain Growth.

Unit III Solid Solution and Phase Diagram: Introduction to Single and Multiphase Solid Solutions and Types of Solid Solution, Importance and Objective of Phase Diagram Systems, Phase and Structure Constituents, Cooling Curves, Unary & Binary Phase Diagrams, Gibbs's Phase Rule, Lever Rule, Eutectic, and Eutectoid Systems, Peritectic and Peritectoid Systems. Iron Carbon Equilibrium Diagram and TTT Diagram.

Unit IV Heat Treatment: Principles, Purpose, Classification of Heat Treatment Processes, Annealing, Normalizing, Stress Relieving, Hardening, Tempering, Carburing, Nitriding, Cyaniding, Flame and Induction Hardening, Allotropic Transformation of Iron and Steel, Properties of Austentic, Ferrite, Pearlite and Martensite.

Unit V Creep Concept, Creep Curve, Mechanism, Factors, Testing and Prevention. Corrosion-Type and Prevention of Corrosion. Fracture, Failures of Metals-Failure Analysis. Fatigue-Characteristics, Mechanism and Factors Affecting Fatigue.

Unit VI Plastic. Composite and Ceramics, Powder Metallurgy Techniques.

Recommended Books

1. Elements of Material Science and Engineering Van Vlack. Wesley Pub.
2. Material Science –Narula, Narula and Gupta, New Age Publishers.
3. Material Science and Engineering- V. Raghvan, Prentice Hall of India Pvt.
4. A test Book of Material Science & Metallurgy-O.P Khana, Dhanpat Rai
5. Material Science and Engineering- an Introduction–Callister; W.D., John Wiley & Sons, Delhi.
6. Engineering Materials: Kenneth G. Budinski, Prentice Hall of India, and
7. Essentials of Materials Science & engineering–Donald R. Askeland, Pradeep P. Phale

MEL 1012			Engineering Mechanics				Pre Requisites			
Version R-01							Co-requisites			
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hour	3 Hours	10	20	20	50	100

Engineering Mechanics

MEL 1012 **3-1-0=4**

Unit I: Force and Force Systems: Coplanar, Concurrent and Non-Concurrent Force Systems, Resultant and Resolutions, Forces in Space, Vectors, Operations on Force using Vectors, Moment of Force, Varignon's Theorem, Couple and Its Properties, Resultant of a Spatial Force System.

Unit II: Equilibrium-Equilibrium of a Particle, External & Internal Forces, Equilibrium of a Rigid Body, Types of Supports, Structural Members and Beams, Reactions of Beams.
Properties of Lines, Areas and Solids: Centre of Gravity, Centroid of Lines (Basic and Composite Areas), Built-Up Sections, Product of Inertia, Mass Moment of Inertia.

Unit III: Trusses, Frames and Mechanisms: Connected Bodies, Two Force and Three Force Members, Trusses, Method of Joints, Method of Sections, Determinateness of Truss, Rigid and Non Rigid Frames, Simple Mechanisms, Space Frames.

Unit IV: Friction: Type of Friction, Characteristics of a Dry Friction, Equilibrium on Rough Inclined Place, The Wedge, The Screw Jack, Journal Bearing, Axle Friction, Thrust Bearing, Disc Friction, Clutches.

UnitV: Introduction to Dynamics, Kinematics and Kinematics of Particle in Rectilinear and Curvilinear Motions, Projectile, Kinematics and Kinematics of a Rigid Body.
Usage of D'Alembert's Principle, Work and Energy, Impulse and Momentum Principles.

Recommended Books:

1. Jurnarkar, S.B. and Shah, H.J.–Applied Mechanics, Charotar
2. Merium and Kraige–Engineering Mechanics, John Wiley & Sons.
3. Sharma, S.M.–Engineering Mechanics, Kirti Publications, Jammu.
4. Engineering Mechanics by Huges and Martin, E.L.B.S. and Macmillan.
5. Beer and E.R. Johnstons–Vector Mechanics, McGraw-Hill, New York

MEL 2015			Kinematics of Machines				Pre Requisites			
Version R-01							Co-requisites			
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	4	1 Hour	3 Hours	10	20	20	50	100

Kinamatics Of Machines

MEL 2015 **3-0-0=4**

Unit I: Introduction-Links, Mechanisms, Kinematic Pair and Chains, Principles of Inversion, Inversion of a Four Bar Chain, Slider-Crank-Chain, Double Slider-Crank Chain and Their Inversions, Kinematic Pairs, Graphical (Relative Velocity Vector and Instant aneous Center Methods), Analytical Methods for Displacement, Velocity, and Acceleration of Mechanisms Including Corriolis Components.
Lower Pairs-Universal Joint, Calculation of Maximum Torque, Steering Mechanisms (Ackerman and davis Approximate Steering Mechanism), Engine Indicator, Pantograph, Straight Line Mechanisms.
Unit II: Belts, Ropes and Chains-Material, Types of Drives, Idle Pulley, Intermediate or Counter Shaft Pulley, Angle and Right Angle Drive, Quarter Turn Drive, Velocity Ratio, Crowning Shaft Pulley, Loose and Fast Pulley, Stepped or Cone Pulleys, Ratio of Tension on Tight and Slack Sides of Belts, H.P Transmitted by Belts with consideration of Creep and Slip, Centrifugal Tensions and Its Effect on H.P Transmitted, Use of Gravity, Idle, Flat, V-Beltsand Rope Materials, Length of Belt, Rope and Chain Drives.
Unit III: Cams- Types of Cams and Followers, Definitions of Connected Terms, Displacement Velocity and Acceleration Diagrams (Cam and Followers), Analytical and Graphical Design of Cam Profiles with Various Motions, Analysis of Follower Motion (Circular, Convex, Tangent Cam Profiles), Calculation of Pressure Angle.
UnitIV: Friction Devices-Concepts of Frictions and Wear Related to Bearings and Clutches, Types of Brakes, Principle of Function of Brakes of Various Types, Braking of Front and Rear Tyres of a Vehicle, Problems to Determine Braking Capacity, Types of Dynamometers.
Unit V: Flywheels-Turning Moment and Crank Effort Diagrams for Reciprocating Machines, Fluctuations of Speed, Coefficient of Fluctuation of Speed and Energy, Determination of Flywheel Mass and Dimensions for Engines and Punching Machines
Governors-Function, Types and Characteristics of Governors, Watt, Porter and Proell Governor. Hartnell and Willson-Hartnell, Spring Loaded Governors, Sensitivity, Stability, Isochronisms And Hunting of Governors, Governor Effortand Power.

Recommended Books:

1. Rao, J.S. andDukkipati, R.V. – Mechanism and MachineTheory, Wiley-Eastern, New Delhi.
2. Ballaney, P.L. – Theory of Machines, Khanna Publishers, New Delhi.
3. Khurmi, R.S. and Gupta, J.K. - Theoryof Machines, Eurasia Publishing House (P) Ltd, New Delhi.
4. Ghosh, A. and Mallick A.K.-Thoery of Mechanisms and Machines, Affiliated East-West Press Pvt. Ltd., New Delhi.
5. Rattan S.S.-Theory of Machines, Tata McGraw Hill, New Delhi.

MEL 2231			Fluid Mechanics				Pre Requisites			
Version R-01							Co-requisites			
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

Fluid Mechanics

MEL 2231 **3-0-2=4**

Unit I: Introduction-Properties of Fluids-Pressure, Force, Density, Specific Weight, Compressibility, Capillarity, Surface Tension, Dynamic and Kinematic Viscosity-Pascal's Law, Newtonian and Non-Newtonian Fluids, Fluid Statics-Measurement of Pressure-Variation, Manometry-Hydrostatic Pressure on Plane and Curved Surfaces, Centre of Pressure, Buoyancy, Floation, Stability of Submerged and Floating Bodies, Metacentric Height, Period of Oscillation.

Unit II: Kinematics of Fluid Motion, Eulerian and Lagrangian Approach, Classification and Representation of Fluid Flow, Path Line, Stream Line and Streak Line. Basic Hydrodynamics, Equation for Acceleration, Continuity Equation, Rotational and Irrotational Flow, Velocity Potential and Stream Function, Circulation and Vorticity, Vortex Flow, Energy Variation Across Stream Lines, Basic Field Flow suchas Uniform Flow, Spiral Flow, Source, Sink, Doublet, Vortex Pair, Flow Pasta Cylinder with a Circulation.

Unit III: Euler's Momentum Equation-Bernoulli's Equation and Its Limitations, Momentum and Energy Correction Factors, Pressure Variation across uniform Conduit and uniform Bend-Pressure Distribution in Irrotational Flow and in Curved Boundaries, Flow Through Orifices and Mouthpieces, Notches and Weirs, Time of Emptying a Tank, Application of Bernoulli's Theorem, Orifice Meter, Venturimeter and Pitot Tube.

Unit IV: Navier-Stoke's Equation, Body Force, Hagen-Poiseullie Equation, Boundary Layer Flow Theory, Velocity Variation, Methods of Controlling, Applications, Diffuser, Boundary Layer Separation, Wakes, Drag Force, Coefficient of Drag, Skin Friction, Pressure, Profile and Total Drag-Stream Lined Body, Bluff Body, Drag Force on a Rectangular Plate, Drag Coefficient for Flow around a Cylinder, Lift and Drag Force on an Aerofoil.

UnitV: Flow of a Real Fluid, Effect of Viscosity on Fluid Flow, Laminar and Turbulent Flow, Boundary Layer Thickness, Displacement, Momentum and Energy Thickness, Flow Through Pipes, Laminar and Turbulent Flow in Pipes, Critical Reynolds Number, Darcy-Weisback Equation, Hydraulic Radius, Moody; S Chart-Pipes in Series and Parallel, -Siphon Losses in Pipes, Power Transmission through Pipes, Water Hammer Equivalent Pipe, Open Channel Flow, Chezy's Equation, Most Economical Cross Section.

Recommended Books:

1. Som S.K. and Biswas, G-Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw-Hill, New Delhi.
2. Agrawal S.K.-Fluid Mechanics and Machinery,Tata McGraw-Hill, New
3. Kumar, D.S.-Fluid Mechanics and Fluid Power Engineering, Kataria & Sons Publishers, New Delhi.
4. Bansal R.K.-Fluid Mechanics and Hydraulic Machines, Laxmi Publications

MEL 2014			Strength of Materials				Pre Requisites			
Version R-01							Co-requisites			
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	2	5	1 Hour	3 Hours	10	20	20	50	100

Strength Of Materials

MEL 2014 **3-1-2=5**

Unit I: Simple Stresses and Strains-Concept of Stress and Strain, St. Vernants Principle, Stress and Strain Diagram, Hooke's Law, Young's Modulus, Poisson Ratio, Stress at a Point, Stress and Strains in Bars subjected to Axial Loading, Modulus of Elasticity, Stress Produced in Compound Bars subject to Axial Loading, Temperature Stresses and Strain Calculations Due To Application of Axial Loads and Variation of Temperature in Single and Compound Bars. Compound Stress and Strains, Two Dimensional System, Stress at a Point on a Plane, Principal Stresses and Principal Planes, Mohr's Circle of Stresses, Hook's Law, Principal Stresses Related to Principal Strains.

Unit II: Bending Moment and Shear Force Diagrams-S.F and B.M Definitions. BM and SF Diagrams for Cantilevers, Simply Supported Beams with or Without Overhangs and Calculation of Maximum BM and SF and the Point of Contra flexure Under A) Concentrated Loads, B) Uniformity Distributed Loads Over Whole Span or Part of Span, C) Combination of Concentrated Loads and Uniformly Distributed Loads, D) Uniformity Varying Loads, and E) Application of Moments.

Unit III: Slope and Deflection-Relationship between Moment, Slope and Deflection, Moment Are a Method; Methods of Integration; Macaulay's Method: Use of these Methods to Calculate Slope and Deflection for A) Cantilevers, B) Simply Supported Beams With or Without Overhang, C) Under Concentrated Loads, Uniformly Distributed Loads or Combination of Concentrated and Uniformly Distributed Loads.

Unit IV: Theory of Bending Stresses in Beams Due to Bending-Assumptions in Simple Bending Theory, Derivation of Formula: Its Application to Beams of Rectangular, Circular and Channel, I & T-Sections, Combined Direct and Bending Stresses in aforementioned Sections, Composite Beams.

Torsion-Derivation of Torsion Equation and its Assumptions, Applications of the Equation to Hollow and Solid Circular Shafts, Torsional Rigidity, Combined Torsion and Bending of Circular Shafts Principal Stress and Maximum Shear Stresses Under Combined Loading of Bending and Torsion, Analysis and Close-Coiled-Helical Springs.

Unit V: Columns and Struts-Failure of Columns, Euler's Formulas, Rankine-Gordon's Formula, Johnson's Emperical Formula for Axially Loaded Columns and their Applications.

Recommended Books:

1. Singer, F.P.andPytel, A.- Strengthof Materials, Harperand Row H.Kogakusha Publishers, New York
2. Popov, E.P.-Mechanics of Materials, Prentice Hall India, New Delhi
3. Bedi, D. S.- Strength of Materials, Khanna Book Publishing Company, New Delhi.
4. Lehri, R.S. and Lehri, A.S.-Strength of Materials, Kataria & Sons Publishers, New Delhi
5. Khurmi, R.S.-Strength of Materials, Khanna Publishers, New Delhi

MEL 1211			Thermodynamics				Pre Requisites			
Version R-01							Co-requisites			
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Thermodynamics

MEL 1211 **3-0-0=3**

Unit I: Introduction–Macroscopic and Microscopic Approaches; Thermodynamic Systems-Closed, Open and Isolated; Property, State, Path and Process; Quasi-Static Process; Temperature, Zeroth Law of Thermodynamics, Concept of Ideal Gas, Type of Thermometers, Work Transfer as a Path Function, P-dv Work in Various Quasi-Static Processes, Free Expansion, Heat Transfer as a Path Function.

First Law of Thermodynamics-Application to Closed System undergoing a Cycle, Closed System undergoing a Change of State, Different forms of Stored Energy, Enthalpy, PMM1.
First Law applied to Flow Processes, Mass and Energy Balance in a Simple Steady Flow Process, Some Examples.

Second Law of Thermodynamics–Statements of Kelvin-Planck and Clausius, Refrigerator and Heat Pump, Reversibility and Irreversibility, Causes of Irreversibility, Conditions of Reversibility, Carnot Cycle, Introduction to Entropy, Temperature-Entropy Plot.

Unit II: Elements of Heat Transfer: Basic Concepts, Conduction Heat Transfer, Convection Heat Transfer, Radiation Heat Transfer, Heat Exchangers.

Unit III: Properties of Pure Substance-PV-T, PT, TS Diagram, Mollier Diagram–Mixture of Gaseous and Vapours-Mixtures of Ideal Gases–Dalton's Law-Thermodynamic. Properties of Mixture–Mixtures of Ideal Gases and Vapours-Psychrometric Principles-Psychometrics Chart-Applications. Introduction to Refrigeration–Vapour Compression Refrigeration.
Unit IV: Vapour Power & Gas Power Cycles: Simple Steam Power Cycle, Rankine Cycle, Actual Vapour Cycle Processes, Comparison of Rankine and Carnot's Cycle, Reheat and Regenerative Cycles, Ericsson Cycle, Otto Cycle, Diesel Cycle and Dual Cycle.

RecommendedBooks:

1. Nag, P.K.- Engineering thermodynamics, Tata McGraw Hill Publishers,
2. Vasandani, V.P.and Kumar, D.S.-Heat Engineering, metropolitan book
3. Kumar, D.S.-thermal science and engineering, Kataria & Sons Publishers,
4. Gupta and Prakash –Engineering thermodynamics, S.Chand Publishers,
5. Kothandaraman, C.P, and Dornkundwar, S.-thermal Engineering, Dhanpat Rai & Sons, New Delhi.
6. Cengel and Boles Thermodynamics & Engineering Approach, Tata Mc GrawHill Publishers, New Delhi.

MEL 2232			Fluid Machines				Pre Requisites			
Version R-01							Co-requisites			
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

FLUID MACHINES

MEL 2232 **3-0-2=4**

Unit I: Impact of Free Jets: Impulse–Momentum Principle, Jet Impingement- on a Stationary Flat Plate, Inclined Plate and a Hinged Plate, at the Center of a Stationary Vane, on a Moving Flat Plate, Inclined Plate, A Moving Vane and a Series of Vanes, Jet Striking Tangentially at the tip of a Stationary Vane and Moving Vane (s), Jet Propulsion of Ships. Problems.

Unit II: Impulse Turbines: Classification–Impulse and Reaction Turbines, Water Wheels, Component Parts, Construction, Operation and Governing Mechanism of a Pelton Wheel, Work Done, Effective Head, Available Head and Efficiency of a Pelton Wheel, Design Aspects, Speed Ratio, Flow Ratio, Jet Ratio, Number of Jets, Number of Buckets and Working Proportions, Performance Characteristics, Governing of Impulse Turbines. Problems

Unit III: Francis Turbines: Component Parts, Construction and Operation of a Francis Turbine, Governing Mechanism, Work Done by the Turbine Runner, Working Proportions and Design Parameters, Slow, Medium and Fast Runners, Degree of Reaction, Inward/Outward Flow Reaction Turbines, Performance Characteristics, Problems.

Unit IV: Propeller and Kaplan Turbines: Component Parts, Construction and Operation of a Propeller, Kaplan Turbine, Differences Between the Francis and Kaplan Turbines, Draft Tube-Its Function and Different Forms, Performance Characteristics, Governing of Reaction Turbine, Introduction to New Types of Turbine, Deriaz (Diagonal), Bulb, Tubular Turbines, Problems.

Unit V: Dimensional Analysis and Model Similitude: Dimensional Homogeneity, Rayleigh's Method and Buckingham's Π-Theorem, Model Studies And Similitude, Dimensionless Numbers and their Significance. Unit Quantities, Specific Speed and Model Relationships for Turbines, Scale Effect, Cavitations–Its Causes, Harmful Effects and Prevention, Thomas Cavitation Factor, Permissible Installation Height, Problems.

Unit VI: Centrifugal Pumps: Classification, Velocity Vector Diagrams and Work Done, Manometric Efficiency, Vane Shape, Head Capacity Relationship and Pump Losses, Pressure Rise in Impeller, Minimum Starting Speed, Design Considerations, Multi-Stage Pumps. Similarity Relations and Specific Speed, Net Positive Suction Head, Cavitation and Maximum Suction Lift, Performance Characteristics. Brief Introduction to Axial Flow, Mixed Flow and Submersible Pumps, Problems.

Unit VII: Reciprocating Pumps: Construction and Operational Details, Discharge Coefficient, Volumetric Efficiency and Slip, Work and Power Input, Effect of Acceleration and Frictionon Indicator Diagram (Pressure–Stroke Length Plot), Separation, Air Vessels and their Utility, Rate of Flow into or From the Air Vessel, Maximum Speed of the Rotating Crank, Characteristic Curves, Centrifugal Vs Reciprocating Pumps, Brief Introduction to Screw, Gear, Vane and Radial Piston Pumps, Problems.

Unit VIII: Hydraulic Systems: Function, Construction and Operation of Hydraulic Accumulator, Hydraulic Intensifier, Hydraulic Crane, Hydraulic Lift and Hydraulic Press, Fluid Coupling and Torque Converter, Hydraulic Ram, Problems.

Recommended Books:

1. Som S.K. And Biswas, G-Introduction To Fluid Mechanics And Fluid Machines, Tata Mcgraw-Hill, New Delhi.
2. Agrawal S.K.-Fluid Mechanics And Machinery, Tata Mcgraw-Hill, New Delhi.
3. Kumar, D.S.-Fluid Mechanics And Fluid Power Engineering, Kataria & Sons Publishers, New Delhi.
4. Bansal R.K.-Fluid Mechanics And Hydraulic Machines, Laxmi Publications (P) Ltd., New Delhi.
5. Ramamrutham S., Fluid Mechanics, Hydraulics And Fluid Machines, Dhanpat Rai & Sons, Delhi.

MEL 2212			Thermal Engineering				Pre Requisites			
Version R-01							Co-requisites			
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

Thermal Engineering

MEL 2212 **3-0-2=4**

Unit I: Steam Generators–Classification of Boilers with Details, Merits and Demerits of Fire Tube and Water Tube Boilers, High Pressure Boilers, Boiler Mounting sand Accessories, Draught and Performance of Boilers.

Unit II: Steam Nozzles– Types of Nozzles, Steam Flow Through Nozzles, Condition for Maximum Discharge, Supersaturated Flow Through Nozzles.

Unit III: Fuels and Combustion–Types of Fuels, Calorific Value of Fuels, Combustion Equation for Hydrocarbon Fuel, Conversion of Volumetric Analysis to Mass Analysis, Determination of Excess Air Supplied. Determination of Percentage Carbon in Fuel Burning to CO And CO_2. Determination of Minimum Quantity of Air Supplied to Gaseous Fuels, Flue Gas Analysis, and Bomb Calorimeter Orsat Apparatus.

Unit IV: Compressors: Compression Processes, Work of Compression, Single-Stage Reciprocating Air Compressor, Volumetric Efficiency, Multi-Stage Compression, Rotary Compressors.

Unit V: Turbines: Impulse and Reaction Principles of Turbines, Compounding, Single and Multistage Turbines, Speed Regulations.

Unit VI: Steam Condenser: Types, Various Efficiencies, Air Leakage, Cooling Towers and Applications.

Recommended Books:

1. Nag, P.K.- Engineering Thermodynamics, Tata McGraw Hill Publishers, New Delhi.
2. Vasandani, V.P. and Kumar, D.S.-Heat Engineering, Metropolitan Book Co.
3. Kumar, D.S.-Thermal Science and Engineering, Kataria & Sons Publishers, New Delhi.
4. Gupta And Prakash –Engineering Thermodynamics, S.Chand Publishers, New Delhi.
5. Kothandaraman, C.P, and Dornkundwar, S.-Thermal Engineering, Dhanpat Rai & Sons, New Delhi.
6. Cengeland Boles Thermodynamics & Engineering Approach, Tata Mc Graw Hill Publishers, New Delhi.

MEL 2113			Manufacturing Processes				Pre Requisites			
Version R-01							Co-requisites			
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

Manufacturing Processes

MEL 2113 **3-0-2=4**

Unit I: Engineering Materials- Classification, Selection of Materials for Mechanical Design, Mechanical, Physical and Thermal Properties, Common Ferrous and Non-Ferrous Metals, Introduction to Ceramics & Composite Materials. Classification of Manufacturing Processes of Materials.

Unit II: Casting -Scope, Pattern, Pattern Allowances, Solidification, Gating and Risering, Sand Mould, Permanent Mould, Cold and Hot Chamber Die Casting, Shell Moulding, Investment Casting and Centrifugal Casting, Casting Defects and Remedies.

Unit III: Forming-Scope, Fundamentals of Forming, Hot & Cold Working Processes, Rolling, Extension, Wire Drawing, Forging, Fundamentals of Sheet Metal Operation, High Energy Rate Forming Processes.

Unit IV: Powder Metallurgy-Scope, Basic Steps, Production of Powders, Powder Characteristics, Advantages and Disadvantages.

Unit V: Welding-Scope, Classification, Fundamental of Welding, Heat Affected Zone, Welding Metallurgy and Its Effecton Performance of Weldments, Residual Stresses and Distortion of Weldments, SMAW, TIG, MIG, SAW, PAW and Gas Welding Process (Principles & Applications), Brazing and Soldering Operations.

Unit VI: Classification, Specifications, Operations and Machining Parameters of Lathe, Milling, Shaper, Drilling, Cylindrical Surface Grinder and Abrasive Wheels.

Recommended Books:

1. Kalpakjian, S.- Manufacturing Engineering and Technology, Pearson Education, Singapore
2. Hajra Choudhry, S. K.- Elements of Workshop Technology, Vol I, Media Promoters & Publishers Pvt., Ltd.
3. Jain, R. K.-A Text Book of Production Technology, Khanna Publishers, New Delhi.
4. Rao, P.N.–Manufacturing Technology (Casting, Forming and Welding), Tata McGraw Hill, New Delhi.
5. De Garmo, E.P.- Materials and Processes in Manufacturing, Prentice Hall of India, New Delhi.

MEL 2018			Dynamics of Machines				Pre Requisites			
Version R-01							Co-requisites			
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

Dynamics Of Machines

MEL2018 **3-0-2=4**

Unit I: Static Force Analysis-Static Equilibrium of Mechanism, Concept of Force and Couple, Free Body Diagram, Conditions of Equilibrium, Methods of Static Force Analysis of Simple Mechanisms and Power Transmission Elements, Consideration of Frictional Forces, Determination of Forces and Couples for a Crank, Inertia of Reciprocating Parts, Dynamically Equivalent System, Analytical and Graphical Method, Inertia Force Analysis of Basic Engine Mechanism, Torque Required to Overcome Inertia and Gravitational Force of a Four Bar Linkage.

Unit II: Balancing-Balancing of Rotating Masses in One Plane and in Several Planes, Unbalanced Forces in Reciprocating Engines, Balancing of In-Line Engines, Firing Order, Radial and V-Engines, Balancing of Machines, Balancing of Linkages, Fisher's Method of Principal Vectors, Method of Linearly Independent Vectors, Balancing of Shaking Moment.

Unit III: Gears-Toothed Gears and Spur Gears, Types of Toothed Gears, Definitions: Pressure Angle, Path of Contact, Arc of Contact, Conditions for Correct Gearing, Forms of Teeth, Involute and Its Variants, Interference and Methods of Removal, Calculation of Minimum No. of Teeth on Pinion/Wheel For Involute Rack, Helical/Spiral/Bevel/Worm Gears.

Gear Trains- Types of Gear Trains, Simple, Compound and Epicyclic Gear Trains, Problems and their Applications, Estimation of Velocity Ratio of Worm and Worm Wheel.

Unit IV: Single Degree Vibration-Natural Frequency of Free Oscillations, Equivalent System, Energy Method, Single Degree Damped Systems, Forced Vibrations, Support Isolation, Measurement of Vibrations, Critical Speed of Simple Shafts; Two and Multi Degree Vibration –Two Degree Freedom Systems, Generalized Coordinates, Principal Coordinates, Coordinate Coupling, Lagrange's Equation, Vibration Absorbers, Multi Degree Freedom Systems-Calculation of Natural Frequencies by Matrix Methods, Stodola, Ralyeigh and Holzer Methods.

Unit V: Kinematic Synthesis of Mechanisms– Freudenstien's Equation, Function Generation Errors in Synthesis, Two/Three Point Synthesis, Transmission Angles, Least Square Techniques.

Recommended Books:

1. Rao, J.S. and Dukkipati, R.V.-Mechanism and Machine Theory, Wiley-Eastern, New Delhi.
2. Ballaney, P.L. – Theory of Machines, Khanna Publishers, New Delhi.
3. Khurmi, R.S. and Gupta, J.K. – Theory of Machines, Eurasia Publishing House (P)Ltd, New Delhi.
4. Ghosh, A. and Mallick A.K.- Thoery of Mechanisms and Machines, Affiliated East-West Press Pvt.Ltd.,New Delhi.
5. Rattan, S.S.- Theory of Machines, Tata McGraw Hill, New Delhi.

MEL 2017			Machine Design				Pre Requisites			
Version R-01							Co-requisites			
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hour	3 Hours	10	20	20	50	100

Machine Design

MEL 2017 **3-1-0=4**

Unit I Design For Production ; Erogonomic and Value Engineering Considerations in Design, Role of Processing in Design, Design Considerations for Casting, Forging and Machining. Variable Loading : Different Types of Fluctuating/ Variable Stresses, Fatigue Strength Considering Stress Concentration Factor, Surface Factor, Size Factor, Reliability Factor, etc., Fatigue Design for Finite and Infinite Life against Combined Variable Stresses using Goodman and Soderberg's Criterion, Fatigue Design using Miner's Equation, Design Problems on above.

Unit II Shafts: Detailed Design of Shafts for Static and Dynamic Loading, Rigidity and Deflection Consideration.

Unit III Springs: Types of Springs, Design for Helical Springs against Tension and their Uses, Compression and Fluctuating Loads, Design of Leaf Springs, Surging Phenomenon in Springs, Design Problems.

Unit IV Bearings: Design of Pivot and Collar Bearing , Selection of Ball and Roller Bearing Based on Static and Dynamic Load Carrying Capacity Using Load-Life Relationship, Selection of Bearings From Manufacturer's Catalogue, Types of Lubrication – Boundary, Mixed And Hydrodynamic Lubrication, Design of Journal Bearing using Raimondi and Boyd's Charts, Lubricants and their Properties, Selection of Suitable Lubricants, Design Problems.

Unit V: I.C. Engine Parts: Cylinder, Piston, Connecting Rod, Crank and Fly Wheel Etc.

Recommended Books:

1. Shigley,J.E. and Mischke - Mechanical Engineering Design, McGraw Hill, New York.
2. Motts, R.L – Machine Elements in Mechanical Design, 3RD Ed., McMillan Publishing House.
3. Sharma, P. C. and Aggarwal, D. K. – Machine design, Kataria & Sons Publishers, New Delhi.
4. Sundarajamurthy, T. V. and Shanmugam, N. - Machine Design, Khanna Publishers, New Delhi.
5. Bhandari, V. B. -Design of Machine Elements, Tata McGraw Hill, New Delhi.
6. Pahl, G. and Beitz, W- Engineering Design, Springer Verlag, London, 1984.
7. Ullman, D.G. - The Mechanical Design Process, Mc-Graw Hill, International Edition, Singapore, 1997.

MEL 2016			Mechanics of Materials				Pre Requisites			
Version R-01							Co-requisites			
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Mechanics Of Materials

MEL 2016 3-0-0=3

Unit I: Strain Energy & Impact Loading: Definitions, Expressions for Strain Energy Stored in a Body when Load is applied (I) Gradually, (II) Suddenly and (III) with Impact, Strain Energy of Beams in Bending, Beam Deflections, Strain Energy of Shafts in Twisting, Energy Methods in Determining Spring Deflection, Castigliano's & Maxwell's Theorems.

Unit II: Theories of Elastic Failure: Various Theories of Elastic Failures with Derivations and Graphical Representations, Applications to Problems of 2- Dimensional Stress System with (I) Combined Direct Loading and Bending, and (II) Combined Torsional and Direct Loading.

Unit III Unsymmetrical Bending: Properties of Beam Cross Section, Product of Inertia, Ellipse of Inertia, Slope of Neutral Axis, Stresses & Deflections, Shear Center and Flexural Axis.

Unit IV: Thin Walled Vessels: Hoop & Longitudinal Stresses & Strains in Cylindrical & Spherical Vessels & their Derivations Under Internal Pressure, Wire Wounld Cylinders, Thick Cylinders & Spheres: Derivation of Lame's Equations, Radial & Hoop Stresses and Strains in Thick, and Compound Cylinders and Spherical Shells Subjected to Internal Fluid Pressure Only, Wire Wound Cylinders, Hub Shrunk on Solid Shaft.

Unit VI: Rotating Rims & Discs: Stresses in Uniform Rotating Rings & Discs, Rotating Discs of Uniform Strength, Stresses in (I) Rotating Rims, Neglecting the Effect of Spokes, (II) Rotating Cylinders, Hollow Cylinders & Solids Cylinders.

Unit VII; Bending of Curved Bars : Stresses in Bars of Initial Large Radius of Curvature, Bars of Initial Small Radius of Curvature, Stresses in Crane Hooks, Rings of Circular & Trapezoidal Sections, Deflection of Curved Bars & Rings, Deflection of Rings by Castigliano's Theorem, Stresses in Simple Chain Link, Deflection of Simple Chain Links, Problems.

Unit VIII: Springs: Stresses in Open Coiled Helical Spring subjected to Axial Loads and Twisting Couples, Leaf Springs, Flat Spiral Springs, Concentric Springs.

Recommended Books:

1. Popov, E. P. - Mechanics of Materials, Prentice Hall India, New Delhi
2. Singer,F.P.&Pytel,A.-Strength of Materials, Harper and Row H. Kogakusha Publishers, New York
3. Bedi, D. S. - Strength of Materials, Khanna Book Publishing Company, New Delhi.
4. Lehri, R.S. and Lehri, A.S.- Strength of Materials, Kataria & Sons Publishers, New Delhi
5. Khurmi, R. S. - Strength of Materials, Khanna Publishers, New Delhi

MEL 3221			Heat and Mass Transfer				Pre Requisites			
Version R-01							Co-requisites			
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

Heat And Mass Transfer

MEL 3221 **3-0-2=4**

Unit I: Modes of Heat Transfer, Conduction-Fourier's Law, Thermal Conductivity of Solids, Liquids and Gases, Factors influencing Thermal Conductivity, General Three Dimensional Heat Conduction Equation in Cartesian, Cylindrical and Spherical Co-ordinates, Heat Flow through Plane Walls, Cylinders and Spheres, Heat Source Systems, Plane Wall and Cylinder, Critical Thickness of Insulation, Different Types of Fins, Heat Transfer from Fins of Uniform Cross Section, Heat Flow in a Semi Infinite Solid with Sudden Change of Surface Temperature, Periodic Variation of Surface Temperature.

Unit II: Convection-Free and Forced Convection, Basic Concepts of Hydrodynamic and Thermal Boundary Layers, Similarity Conditions of Heat Transfer Processes, Equations of Motion and Energy, Application of Dimensional Analysis, Empirical Equation of Convective Heat Transfer-Reynolds Analogy, Fundamentals of Boiling Heat Transfer, Pool Boiling, Heat Transfer in Condensation, Drop Wise and Film Condensation, Emperical Equations.

Unit III: Radiation-Thermal Radiation, Monochromatic and Total Emissive Power Absorptivity, Reflectivity and Transmissivity, Black, Grey and Real Surfaces, Planck's Distribution-Law, Wien's Displacement Law, Stefan-Boltzmann's Law, Kirchhoff's Law, Heat Transfer by Radiation between Black Surface and Grey

Surfaces, Heat Transfer in Presence of Re-Radiating Surface, Electrical Network Method of Solving Radiation Problems, Radiation Shields, Shape Factors.

Unit IV: Heat Exchangers-Basic Type of Heat Exchangers, Fouling Factor, Overall Heat Transfer Co-efficient, Logarithmic Mean Temperature Difference (LMTD), Effectiveness-NTO Methods of Design of Single and Multiple Pass Heat Exchangers.

Unit V: Mass Transfer-Rate Equations, Mass Diffusion in Binary Mixtures, Evaporation in a Column, Forced Convective Mass Transfer, Heat and Mass Transfer Analogies.

Recommended Books:

1. Yadav, R.-Heat and Mass Transfer, Central Publishing House, Allahabad.
2. Sachdeva,R. C.- Fundamentals of Engineering Heat and Mass Transfer, New Age International Publishers, NewDelhi.
3. Holman J.P.- Heat and Mass Transfer, Tata McGraw Hill, New Delhi.
4. Ozisik, M. N.- Heat Transfer, McGraw Hill, New York.
5. Kothandaraman, C.P.-Fundamentals of Heat and Mass Transfer, New Age International Publishers, New Delhi.

MEL 3131			Industrial Engineering				Pre Requisites			
Version R-01							Co-requisites			
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Industrial Engineering

MEL 3131 **3-0-0=3**

Unit I: Introduction - Definition and Scope of Industrial Engineering, Role of an Industrial Engineer in Industry, Functions of Industrial Engineering Department and Its Organization, Qualities of an Industrial Engineer, Principles of Industrial Engineering, System and Review of Growth and Development of Industrial Engineering and Scientific Management.

Unit II: Plant Layout and Material Handling - Different Types of Layouts Viz. Product, Process and Combination Layouts, Introduction to Layouts Based on GT, JIT and Cellular Manufacturing Systems, Development of Plant Layout, Types of Material Handling Equipments, Relationship of Material Handling with Plant Layouts.

Unit III: Work Study - Use and Applications, Techniques, Human Factors in the Application of Work Study, Method Study Objectives, Basic Procedure, Various Charting Techniques, Use of Photographic Techniques, SIMO Charts, Principles of Motion Economy, Work Measurement Techniques, Time Study, Work Sampling, Predetermined Motion Time Standards (PMTS), Analytical Estimation.

Unit IV: Production Planning and Control – Functions, Forecasting Techniques, Product Design, Process Planning, Machine Loading and Scheduling, Dispatching, Progress Reporting, Corrective Action.

Inventory Control - Different Costs, Determining Economic Order Quantity, Quantity Discounts, Re-order Level, Re-order Cycle Systems, ABC, VED, FSN Models.

Unit V: Quality Control - Meaning of Quality and Quality Control, Quality of Design, Quality of Conformance and Quality of Performance, Functions of Quality Control, Introduction to Statistical Quality Control-Control Charts and Sampling Plans.

Recommended Books:

1. Khanna, O.P. - Industrial Engineering and Management, Khanna Publishers, New delhi.
2. Dalela, S. and Mansuor Ali - Industrial Engineering and Management systems, Standard Distributors and Publishers, New Delhi.
3. Ralph, M. B. - Motions and Time Standards, John Wiley, New York.
4. ILO - Introduction to Work Study, International Labor Office , Geneva.
5. Jain, K.C. and Agarwal, L. N. – Production Planning Control & Industrial Management, Khanna Publishers, New Delhi.

MEL 3019			Design of Machine Elements				Pre Requisites			
Version R-01							Co-requisites			
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Design Of Machine Elements

MEL 3019 **3-0-0=3**

Unit I: Product Development Principles – Mechanical Properties of Materials, Simple Stresses, Torsional Stresses, Bending Stresses, Variable Stresses in Machine Parts.
Theories of Failure: Maximum Normal Stress, Maximum Shear Stress, Maximum Principal Strain, Maximum Strain Energy, Maximum Distortion Energy Theories, Criteria of Failure, Stress Concentration Factor, Size Factor, Surface Factor, Load Factor, Factor of Safety, Design Stress.

Unit II: Design of Shafts and Springs: Design of Shafts Based on Bending Moment, Twisting Moment, Combined Bending & Twisting Moments, Axial Loads in Addition to Combined Torsional and Bending Loads,Rigidity and Stiffness.

Unit III: Couplings, Keys, Belts, Chains and Design of Rigid and Flexible Couplings, Design of Keys, Design of Belt and Chain Drives, Selection of Belt and Chain Drives, Design of Elements Subjected to Simple Loading, Screws Including Power Screws, Bolted Joints Including Eccentrically Loaded Joints, Clutches and Brakes.

Unit IV: Design of Welded And Riveted Joints: Types of Welded Joints, Weld Symbols and their Representation, Strength of Welded Joints Subjected to Various Types of Loads.
Riveted Joints: Types of Joints, Design of Riveted Joints for Pressure Vessels, Design of Riveted Joints for Structures.

Unit V: Design of Gears: Design of Spur, Helical, Bevel and Worm Gears, Design of Gear Box, Layout Diagram, Speed Diagram, Fixing Number of Teeth And Module Of Gears.

Recommended Books:

1. Shigley,J.E. and Mischke - Mechanical Engineering Design, McGraw Hill, New York.
2. Khurmi,R. S. and Gupta, J. K.- A Text Book of Machine Design, Eurasia Publishing House (P) Ltd, New Delhi.
3. Sharma, P. C. and Aggarwal, D. K. – Machine design, Kataria & Sons Publishers, New Delhi.
4. Sundarajamurthy, T. V. and Shanmugam, N. - Machine Design, Khanna Publishers, New Delhi.
5. Bhandari, V. B. -Design of Machine Elements, Tata McGraw Hill, New Delhi.
6. Pahl, G. and Beitz, W- Engineering Design, Springer Verlag, London, 1984.
7. Ullman, D.G. - The Mechanical Design Process, Mc-Graw Hill, International Edition, Singapore, 1997.

MEL 3114			Machining Processes				Pre Requisites			
Version R-01							Co-requisites			
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Machining Processes

MEL 3114 **3-0-0=3**

Unit I :Mechanism of Metal Cutting: Deformation of Metal During Machining, Nomenclature of Lathe, Milling Tools, Mechanics of Chip Formation, Built-Up Edges, Mechanics of Orthogonal and Oblique Cutting, Merchant Cutting Force Circle and Shear Angle Relationship in Orthogonal Cutting, Factors Affecting Tool Forces. Cutting Speed, Feed and Depth of Cut, Surface Finish. Temperature Distribution , Tool Chip Interface. Numericals on Cutting Forces and Merchant Circle.

Unit II: Cutting Tool Materials & Cutting Fluids: Characteristics of Tool Materials, Various Types of Cutting Tool Materials, Coated Tools, Cutting Tool Selection, Purpose and Types of Cutting Fluids, Basic Actions of Cutting Fluids, Effect of Cutting Fluid on Tool Life, Selection of a Cutting Fluid.

Unit III: Tool Wear and Machinability: Types of Tool Wear, Tool Life, Factors Governing Tool Life, Machinability: Definition and Evaluation. Economics of Machining. Numericals on Tool Life.

Unit IV: Gear Manufacturing: Introduction, Methods of Manufacture, Gear Generation and Forming: Gear Cutting by Milling, Single Point Form Tool, Gear Hobbing and Shaping. Gear Finishing Operations: Gear Shaving, Gear Burnishing, Gear Grinding, Lapping.

Unit V: Non-Conventional Machining Processes: Abrasive Jet Machining: Principles, Applications, Process Parameters. Ultrasonic Machining: Principles, Applications, Analysis of Process Parameters. Electro-Chemical Machining and Grinding: Principles, Classifications, Choice of Electrolytes, Applications. Electric Discharge Machining: Principles, Selection of Tools Materials and Dielectric Fluid. Electron Beam Machining: Generation of Electron Beam, Relative Merits and Demerits. Laser Beam Machining: Principles and Applications.

Unit VI: Jigs & Fixtures: Introduction, Location and Location Devices, Clamping and Clamping Devices, Drill Jigs, Milling Fixtures.

Recommended Books:

1. HMT - Production Technology, Tata Mcgraw Hill, New Delhi.
2. Kalpakjian, S. - Manufacturing Engineering and Technology, Pearson Education, Singapore
3. Hajra Choudhry, S. K. - Elements of Workshop Technology, Vol II, Media Promoters & Publishers Pvt., Ltd.
4. Jain, R. K. – A Text Book of Production Technology, Khanna Publishers, New Delhi.
5. Khanna, O.P. And Lal, M.- A Textbook of Production Technology, Vol II, Dhanpat Rai & Sons, New Delhi.

MEL 3021			CAD/CAM				Pre Requisites			
Version R-01							Co-requisites			
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

MEL 3021 **CAD/CAM** **3-0-2=4**

Unit I: Fundamentals of CAD – Introduction, Design Process, Application of Computers in Design, Benefits of CAD, Computer Hardware, Graphic Input Devices, Display Devices, Graphics Output Devices, CAD Software and Database, Software Configuration of a Graphic System, Functions of a Graphic Package, Geometric Modeling, Database Structure and Control, Graphic Standards such as GKS and IGES.

Unit II: Geometric Transformations - Mathematics Preliminaries, Matrix Representation of 2 and 3 Dimensional Transformation, Concatenation of Transformation Matrices, Application of Geometric Transformations, Representation of Curves and Surfaces: Polygon, Meshed and Ruled Surfaces, Bezier Curves, B-Spline Curves.

Unit III: Geometric Modeling - Wireframe Modeling, Solid Modeling Representation, Volumetric Properties, Surface Modeling, Concept of Hidden-Line Removal and Shading, Kinematics Analysis and Simulation.

Unit IV: CNC Machine Tools - Development Of CNC Technology, Principles, Features, Advantages, Economic Benefits, Applications, CNC, DNC Concept, Classification of CNC Machines, Types of Control, CNC Controllers, Characteristics, Interpolators.

Unit V: Drives and Controls - Spindle Drives, Feed Drives, Open Loop and Closed Loop Control, Axis Measuring Systems. Tooling and Maintenance Of CNC Machine Tools.

Unit VI: CNC Programming - Coordinate System, Structure of a Part Program, G & M Codes, Manual Part Programming for Fanuc, Heidenhain, Numeric Control Systems, APT Part Programming, Programming Exercises. Computer Aided Process Planning – Retrieval, Generative and Hybrid Approaches, Advantages, Case Studies.

Recommended Books:

1. Groover, M. P. and Zimmers, E. W. - CAD/CAM, Prentice Hall of India, New Delhi.
2. Zeid, I. - CAD/CAM - Theory and Practice, Tata McGraw Hill, New Delhi.
3. Rao, P. N. – CAD/CAM, Tata McGraw Hill, New Delhi.
4. Groover. M. P. - Automation, Production Systems and computer Integrated Manufacturing, Pearson Education Asia, New Delhi.
5. Reddy, J. N.-An Introduction to the Finite Element Method, McGraw Hill, New York.
6. Pham, D.T. and Dimov, S.S. - Rapid Manufacturing, Springer Verlag,
7. Ranky, P. G. -Computer Integrated Manufacture, Prentice-Hall

			Finite Element Analysis				Pre Requisites			
Version R-01							Co-requisites			
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	4	1 Hour	3 Hours	10	20	20	50	100

Finite Element Analysis

3-0-0=4

Section - I

1Introduction to the Finite Element Method: 03

General theory, A simple one-dimensional element, Pin-jointed bar, Stress analysis of a stepped bar, Thermal rod, Heat conduction through wall.

2 Discritization of the Problem: 03

Introduction, Geometrical approximations, Simplification through symmetry, Basic element shapes and behaviour, Choice of element type, Size and number of elements, Element shape and distortion, Location of nodes, Node and element numbering

3 Interpolation Functions And Simplex Elements: 03

Introduction, simplex, complex and multiplex elements, linear interpolation polynomials for simplex elements, Natural co-ordinates, vector quantities, an axi-symmetric element

4 Formulation of the Elements Characteristic Matrices And Vectors For Elasticity Problems: 06

Introduction, the variational formulation, one dimensional elasticity, two dimensional elasticity, axi-symmetric elasticity

5 Formulation Of The Elements Characteristic Matrices And Vectors For Field Problems: 06

Introduction, Formulation procedures, The variational formulation, The weighted residual method. Thermal problems, One dimensional heat transfer, two dimensional heat transfer, three dimensional heat transfer, axi-symmetric heat transfer. Torsional problems, Fluid flow problems

Section II

6 Assembly And Solution Of The Finite Element Equations: 05

Introduction, co- ordinate transformations, assembly of element equations, incorporation of the boundary conditions, solution of the equations, elimination method, penalty method.

7 Higher Order Element Formulations: 08

Introduction, Natural co – ordinates systems and numerical integration, higher order one dimensional elements – quadratic and cubic elements, evaluation of the element equations, an alternative formulation. Higher order two and three dimensional elements – iso-parametric triangular elements, iso-parametric quadrilateral elements, isoparametric solid elements, stress and heat flow calculations.
Structural beam, plate and shell elements, convergence requirements of interpolation functions.

8 Modeling Procedures And Results Processing: 04

Introduction, model validity and accuracy, mesh design and refinement, element distortions, result processing , model checking

9 Further Applications Of The Finite Element Method: 04

Introduction, nonlinear static elasticity problems – Material nonlinearity, Geometric nonlinearity.

Buckling problems, Dynamic problems – Modal analysis, Transient response analysis, Harmonic response analysis, shock spectrum analysis, Transient thermal problems

Reference Books:

1 "Introduction to Finite Elements in Engineering"; Chandrapatala, Belgundu, PHI.
2 "Concepts & Applications of Finite Element Analysis"; R. D. Cook, D. S. Malku; John Wiley & sons Publications 3/e 1989
3 "An Introduction to Finite Element Method"; J. N. Reddy; 2/e, McGraw Hill International Editions, ISBN 0-07-112799-2
4 "Finite Element Analysis- Theory and Practice"; Longman Scientific & Technical
5 "Finite Element Method 1-2-3"; A. J. Baker; McGraw Hill International Editions, ISBN 0-07-909975-0
6 "The Finite Element Method – Basic Concepts and Linear Applications"; O. C, Zienkiewicz; McGraw Hill International Editions; ISBN 0-07-084175-6

MEL 3121			Metrology and Measurements				Pre Requisites			
Version R-01							Co-requisites			
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

Metrology And Measurements

MEL3121 **3-0-2=4**

Unit I: Linear Measurements- Vernier Scale and Micrometer, Vernier Height Gauge and Depth Guage; Comparators - Types, Relative Merits and Limitations; Angular Measurements-Sine Bar, Clinometer, Angle Guage; Concept and Measurement Of Straightness and Flatness by Interferometry; Surface Roughness - Specifications and Measurement by Talysurf, Measurements for Internal and External Threads; Measurements for Gears.

Unit II: Static and Dynamic Characteristics of Instruments, Zero, First and Second Order Systems and their Response to Step, Ramp and Sinusoidal Input Signals, Sources of Errors, Systematic and Random Errors; Statistical Analysis of Test-Data, Probable Error and Probability Tables, Ejection of Test Data; Curve Fitting, Error Propagation.

Unit III: Review of Electro-Mechanical Sensors and Transducers - Variable Resistance, Inductance and Capacitive Pick Ups, Photo Cells and Piezo-Electric Transducers, Resistance Strain Guages and Application of these Elements for Measurement of Position/Dispmlacement, Speed/Velocity/ Acceleration, Force and Liquid Level.

Unit IV: Pressure and Flow Measurement - Bourdon Tube, Diaphragm and Bellows, Vaccum Measurement - Mcleod Guage, Thermal Conductivity Guage and Ionisation Guage; Ultra-Sonic Flow Meters and Hot Wire Anemometer. Temperature Measurement - Thermal Expansion Methods, Thermo-Electric Sensors - Common Thermo Couples, Resistance Thermometers and Thermistors, Optical and Total Radiation Pyrometers. Speed, Force, Torque and Shaft Power Measurement - Mechanical Tachometers, Vibration Reed Tachometer and Stroboscope; Proving Ring, Hydraulic and Pneumatic Load Cells, Torque On Rotating Shafts; Absorption, Transmission and Driving Dynamometers.

Recommended Books:

1. Kumar, D. S. - Mechanical Measurement and Control, Metropolitan Book Co Pvt. Ltd., New Delhi.
2. Holman, J. P.- Experimental Methods for Engineers, McGraw Hill, New York.
3. Doebelin, E.O.-Measurement System: Application and Design, McGraw Hill, New York.
4. Jain, R. K. – Mechanical and Industrial Measurement, Khanna Publishers, New Delhi.
5. Jain, R. K. - Engineering Metrology, Khanna Publishers, New Delhi.

MEL 3222			Internal Combustion Engines				Pre Requisites			
Version R-01							Co-requisites			
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

Internal Combustion Engines

MEL3222 **3-0-2=4**

Unit I: Introduction - Classification & Nomenclature, Application of Internal Combustion (I.C.) Engines, Thermodynamic Analysis of Carnot, Sterling, Ericson, Otto, Diesel, and Dual Cycles. Working of 4 Stroke Petrol & Diesel Engines, Valve Timing Diagrams, Working of 2-Stroke Petrol & Diesel Engines (with Valve Timing Diagrams), Comparison of Two Stroke & Four Stroke Engines, Fuel Air Cycles and Analysis, Actual and Fuel-Air Cycles for S.I. and C.I. Engines.

Unit II: I.C. Engine Fuels- Types of Fuels, Solid, Liquid and Gaseous Fuels, Chemical Structure of Petroleum, Petroleum Refining Process, Important Qualities of S.I. & C.I. Engine Fuels and Their Rating, Combustion of Fuels, Calorific Valves of Fuels, Theoretical Determination of CV of Fuel, Combustion Equation for Hydrocarbon Fuels, Determination of Minimum Air Required for Combustion, Volumetric Analysis, Mass Analysis.

Fuel Supply System and Fuel Pumps, Properties of Air Fuel Mixture, A Simple Carburetor and Its Working, Approximate Analysis of Simple Carburetor, Actual Air Fuel Ratio of Single Jet Carburetor, Exact Analysis of Single Jet Carburetor, Ideal Requirements from a Carburetor, Different Modern Carburetors, Introduction to Fuel Injection Systems for C.I. Engines, Fuel Filters.

Unit III: Combustion in S.I. Engines - Stages of Combination in S.I. Engine, Flame Font Propagation, Flame Speed, Ignition Lag and Factors Affecting the Lag, Abnormal Combustion and Knocking, Control and Measurement of Knock, Rating of S.I. Engine Fuels and Anti Knock Agents, Combustion Chambers of S.I. Engines

Unit IV: Supercharging - Purpose of Supercharging, Type of Superchargers, Analysis of Superchargers, Performance of Superchargers, Arrangement of Supercharger and Its Installation, Turbo Charged Engines, Supercharging of S.I. & C.I. Engines, Limitations of Supercharging.

Unit V: Measurement and Testing - Measurement of Friction Horse Power, Brake Horse Power, Indicated Horse Power, Measurement of Speed, Air Consumption, Fuel Consumption, Heat Carried by Cooling Water, Heat Carried by the Exhaust Gases, Heat Balance Sheet, Governing of I.C. Engines, Performance Characteristics of I.C. Engines.

Recommended Books:

1. Ganesan, V. - Internal Combustion Engines, Prentice Hall of India, New Delhi.
2. Domkundwar - A Course in Internal Combustion Engines, Dhanpat Rai & Sons, New Delhi.
3. Kumar, D. S. - Thermal Science and Engineering, Kataria & Sons Publishers, New Delhi
4. Vasandani, V. P. and Kumar, D. S. - Heat Engineering, Metropolitan book Co.

Kothandaraman, C.P. and Dornkundwar, S. – Thermal Engineering, Dhanpat Rai & Sons, New Delhi

MEL 3022			Mechanical Vibrations				Pre Requisites			
Version R-01							Co-requisites			
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	2	4	1 Hour	3 Hours	10	20	20	50	100

Mechanical Vibrations

MEL 3022 3-1-2=4

Unit I: Introduction - Periodic Motion, Harmonic Motion, Period, Frequency, Amplitude and Phase Angle of Vibratory Motion, Vector Representation, Dispmlacement, Velocity and Acceleration in Harmonic Motion, Superposition of Simple Harmonic Motions, Non- Harmonic Motions, Harmonic Analysis.

Unit II: Systems Having Single Degree of Freedom- Free Vibrations of Systems without Damping, Equilibrium and Energy Methods For Determining Natural Frequency, Rayleigh Method, Equivalent Systems; Free Vibrations of Systems with Viscous, Coulomb and Structural Damping. Forced Vibration of Systems with Viscous Damping, Simple Cases of Translent Excitation- Undamped Systems.

Unit III: Systems with Two Degrees of Freedom - Free Undamped Vibrations, Static and Dynamic Coupling, Principal Modes of Vibration, Undamped Dynamic Vibration Absorbers.
Multi Degree Freedom Systems - Calculation of Natural Frequencies by Matrix Methods, Stodola , Ralyeigh and Holzer Methods, Simple Geared Systems, Dunkerley's Method.

Unit IV: Vibration Measuring Instruments - Principle of Frequency, Dispmlacement, Velocity and Acceleration Measuring Instruments, Amplitude and Phase Shift Response.

Unit V: Whirling of Shafts - Whirling of Light Flexible Shaft with a Single Disc at the Centre of its Length with and without Damping, Critical Speeds of a Shaft Having Multiple Discs.

Recommended Books:

1. Dukkipati, R. V. and Srinivas, J. - Advanced Mechanical Vibrations, Narosa Publishing House, New Delhi.
2. Den Hartog, J.P. - Mechanical Vibrations, Dover Publications.
3. Thomson, W.T. - Theory of Vibrations with Applications, CBS Publishers,
4. Rao, S.S. - Mechanical Vibrations, Addison-Wesley, New York.
5. Rao, J. S. and Gupta, K. – Theory and Practice of Mechanical Vibrations, Tata McGraw Hill, New Delhi.

MEL 2133			Operations Research				Pre Requisites			
Version R-01							Co-requisites			
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Operations Research

MEL 4133 3-0-0=3

Unit I: Origin of Operations Research And its Role in solving Industrial Problems, Classification of Mathematical Models, Various Decision Making Environments.
Deterministic Models - Linear Programming - Graphical Method - Simplex Algorithm – Duality, Transportation Problems, Assignment Problems, Applications to Problems with Discrete Variables, Introduction to Goal Programming; Solution Techniques of Linear Goal Programming Problems.

Unit II: Probabilistic Models - Decision Making Under Uncertainty, Maximum and Minimum Models, Introduction to Decision Tree.
Game Theory - Solution of Simple Two Person Zero-Sum Games, Examples of Simple Competitive Situation.
Dynamic Programming - Introduction to Deterministic and Probabilistic Dynamic Programming, Solution of Simple Problems.

Unit III: Network Models - Shortest Route, Minimal Spanning Tree, Maximum Flow Models, Project Network - CPM and PERT Networks, Critical Path Scheduling, Sequencing Models.

Unit IV: Inventory Models - Economic Order Quantity Models, Quantity Discount Models, Stochastic Inventory Models, Multi Product Models.

Unit V: Queueing Models - Queueing Systems and Structures, Notation, Parameters, Single Server And Multi Server Models, Poisson Input, Exponential Service, Constant Rate Service, Infinite Population, Simulation.

Recommended Books:

1. Taha, H. A. - Operations Research, Prentice Hall of India, New Delhi.
2. Wagner, H. M. - Principles of Operations Research, Prentice Hall, New Jersey.
3. Gupta, P. K. and Hira, D. S. - Operations Research, S. Chand & Co., New Delhi.
4. Bazara, M. J. and Sherali,J. H. - Linear Programming and Network Flows, John Wiley, New York.
5. Srinath, L. S. - PERT and CPM, Principles and Applications, East-West Press, New Delhi.

MEL 4223			Refrigeration & Air Conditioning				Pre Requisites			
Version R-01							Co-requisites			
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

Refrigeration & Air Conditioning

MEL 4223 3-0-2=4

Unit I: Introduction, Refrigeration Cycle, Departure of Actual Vapour Compression Cycle from Theoretical Cycle, Compressor Volumetric Efficiency, Analysis of Actual Cycle, Effect of Suction and Discharge Pressure, Subcooling and Super Heating on Performance, Compound Vapour Compression System With Intercooling for Single and Multiple Evaporators, Cascading, Manufacturing of Dry Ice, Leak Detection, Charging of Refrigerants.

Unit II: Aqua-Amonia Absorption Refrigeration System, Lithium Bromide-Water Absorption System, Electrolux System, Properties of Aqua-Ammonia Solution, Heat of Solution, Enthalpy Concentration Diagram.
Actual Air Refrigeration Cycle, Air Craft Cooling, Liquefaction of Gases, Minimum Work Cycle, Engineering Application of Cryogenics.

Unit III: Refrigerants - Introduction, Classification of Refrigerants, Required Properties of An Ideal Refrigerant, Important Refrigerants, Secondary Refrigerants, Antifreeze Solutions, Selection of Refrigerant.

Unit IV: Air Conditioning - Industrial and Comfort Air Conditioning, Physiologica1 Principle, Comfort Indices, Comfort Chart, Ventilation Requirements.
Psychrometry, Air Washer, Evaporative Cooling, Humidifier Efficiency, Cooling Tower,Performance Cooling and Dehumidification by Chilled Water Spray and Cooling Coils Equivalent by Pass Factor, Chemical Dehumidification, Sensible Heat Factor and Apparatus Dew Points

Unit V: Equipment - Description of Refrigeration and Air Conditioning Equipment, Compressors, Condensers, Evaporators, Air Washer and Expansion Devices. Central Air Conditioning Plants.
Applications - Manufacturing of Ice, Cold Storage and Food Freezing, Air Conditioning of Building.

Recommended Books:

1. Jordan Priester - Refrigeration and Air Conditioning, Prentice Hall of India,
2. Stoecker, W. F. and Jones, J. W. - Refrigeration And Air Conditioning, Tata McGraw Hill, New Delhi.
3. Arora, C. P. - Refrigeration and Air Conditioning, Tata McGraw Hill, New
4. Prasad, M. - Refrigeration and Air Conditioning, New Age International,
5. Arora, C. P. and Domkundwar - Refrigeration and Air Conditioning, Dhanpat Rai & Sons, New Delhi.

MEL 4031			Automobile Engineering				Pre Requisites			
Version R-01							Co-requisites			
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

Automobile Engineering

MEL4031 **3-0-2=4**

Unit I Introduction To Automobiles : Classification, Components, Requirements of Automobile Body; Vehicle Frame, Separate Body & Frame, Unitised Body, Car Body Styles, Bus Body & Commercial Vehicle Body Types; Front Engine Rear Drive & Front Engine Front Drive Vehicles, Four Wheel Drive Vehicles, Safety Considerations; Safety Features of Latest Vehicle; Future Trends in Automobiles.

Unit II Clutches : Requirement of Clutches – Principle of Friction Clutch – Wet Type & Dry Types; Cone Clutch, Single Plate Clutch, Diaphragm Spring Clutch, Multi Plate Clutch, Centrifugal Clutches, Electromagnetic Clutch, Over Running Clutch; Clutch Linkages.

Unit III Power Transmission : Requirements of Transmission System; General Arrangement of Power Transmission System; Object of the Gear Box; Different Types of Gear Boxes; Sliding Mesh, Constant Mesh, Synchro- Mesh Gear Boxes; Epi-Cyclic Gear Box, Freewheel Unit. Overdrive Unit-Principle of Overdrive, Advantage of Overdrive, Transaxle, Transfer Cases.

Unit IV Drive Lines, Universal Joint, Differential and Drive Axles: Effect of Driving Thrust and Torque Reactions; Hotchkiss Drive, Torque Tube Drive and Radius Rods; Propeller Shaft, Universal Joints, Slip Joint; Constant Velocity Universal Joints; Front Wheel Drive; Principle, Function, Construction & Operation of Differential; Rear Axles, Types of Load Coming on Rear Axles, Full Floating, Three Quarter Floating and Semi Floating Rear Axles.

Unit V Suspension Systems: Need of Suspension System, Types of Suspension; Factors Influencing Ride Comfort, Suspension Spring; Constructional Details and Characteristics of Leaf Springs.

Unit VI Steering System : Front Wheel Geometry & Wheel Alignment Viz. Caster, Camber, King Pin Inclination, Toe-In/Toe-Out; Conditions For True Rolling Motions of Wheels During Steering; Different Types of Steering Gear Boxes; Steering Linkages and Layout; Power Steering – Rack & Pinion Power Steering Gear, Electronics Steering.

Unit VII Automotive Brakes, Tyres & Wheels : Classification of Brakes; Principle and Constructional Details of Drum Brakes, Disc Brakes; Brake Actuating Systems; Mechanical, Hydraulic, Pneumatic Brakes; Factors Affecting Brake Performance, Power & Power Assisted Brakes; Tyres of Wheels; Types of Tyre & Their Constructional Details, Wheel Balancing, Tyre Rotation; Types of Tyre Wear & Their Causes.

Unit VIII Emission Control System & Automotive Electrical : Sources of Atmospheric Pollution from the Automobiles, Emission Control Systems – Construction and Operation of Positive Crank Case Ventilation (PVC)

Systems, Evaporative Emission Control, Heated Air Intake System, Exhaust Gas Recirculation (ECR) Systems, Air Injection System and Catalytic Converters; Purpose Construction & Operation of Lead Acid Battery, Capacity Rating & Maintenance of Batteries; Purpose and Operation of Charging Systems, Purpose and Operations of the Starting System; Vehicle Lighting System.

Recommended Books:

1. Automotive Mechanics – Crouse / Anglin, TMH.
2. Automobile Engineering by Anil Chhikara, Satya Prakashan, New Delhi.
3. Automobile Engineering by Dr. Kirpal Singh, standard Publishers Distributors.
4. Automotive Technology – H.M. Sethi, TMH, New Delhi.
5. Automotive Mechanics – S.Srinivasan, TMH, New Delhi.
6. Automotive Mechanics – Joseph Heitner, EWP.
7. Motor Automotive Technology by Anthony E. Schwaller – Delmer Publishers, Inc.
8. The Motor Vehicle – Newton steeds Garrett, Butter Worths.

MEC 4913			Colloquium				Pre Requisites	
Version R-01							Co-requisites	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	External Marks	Total Marks
0	0	2	1	-	-	100	-	100

Colloquium

EMEC 4913 **0-0-2=1**

Introduction to Planning, Preparing and Making Presentation - Preparation of Slides, Time Management, Communication Aspects, etc. Making of a Presentation based on Practical Training with Response Sheet for Audience. Reading an Assigned Project Report, Making a Presentation with Audience Response Sheet and a Critique on Writing Style, Completeness and Editorial Get-Up. Performing Patent Searches on a Production or Industrial Engineering Process/ Product and Making a Presentation. Preparing Posters on Practical Training and Presenting Them during a Poster Session.

ECD 4992/ ECC4982			Major Project				Pre Requisites	
Version R-01							Co-requisites	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	External Marks	Total Marks
			12	-	-	50	50	100

Major Project

ECD 4992/ ECC 4982

Team Formation For Designing, Manufacturing and Operating A Selected Product, Formulating Project Management Procedures. Need Identification, Assessment of Alternative Designs, Selection of Design for Development, Defining Design and Performance Specification and Testing Procedure. Detailed Mechanical, Thermal and Manufacturing- Related Design of Systems, Assemblies, Sub- Assemblies and Components Culminating in Engineering Drawings and Material Specifications; Preparing Bill of Materials and Identification of Standard Components and Bought-Out Parts using Engineering Drawings, The Process Sheets are Developed based on Available Materials, Machine Tools and other Fabrication Facilities. Materials and Standard Components are Procured and Manufacturing is carried out. After Inspection, Parts are Accepted. Assembly Procedure is Finalized and the Machine is Assembled. Acceptance Tests are carried out vis-a-vis Specifications From Phase-I. Functioning Product is Displayed at an Open House. Professional Quality Documentation of All Designs, Data, Drawings, and Results, Change History, Overall Assessment, etc. Is Mandatory along with a Final Presentation.

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List of Electives:

School Elective-I

Power Plant Engineering

MEE 3224 **3-0-0=3**

Unit I: Basics of Steam Power Plant - Various Components of Steam Power Plant, Layout, Types of Firing, Stokers, Pulverized Coal Burners and Fluidized Bed Combustion. Coal Handling System - Trippers, Plough Feeders, Crushers, Gravimetric Feeders, Pulverizers, Ash Handling - Hydraulic & Pneumatic, Forced Draft and Induced Draft Fans, Primary Air Fans.

Unit II: Components of a Steam Power Plant - High Pressure and Superficial Boilers, Feed Pump, Economizer, Superheater, Desuperheater, Regenerator, Condensers, Deaerators, Cooling Towers.

Unit III: Nuclear and Gas Turbine Power Plant - Basic Nuclear Physics and Nuclear Reaction Related to Nuclear Reactors, Nuclear Materials, Radiation Shielding, Waste Disposal. Gas Turbine Power Plant - Application, Components and Layouts, Open and Closed Cycles Plants, Combined Gas Turbine and Steam Power Plants.

Unit IV: Hydro and Diesel Power Plant - Hydro Electric Power Plants, Layout, Selection of Water Turbine, Various Hydro Electric Power Plants and Their Applications, Diesel Engine Power Plant - Component and Layout
.

Unit V: Power Plant Economics and Environmental Hazards - Load Curve, Fixed and Operating Costs, Economics of Different Types of Power Plants, Environmental Hazards of Various Power Plants, CO, SO_x, NO_x , Particulates, Trace Metals.

Recommended Books:

1. Vopat and Stortzki - Power Station Engineering and Economy, Tata McGraw Hill, New Delhi.
2. Arora and Domkundwar - Power Plant Engineering, Dhanpat Rai & Sons, New Delhi.
3. Nag, P. K. - Plant Engineering, Tata McGraw Hill, New Delhi.
4. Nagpal - Power Plant Engineering, Khanna Publishers, New Delhi.
5. Wakil, M.M.E.I. - Power Plant Technology, McGraw Hill, New York.

WORK Study & Ergonomics

MEE 3134 **3-0-0=3**

Unit I: Work Study - Areas of Application of Work Study in Industry; Method Study and Work Measurements and their Inter-Relationship, Reaction of Management and Labor to Work Study, Role of Work Study in Improving Plant Productivity and Safety.

Unit II: Method Study - Objectives and Procedure for Methods Analysis, Select, Record, Examine, Develop, Define, Install and Maintain; Recording Techniques, Micro Motion and Macro-Motion Study, Principles of Motion Economy, Normal Work Areas and Work Place Design.

Unit III: Work Measurement - Objectives, Work Measurement Techniques - Time Study, Work Sampling, Pre-Determined Motion Time Standards (PMTS), Etc., Determination of Time Standards, Observed Time, Basic Time, Normal Time, Rating Factors, Allowances, Standard Time.

Unit IV: Introduction to Ergonomics - Historical Development of Human Factors Engineering, Importance of Ergonomics Workplace Improvement and Preventing Workplace Injuries.

Unit V: Human-Machine Interface - The Man-Machine System, Machine as a System Component, Reaction Time, Muscular Performance, Static Work.

Types of Displays - Quantitative, Qualitative, Representative and Alpha-Numeric, Efficiency of Each Type, Pedal Design, Design of Tools and Controls, Stress in Human Body and its Consequences, Human Anthropometry - Measurement, Instrumentation, Adjustments in Measurement, Anthropometric Data for Indian Workers, Uses of Anthropometric Data, Computer-Aided Man-Machine System Design.

Recommended Books:

1. Shan, H. S. - Work Study and Ergonomics , Dhanpat Rai & Sons, New Delhi.
2. Dalela, S. and Saurabh -Work study and Ergonomics, Standard Publishers Distributors, New Delhi.
3. Bridger, R. S.- Introduction to Ergonomics ,Mcgraw Hill, New York.
4. Hicks - Industrial Engineering & Management, Tata McGraw Hill, New Delhi.
5. ILO - Introduction to Work Study, International Labor Office, Geneva.

Computer Integrated Manufacturing Systems

MEE 3122 **3-0-0=3**

Unit I: Introduction - Production Systems Facilities, Automation in Production Systems, Manual Labor in Production Systems, Automation Principles and Strategies; Manufacturing Operations, Production Concepts and Mathematical Models, Cost of Manufacturing Operations.

Unit II: Group Technology and Cellular Manufacturing, Parts Classification and Coding, Production Flow Analysis, Cellular Manufacturing.
Industrial Robotics: Robot Anatomy and Related Attributes, Robot Control Systems, Robot Applications.

Unit III: Definition and Broad Characteristics of Flexible Manufacturing Cells, Systems, Flexible Transfer Lines, Place of Flexible Manufacturing Systems in CIM, Economics and Technological Justification for FMS, Design and Planning, Role of Associated Technologies such as GT, JIT and Simulation, Operation and Evaluation, Scheduling Problems, FMS Hardware, Control Aspects of FMS, Flexible Machining Cells.

Unit IV: Introduction to Material Handling, Material Transport Systems, Storage Systems- Conventional / Automated Storage Systems, Automatic Identification Methods.

Unit V: Shop Floor Control – Functions, Order Release, Order Scheduling, Order Progress, Factory Data Collection Systems, Corrective Actions.

Recommended Books:

1. Groover, M. P.-Automation Production Systems and Computer Integrated Manufacturing, Pearson Education Asia, Delhi.
2. Zeid, I. - CAD/CAM - Theory and Practice, Tata McGraw Hill, New Delhi.
3. Ranky, P. G. -Computer Integrated Manufacture, Prentice-Hall International, UK.
4. Rao, P. N. – CAD/CAM, Tata McGraw Hill, New Delhi.
5. Craig, J. J. - Introduction to Robotics: Mechanics and Control, Addison-Wesley, New York.

Concurrent Engineering

MEE 3024 **3-0-0=3**

Unit I: Historical Background of Concurrent Engineering (CE), Sequential and Concurrent Processes; Definition and Framework of CE; Decomposition of Product Development Stages, CE Team, Implementation of CE; Role of Information Technology in CE; Examples Of CE Applications.

Unit II: Concurrent Engineering Tools – Design For Manufacture and Assembly (DFMA), Design For Quality (DFQ), Design For Cost (DFC), Failure Modes Effects Analysis (FMEA), Fault Tree Analysis (FTA), Design of Experiments, Taguchi's Methods, Quality Function Deployment (QFD), Simulation, etc.

Unit III: Integration of Design and Manufacturing, Design Evaluation for Manufacturing Cost, Design Process Optimization for CE, Role of CAD/CAM and Automation in CE, Virtual Reality Tools and Techniques for Product Development and Interactive Modeling and Visualization, Rapid Prototyping. Design For Manufacturing (DFM) - Case Studies; Design For Reliability, Maintainability And Reparability and their implication on CE.

Unit IV: CE Application to Composite Structures - Structural Design using Composite Materials, Mechanical Properties and Design Parameters of Composite Materials, Composite Manufacturing Processes with emphasis on Manufacturing Time, Quality and Cost; Case Studie(s) on Design for Manufacturing of Composite Structural Elements.

Unit V: Submission of a Report: Real Industrial World Case Studies.

Recommended Books:

1. Biren Prasad - Concurrent Engineering Fundamentals, Vol. I & II, Prentice Hall, New Jersey.
2. Andrew Kusiak - Concurrent Engineering, Automation, Tools and Techniques, John Wiley & Sons, New York.
3. Backhouse, C.J. and Brookes - Concurrent Engineering, Gower Publishing House.
4. Karandikar, H. and Mistree, F. - Designing a Composite Material Pressure Vessel for Manufacturing: A Case Study in Concurrent Engineering, Engineering Optimization, Vol 18, pp. 235-262., 1992.
5. Moustapha, I. - Concurrent Engineering in Product Design and Development, New Age International, New Delhi.

Industrial Automation

MEE 3032 **3-0-0=3**

Unit I: Concept and Scope of Automation, Socio Economic Consideration, Low Cost Automation, Fluid Power Control - Fluid Power Control Elements and Standard Graphical Symbols. Construction and Performance of Fluid Power Generators, Hydraulic and Pneumatic Cylinders- Construction, Design and Mounting; Hydraulic and Pneumatic Valves for Pressure, Flow and Direction Control, Servo Valves and Simple Servo Systems with Mechanical Feedback, Governing Differential Equation and Its Solution for Step Position Input, Basic Hydraulic and Pneumatic Circuits.

Unit II: Pneumatic Logic Circuits - Design of Pneumatic Logic Circuits for a given Time Dispmlacement Diagram or Sequence of Operations.

Unit III: Fluidics - Boolean Algebra, Truth Tables, Conda Effect, Fluidic Elements – Their Construction Working and Performance Characteristics, Elementary Fluidic Circuits.

Unit IV: Transfer Devices and Feeders – Classification, Construction Details and Application of Transfer Devices and Feeders (Vibratory Bowl Feeder, Reciprocating Tube and Centrifugal Hopper Feeder).

Unit V: Electrical and Electronic Controls - Introduction to Electrical and Electronic Controls such as Electromagnetic Controllers - Transducers and Sensors, Microprocessors, Programmable Logic Controllers (PLC); Integration of Mechanical Systems with Electrical, Electronic and Computer Systems.

Recommended Books:

1. Anthony Esposito - Fluid Power with Applications, Prentice Hall of India, New Delhi.
2. Majumdar, S. R. - Pneumatic Control, Tata McGraw Hill, New Delhi.
3. Deb, S. R. - Robotics and Flexible Automation, Tata McGraw Hill, New Delhi.
4. Kumar, D. S. - Mechanical Measurement and Control, Metropolitan Book Co Pvt. Ltd., New Delhi.
5. Kuo, B.C. - Automatic Control Systems, Prentice Hall, New Jersey.

Gas Dynamics And Jet Propulsion

MEE 3233 **3-0-0=3**

Unit – I Gas Turbines - Introduction, Classification, Applications. Gas Turbine and Its Components, Gas Turbine Power Plants. Optimum Pressure Ratio for Maximum Specific and Thermal Efficiency in Actual Gas Turbine Cycle. Effect of Operating Variables on Thermal Efficiency, Air Rate and Work Ratio.

Unit – II Combustion Chamber- Types of Combustion Chamber, Factors Affecting Combustion Chamber Design, Combustion Processes, Combustion Chamber Performance, Fuel Injection Systems. Axial Flow Turbines & Combustion Chamber- Classification, Elementary Theory, Vortex Theory, Limiting Factors in Turbine Design, Overall Turbine Performance, Design Performance of Gas Turbine Plant, Matching of Turbine Components.

Unit – III Centrifugal Compressors- Prewhirling, Adiabatic Efficiency, Performance Characteristics, Pressure Coefficient and Slip Factor, Losses, Surging, Compressor Design Calculations, Mach Number.

Unit – IV Axial Flow Compressors- Principles of Operation, Simple Design Method, Blade Design, Calculation of Stage, Overall Performance, Compressor Characteristics, Mach Number, Reynolds Number.

Unit – V Jet Propulsion- Turbo Jet, Turbo Prop, Ram Jet, Rocket Engines Thrust Power, Propulsive Efficiency and Thermal Efficiency, Jet Propulsion Performance, Specifying Thrust and Specific Fuel Consumption in each case For Turbo Jet and Turbo Propulsion Units.

References:

- Gas Turbine Theory, Sarvanamatto, Cohen H, Rogers, Longmans Green.
- Turbines, Compressors and Fans, S M Yahya, Tata McGraw Hill book Co., New Delhi.
- Steam and Gas Turbines, R Yadav.

Control Systems

EMEE 3033 **3-0-0=3**

Basic Concepts: Historical review, Definitions, Classification, Relative merits and demerits of open and closed loop systems

Mathematical Models of Physical Systems: Linear and non-linear systems, Transfer function, Mathematical modeling of electrical, Mechanical, Thermal, Hydraulic and pneumatic systems, Analogies, Block diagrams and signal flow graphs.

Components: AC and DC servomotors and tachogenerators, Potentiometers, Synchros, Stepper motors.

Analysis: Time and frequency domain analysis, Transient and frequency response of first and second order systems, Correlationship between time and frequency domain specifications, Steady-state errors and error constants, Concepts and applications of P, PD, PI and PID types of control.

Stability: Definition, Routh-Hurwitz criterion, Root locus techniques, Nyquist criterion, Bode plots, Relative stability, Gain margin and phase margins, M and N circles, Nichols charts

Compensation: Lead, Lag and lag-lead compensators, Design of compensating networks for specified control system performance.

Components: D.C. and A.C. Servomotors, D.C. and A.C. Tachogenerators, Potentiometers and optical encoders, Synchros and stepper motors, Introduction to PLCs, their hardware and ladder diagram programme.

State Space Analysis: Concepts of state, State variables and state models, State space equations, Transfer function, Transfer model, State space representation of dynamic systems, State transition matrix, Decomposition of transfer function, Controllability and observability.

Computational Fluid Flow And Heat Transfer

MEE 4234 **3-0-0=3**

Unit I: Introduction - Mathematical Description of Fluid Flow and Heat Transfer; Conservation Equations for Mass, Momentum, Energy and Chemical Species, Finite Difference Method, Finite Volume Method, Finite Element Method, Governing Equations and Boundary Conditions, Derivation of Finite Difference Equations.

Unit II: Solution Methods of Elliptical Equations – Finite Difference Formulations, Interactive Solution Methods, Direct Method With Gaussian Elimination.Parabolic Equations-Explicit Schemes and Von Neumann Stability Analysis, Implicit Schemes, Alternating Direction Implicit Schemes, Approximate Factorization, Fractional Step Methods, Direct Method with Tridiagonal Matrix Algorithm.

Unit III: Hyperbolic Equations - Explicit Schemes and Von Neumann Stability Analysis, Implicit Schemes, Multi Step Methods, Nonlinear Problems, Second Order One-Dimensional Wave Equations.Burgers Equations - Explicit and Implicit Schemes, Runge-Kutta Method. Formulations of Incompressible Viscous Flows - Formulations of Incompressible Viscous Flows by Finite Difference Methods, Pressure Correction Methods, Vortex Methods.

Unit IV: Treatment of Compressible Flows - Potential Equation, Euler Equations, Navier-Stokes System of Equations, Flow Field-Dependent Variation Methods, Boundary Conditions, Example Problems.
Finite Volume Method - Finite Volume Method Via Finite Difference Method, Formulations For Two and Three-Dimensional Problems.
Unit V: Standard Variational Methods - Linear Fluid Flow Problems, Steady State Problems, Transient Problems.

Recommended Books:

1. Chung, T. J. - Computational Fluid Dynamics, Cambridge University Press.
2. Frank Chorlton - Text Book of Fluid Dynamics, CBS Publishers, New Delhi.
3. Patankar, S. V. - Numerical Heat Transfer and Fluid Flow, Hemisphere Publishing Corporation.
4. Anderson, D. A., Tannehill J. C. and Pletcher, R. H. - Computational Fluid Mechanics and Heat Transfer, Hemisphere Publishing Corporation.
5. H. K. Versteeg and W. Malalasekara, An Introduction to Computational Fluid Dynamics, Longman Publishers.

Design For Manufacturing And Assembly

EMEE 4025 **3-0-0=3**

Unit I: Effect of Materials & Manufacturing Processes on Design - Major Phases in Design & Manufacture, Effect of Material Properties on Design, Effect of Manufacturing Process on Design, Material Selection Process, Cost Per Unit Property & Weighed Properties Methods.

Unit II: Tolerancing - Tolerance Specification & Representation of Various Tolerances, their Significance in Assembly, Material Tolerances for Assembly Line -True Position Tolerancing, Cumulative Effect of Tolerances in Assembly, Interchangeability and Selective Assembly in Manufacturing, Process Capability & Its Significance with Ref. to Tolerancing, Achieving Larger Machining Tolerances.
Datum Features - Functional Datum, Datum for Manufacturing, Changing the Datum, etc.

Unit III: Design Considerations - Design of Components with Casting Considerations, Pattern, Mould, and Parting Line, Cored Holes and Machine Holes, Identifying the Possible and Probable Parting Line, Castings Requiring Special Sand Cores, Designing of Obviate Sand Cores.
Component Design - Component Design with Machining Considerations(Design for Turning Components-Milling, Drilling and other Related Processes Including Finish-Machining Operations).

Unit IV: Design of Gauges - Design of Gauges for Checking Components In Assembly with emphasis on Various Types of Limit Gauges For Both Hole and Shaft.

Unit V: Case Studies - Related to Above Topics and (I) Redesign to Suit Manufacture of Typical Assemblies (II) Tolerance Design of a Typical Assembly (III) Design to Minimize Cost of A Product (IV) Computer Aided DFMA

Recommended Books:

1. Harry Peck, Design for Manufacture, Pitman Publications.
2. Boothroyd, G., Dewhurst, P. and Knight, W. - Product Design for Manufacture and Assembly, Mercel Dekker, New York.
3. Dieter -Machine Design, McGraw Hill, New York.
4. Groover. M. P. - Automation, Production Systems and computer Integrated Manufacturing, Pearson Education Asia, New Delhi.
5. Zeid, I. - CAD/CAM - Theory and Practice, Tata McGraw Hill, New Delhi.

Environmental Science And Engineering

EMEE 4034 **3-0-0=3**

Unit I: Components of Environment- Water, Air and Land, Inter-Relationship between Components, Subcomponents, Ecosystem Structure and Functional Components of Ecosystem, Development and Evolution of Ecosystem, Energy Flow and Material Cycling in an Ecosystem, Natural and Man Made Impact on Water, Air and Land, Environment and Development, Concept of Sustainable Development.

Unit II: Chemistry, Physics and Biology of Water, Air and Land; Stress on Chemistry, Physics and Biology of Water, Air and Land Owing to The Impact, Environmental Quality Objectives and Goals, Policies on Development Projects and Their Impacts.

Unit III: Current Environmental Issues at Country Level - Management of Municipal Sewage, Municipal Solid Waste, Hazardous Waste and Bio-Medical Waste, Air Pollution Due to Industries and Vehicles, Global Issues - Biodiversity, Climatic Change, Ozone Layer Depletion.

Unit IV: Minimization of Stress - Principles of Physics, Chemistry and Biology in Engineering Interventions such as Waste Treatment, Flow Sheets of Engineering Interventions Relevant to Engineering Discipline of the Student, Waste Minimization Techniques, Clean Technology Options, Standards of Performance of Interventions.

Unit V: Environmental Impact Assessment; Precautionary Principle and Polluter-Pays Principle, Constitutional Provisions, Legal and Economic Instruments in Environmental Management; Role of Non-Government Organizations, Community Participation Environmental Management Works, International Conventions and Protocols, Pollution Control Boards and Pollution Control Acts.

Recommended Books:

1. Masters, G. M. - Introduction to Environmental Engineering & Science, Prentice Hall of India, New Delhi.
2. Henry, J.G. and Heike, G.W.- Environmental Science s& Engineering, Prentice Hall, New Jersey
3. Dhameja S K, Environmental Engineering & Management, Kataria & Sons
4. State of India's Environment- A Citizen's report, Center for Science and Environment and others
5. Shyam Divan and Armin Rosancranz- Environmental Law and Policy in India, Oxford University Press

Maintenance Engineering

MEE 4141 **3-0-0=3**

Unit-I : Introduction

Fundamentals of Maintenance Engineering, Maintenance Engineering, Its Importance in Material & Energy Conservation, Inventory Control, Productivity, Safety, Pollution Control, etc. Safety Regulations, Pollution Problems, Human Reliability, Total Quality Management (TQM), Total Productivity Maintenance (TPM), Environmental Issues in Maintenance, ISO 9000.

Unit-II Maintenance Management

Types of Maintenance Strategies, Planned and Unplanned Maintenance, Breakdown, Preventive & Predictive Maintenance, Comparison, Advantages & Disadvantages, Computer Aided Maintenance, Maintenance Scheduling, Spare Part Management, Inventory Control, Organization of Maintenance Department.

Unit-III Tribology In Maintenance

Friction Wear and Lubrication, Friction & Wear Mechanisms, Prevention of Wear, Types of Lubrication Mechanisms, Lubrication Processes. Lubricants- Types, General and Special Purpose, Additives, Testing of Lubricants, Degradation of Lubricants, Seal & Packing.

Unit-IV Machine Health Monitoring

Condition Based Maintenance, Signature Analysis, Oil Analysis, Vibration, Noise and Thermal Signatures, OnLine & Off Line Techniques, Instrumentation & Equipment Used in Machine Health Monitoring,Instrumentation In Maintenance, Signal Processing, Data Acquisition and Analysis, Application of Intelligent Systems, Data Base Design.

Unit-V Reliability, Availability & Maintainability (RAM) Analysis

Introduction to RAM Failure Mechanism, Failure Data Analysis, Failure Distribution, Reliability of Repairable and Non-Repairable Systems, Improvement in Reliability, Reliability Testing, Reliability Prediction, Utilization Factor, System Reliability by Monte Carlo Simulation Technique.

References :

1 Gopal Krishnan and Banerji, Maintenance & Spare parts Management,

2 Mishra and Pathak, Maintenance Engineering and Management, PHI

3 S.K. Shrivastava, Industrial Maintenance Management.

4 CNR Rao, Handbook of Condition Monitoring,.

5 Higgins, Maintenance Engineering Hand Book.

Mechanical System Design

MEE 4026 **3-0-0=3**

Unit-I : Introduction to Mechanical Systematic Design Approach, Need, Need Analysis. Conceptual Design,Phases of a Design Process at Conceptual Design Stage. Problem Identification in a Design Approach,Concept Hunt, etc.

Unit–II Functional Tree, Function Structure, Physical Reliability, Economical and Social Criteria, Possible Solutions, Concept of Embodiment Design , Preliminary Design Layouts, Selecting Best Preliminary Layouts, Design Optimization.

Unit-III Design Modeling, Reliability, Maintainability, Safety, Meterial Selection, Value Engineering, Experimental Design, Design and Patent. Detailed Design, Final Design, Complete Detail Drawing Check All Documents, Documentation Solution, etc.

Unit-IV Role of Artificial Intelligence in Mechanical Engineering: Introduction to Artificial Intelligence, Computer Programming and Development of Algorithms, Programming of Various Algorithms, Expert Systems, Expert System Packages,Concept of Knowledge Base, Artificial Neutral Network (ANN) and Varoius Optimization Techniques, Solution of Mechanical Design Problems using Artificial Intelligence Techniques to Shafts, Bearings, Gears, Clutches, Brakes, Hydraulic System. Pneumatic System, etc.

References :

1. Pahl, G. and Beitz, W- Engineering Design, Springer Verlag, London, 1984.
2. Shigley,J.E. and Mischke - Mechanical Engineering Design, McGraw Hill, New York.
3. Motts, R.L – Machine Elements in Mechanical Design, 3RD Ed., McMillan Publishing House.
4. Ullman, D.G. - The Mechanical Design Process, Mc-Graw Hill, International Edition, Singapore, 1997.
5. Some **Research Papers** relevant to the Subject area may also be referred.

Product Design And Development

MEE 4027 **3-0-0=3**

Unit-I: Product Design – Traditional and Modern Design Processes, Innovation, Creation and Diffusion Techniques, and Functional, Technological, Ecological, Ligiale Evaluation of New Product Ideas.

Unit-II: Product Modeling and Reverse Engineering-Wireframe, Surface, and Solid Modeling Techniques, Reverse Engineering

Unit- III: Product Data Exchange-Neutral File Format such as DXF, IGES, STEP, Concurrent Engineering-Concept Design for X, DFM, DFA, DFR, DFQ

Unit-IV: Rapid Protyping Methods-Liquid Based RP Methods such as SLA, SGC, And SCS, Solid Based RP Methods Such As FDM, And LOM, Powder Based RP Methods such as SLS, 3DP, And BPM

References Books

1. Product Design & Manufacturing - A.K.Chitab &R.C.Gupta, PHI (EEE).
2. The Technology of Creation Thinking - R.P.Crewford – Prentice Hall
3. The Art of Thought – Grohem Walls – Bruce &Co., New York
4 Product Design & Decision Theory - M.K. Starr - Prentice Hall
5. Engg . Product Design -C .D. Cain, Bussiness Books.
6. Industrial design for Engineers –W .H. Mayall, Itiffe.

Tool Design

MEE 4035 **3-0-0=3**

Unit I: Principles of Jigs and Fixtures Design, Locating Principles, Locating Elements, Standard Parts, Clamping Devices, Mechanical Actuation, Pneumatic & Hydraulic Actuation, Analysis Of Clamping Forces, Tolerance and Error Analysis.

Unit II: Design of Jigs - Drill Bushes, Different Types of Jigs, Plate Latch, Channel, Box, Post, Angle Plate, Angular Post, Turnover, Pot Jigs, Automatic Drill Jigs, Rack & Pinion Operated, Air Operated Jigs Components.

Unit III: Design of Fixtures - General Principles of Boring, Lathe, Milling and Broaching Fixtures, Grinding, Planing and Shaping Fixtures, Assembly, Inspection and Welding Fixtures, Modular Fixtures, Design and Development of Jigs and Fixtures for Given Components.

Unit IV: Design of Press Tools - Press Working Terminology, Presses and Press Accessories, Computation of Capacities and Tonnage Requirements, Strip Layout, Design and Development of Various Types of Cutting, Forming and Drawing Dies, Blank Development for Cylindrical and Non Cylindrical Shells, Compound, Progressive, and Combination Dies.

Unit V: Submission of an Industrial Report: On Training In Jigs, Fixture and Press Tools.

Recommended Books:

1. ASTME - Handbook of Fixture Design, McGraw Hill, New York.
2. ASTME - Fundamentals of Tool Design, McGraw Hill, New York.
3. Sharma, P. C. - A Textbook of Production Engineering, S. Chand Publishers, New Delhi.
4. Goroshkin, A. K. - Jigs and Fixtures Handbook, MIR Publishers, Moscow.
5. Die Design Handbook, McGraw Hill, New York.
6. Rao, J. S. and Gupta, K. – Theory and Practice of Mechanical Vibrations, Tata McGraw Hill, New Delhi.

Total Quality Management

MEE 4143 **3-0- 0=3**

Unit I: Evolution of Philosophy of Quality Management: Attributes of Quality, Various Approaches of Quality Definitions, Contributions of Deming, Juran, Taguchi, Crosby, Ishikawa, Shewhart, And Feigenbaum In Quality Revolution.

Unit II: Total Quality Management: Concept of TQM, Salient Feature of TQC And TQM, Quality Assurance, 7-Basic Tools of Quality Control, and Concept Of Six-Sigma.

Unit III: Customer Focus: Customer Satisfaction, Total Employee Involvement, Employee Empowerment, Education and Training, Quality Circle and Processes of Brainstorming.

Unit IV

Just-In-Time (JIT), Zero Defect, Waste Management, MRP (Material Requirement Planning), MRP Vs JIT, Kanban Systems.

Unit V

Concept Of Quality Standards, Benchmarking, Origin and Clauses of ISO 9000, International Quality Awards, Quality Awards In India.

References

1. The Management and Control of Quality, J R Evans and W M Lindsay, Thomson south western.
2. Total Quality Management: A cross functional perspective, Ashok Rao, john Wiley & Sons.
3. Total Quality Management, Besterfield, et al, PHI.

Energy Management

MEE 4235 **3- 0- 0=3**

Unit 1:- Importance of energy management. Energy auditing :(methodology, analysis of past trends plant data),laws of thermodynamics, measurements, portable and on line measurements.

Unit 2:- Energy economics – Discount rate, pay back period, internal rate of return, life cycle costing.Steam systems:Boiler – efficiency testing, steam distribution and use steam traps, condensate recovery, flash steam utilisation.Thermal insulation.

Unit 3:- Electrical systems: Demand control, power factor correction, Motor drives- motor efficiency testing, energy efficient motors, motor speed control.Varaible speed drives. Lighting-lighting levels, fixtures, daylighting, timers, energy efficient windows.

Unit 4:- Energy conservation in pumps, Fans (flow control), compressed air systems, Refrigeration and air conditioning systems.Waste heat recovery: recuprators, heat wheels, heat pipes, heta pumps.

Unit 5:- Cogeneration – concept, options (steam/ gas turbines/diesel engine based), selection criteria, control strategy.

Texts/Recommended Books:

1. Hand book on Energy Audit and Management, Amit kumar Tyagi, TERI Press.
2. L.C.Witte, P.S.Schimdt, D.R.Brown, Industrial Energy Management and Utilisation, Hemisphere Publ,Washington, 1988.
3. Practical hand book on Energy Conservation in Buildings, Indian Building Congress, Nabhi Publication.
4. The Efficient use of Energy, Ed: I.G.C.Dryden, Butterworths, London, 1982.
5. Energy Management Handbook, Ed: WQ.C.Turner, Wiley, New York, 1982.

Open Elective:

Injection Moulding And Mould Design

MEE 4142 **3-0-0=3**

Unit I: Introduction to Moulding Process- Injection Moulding Process, Compression /Transfer Moulding Process, Blow/Rotational Moulding Process, Thermo forming Process, Examples of Products.

Unit II: Moulding Machines-Injection and Compression Moulding Machines-Classification, Specifications, Parts and Their Functions, Hand Machines.

Unit III: Injection Moulds- Main Parts and Their Function, Feeding Systems, Runners, Gates, Parting Line, Ejection Systems, Ejector Return Mechanism, Under Cuts, Sliders, Spmlit Moulds, Multicavity Moulds, Moulds for Threaded Components, Draft Angle Placement of Cavities, Three Plate Moulds, Mould Cooling, Location and Guide System, Shrinkage Allowances, Clamping Force, Mould Ventilation, Moulding Defects, Moulding Cycle.

Unit IV: Compression/Transfer Moulds-Main Parts of Compression Moulds and Their Function, Ejection System, Ejector Return, Mould Heating, Moulding Pressure, Tool Location. Hand Mould, Multicavity Mould, Semi Positive Mould, Flash Mould, Encapsulation, Work Cycle, Draft Angle, Transfer Moulds. Main Parts and Their Functions, Runners and Gates, Location of Gate Ventilation, Moulding Materials, Powder, Pre-Heating.

Unit V: Material for Mould Parts-Materials Used for Various Mould Parts, Their Treatment Like Hardening, Tempering, Electroplating.
Mould Maintenance- Maintenance, Storage and Safety of Moulds, Transportation/Handling.
Making Drawings of Relevant Topics Learned, Design & Drawing of Multicavity, Mould for Simple Components, Injection & Compression.

Recommended Books:

1. Glanvill, A. B. and Denton, E.N. –Injection Mould Design Fundamentals, Industrial Press Inc.
2. Athalye, A.S.-Plastic Material Handbook, Vol. I & II, Multitech Publishers Co., Mumbai.
3. Athalye, A.S.-Injection Moulding, Multitech Publishers Co., Mumbai.
4. Chandra & Mishra-Rubber& Plastic Technology, CBS Publishers, New Delhi.
5. Harry, D.B. andWaynel,P.-PlasticsMouldEngineeringHandbook,VanNostrandRehnhold Company.