RAJASTHAN TECHNICAL UNIVERSITY

III & IV SEMSTER'S SCHEME AND SYLLABUS

APPROVED BY BOARD OF STUDIES

(In Meeting of BOS on _____ and in the meeting of FOMS on _____)

FOR

BACHELOR OF TECHNOLOGY
B.Tech. (Mechatronics)

2016-2017

RAJASTHAN TECHNICAL UNIVERSITY

Syllabus for III Semester (II Year) B. Tech. (Mechatronics Engineering)

3MH1: MECHANICS OF SOLIDS

B.Tech. (MH) 3rd Sem. **Max. Marks: 100**

3L+1T **Exam Hours: 3**

UNIT	CONTENTS	Hrs
I	**Stress and Strain:** Tension, compression, shearing stress and strain, Poisson's ratio, stress-strain relationship, Hooke's law, equations of static equilibrium for 2D and 3D cases, elastic constants and their relations for an isotropic hookean material, anisotropy and orthotropic, thermal stresses, composite bars, simple elastic, plastic and visco-elastic behavior of common materials in tension and compression test, stressstrain curves, concept of factor of safety and permissible stress, conditions for equilibrium, concept of free body diagram, introduction to mechanics of deformable bodies.	
II	**Members Subjected to Flexural Loads:** Theory of simple bending, bending moment and shear force diagrams for different types of static loading and support conditions on beams, bending stresses, section modulus and transverse shear stress distribution in circular, hollow circular, I, Box, T, angle sections etc.	
III	**Principal Planes, Stresses and Strains:** Members subjected to combined axial, bending and torsional loads, maximum normal and shear stresses, concept of equivalent bending and equivalent twisting moments, Mohr's circle of stress and strain. **Theories of Elastic Failures:** The necessity for a theory, different theories, significance and comparison, applications.	
IV	**Torsion:** Torsional shear stress in solid, hollow and stepped circular shafts, angular deflection and power transmission capacity. **Stability of Equilibrium:** Instability and elastic stability, long and short columns, ideal strut, Euler's formula for crippling load for columns of different ends, concept of equivalent length, eccentric loading, Rankine formulae and other empirical relations.	
V	**Transverse Deflection of Beams:** Relation between deflection, bending moment, shear force and load, transverse deflection of beams and shaft under static loading, area moment method, direct integration method, method of superposition and conjugate beam method, variational approach to determine deflection and stresses in beam. **Elastic Strain Energy:** Strain energy due to axial, bending and torsional loads, stresses due to suddenly applied loads, use of energy theorems to determine deflections of beams and twist of shafts, Castigliano's theorem, Maxwell's theorem of reciprocal deflections.	

TEXT BOOKs/ REFERENCE BOOKs:

SN	Name of Authors /Books /Publisher	Year of Publication
1	Mechanics of Materials, James M. Gere, Cengage Learning (Brooks\Cole).	
2	Mechanics of Material, Pytel and Kiusalaas, Thomson (Brooks\Cole).	
3	An Introduction to the Mechanics of Solids, Crandall, Dahl and Lardner, Tata McGraw Hill.	
4	Mechanics of Materials, Beer, Johnston, Dewolf and Mazurek, Tata McGraw Hill.	
5	Strength of Materials, Ryder G.H., Macmillan India.	
6	Strength of Materials, Sadhu Singh, Khanna Publishers.	
7	Mechanics of Material, Punmia, Jain and Jain, Laxmi Pu	

3MH2: ENGINEERING THERMODYNAMICS

B.Tech. (MH) 3rd Sem. **Max. Marks: 100**

3L+1T **Exam Hours: 3**

UNIT	CONTENTS	Hrs
I	**Basic Concepts of Thermodynamics:** Thermodynamics system, control volume, properties, state, processes and cycle, equality of temperature, zeroth Law of thermodynamics, temperature scale, laws of perfect gas, pure substances, vapour-Liquid –solid-phase equilibrium in a pure substances, thermodynamic surfaces.	
II	**Work and Heat:** Law of conservation of mass and energy, first law of thermodynamics, steady state processes, second law of thermodynamics, heat engine, carnot cycle, thermodynamic temperature scale, entropy, change of entropy for different processes, equivalence of Kelvin, Plank and clausius statements, clausius inequality.	
III	**Available and Unavailable Energy:** Availability of a non flow and steady flow system, Helmbeltz and Gibb's functions, thermodynamic Relations, Important mathematical relations, Maxwell relations, Tds Relations, Joule- Thomson coefficient, clayperon relation.	
IV	**Air–Standard Power Cycle:** Brayton cycle, Otto cycle, Diesel cycle, Dual cycle, Stirling cycle, Ericssion cycle and Atkinson cycle, Mean effective pressure and efficiencies, Four stroke petrol and diesel engine, Two stroke petrol and diesel engine.	
V	**Properties of Steam:** Phase change process, use of steam table and mollier chart, Rankine cycle, Reheat cycle, Regenerative cycle, cogeneration vapour compression refrigeration cycle.	

TEXT BOOKs/ REFERENCE BOOKs:

SN	Name of Authors /Books /Publisher	Year of Publication
1	Engineering Thermodynamics, Chottopadhyay P., Oxford University Press.	
2	Thermal Science & Engineering, Kumar D.S., S.K.Kataria & Sons	
3	Engineering Thermodynamics, Nag P.K., Tata McGraw-Hill, New Delhi	
4	Fundamentals of Classical Thermodynamics, Gordan J Van Wylen, Willey Eastern Ltd.	
5	Engineering Thermodynamics, Cengel & Boles, Tata McGraw-Hill, New Delhi.	

3MH3: MANUFACUTRING PROCESSES

B.Tech. (MH) 3rd Sem. **Max. Marks: 100**

3L+0T **Exam Hours: 3**

UNIT	CONTENTS	Hrs
I	Importance of manufacturing, economic and technological definition of manufacturing, survey of manufacturing processes. **Foundry Technology:** Patterns practices, Types of patterns, allowances and material used for patterns, moulding materials, moulding sands, Moulding sands, properties and sand testing, grain fineness, moisture content, clay content and permeability test, core materials and core making, core print, core boxes, chaplets, gating system design, Moulding practices**,** green, dry and loam sand moulding, pit and floor moulding, shell moulding, permanent moulding, carbon dioxide moulding. **Casting practices:** Fundamental of metal casting, sand casting, shell-mould casting, mold casting (plaster and ceramic), investment casting, vacuum casting, permanent mould casting, slush casting, pressure casting, die casting, centrifugal casting, continuous casting, squeeze casting, casting alloys, casting defects, design of casting, gating system design, and riser design, melting furnaces-rotary, pit electric, tilting and cupola.	
II	**Metal Joining Processes:** Principle of welding, soldering, brazing and adhesive bonding, Survey of welding and allied processes, Arc welding, power sources and consumables, Gas welding and cutting, Processes and equipments. Resistance welding, principle and equipment, spot, projection and seam welding process, Atomic hydrogen, ultrasonic, plasma and laser beam welding, electron beam welding, and special welding processes e.g. TIG, MIG, friction and explosive welding, welding of C.I. and Al, welding defects. Electrodes and Electrode Coatings	
III	**Forming and Shaping Processes:** Metal working, elastic and plastic deformation, concept of strain hardening, hot and cold working, rolling, principle and operations, roll pass sequence, forging, forging operations, extrusion, wire and tube drawing processes. Forging, Method of forging, forging hammers and presses, principle of forging tool design, cold working processes - shearing, drawing, squeezing, blanking, piercing, deep drawing, coining and embossing, metal working defects, cold heading, riveting, thread rolling bending and forming operation.	
IV	**Powder Metallurgy:** Powder manufacturing, mechanical pulverization, sintering, electrolytic process, chemical reduction, atomization, properties of metal powders, compacting of powders sintering, advantages and applications of P/M. **Rapid Prototyping Operations:** Introduction, subtractive processes, additive processes, virtual prototyping and applications.	
V	**Plastic Technology:** Introduction, classification of plastics, Ingredients of moulding compounds, general properties of plastics, plastic part manufacturing processes such as compression moulding, transfer moulding, injection moulding, extrusion moulding, blow moulding, calendaring, thermoforming, slush moulding, laminating	

TEXT BOOKs/ REFERENCE BOOKs:

SN	Name of Authors /Books /Publisher	Year of Publication
1	Manufacturing Technology, Rao P.N., Tata McGraw-Hill, New Delhi.	
2	Manufacturing Engineering and Technology, Kalpkajin, Addison Wesley Publishing Company.	
3	Processes and Materials of Manufacture, Lindberg R. A., Prentice Hall of India.	
4	Principles of Manufacturing Materials and Processes, Campbell J.S., McGraw Hill	

3MH4: ELECTROMAGNETIC PROPERTIES OF MATERIALS

B.Tech. (MH) 3rd Sem. **Max. Marks: 100**

3L+0T **Exam Hours: 3**

UNIT	CONTENTS	Hrs
I	**Dielectrics Materials -** Introduction, Polarization, Polarizability, Different types of polarization, Electronic, ionic, Orientation and space polarization, frequency and temperature dependence of different polarization, Dielectric loss and loss tangent, energy store and loss in dynamic polarization, Phenomenon of spontaneous polarization and ferro-electricity, Ferroelectric hysteresis loop, Piezoelectricity, piezoelectric materials: Quartz, Rochelle salt and PZT , Applications of dielectrics.	
II	**Magnetic Materials -** Introduction, magnetization, theory of Dia, Para, Ferro-Ferrimagnetism and antiferromagnetism, Weiss field and magnetic domains, BH hysteresis loop, soft and hard magnetic materials and their applications, magnetic energy. Magnetostriction, giant magnetostriction resistor (GMR) and engineering applications of it. Magnetic spin, new electronic devices based on magnetic spin.	
III	**Semi Conductor Materials -** Introduction, Energy band gap structures of semiconductors, Classifications of semiconductors, Degenerate and non-degenerate semiconductors, Direct and indirect band gap semiconductors, Electronic properties of Silicon, Germanium, Compound Semiconductor, Gallium Arsenide, Gallium phosphide & Silicon carbide, Variation of semiconductor conductivity, resistance and bandgap with temperature and doping. Thermistors, Sensitors.	
IV	**Conductive & Superconductive Materials -** Electrical properties of conductive and resistive materials. Energy bandgap structures of metals, resistivity of conductors and multiphase solids, Matthiessen's rule, Important characteristics and electronic applications of specific conductor & resistance materials, Superconductor phenomenon, Type I and Type II superconductors. Theory of superconductors, High temperature superconductors and their applications.	
V	**Nanomaterials -** Introduction, Change in band structure at nano-stage. Structure of Quantom dots (nano-dots) & Quantom wires, Fabrication & Characterization of nanomaterials, Structure of single wall and multi-wall carbon nanotube (CNT), Change in electrical, Electronic and optical properties at nano stage, Potential applications of nano materials.	

TEXT BOOKs

SN	Name of Authors /Books /Publisher	Year of Publication
1	Kasap, Principles of Electronic Materials and Devices, TMH (2005).	
2	Robert M Rose, Lawrence A. Shepard and Jhon Wulff, The structure and peroperties of materials vol.4 (Electronic properties), Willey Eastern University press. (2011)	

REFERENCE BOOKs:

SN	Name of Authors /Books /Publisher	Year of Publication
1	Askeland – The science and engineering of materials, Cengage learning 2005	
2	Electronic Materials and Processes, Kaul Bhan & Jain, Genius publications 2013	
3	Allison, Principles of Electronic Materials and Devices, TMH 2005	
4	Neamen, Semiconductor Physics and Devices, TMH 2009	
5	Guozhong Cao, Ying Wang Nanostructures and Nanomaterials Synthesis, Properties and Applications, World Scientific Series in Nanoscience and Nanotechnology 2011	
6	Dekker, Electrical properties of materials 1995	

3MH5: ANALOG ELECTRONICS - I

B.Tech. (MH) 3rd Sem. **Max. Marks: 100**

3L+0T **Exam Hours: 3**

UNIT	CONTENTS	Hrs
I	**PN Junction Diodes:** Open-circuited p-n junction and space charge region. The biased p-n junction, volt-ampere characteristics, cutin voltage and effect of temperature on V-I characteristics. Minority carrier density distribution in (i) a forward biased junction and (ii) a reverse biased junction, diode capacitances, junction diode switching times and characteristics. **Other Diodes:** Avalanche breakdown and zener breakdown, working principles of zener diodes, photo-diodes, light emitting diodes, solar cell and varactor diodes.	
II	**Analysis of Diode Circuits: D**iode as a circuit element, load line, small signal diode model and large signal diode model, analysis of half wave and full wave single-phase rectifiers, peak inverse voltage, various types of filters, their analysis and applications, voltage multipliers, clipping and clamping circuits.	
III	**Bipolar Junction Transistors (BJT):** P-N-P and N-P-N transistors, transistor current components, common base (CB) and common emitter (CE) configurations: input & output characteristics, current Gains: alpha & beta, transistor operating regions: active region, saturation region and cutoff region, common collector configuration, BJT biasing and DC models, thermal stability and stabilization Techniques, small signal models: h-parameters and hybrid pie models, BJT as a switch, minority carrier concentration in the base for cutoff, active and saturation conditions, transistor switching times and characteristics, transistor ratings.	
IV	**Field Effect Transistors:** Construction, working, V-I characteristics and transfer characteristics of JFET. MOSFET: Enhancement type and depletion type: construction, working, V-I characteristics, and transfer characteristics. DC analysis of FETs. FET as a voltage variable resistor. FET small signal models. FET as a switch. CMOS.	
V	**Small Signal Amplifiers:** Analysis of BJT and JFET amplifiers at low frequency: input and out resistances, voltage and current gains, frequency response of common emitter transistor amplifier at high frequency. Miller's theorem and its dual. Cascaded BJT amplifiers. Darlington pair and Bootstrapped Darlington circuit.	

TEXT BOOKs/ REFERENCE BOOKs:

SN	Name of Authors /Books /Publisher	Year of Publication
1	J. Millman's & C. Halkias–Integrated Electronics: Analog & Digital Circuits Systems,2/e TMH	
2	David A. Bell – Electronic Devices and Circuits, 5th Ed Oxford.	
3	Millman & Halkias- Millmans Electronic Devices & Circuits 2/e TMH	
4	Robert L. Boylested & Louis Nashelshky– Electronic Devices and Circuit theory, PHI	
5	Allen Mottershed – Electronic Devices and Circuits, PHI.	
6	Jacob Millman, Arvin Grabel, Microelectronics, TMH.	
7	Salivahanan: Electronic Devices and Circuits, TMH	

3MH6: ADVANCED ENGINEERING MATHEMATICS

B.Tech. (MH) 3rd Sem. **Max. Marks: 100**

3L+0T **Exam Hours: 3**

UNIT	CONTENTS	Hrs
I	**Fourier Series and Method of Separation of Variables (Boundary Value Problems):** Expansion of simple functions in Fourier series, half range series, change of interval, harmonic analysis, application to the solution of wave equation and diffusion equation in one dimension and Laplace's equation in two dimensions by method of separation of variable.	
II	**Laplace Transform:** Laplace transform with its simple properties, Inverse Laplace transform convolution theorem (without proof) solution of ordinary differential equation with constant coefficient.	
III	**Special Functions:** Bessel's function of first kind, simple recurrence relations, orthogonal property, Legendre's function of first kind simple recurrence relations, orthogonal property, Rodrigue's formula.	
IV	**Numerical Analysis:** Finite differences, difference operators, forward, backward, central and average operators, Newton's forward and backward interpolation formula, Stirling's central difference formula Lagrange's interpolation formula for unequal interval, Solution of non linear equations in one variable by newton raphson's and regula falsi's method.	
V	**Numerical Analysis:** Numerical solution of simultaneous algebraic equation by Gauss elimination and Gauss Siedel method, Numerical differentiation, Numerical integration trapezoidal rule, Simpson's one third and three eight rule, Numerical solution of ordinary differential equation of first order, Picard's method, Euler's, and modified Euler's method, Milne's methods and Runga Kutta fourth order method.	

TEXT BOOKs/ REFERENCE BOOKs:

SN	Name of Authors /Books /Publisher	Year of Publication
1	Advanced Engineering Mathematics, Kreyszig E., Wiley Eastern.	
2	Advance Mathematics for Engineers, Chandrika Prasad, Prasad Mudranalaya, Allahabad.	
3	Advanced Engineering Mathematics, Potter, Goldhers and Aboufadel, Wiley Eastern.	
4	Numerical Methods for Scientist And Engineers, Jain and Jain, Iyengar S.R.K., Wiley Eastern	
5	A First Course in Numerical Analysis, Ralston A., Rabinowitz P., McGraw Hill	

3MH7:MACHINE DRAWING

B.Tech. (MH) 3rd Sem. **Max. Marks: 100**

3P **Exam Hours: 3**

SN	CONTENTS
1	**Detail drawings:** Couplings: Pin-type flexible coupling etc, IC. Engine parts: connecting rod, crank shaft, etc, Boiler Mountings: Steam stop valve/ feed check-valve/ safety valve /three way stop valve blow offcock. Bearings: Swivel bearing Machine Tool Parts: Shaper tool head, Lathe Tail Stock, Turret Tool Post, Turret Bar feeding Mechanism / Universal Dividing Head, Swivel machine vice. Miscellaneous: Screw jack and drill-press vice. Free Hand Sketches: Pipes and Pipe fittings, clutches, bearings, bearing puller, valve gear mechanisms, machine arbor and cutter, universal dividing head, jigs and fixtures, Step less drive sliding gear box.

3MH8:THERMAL ENGINEERING LAB I

B.Tech. (MH) 3rd Sem. **Max. Marks: 75**

2P **Exam Hours: 2**

SN	CONTENTS
1	Comparative study of four stroke diesel and petrol engines.
2	Comparative study of two stroke petrol and diesel engines.
3	Studies of fuel supply systems of diesel and petrol engines.
4	Study of cooling, lubrication and ignition system in diesel and petrol engines.
5	To study various types of Boilers and to study Boiler mounting and accessories.
6	To study various types of Dynamometers.
7	To study Multi Stage Air Compressors.
8	To find the BHP, Thermal efficiency of four stroke diesel engine.
9	Study of Brakes, Clutches, and Transmission System.
10	To prepare a comparison sheet of various automobiles (4 Wheeler and 2 Wheeler).

3MH9: PRODUCTION ENGINEERING PRACTICE

B.Tech. (MH) 3rd Sem. **Max. Marks: 100**

3P **Exam Hours: 3**

SN	CONTENTS
	Machine Shop
1	Study of lathe machine, lathe tools cutting speed, feed and depth of cut.
2	To perform step turning, knurling and chamfering on lathe machine as per drawing.
3	Taper turning by tailstock offset method as per drawing.
4	To cut metric thread as per drawing.
5	To perform square threading, drilling and taper turning by compound rest as per drawing.
6	To study shaper machine, its mechanism and calculate quick return ratio.
	Foundry Shop
7	To prepare mould of a given pattern requiring core and to cast it in aluminium.
8	Moisture test and clay content test.
9	Strength Test (compressive, Tensile, Shear Transverse etc. in green and dry conditions) and Hardness Test (Mould and Core).
10	Permeability Test.
11	A.F.S. Sieve analysis Test.

3MH10:ANALOG ELECTRONICS LAB-I

B.Tech. (MH) 3rd Sem. **Max. Marks: 75**

2P **Exam Hours: 2**

SN	CONTENTS
	Machine Shop
1	Study the following devices: (i) Analog & digital multimeter (ii) Function/ Signal generators (iii) Regulated d. c. power supplies (constant voltage and constant current operations)
2	Study of digital storage CRO and store a transient on it.
3	Study of analog CRO, CRO probes, measurement of time period, amplitude, frequency & phase angle using Lissajous figures.
4	Plot V-I characteristic of P-N junction diode & calculate cut-in voltage, reverse Saturation current and static & dynamic resistances.
5	Plot V-I characteristic of zener diode and study zener diode as voltage regulator. Observe the effect of load changes and determine load limits of the voltage regulator.
6	Plot frequency response curve for audio amplifier and to determine gain bandwidth product.
7	Plot drain current - drain voltage and drain current – gate bias characteristics of field effect transistor and measure of Idss & Vp
8	Plot gain- frequency characteristic of two stages RC coupled amplifier & calculate its bandwidth and compare it with theoretical value.

9	Plot gain- frequency characteristic of emitter follower & find out its input and output resistances.
10	Plot input and output characteristics of BJT in CB, CC and CE configurations. Find their hparameters.
11	Study half wave rectifier and effects of filters on wave. Also calculate ripple factor.
12	Study bridge rectifier and measure the effect of filter network on D.C. voltage output & ripple factor.

Syllabus for IV Semester (II Year) B. Tech. (Mechatronics Engineering)

4MH1: FLUID MECHANICS

B.Tech. (MH) 4th Sem. **Max. Marks: 100**

3L+1T **Exam Hours: 3**

UNIT	CONTENTS	Hrs
I	**Basic Definitions and Fluid Properties:** Definition of Fluid, Incompressible and compressible fluids, Fluid as a continuum, mass, density, specific weight, relative density, specific volume, bulk modulus, velocity of sound Ideal fluid viscosity, Newtonian and Non Newtonian fluid, kinematic viscosity, effect of temperature and pressure on viscosity, surface tension capillarity, vapour pressure and cavitation. **Fluid Statics:** General differential equation, hydrostatics manometry, fluid forces on submerged surfaces, curved surfaces, aerostatics, Isothermal atmosphere, polytropic atmosphere, static stability, the international atmosphere, submerged bodies, floating bodies.	
II	**Kinematics and Conservation of Mass:** Flow classifications, Fluid velocity and acceleration, streamlines and the stream function, pathlines and streak lines, deformation of a fluid element, vorticity and circulation. Irrotational and rotational flow, flow net, laplace equation, conservation of mass and the continuity equation for three dimensions. **Fluid Momentum:** The Momentum theorem, applications of the momentum theorem, equation of motion, Euler's equation of motion, Integration of Euler's equation of motion, Bernoulli's equation, applications of Bernoulli's pilot tube, equation of motion for viscous fluid, Navier Stoke's equation.	
III	**Orifice Discharging:** Free Jet, vena contracts, co-efficient of contraction, velocity and discharge, coefficient of resistance, orifices and mouthpieces, nozzles and weires. **Flow Through Pipes:** Reynold's experiment, Darcy's Weisback equation, loss of head due to sudden enlargements, contraction, entrance, exit obstruction, bend, pipe fittings, total and hydraulic gradient lines, Flow through pipe line, pipes in series, parallel, transmission of power through pipes.	
IV	**Laminar Flow:** Simple solution of Navier Stokes equations, Hagen – Poiseuille flow, Plans Poiseuille flow and coutte flow. **Turbulent Flow:** Variation of friction factor with Reynold's number, Prandtl mixing length hypothesis applied to pipe flow, velocity distribution in smooth pipes, sough pipes, Universal pipe friction laws, Colebrook White formula. **Dimensional Analysis:** Buckingham variables, model similitude, force ratio, Reynold's, Froude's, Mach, Weber and Euler numbers and their applications, undistorted model distorted model scale effect.	
V	**The Boundary Layer:** Description of the boundary layer, boundary Layer thickness boundary layer separation and control, Prandtl boundary layer equation, solution for laminar boundary layer, momentum equation for the boundary layer, flat plate in uniform free stream with no pressures gradients, approximate momentum analysis laminar boundary, aerofoils theory. **Flow Round a Body:** Drag skin friction drag, pressure drag, combined skin friction and pressure drag (Profile drag) wave drag, lift induced drag, Flow past sphere and cylinder.	

TEXT BOOKs/ REFERENCE BOOKs:

SN	Name of Authors /Books /Publisher	Year of Publication
1	Fluid Mechanics, Frank M. White, McGraw-Hill Publications.	
2	Fluid Mechanics, Cengel and Cimbala, Tata McGraw-Hill, New Delhi.	
3	Hydraulics and Fluid Mechanics, Modi and Seth, Standard Book House.	
4	Fluid Mechanics, Jain A.K., Khanna Publishers.	
5	Introduction to Fluid Mechanics, Fox and McDonald, John Wiley and Sons.	

4MH2: DYNAMICS OF MACHINERY

B.Tech. (MH) 4th Sem. **Max. Marks: 100**

3L+1T **Exam Hours: 3**

OBJECTIVES

* To understand the force-motion relationship in components subjected to External Forces.
* To understand the force-motion analysis of standard mechanisms.
* To understand the undesirable effects of unbalances resulting from prescribed motions in mechanism.
* To understand the effect of dynamics of Undesirable Vibrations.

To understand the principles in mechanisms used for governing of machines.

UNIT	CONTENTS	Hrs
I	**FORCE ANALYSIS** Rigid Body dynamics in general plane motion – Equations of motion- Dynamic force analysis – Inertia force and Inertia torque – D. Alemberts principle – The principle of superposition – Dynamic Analysis in Reciprocating Engines – Gas Forces – Equivalent masses – Bearing loads – Crank shaft Torque – Turning moment diagrams – Fly wheels.	
II	**BALANCING** Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder Engine Balancing Multi – cylinder Engines – Partial balancing in locomotive Engines – Balancing linkages.	
III	**FREE VIBRATION** Basic features of vibratory systems – Degrees of freedom – Single degree a freedom – Free vibration – Equations of motion – natural frequency – Types of Damping – Damped vibration critical speeds of simple shaft – Torsional systems; Natural frequency of two and three rotor systems.	
IV	**FORCE VIBRATION** Response to periodic forcing – Harmonic Forcing – Forcing caused by unbalance – Support motion – Force transmissibility and amplitude transmissibility vibration isolation.	
V	**MECHANISM FOR CONTROL** Governors – Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors – Characteristics – Effect of friction – Controlling Force other governor mechanisms. Gyroscopes – Gyroscopic forces and Torques – Gyroscopic stabilization - Gyroscopic effects in Automobiles, ships and airplanes.	

TEXT BOOKs:

SN	Name of Authors /Books /Publisher	Year of Publication
1	Rattan S.S., "Theory of Machines", Tata McGraw – Hill Publishing Company Ltd., New Delhi, 1994.	

REFERENCE BOOKs:

SN	Name of Authors /Books /Publisher	Year of Publication
1	Thomas Bevan, "Theory of Machines", CBS Publishers and distributors, 1984.	
2	Ghosh A. and Mallick A.K., "Theory of Mechanisms and Machines", Affiliated East- West Press Pvt. Ltd., New Delhi, 1988.	
3	Shigley J.E. and Uicker J.J., "Theory of Machines and Machanisms", McGraw – Hill, Inc., 1995.	
4	Rao J.S. and Dukkipati R.V., "Mechanism of Machine Theory", Wiley – Eastern Limited, New Delhi, 1992.	
5	John Hannah and Stephens R.C., "Mechanics of Machines", Viva low – Priced Student Edition,	

4MH3: CONTROL SYSTEMS

B.Tech. (MH) 4th Sem. **Max. Marks: 100**

3L+0T **Exam Hours: 3**

OBJECTIVE

To study the response and stability of mechanical and electrical systems so as to design for stable operation.

UNIT	CONTENTS	Hrs
I	**BASIC CONCEPTS AND SYSTEM REPRESENTATION** Basic elements in control systems – Open and closed loop systems with example – Mathematical model of Translational, Rotational & Electrical systems – Transfer function – Block diagram reduction techniques – Signal flow graph.	
II	**TIME RESPONSE ANALYSIS** Introduction – Time domain specifications – Types of test inputs –I and II order system response – Steady state error – Error coefficients – Generalized error series – P, PI, PD, PID Controlled characteristics.	
III	**FREQUENCY RESPONSE ANALYSIS AND DESIGN** Introduction – Frequency domain specifications – Bode plots and polar plots – Constant M and N circles and Nichols chart – Correlation between frequency domain and time domain specifications.	
IV	**STABILITY OF CONTROL SYSTEMS** Characteristics equation – Location of roots in s-plane for stability – Routh Hurwitz criterion – Root locus construction – Gain margin and phase margin – Nyquist stability criterion.	
V	**COMPENSATION DESGIN** Realization of basis compensation – Lag, Lead and Lag – lead networks – Compensator design using Bode plots. **MATLAB applications:** Partial Fraction expansion, Transformation of a Mathematical models, Transient response analysis, Root locus, Bode diagrams, Nyquist plots, analysis of compensator design problems.	

TEXT BOOKs/ REFERENCE BOOKs:

SN	Name of Authors /Books /Publisher	Year of Publication
1	Katsuhiko Ogata, “Modern Control Engineering”, 4th Edition, Pearson Education 2003.	
2	I.J.Nagrath & M. Gopal, “Control Systems Engineering”, New Age International Publishers, 2003.	
3	B.C.Kuo, “Automatic control systems”, Prentice Hall of India ltd, New Delhi 1995.	
4	Dorf R.C. and Bishop R.H., “Modern Control systems”, Addison – Wesley, 1995 (MATLAB reference).	
5	Leonard N.E. and William Levine, “Using MATLAB to Analyze and Design Control Systems,” Addision Wesley, 1995.	

4MH4: MEASURMENT AND CONTROL

B.Tech. (MH) 4th Sem. **Max. Marks: 100**

3L+0T **Exam Hours: 3**

UNIT	CONTENTS	Hrs
I	System configuration, basic characteristic, calibration, classification and performance characteristics of a instrumentation system, Specification and testing of dynamic response, Strain Measurement, electric strain gauges types, selection and installation, strain gauge circuits, temperature compensation and calibration, use of strain gauges on rotating shafts, load cells, Mechanical and Optical Strain Gauges.	
II	Various Mechanical, Electro-Mechanical and Photoelectrical Sensors for sensing of displacement, velocity, acceleration, torque, force, temperature from low to high range, flow, level of fluid , pressure, angular speed, voltage, frequency and current.	
III	Introduction to Multi-Channel Data-Acquisition System, measurement pods, Interface Hardware, data analysis software, interfacing, Concepts and examples of automatic control systems, systems by differential equations, transfer function, block diagram, open and feed back control systems, signal flow graphs and its constructions, control system components, error sensing devices and servo motors.	
IV	Control for mechanical systems and processes, speed control system for steam/gas turbines, constant tension, reeling system, electro-mechanical systems, thermal systems, pneumatic systems, mathematical models of physical systems, feedback characteristics of control systems, time response analysis, transient response analysis, time response specifications, steady state-error.	
V	Concepts of stability, Routh-Hurwiz stability criterion, relative stability, root locus technique, use of construction rules without any derivation, frequency response analysis, polar plots, stability in frequency domain, bode / logrithmic plots, Nyquist stability criterion.	

TEXT BOOKs/ REFERENCE BOOKs:

SN	Name of Authors /Books /Publisher	Year of Publication
1	Mechanical Measurement, Beckwith, Pearson Education.	
2	Experimental Methods for Engineers, Holman, McGraw Hill Publication.	
3	Mechanical Engineering Measurement, Sahwney A.R., Dhanpat Rai and Sons.	
4	Modern Control Engineering, Ogata, Pearson Education India.	
5	Control System, Gopal M., Tata McGraw Hill New Delhi.	
6	Mechanical Measurement and Instrumentation, Rajput R.K., S.K. Kataria and Sons.	

4MH5: ENGINEERING METROLOGY

B.Tech. (MH) 4th Sem. **Max. Marks: 100**

3L+0T **Exam Hours: 3**

OBJECTIVE

For understanding the principle of Dimensional metrology and applying principles, techniques and devices used for quality control in modern Industrial environment.

UNIT	CONTENTS	Hrs
I	**BASIC CONCEPTS AND COMPARATORS** Basic concept – Legal metrology – Precision – Accuracy – Types of errors – standards of measurement – traceability – interchangeability and selective assembly, gauge blocks, limit gauges – tailors principle of gauge design. Comparators: Mechanical, Electronic, optical and Pneumatic – Automatic gauging.	
II	**ANGULAR MEASUREMENT AND SURFACE FINISH MEASUREMENT** Angular measurement : sine bar – Autocollimator, optical projectors: profile projectors – toolmakers microscope, measurement of surface finish: Terminology – roughness – waviness – analysis of surface finish – stylus probe instrument –Talysurf.	
III	**SCREW THREAD AND GEAR METROLOGY** Screw thread metrology: errors in thread – pitch error – drunkenness – measurement of various elements thread – two and three wire method – best wire size – Thread gauges – floating carriage micrometer. Measurement of gears – Terminology – measurement of various elements of gear – tooth thickness – constant chord and base tangent method – Parkinson Gear Tester.	
IV	**LASER METROLOGY** Laser Metrology: LASER interferometer – constructional features, sources of error, measurement of positional error, straightness and flatness of machine tools – LASER Alignment Telescope – LASER Micrometer – LASER Triangulation technique – in process and on line measurement.	
V	**ADVANCES IN METROLOGY** Coordinate measuring machine (CMM): Constructional features – types, applications, Applications of Image Processing in measurement – computer aided inspection.	

TEXT BOOKs/ REFERENCE BOOKs:

SN	Name of Authors /Books /Publisher	Year of Publication
1	Jain R.K., “Engineering Metrology”, Khanna Publishers, 1994.	
2	Gupta I.C , “Engineering Metrology”, Dhanpat rai Publications, fifth edition, 1998.	
3	Connie Dotson, et al., “Fundamentals of Dimensional Metrology”, Thomas Asia, Singapore, First print, 2003.	
4	Doeblin E.O., “measurement system applications and design” First Edition, 1990.	
5	Groover M.P., “Automation, production system and computer integrated manufacturing “, Prentice – Hall, New Delhi, 2003. (for a batch of 30 students)	

SN	Equipments Qty
1	8085 Microprocessor trainer kits 15
2	ADC interface card 3
3	DAC interface card 3
4	Stepper motor interfacing card with stepper motor 3
5	Temperature controller with sensors like thermocouple 3

4MH6: MICROPROCESSORS AND APPLICATIONS

B.Tech. (MH) 4th Sem. **Max. Marks: 100**

3L+0T **Exam Hours: 3**

OBJECTIVE

Most of the Mechatronics systems control is based on Microprocessor or Microcontroller. So it is necessary to include this subject in the syllabus so that students will be exposed to the knowledge of Microprocessor based systems and design of these systems.

UNIT	CONTENTS	Hrs
I	**INTRODUCTION** Organization of Micro Computers – Organization of 8085: Architecture, Internal Register Organization and Pin Configuration – Instruction Set of 8085 – addressing modes – instruction and machine cycles with states and timing diagram. Methods of 8085 programs and 8085 assembly language.	
II	**INTERFACING AND I/O DEVICES** Need for Interfacing - /Memory Interfacing: address space partitioning – address map – Address decoding – Designing decoders circuit for the given address map – Bus connection and Z – line Control – Access Time Computations. **I/O Interfacing:** Data transfer schemes – programmed Synchronous and asynchronous – Interrupt driven Transfer – Multiple devices and multiple interrupt levels – enabling disabiling and masking of interrupts. **DMA transfer:** Cycle stealing – Burst mode – Multiple DMA devices – DMA transfer in 8085 system – serial data transfer.	
III	**INTERFACING DEVICES** Programmable peripheral device – programmable interval timer (8253) – Programmable communication interface (USART) – Programmable interrupt controller – Programmable DMA Controller (8257)- Programmable Keyboard/display controllers.	
IV	**DESIGN USING PERIPHERAL DEVICES** Interfacing A/D and D/A converters – Matrix Keyboard design using 8255 using 8085 programs. Designing real time clock, detecting power failure, detecting presence of objects using 8253 - Design of Keyboard and display interfacing using 8279 – Design of digital transmission with modems and telephone lines using 8251 A.	
V	**MICROPROCESSOR APPLICATIONS** Temperature monitoring system – Automotive applications – Closed loop process control – Stepper motor control.	

TEXT BOOKs:

SN	Name of Authors /Books /Publisher	Year of Publication
1	Introduction to Microprocessor – Third Edition – Aditya P Mathur Tata McGraw – Hill Publishing Company Ltd., New Delhi 3rd Edition 2003.	

TEXT BOOKs:

SN	Name of Authors /Books /Publisher	Year of Publication
1	Microprocessor Architecture. Programming and Applications with the 8085 Ramesh Goankar, fifth edition – Penram International Publishing (India) Private Limited.	
2	Microprocessors and Interfacing, Programming and Hardware" Douglas V. Hall.Tata McGraw – Hill Publishing Company Ltd., New Delhi, 1997.	

4MH7: FLUID MECHANICS LAB.

B.Tech. (MH) 3rd Sem. **Max. Marks: 100**

3P **Exam Hours: 3**

SN	LIST OF EXPERIMENTS
1	Determine Metacentric height of a given body.
2	Determine Cd, Cv and Cc for given orifice.
3	Determine flow rate of water by V-notch.
4	Determine velocity of water by pitot tube.
5	Verify Bernoulli's theorem.
6	Determine flow rate of air by Venturi meter.
7	Determine flow rate of air by orifice meter.
8	Determine head loss of given length of pipe.
9	Determine flow rate of air by nozzle meter.
10	Study of Pelton, Kaplan Turbine models.

4MH8: MICROPROCESSOR LABORATORY

B.Tech. (MH) 3rd Sem. **Max. Marks: 75**

2P **Exam Hours: 2**

SN	LIST OF EXPERIMENTS
	I. PROGRAMMING 30
1	Addition of two 8 – bit numbers, sum of 8 – bits and 16 bits.
2	Decimal addition of two 8 – bit numbers Sum: 16 bits.
3	8 - bit subtraction.
4	8 – bit decimal subtraction.
5	Additional of two 16 – bit numbers, Sum: 16 bits or more.
6	Multibyte subtraction.
7	To arrange a series of numbers in Ascending order.
8	To arrange a series of numbers in Descending order.
9	8 – bit Multiplication.
10	8 – bit Division.
11	Decimal to hexadecimal conversion and hexadecimal number to decimal number conversion.
	II. INTERFACING 15
1	Analog to digital conversion.
2	Digital to analog conversion.
3	Steeper motor controller.
4	Temperature controller.

LIST OF EQUIPMENTS

(for a batch of 30 students)

TOTAL:45 PERIODS

S.No	Equipments	Qty
1	8085 Microprocessor trainer kits	15
2	ADC interface card	3
3	DAC interface card	3
4	Stepper motor interfacing card with stepper motor	3
5	Temperature controller with sensors like thermocouple	3

4MH9: DYNAMICS OF MACHINES LAB I

B.Tech. (MH) 3rd Sem. **Max. Marks: 100**

3P **Exam Hours: 3**

SN	LIST OF EXPERIMENTS
1	To study inversion of four bar chain
2	Coupling Rod
3	Beam Engine
4	Steering Mechanism
5	Study of quick return mechanism (Crank and Slotted lever mechanism.)
6	To draw velocity and acceleration diagram for Crank and slotted lever mechanism.
7	Study of inversion of Double slider chain: Oldham Coupling Scotch Yoke Elliptical Trammel
8	To plot displacement v/s curve for various cams.
9	Study of various cam-follower arrangements.
10	To determine co-efficient of friction.
11	Study of various types of dynamometers, Brakes and Clutches.
12	To determine moment of inertia of the given object using of Trifler suspension.

4MH10: MECHANICAL MEASURMENTS AND CONTROL LAB.

B.Tech. (MH) 3rd Sem. **Max. Marks: 75**

2P **Exam Hours: 2**

SN	LIST OF EXPERIMENTS
	INSTRUMENTATION LAB. SESSIONAL
1	Displacement Measurement using Capacitive Pick -up System.
2	Displacement Measurement Using Inductive Pick-up System.
3	Displacement Measurement Using Light Dependent Register Set up.
4	1. Study of Speed Measurement System. a) Magnetic Pick-up. b) Strobometer.
5	Study of Load Measurement System Load Cell + Load Indicator.
6	Calibration of Thermocouple Wire.
	CONTROL LAB. SESSIONAL
7	Problems on a. Block diagram reduction technique b. Block diagram formation for Control Systems. c. Root Locus Plot d. Bode Plot e. Polar plot and Nyquist Stability Criterion
8	Experiments on a. Hydraulic System b. Control System
	METROLOGY LAB. SESSIONAL
9	Measurement of lengths,heights,diameters by Vernier Calipers, Micrometers etc.
10	Measurement of bores by Internal Micrometers and dial bore indicators.
11	Use of gear teeth, Vernier Calipers and checking the chordal addendum and cordal height of spur gear.
12	Machine tool “alignment test” on the Lathe.
13	Machine tool “alignment test” on the Milling Machine.
14	Use of spirit level in finding the flatness of surface plate.
15	Thread measurement by Two wire method or tool makers microscope.