

B.Tech in Mechatronics Engineering**SEMESTER –IV**

Sl No.	Course Code	Course Title	Hours Per Week			Total Credits
			Lecture	Tutorial	Practical	
1.	161401	Electrical Machines and Power Systems	3	0	0	3
2.	161402	Analog and Digital Electronics	3	0	0	3
3.	161403	Kinematics and Theory of Machines	3	0	0	3
4.	161404	Control System Engineering	3	0	0	3
5.	161405	Power Electronics and Electrical Drives	3	0	0	3
6.	161406	Energy, Environment and Sustainability	3	0	0	0
7.	161407	Indian Knowledge System	3	0	0	0
8.	161401P	Electrical Machines and Power Systems Lab	0	0	3	1.5
9.	161402P	Analog and Digital Electronics Lab	0	0	3	1.5
10.	161404P	Control System Engineering Lab	0	0	3	1.5
11.	161405P	Power Electronics and Electrical Drives Lab	0	0	3	1.5
TOTAL						21

Unit- 1.0: Transformers

8 hrs

Single phase transformer - construction, working principle, emf equations and no load and resistive load phasor diagrams, Voltage regulation, losses and efficiency of transformer, direct load test, Polarity of transformer, Condition for parallel operation of two single phase transformers and advantages, Auto transformer – construction, working principle, advantages and disadvantages, Three phase transformers- construction and applications, Tap changers- online and offline, Introduction to pulse and high frequency transformers, Special purpose transformers -isolation transformer, grounding transformer, instrument transformer-current transformer (CT) and potential transformer (PT) and applications, Applications of transformers in mechatronic systems.

Unit- 2.0: DC Motors

7 hrs

DC Machine: Construction, types – DC motor and DC generator, working principle, Emf equation, DC Motor – Types—Shunt- Self and separately excited, series and compound, diagrams, EMF equation, significance of back EMF, Torque and speed, Characteristics of DC motors: Torque vs Speed, Flux vs Current, Torque vs current, Speed vs Current, Need of starters -3-point and 4-point starters, Losses and efficiency, swimburne's test, Speed control of DC motors: Armature Control Method, Field Flux Control Method, Applications of different types of DC motors.

Unit- 3.0: AC Motors

10 hrs

Three phase induction motor -Construction and working principle, Slip and slip speed, equivalent circuit, Types-Squirrel Cage (SQIM) and Slip Ring Induction motors (SRIM), Torque equation, Starting, running and condition for the maximum torque (Only expression), Starter and its need, types - DOL, Star Delta, Autotransformer starter, soft starter and rotor resistance starter (SRIM), Speed control of SQIM and SRIM: stator voltage, pole changing, rotor resistance and Variable Voltage and Variable Frequency (VVVF), Motors selection for different applications as per the load torque speed requirements, Single phase induction motor -Construction, Principle of operation: Double revolving field theory, equivalent circuit, Starting of Single-phase Induction Motor: Split phase- Resistance start, capacitor start, capacitor start capacitor run and shaded pole Induction motor with their torque speed characteristics, Applications of various types of single-phase induction motor. Three phase Synchronous motor –Construction, working principle, special features, applications, hunting and damper winding.

Unit- 4.0: Special Motors

5 hrs

Construction, working and speed-torque characteristics and applications of – AC servo motor , Stepper motor, Linear Induction Motor (LIM), Reluctance motor, Hysteresis motor, BLDC motor, Universal motor.

Unit- 5.0: Power Systems

8 hrs

Power System Components, Generating Station – Generating voltage, Conventional - Thermal, Hydro, Nuclear and Gas power plant, Non-conventional methods- Thermal, Hydro, Nuclear and Gas power plant (Only principle of generation), Transmission System – Primary and secondary transmission, voltage levels, transmission losses and efficiency, Distribution System – Primary and secondary distribution system and voltage levels, Electrical Load – Single phase and three phase loads, Earthing – need and significance, types, procedure of pipe earthing, Underground Cables: Requirements, classification, comparison with overhead lines, laying of underground cable: Direct laying, Draw in system and Solid system, Power requirements for mechatronic systems, Implications of grid stability on the performance of mechatronics systems, Voltage stability, frequency regulation, Power Quality, types -Sag, Swell, transients, Interruption, harmonics, voltage notching and noise and its Impact on Mechatronic Systems, Techniques for maintaining voltage stability, frequency regulation, and power quality, Energy Storage Systems types and its characteristics – Batteries, Capacitors, Flywheels, supercapacitors, and other emerging energy storage technologies, Emerging Trends and Future Directions.

Unit- 6.0: Smart Grid Technologies

4 hrs

Smart grid technologies: IoT integration, demand-side management, Renewable energy integration: solar, wind, and hydroelectric power system, Energy harvesting techniques for mechatronic applications.

Text/ Reference:-

1. Electrical Machines & Power Systems, V.Del Toro Pearson Education India; 1st ed., 2016, ISBN-13: 978-9332571815.
2. Electrical Machines, S K Bhattacharya, McGraw-Hill, Delhi, 2008, ISBN-10 : 007066921X, ISBN-13:9780070669215
3. Electric Machinery, A.E. Fitzgerald, C. Kingsley & S.D. Umans, Tata McGraw Hill New Delhi ,6th ed., 2002, ISBN-13: 978-0071230100.
4. Electrical Technology, Volume – II, (AC & DC Machines)Theraja B.L., VISION IAS, 2022, ASIN: B0CG61Y62H.
5. Electrical Machinery, P.S. Bimbhra R.C. KHANNA & VINEET KHANNA, 1st ed., 2021, ISBN-13 :978-9389139105.
6. Generalized Theory of Electrical Machines, P. S. Bimbhra Khanna Book Publishing Co. P Ltd; 7th ed., 2021,ISBN-13:978-9391505080.
7. Power system Analysis, John Grainger and William Stevenson, McGraw Hill, 2017, ISBN-13: 9780070612938
8. Modern Power System Analysis, D P Kothari, J Nagrath, R K Saket, McGraw Hill; 5th ed., 2022, ISBN-13:978-9354600968.
9. A Detailed Study on Special Electrical Machines, V. Vedanarayanan, Notion Press; 1st ed., 2021, ISBN-13: 979-8885465403.
10. Electrical Machines: AC, DC and Special Machines, Nilima Zade, Prachi Godbole Rabinder Henrym, Shroff Publishers & Distributors Pvt. Ltd., 1st ed., 2023, ISBN-13:978-9355423986.

Unit- 1.0: Basic Analog Circuit**7 hrs**

Introduction, Open circuited P-N junction , P-N junction as a rectifier, V-I Characteristics, Effect of temperature, diode resistance, Diffusion Capacitance, Drift Capacitance, Diode switching times, Breakdown diodes, Tunnel diode, Photo diode, LED, Clipping circuits, Comparators, Half wave rectifier, Full wave rectifier, Rectifier with capacitor filter.

Unit- 2.0: Bipolar Junction Transistors**8 hrs**

Transistor characteristics: The junction transistor, Transistor as an amplifier, CB, CE, CC Configurations, Comparison of transistor configurations, Operating point, Self-bias or Emitter bias, Bias Compensation, Thermal Runaway and Stability, Transistor at low frequencies, CE Amplifier Response, Gain Bandwidth Product, Emitter Follower, RC Coupled Amplifier, Two Cascaded CE and Multistage CE Amplifiers.

Unit- 3.0: Field-Effect Transistors**6 hrs**

JFET, V-I Characteristics, Effects in real devices, high-frequency and high-speed issues, MOSFET, RTL, DCTL and CMOS. Devices, Differences between JFETs and MOSFETs, Biasing MOSFETs, Comparison of Logic Families, FET Applications, Wave-Shaping Circuits: Integrated Circuit (IC) Multivibrators.

Unit- 4.0: Operational Amplifier**8 hrs**

Introduction to Operational Amplifier, Ideal v/s practical Opamp, Performance Parameters, Operational Amplifier, Low frequency CS and CD Amplifiers, Operational Amplifier Application Circuits: Peak Detector, Schmitt trigger, Active Filters, Non-Linear Amplifier, Relaxation Oscillator, Current-to-Voltage and Voltage-to-Current Converter, Regulated Power Supply Parameters, adjustable voltage regulator, D to A and A to D converter.

Unit- 5.0: Combinational Logic Circuits**7 hrs**

Basic Theorems and Properties of Boolean Algebra, Canonical and Standard Forms, Digital Logic Gates, The K Map Method, Product-of-Sums Simplification, Don't Care Conditions, NAND and NOR Implementation, Exclusive-OR Function, Binary Adders, Binary Adder-Subtractor, Decimal Adder Binary Multiplier, Magnitude Comparator, Decoders, Encoders, Multiplexers.

Unit- 6.0: Sequential Circuits**6 hrs**

Storage Elements: Latches and flip flops, Analysis of Clocked Sequential Circuits, State Reduction and Assignment, Shift Registers, Ripple Counters, Synchronous Counters, Random-Access Memory, Read-Only Memory.

Text/Reference:

1. Fundamentals of Electric Circuits, Charles K. Alexander Matthew N. O. Sadiku McGraw Hill; Standard Edition, 7th Ed. 2022, ISBN-13 : 978-9355320162
2. Electronics: Analog and Digital, Barun Raychaudhuri, Cambridge University Press, 2022 ISBN-13: 978-1009214230.
3. Integrated Electronics: Analog and Digital Circuits and Systems, 2/e Jacob Millman, Christos Halkias and Chethan D. Parikh, Tata McGraw-Hill Education, India, 2nd Ed. 2017, ISBN-13: 978-0070151420.
4. Analog and Digital Electronics, Jr./Larry L. Kinney.
5. Raghunandan G. H. Charles H. Roth Cengage India Private Limited; 1st Ed., 2019, ISBN-13: 978-9353502355.

B.Tech in Mechatronics Engineering

6. Modern Digital Electronics, R P Jain, Kishor Sarawadekar, McGraw Hill 5th Ed. 2022, ISBN-13: 978-9355321770
7. A Text Book on Analog Electronics A. Rajkumar, Made Easy Publications, 2019, ISBN-13 : 978-9381069455
8. Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog Morris Mano and Michael D. Cilette Pearson Education, 6th ed. 2018, ISBN-13: 978-9353062019.



Unit 1.0: Introduction to Mechatronics Systems

8 hrs

Introduction to kinematics, definition and importance of kinematics, Basic concepts and terminology: position, distance, displacement, speed, velocity, acceleration, Types of motion: rectilinear, curvilinear, angular motion, translation, rotation, degrees of freedom, kinematic chains and links Rectilinear motion-equations of motion, graphical representation, uniformly accelerated motion, relative motion, curvilinear motion, Motion in a plane-projectile motion, circular motion-tangential and normal components of acceleration, Relative motion-relative velocity, relative acceleration, motion analysis using relative motion, Plane kinematics of rigid bodies-translation, rotation, general plane motion, instantaneous center of rotation, Kinematic diagrams and Symbols: representation of mechanisms, standard symbols for kinematic diagrams, joint types: revolute, prismatic, and higher pairs, Kinematic inversions of four bar chain and slider crank chains, Limit positions, transmission angle, common mechanisms- quick return mechanism, straight line generators- universal joint, rocker mechanisms.

Unit 2.0: Kinematic Analysis and Synthesis of Mechanisms

9 hrs

Degrees of Freedom and Mobility Analysis: Gruebler's equation for planar and spatial mechanisms, mobility of simple kinematic chains, practical applications, Position and Displacement Analysis of simple mechanism: Vector loop closure equations, Coordinate transformation methods, Graphical and analytical techniques for determining position, Velocity and Acceleration Analysis- Graphical and analytical velocity analysis of four bar pin jointed linkages and four bar slider crank linkages, instantaneous centre of velocity (ICV) method, Graphical and analytical acceleration analysis of four bar pin jointed linkages and four bar slider crank linkages, Graphical velocity and acceleration analysis of quick return mechanisms, Synthesis of Four-Bar Linkages: Types of four-bar linkages and their applications, Function generation, path generation, and motion generation, Applications in automotive and industrial machinery.

Unit 3.0: Cam and Gear Trains

8 hrs

Introduction to cam and gear mechanisms, basic principles and classifications, overview of cam and gear terminology, Types of Cams and Followers: Radial (disk) cams, Cylindrical cams, Translating and oscillating followers, Specific motion requirements for different follower types, Cam Profile Design: Graphical and analytical methods for cam profile generation for uniform motion, simple harmonic motion, and cycloidal motion, Considerations for pressure angle and radius of curvature, undercutting and sizing of cams, Types of Gear Trains: Simple gear trains, Compound gear trains, Planetary (epicyclic) gear trains, Differential gear systems, Gear train kinematics: gear ratio calculations, torque and speed relationships in gear systems, efficiency and power transmission in gear trains, Selection of gear types and materials, Design considerations for spur, helical, bevel, and worm gears, Kinematic analysis of simple and compound gear trains.

Unit 4.0: Dynamic of Machines I

6 hrs

Force Analysis: Basic principles and definitions, Difference between static and dynamic analysis, Inertia Forces and Torques: Concepts of mass moment of inertia, inertia forces in linear and rotational motion, D'Alembert's principle and its application in dynamic analysis, Force analysis in planar mechanisms, Analytical and graphical methods for dynamic force analysis, Dynamic force balance in linkages and slider-crank mechanisms,

Unit 5.0: Dynamic of Machines II

6 hrs

Vibration Analysis: Free and forced vibrations of undamped and damped single-degree-of-freedom systems, resonance phenomena, Transmissibility Ratio, Effect of damping, Vibration Isolation and Absorption, Critical Speed of Shafts, Vibration Measurement and Analysis, Balancing of Rotating and

B.Tech in Mechatronics Engineering

Reciprocating Masses, Static and dynamic balancing of rotating masses, Unbalance of force or moment, Techniques for achieving balance in machinery to reduce vibrations, Dynamic Analysis of Cam Mechanisms: Force and torques analysis in cam-follower systems, Effects of cam profile design on dynamic forces, Balancing and minimizing vibration in cam designs.

Unit 6.0: Mechanism for Control

5 hrs

Governors -Types, Centrifugal governors, Gravity controlled and spring controlled centrifugal governors, Characteristics, Effect of friction, Controlling force curves, Gyroscopes –Gyroscopic forces and torque, Gyroscopic stabilization, Gyroscopic effects in Automobiles, ships and airplanes, Flywheel- Inertia force and inertia torque in reciprocating engine, correction couple (torque), Turning moment diagram, Surface contacts- sliding and rolling friction, friction drives, bearings and lubrication, friction clutches, belt and rope drives, friction in brakes.

Text/Reference:

1. Theory of Machines: Kinematics and Dynamics, B. V. R. Gupta, I. K. International Pvt Ltd, 2010, ISBN : 9380578709, 9789380578705
2. Mechanisms and Machines: Kinematics, Dynamics, and Synthesis Michael, M. Stanisic, Cengage Learning, Publication, 2020, ISBN-10: 1133943918, ISBN-13: 978-1133943914.
3. Kinematics, Dynamics, and Design of Machinery, Kenneth J. Waldron, Sunil K. Agrawal, Gary L. Kinzel, WILEY, 2016, ISBN: 978-1-118-93328-2.
4. Mechanism Design: Analysis and Synthesis Arthur, G. Erdman, George N. Sandor, Pearson Education (US) ISBN-10: 0132677822, ISBN-13: 978-0132677820.
5. A Textbook of Theory of Machine, R.S. Khurmi, S Chand, 14 ed, 2020, ISBN-10: 812192524X, ISBN-13:978-8121925242.

Unit-1.0: Introduction to Control System and Mathematical Modelling 8 hrs

Control system terminology and structure - sensors, actuators, controllers, Types -open and closed loop, linear and nonlinear, time variant and time invariant, SISO and MIPO, Degenerative and Regenerative feedback, Mathematical Model of Physical Systems-mechanical translational and rotational systems in F-V and F-I analogy, Order and type of system with standard equations and examples, Transfer function-Definition and transfer function, representation and output response of 1st and 2nd order only, Poles and Zeros of a Transfer function, Pole - zero plot in S-plane, Need and significance of block diagram: Represent simple physical system in terms of block diagram having various inputs and outputs. Block diagram and its reduction techniques, Signal flow graphs and Mason's gain formula, Control system components - Construction, working and applications of Servomotors -AC and DC, Stepper motor, Error Detector-Potentiometer and Synchro, Optical encoder -Incremental and absolute.

Unit-2.0: Time Response Analysis 6 hrs

Transient and steady state response, Standard Test Inputs: Step, Ramp, Parabolic, Impulse inputs, their Laplace Transform and graphical representation, First order control system: Analysis for unit step input, concept of time constant (derivation not required), Second order control system: Analysis for unit step input, effect of damping, Time Response Specifications: Rise time, Delay time, Peak time, Settling time, Peak overshoot, steady state errors and static error coefficients and numerical, Control actions: Proportional control, Derivative control, Integral Control and , Proportional plus Derivative plus Integral (PID) Control.

Unit-3.0: Stability Analysis in Time Domain 6 hrs

Stability: Concept of stability, Absolute and relative stability, root locations in S-plane and its analysis- stable, unstable, critically stable, conditionally stable system, Routh's Stability Criterion-Steps and procedures to find stability by Routh's stability criteria, numerical problems, Routh - Hurwitz polynomials, Necessary and sufficient conditions for stability, Root Locus Technique: Concept of poles and zeros Root locus construction rules, Root locus plot and analysis, Controller design using root locus.

Unit-4.0: Frequency Response Analysis 8 hrs

Frequency Response Analysis method: Concept, Advantages and Disadvantages, Frequency response specifications, Bode Plot: Need, Magnitude plot and phase angle plot, Bode plot for gain K, poles and zeros at origin, and 1st order system, Analysis of stability from Bode plot using Gain margin and Phase margin, Frequency response of second order systems, Polar plot, Nyquist stability criterion.

Unit-5.0: State-Space analysis 7 hrs

State variable representation-Concept and definitions and representation, Conversion of state variable models to transfer functions-Conversion of transfer functions to state variable models-Solution of state equations, Concepts of Controllability and Observability,

Unit-6.0: Advanced Control Techniques 7 hrs

Introduction to Digital Control Systems - Basics of digital control, Z-transform and discrete-time systems and digital PID controllers, Introduction to Nonlinear Control- Nonlinear control techniques, phase-plane analysis, limitations and challenges, Introduction to Robust Control, Robustness in control systems, robust stability and performance, H-infinity control, Real-world applications of advance controllers.

B.Tech in Mechatronics Engineering

Text/Reference:

1. Linear Control Systems B.S. MankeKhanna Publishers, 2005, ISBN-13 : 978-9387394711
2. Linear control system analysis and design with matlab Constantine H. Houpis Stuart N. Sheldon, John J. D'Azzo CRC Press, 5th ed., 2003, ISBN-13 : 978-0824740382
3. Introduction to Linear and Digital Control Systems, Ghosh Arun K Prentice Hall India Learning Private Limited, 2007, ISBN-13 : 978-8120331242
4. Nonlinear Control Systems, Alberto Isidori Springer London Ltd; 3rd ed., 1995. ISBN-13 : 978-1447139096
5. Control Systems Engineering, With MATLAB Applications I.J. Nagrath and M. Gopal Wiley, 5th ed., 2017, ISBN-13: 978-8126511029
6. Automatic Control systems (With Matlab Programs) S. Hasan Saeed, Arihant, Reprint 2013, ISBN-13 : 978-8190691925
7. CONTROL SYSTEMS: With Matlab Programs Sonveer Singh, Sanjay Agrawal, TechSar Pvt. Ltd, 2023, ISBN-13 : 978-9390620012
8. Modern Control Engineering Ogata Katsuhiko Pearson Education India; 5th ed., 2015, ISBN-13 : 978-9332550162
9. Control System Engineering S. Salivahanan, R. Rengaraj, G.R. Venkatakrishnan Pearson Education; 1st ed., 2016, ISBN-13 : 978-9332581500
10. Control System Engineering: Analysis and Design in Time and Frequency Domain Varsha U. Bakshi, Uday A. Bakshi Technical Publications, 2020, ISBN-13: 978-9350998558, ISBN-13 : 978-9333223683
11. Design of feedback control systems Raymond T. Stefani, Bahram Shahian, Gene H. Hostetter, and J. Y. Savant Oxford University Press, 4th ed., 2001, ISBN-13: 978-0195142495
12. Control Systems Engineering Norman S. Nise Wiley, 7th ed., 2018, ISBN-13: 978-1118170519.

Unit- 1.0: Introduction to Power Semiconductor Devices

8 hrs

Power Electronics: Scope and applications, Construction, Operation, characteristic curves and applications of power electronics devices. – SCR, IGBT, MOSFET, GTO, DIAC and TRIAC, SCR Turn-on methods: High Voltage triggering, thermal triggering, illumination triggering, dv/dt triggering, Gate triggering, Gate trigger circuits: Resistance and Resistance capacitance circuits, SCR triggering using UJT Relaxation Oscillator and Synchronized UJT circuits, SCR Turn-Off methods: Natural and forced commutation, Class A, Class B, Class C, Class D commutation

Unit- 2.0 Phase Controlled Rectifier I

7 hrs

Phase control: firing angle, conduction angle, Single Phase Fully Controlled Half Wave Converter: With R, RL and RLE load: Circuit diagram, working, input- output waveform, equations for DC outputs. Single-phase full-wave mid-point and bridge converter with R load, RL load, RL load with DC source: Circuit diagram, working, input- output waveform, equations for DC outputs,

Unit- 3.0 Phase Controlled Rectifier II

5 hrs

Single-phase semi converter with R, RL load with DC source: Circuit diagram, working, input- output waveform, equations for DC outputs, Three-phase half wave converter with R load: Circuit diagram, working, input- output waveform, Three-phase full wave converter with R load: Circuit diagram, working, input- output waveform, Dual Converter.

Unit- 4.0 Fundamentals of Electric Drives

6 hrs

Need and significance of Electric Drives, Functional Block diagrams of an electric drives, Function of all types of power converters, Fundamental torque Equation, Multi-quadrant operation, Components of Load torque, Nature and classification of Load torque, Steady State Stability (derivation not required) Classes of motor duty, Motor Rating.

Unit- 5.0 DC Drives

9 hrs

Characteristics and speed control of Series, Shunt and Separately Excited DC Motors, DC motor: Braking – Plugging, Rheostatic, and Regenerative, Single phase SCR Drives of DC separately excited motor: Half wave converter Full wave converter Semi-converter, Dual converter Introduction to Three Phase SCR Drives of DC separately excited motor and its types Half wave converter, Full wave converter, Semi-converter, Rectifier control of DC separately excited shunt motor and DC Series motor, Chopper: Working Principle and its applications, Classification of Choppers: Step Up and Step-down choppers, Class A, Class B, Class C, Class D and Class E chopper, Chopper Control of separately excited DC motor, Chopper Control of DC series motor.

Unit- 6.0 AC Drives

7 hrs

Need, significance and working of soft starters, Stator voltage control using AC voltage controller Cycloconverter, Variable Frequency Control (VFD), Voltage Source Inverter Control, AC drives using PWM technique, Current Source Inverter Control, Basics of Slip power recovery, Rotor Resistance Control.

Text/ Reference:-

1. Power Electronics, Bimbhra, P. S Khanna Publication, 5th Edition, 2012, ISBN: 978-8174092793
2. Power Electronics Circuit Devices and application Rashid, Muhammad H. Pearson Education India, 4th Edition, 2020, ISBN: 9789332584587, 9789332584587
3. Power Electronics Handbook, Rashid, Muhammad H. Butterworth-Heinemann Inc, 4th Edition, 2017, ISBN: 9780128114070, eBook ISBN: 9780128114087

B.Tech in Mechatronics Engineering

4. Power Electronics, Ned Mohan, Tore M. undeland, William P Robbins Wiley India, 3rd edition, 2010, ISBN: 9788126510900, 8126510900
5. Modern Power Electronics, P.C SEN S. CHAND & CO. Ltd., ISBN: 9788121924252, 9788121924252
6. Power Electronics, Singh M.D., Khanchandani K.B. Mcgraw Hill Education, 2nd edition, 2017, ISBN:978-0070583894
7. Fundamentals of Power Electronics Bhattacharya, S. K. Vikas publishing House, 1st Edition,2009, ISBN: 978-8125918530
8. Power Electronics Chitode, J.S. Technical Publications, 1st edition, May 2008, ISBN: 978-8184314182
9. Power Electronics Gupta, B. R., Singhal V. Katson Books, 6th Edition, 2010, ISBN: 978-8185749532
10. Fundamentals of Electrical Drives G. K. Dubey Narosa Publishing House, ISBN: 978-81-7319-428-3
11. Electric Drives D. P. Kothari and Rakesh Singh Lodhi WILEY India Edition ISBN:978-9384588120
12. Control of DC and AC Drives Srinivas Vemula and Ramaiah Veerlapati Lap lambert academic publishing ISBN: 9783330053434
13. Thyristor DC Drives P.C SEN, Wiley–Blackwell, ISBN: 978-0471060703
14. Fundamentals of Industrial Drive B. N. Sarkar PHI Learning Pvt. Ltd. ISBN:9788120344334.

Unit-1.0: Ecosystem and Biodiversity**7 hrs**

Ecosystem - definition, types - aquatic and terrestrial ecosystem, structure of a basic ecosystem, Food chain and food web, Cycles in ecosystem – water, carbon, nitrogen, sulphur and phosphorus, Biodiversity – definition, types-genetic, species and ecosystem biodiversity, Threats -Habitat loss, poaching of wild life, man-wild life conflicts-endangered and endemic species of India, Conservation of biodiversity.

Unit- 2.0: Sustainable Energy Sources I**7 hrs**

Sustainable/ Renewable energy sources – solar energy, wind energy, small hydro energy, bio energy, geothermal, and new energy sources - hydrogen energy, ocean energy and tidal energy, Definition of energy audit, energy conservation, energy efficiency and energy management (definition only with one/two examples), Solar Energy - (i) Solar thermal energy conversion principle and applications - solar water heater, solar dryers, solar stills distillation, solar cooker, solar ponds, (ii) PV system energy conversion principle, solar cell technologies, thin film generations, solar cell, module, array, series parallel combinations and operations, applications – standalone, SPV water pump,

Unit-3.0: Sustainable Energy Sources II**7 hrs**

Wind Energy, wind plant and its parts, types – horizontal and vertical axis, principle of harnessing wind energy, advantages and challenges of harnessing wind energy, Small hydro energy – Principle, types-Mini, Micro and Pico, advantages and disadvantages, Biomass -biomass energy sources and their energy content, biological conversion technologies -thermo-chemical conversion, bio-chemical conversion and oil extraction, biogas production, types of biogas plant- floating (gobar gas) and fixed type, New Energy Sources: hydrogen energy, geothermal, ocean – tidal and wave energy.

Unit-4.0: Environmental Pollution**7 hrs**

Environment pollution -air, water, noise and soil, Air pollution- sources of air pollution-chemical, photochemical, green house effect, ozone layer depletion and acid rain, Air pollutants classification-primary and secondary pollutants, adverse effects of air pollution on human, plant and animal, Air monitoring system and air pollution control, Water pollution - sources of water pollution, Adverse effects of water pollution, Control of water pollution, Physical and chemical standard of domestic water as per indian standard, Sound Pollution - causes, controlling measures, measurement of sound pollution (deciblage), industrial and non – industrial, Soil Pollution – soil profile, pollutants in soil, their adverse effects, controlling measures.

Unit-5.0: Climate Change and Sustainable Development**7 hrs**

Impact of climate change, Factor contributing to climate change, Global warming – causes and effect, Comparison of climate change with global warming, Action plan on climate change- India, Concept of sustainability, social, environmental and economic aspect of sustainability, Origins of sustainable development: definition, evolution and principles, brundtland report , Sustainable development goals (SDGs), Strategies for sustainable development.

Unit-6.0: Sustainability Practices**7 hrs**

Environment management system and planning, Environment protection acts, legislation and laws, Zero waste and R concept, circular economy environmental management standards, ISO 14000 series, Material life cycle analysis (LCA), scope and goal, bio-mimicking, environment impact assessment (EIA), procedures of EIA in India, Energy cycles- carbon cycle, emission and sequestration, zero carbon foot-print building for sustainable construction, Green engineering: sustainable urbanization- socio- economic and technological change, Sustainable habitat-(i) Green buildings, (ii) Green and sustainable materials -5R concept, (iii) Sustainable/green transports.

B.Tech in Mechatronics Engineering

Text/Reference:-

1. Ecology and Control of the Natural Environment, Izrael, Y.A., Kluwer Academic Publisher
2. eBook ISBN: 978-94-011-3390-6
3. Renewable Energy Sources and Emerging Technologies, Kothari, D.P. Singal, K.C., Ranjan, Rakesh, PHI Learning, New Delhi, 2009, ISBN-13 - 978-8120344709
4. Green Technologies and Environmental Sustainability, Singh, Ritu, Kumar, Sanjeev, Springer International Publishing, 2017 eBook ISBN 978-3-319-50654-8.
5. Coping with Natural Hazards: Indian Context, K. S. Valadia Orient Longman, ISBN-10:8125027351, ISBN-13: 978-8125027355.
6. Introduction to Engineering and Environment, Edward S. Rubin McGraw Hill Publications ISBN-10: 0071181857, ISBN-13: 978-0071181853.
7. Environmental Science, Subrat Roy, Khanna Book Publishing Co. (P) Ltd., ISBN-978: 93-91505-65-3



Unit-1.0

7 hrs

Introduction to Indian Knowledge Systems

Overview of IKS, Organization of IKS , Conception and constitution of knowledge in indian tradition, The oral tradition, Models and Strategies of IKS.

Unit-2.0

5 hrs

Overview of IKS Domains

The vedas as the basis of IKS, Overview of all the six vedāṅgas.

Unit-3.0

8 hrs

Relevance in Current Technical Education System I

Relevance of following IKS domains in present technical education system: Arthashastra (Indian economics and political systems), Ganita and Jyāmīti (Indian mathematics, astronomy and geometry, Rasayana (Indian chemical Sciences).

Unit-4.0

8 hrs

Relevance in Current Technical Education System II

Ayurveda (Indian Biological Sciences / Diet & Nutrition), Jyotiṣa (observational astronomy and calendar systems), Prakṛti Vidya (Indian system of terrestrial/ material sciences/ecology and atmospheric sciences).

Unit-5.0

7 hrs

Relevance in Current Technical Education System III

Vastu Vidya (Indian system of aesthetics-iconography and built-environment /architecture), Nyāya Śāstra (Indian systems of social ethics, logic and law).

Unit-6.0

7 hrs

Śilpa and Nāṭya Śāstra (Indian classical arts: performing and fine arts), Sāṅkhya and Yoga Darśana (Indian psychology, yoga and consciousness studies), Vrikṣa Ayurveda (plant science/sustainable agriculture/food preservation methods).

Text/Reference:-

1. Introduction to Indian Knowledge System: Concepts and Applications, Archak, K.B. (2012), Kaveri Books, New Delhi, ISBN-13:978-9391818203
2. Introduction To Indian Knowledge System: Concepts and Applications, Mahadevan, B. Bhat, Vinayak Rajat, Nagendra Pavana R.N., PHI, ISBN: 9789391818203.
3. Glimpse into Kautilya's Arthashastra Ramachandrudu P. (2010) , Sanskrit Academy, Hyderabad, ISBN:9788380171074.
4. "Introduction" in Studies in Epics and Purāṇas, (Eds.), KM Munshi and N Chandrashekara Aiyer Bhartiya Vidya Bhavan.

List of Experiments:

1. Perform turn ratio and polarity test on 1-phase transformer.
2. Perform direct load test on a 1-phase transformer and plot its load characteristic.
3. Assemble and disassemble a given type of DC machine
4. Speed control of D.C shunt motor above rated speed.
5. Speed control of D.C shunt motor below rated speed
6. Swinburne's test on DC shunt motor
7. Assemble/ Disassemble a cut section model of a given 3 phase Induction motor and identify its parts and material
8. Slip measurement of a 3- phase Induction motor by using:
 - (i) Tachometer and
 - (ii) Stroboscopic method.
9. Starting of three phase induction motor using starters.
10. Speed control of squirrel cage induction motor.
11. Speed control of slip-ring induction motor.
12. No-load test on a 1- phase IM to determine the rotational losses
13. Control the speed and position of a stepper motor
14. Generate pulse waveforms to control a stepper motor.
15. Speed-Torque characteristics of a AC servo motor
16. AC Servo position
17. Pipe ear thing
18. Simulate a typical Smart Grid using MATLAB/ SIMULINK software.

Perform any ten experiments**List of Experiments:**

1. Determine the value of the given resistor
2. Operate different components like CRO, Function generator
3. Determine P-N junction diode forward and reverse bias characteristics.
4. Determine Zener diode characteristics in reverse bias
5. Design a +5 V DC regulated power supply delivering up to 1A of current to the load and determine the load regulation and efficiency of the regulated power supply.
6. Design a BJT Common Emitter (CE) /CB/CC Amplifier using voltage divider bias (self-bias) bypassed emitter resistor to
 - Measurement of gain
 - Plot the frequency response & Determination of Gain Bandwidth Product.
7. Plot the input and output characteristics of a BJT in CB Configuration and compute the h-parameters.
8. Plot the input and output characteristics of a BJT in CE Configuration and compute the h-parameters.
9. Determine frequency response curve and to obtain its band width of Common Source (CS) Amplifier
10. Simulate BJT CE voltage divider biased voltage amplifier using any suitable circuit simulator.
11. Design a RC coupled single stage BJT amplifier and determine the gain-frequency response, input and output impedance.
12. Design a BJT Darlington Emitter follower and determine the gain and input resistance and output impedance, compare with calculated values, Plot the frequency response & determination of gain bandwidth product.
13. Design a FET /BJT voltage series feedback amplifier and determine the gain, feedback response, input and output impedance with and without feedback.
14. Construct a differential amplifier and to determine Transfer Characteristics.
15. Construct and verify the performance of two stage Cascode/ Cascade amplifier and to determine the frequency response and Bandwidth.
16. Design a RC coupled single stage FET amplifier and determine the gain-frequency response, input and output impedance, Transconductance, amplification factor
17. Design and test for the RC phase shift Oscillator for the given operating frequency
18. Design and test for the performance of FET- Hartley & Colpitts oscillators
19. Determine practical output of Adder, circuit using OP-AMP IC741 and compare it with theoretical output.
20. Operate Integrator & differentiator using op-amp and trace the output wave forms for sine and square wave inputs.
21. Use ua 741 Opamp, design a 1 kHz Relaxation Oscillator with 50% duty cycle.
22. Design an astable multivibrator circuit for three cases of duty cycle (50%, <50% and >50%) using N 555 timer IC.
23. Use ua 741 opamp, design a window comparator for any given UTP and LTP
24. Find out BCD to excess-3 code conversion using logic gate
25. Find out the truth table of MUX and DEMUX using logic gates
26. Find out the truth table verification of JK flip-flop
27. Find out the truth tables of AND, OR, NOT logic gates
28. Find out the Truth Tables of AND, OR, NOT, NAND, NOR, EXOR logic gates
29. Determine the given function using basic gates $F(w,x,y,z)=\sum(0,1,2,3,4,5,6,9,10,11,12,13)$
30. Determine half/full adder Using X-OR and basic gates

B.Tech in Mechatronics Engineering

31. Determine half/full subtractor Using X-OR and basic gates
32. Construct and operate the circuit of multiplexer
33. Design and implement encoder and decoder using logic gates.
34. Design the 3-bit counter, ring counter as a sequential circuit
35. Find out state tables of R-S flip-flop, J - K flip-flop, T Flip-Flop, D Flip-Flop using NAND and NOR gates.
36. Implement decoder, de-multiplexer and encoder, using logic gates.
37. Design 4-bit synchronous counter
38. Identify the truth table of one bit and two-bit comparators using logic gates
39. Find out the truth table for various combinations of inputs of Flip-Flops- JK Master Slave, D-Type, T-Type
40. Design and test ring counter /Johnson counter.
41. Covert a given octal input to the binary output and note the display using 7447 7- segment decoder/ driver.
42. Develop sequential circuit using 3-bit counters and Mod-N counter design (7476, 74192, 74193)
43. Design and test monostable and astable multi vibrators using 555 timer.

(Perform any 10 Experiments)

List of Experiments:

1. Synchro transmitter and receiver pairs.
2. Speed-torque characteristics of an AC servomotor.
3. Speed-torque characteristics of a DC servomotor.
4. DC motor position control
5. AC Position system
6. ON/OFF temperature control system
7. Transient response of a first order system
8. Steady State error using MATLAB
9. Verification of output response of a Second Order System using RLC circuit.
10. Design PID Controller for first order and second order systems.
11. Step, ramp, impulse response of first and second order system.
12. Time response of second order system when subjected to unit a step input.
13. Stability analysis of linear time invariant systems using MATLAB
14. PID Controller Design for Two Tank System (Linear Control Systems).
15. Use open source software i.e. SCILAB to find the stability of the system
16. Observe the effect of adding poles & zeros on root loci and bode plots of type-1, type-2 systems using MATLAB.
17. Frequency response of a system by plotting Root locus plot using MATLAB.
18. Stability analysis of linear time invariant systems using MATLAB
19. Analyze frequency response of a system by plotting Bode plot using MATLAB.
20. Analyze frequency response of a system by plotting Nyquist plot using MATLAB.
21. Conversion of transfer function to state space model
22. Develop state space model for a transfer function using MATLAB.

Perform any 10 Experiments

List of Experiments:

1. V-I Characteristics of SCR.
2. Characteristics of IGBT.
3. Characteristics of power MOSFET.
4. Characteristics of DIAC.
5. Characteristics of TRIAC.
6. R and RC triggering circuits of SCR.
7. UJT triggering circuits of SCR.
8. Forced commutation circuit (A, B, C, D and E)
9. Performance of a half wave-controlled rectifier comprising of SCR for R, RL load and RL load with freewheeling diode.
10. Performance of a full wave-controlled rectifier comprising of SCR for R, RL load and RL load with freewheeling diode.
11. Performance of three phase half-controlled bridge converter.
12. Performance of waveforms of 3-phase half-controlled bridge converter with R and RL and loads.
13. Determine waveforms of 3-phase full controlled bridge converter with R and RL and loads
14. Performance of the firing circuit of Three Phase Full Controlled Bridge Converter.
15. Speed control of DC shunt motor using single phase full wave converter.
16. Speed control of DC shunt motor using single phase semi converter.
17. Speed control of DC Series motor using single phase full wave converter.
18. Speed control of DC Series motor using single phase semi converter.
19. Speed control of DC Shunt motor by armature voltage control method using step down chopper.
20. Speed control of DC series motor by armature voltage control method using step down chopper.
21. Speed control of three phase squirrel cage induction motor using VFD.
22. Speed control of three phase wound rotor induction motor using rotor resistance control method.
23. Test 3-phase AC voltage regulator
24. Speed control of a 3-phase induction motor in variable stator voltage mode using 3-phase AC voltage regulator
25. Speed control of synchronous motor using Cycloconverter.
26. Control of a 3-phase induction motor in variable frequency V/f constant mode using 3-phase inverter.