Syllabus of

UNDERGRADUATE DEGREE COURSE

Mechatronics Engineering

Rajasthan Technical University, Kota

Effective from session: 2021 – 2022

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

SYLLABUS

2nd Year - IV Semester: B.Tech. (Mechatronics Engineering)

4MH2-01: ANALOGELECTRONICS

Credit: 2 **Max. Marks: 100 (IA:30, ETE:70)**

2L+0T+0P **End Term Exam: 2 Hours**

SN	CONTENTS	Hours
1	**Introduction:** Objective, Scope and Outcome of the course	1
2	**PN Junction Diodes:** Open-circuited p-n junction and space charge region. The biased p-n junction, volt-ampere characteristics, cut in 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.	3
3	**Other Diodes:** Avalanche breakdown and zener breakdown, working principles of zener diodes, photo-diodes, light emitting diodes, solar cell and varactor diodes.	2
4	**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.	3
5	**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 cut off 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.	8
6	**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.	6
7	**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.	4
	Total	27

Office of Dean Academic Affairs
Rajasthan Technical University, Kota

4MH1-03/3MH1-03: MANAGERIAL ECONOMICS AND FINANCIAL ACCOUNTING

Credit :2 **Max. Marks: 100 (IA:30, ETE:70)**
2L+0T+0P **End Term Exam.: 2 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, Scope and Outcome of the course.	1
2	**Basic economic concepts-** Meaning, nature and scope of economics, deductive vs inductive methods, static and dynamics, Economic problems: scarcity and choice, circular flow of economic activity, national income-concepts and measurement.	3
3	**Demand and Supply analysis-** Demand- types of demand, determinants of demand, demand function, elasticity of demand, demand forecasting –purpose, determinants and methods, Supply-determinants of supply, supply function, elasticity of supply.	5
4	**Production and Cost analysis-** Theory of production- production function, law of variable proportions, laws of returns to scale, production optimization, least cost combination of inputs, isoquants. Cost concepts-explicit and implicit cost, fixed and variable cost, opportunity cost, sunk costs, cost function, cost curves, cost and output decisions, cost estimation.	5
5	**Market structure and pricing theory**- Perfect competition, Monopoly, Monopolistic competition, Oligopoly.	4
6	**Financial statement analysis-** Balance sheet and related concepts, profit and loss statement and related concepts, financial ratio analysis, cash-flow analysis, funds-flow analysis, comparative financial statement, analysis and interpretation of financial statements, capital budgeting techniques.	8
	Total	26

Office of Dean Academic Affairs
Rajasthan Technical University, Kota

4MH1-02/3MH1-02: TECHNICAL COMMUNICATION

Credit :2 **Max. Marks: 100 (IA:30, ETE:70)**
2L+0T+0P **End Term Exam.: 2 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, Scope and Outcome of the course.	1
2	**Introduction to Technical Communication-** Definition of technical communication, Aspects of technical communication, forms of technical communication, importance of technical communication, technical communication skills (Listening, speaking, writing, reading writing), linguistic ability, style in technical communication.	3
3	**Comprehension of Technical Materials/Texts and Information Design & development-** Reading of technical texts, Reading and comprehending instructions and technical manuals, Interpreting and summarizing technical texts, Note-making. Introduction of different kinds of technical documents, Information collection, factors affecting information and document design, Strategies for organization, Information design and writing for print and online media.	6
4	**Technical Writing, Grammar and Editing**- Technical writing process, forms of technical discourse, Writing, drafts and revising, Basics of grammar, common error in writing and speaking, Study of advanced grammar, Editing strategies to achieve appropriate technical style, Introduction to advanced technical communication. Planning, drafting and writing Official Notes, Letters, E-mail, Resume, Job Application, Minutes of Meetings.	8
5	**Advanced Technical Writing**- Technical Reports, types of technical reports, Characteristics and formats and structure of technical reports. Technical Project Proposals, types of technical proposals, Characteristics and formats and structure of technical proposals. Technical Articles, types of technical articles, Writing strategies, structure and formats of technical articles.	8
	Total	**26**

Office of Dean Academic Affairs
Rajasthan Technical University, Kota

4MH3-04: MEASURMENT AND METROLOGY

Credit: 2 **Max. Marks: 100 (IA:30, ETE:70)**
2L+0T+0P **End Term Exam: 2 Hours**

SN	CONTENTS	Hours
1	**Introduction:** Objective, Scope and Outcome of the course	1
2	**BASIC MEASUREMENT SYSTEM:** 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.	5
3	**SENSORS:** 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.	5
4	**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.	5
5	**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.	5
6	**ADVANCES IN METROLOGY** Coordinate measuring machine (CMM): Constructional features–types, applications, Applications of Image Processing in measurement –computer aided inspection.	5
	Total	26

Office of Dean Academic Affairs
Rajasthan Technical University, Kota

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

SYLLABUS

2nd Year - IV Semester: B.Tech. (Mechatronics Engineering)

4MH4-05: FLUID MECHANICS

Credit: 4 **Max. Marks: 100 (IA:30, ETE:70)**

3L+1T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	Hours
1	**Introduction:** Objective, Scope and Outcome of the course.	1
2	**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.	4
3	**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.	3
4	**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.	4
5	**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.	3
6	**Orifice Discharging:** Free Jet, vena contracts, co-efficient of contraction, velocity and discharge, coefficient of resistance, orifices and mouthpieces, nozzles and weires.	3
7	**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.	4
8	**Laminar Flow:** Simple solution of Navier Stokes equations, Hagen–Poiseuille flow, Plans Poiseuille flow and coutte flow.	3
9	**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.	4

10	**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.	**4**
11	**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, aero foils theory.	**4**
11	**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.	**3**
	Total	**40**

4MH4-06: DYNAMICS OF MACHINERY

Credit: 3 **Max. Marks: 100 (IA:30, ETE:70)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	Hours
1	**Introduction:** Objective, Scope and Outcome of the course	1
2	**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, Crankshaft Torque, Turning moment diagrams, Flywheels.	8
3	**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.	8
4	**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.	8
5	**FORCE VIBRATION** Response to periodic forcing, Harmonic Forcing, Forcing caused by unbalance, Support motion, Force transmissibility and amplitude transmissibility vibration isolation.	7
6	**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.	8
	Total	40

4MH4-07: CONTROL SYSTEMS

Credit: 4 **Max. Marks: 100 (IA:30, ETE:70)**
3L+1T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	Hours
1	**Introduction:** Objective, Scope and Outcome of the course	1
2	**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.	8
3	**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.	8
4	**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.	8
5	**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.	8
6	**COMPENSATION DESGIN** Realization of basis compensation–Lag, Lead and Lag–lead networks –Compensator design using Bode plots.	3
7	**MATLAB applications:** Partial Fraction expansion, Transformation of a Mathematical models, Transient response analysis, Root locus, Bode diagrams, Nyquist plots ,analysis of compensator design problems.	4
	Total	40

Office of Dean Academic Affairs
Rajasthan Technical University, Kota

4MH4-21: FLUID MECHANICS LAB

Credit: 1.5 **Max. Marks: 100 (IA:60, ETE:40)**
0L+0T+3P

List of Experiments
1. Determine Meta centric 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.

4MH4-22: DYNAMICS OF MACHINES LAB-I

Credit: 1.5 **Max. Marks: 100 (IA:60, ETE:40)**
0L+0T+3P

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.

4MH4-23: MECHANICAL MEASURMENT SANDCONTROL LAB

Credit: 1.5 **Max. Marks: 100 (IA:60, ETE:40)**
0L+0T+3P

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 Setup. 4.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.Problemson: **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 toolmakers microscope.

4MH4-24: ANALOG ELECTRONICS LAB

Credit: 1.5 **Max. Marks: 100 (IA:60, ETE:40)**
0L+0T+3P

List of Experiments
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.Plotgain-frequency characteristic of two stages RC coupled amplifier & calculate its Band width and compare it with theoretical value. 9.Plot gain-frequency characteristic of emitter follower & findout its input and output resistances. 10. Plot input and output characteristics of BJT in CB, CC and CE configurations. Find their h parameters. 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.