

B.Tech. Automation and Robotics

6th SEMESTER



ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)
Khwaja Moinuddin Chishtil Language University, Lucknow, U.P. (India)

U.P. STATE GOVERNMENT UNIVERSITY,
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Paper Code- ME-601
Credit- 4

MACHINE DESIGN-II

Course Outcomes:

At the end of the course the students will be able to

1. Students understand the principles of mechanical components and mechanisms, applying them to design various machine elements such as gears, shafts, and bearings.
2. Proficient in DFM/DFA principles, students design machine components considering ease of manufacturing, assembly, and maintenance, optimizing production processes.
3. Understanding material properties and failure modes, students design machine elements to withstand loads and prevent failures, employing techniques such as stress analysis and fatigue prediction.
4. Students analyze the motion of machine components using kinematic and dynamic principles, designing mechanisms to achieve desired motion profiles and performance characteristics.
5. Proficient in CAD software, students create and simulate machine designs, evaluating performance, and optimizing designs before fabrication, reducing time and cost in the design process.

UNIT-I

Spur Gears

Friction wheels, Advantages and disadvantages of gear drive, Classification of gear, Terminology of gears, Law of gearing Tooth forms, System of gear teeth, Standard proportions of gear systems, Interference in involute gears, Selection of gear materials, Gear manufacturing methods, Load on gear, Beam strength of gear tooth, Effective tooth load, Wear strength of gear tooth, Dynamic tooth load, Static tooth load, Cause of Failure of gear tooth, Design of spur gears, Spur gear construction.

UNIT-II

Helical Gears

Introduction, Classification of Helical gear, Terminology of helical gear, Helical gear force analysis, Face width of helical gears, Formation or equivalent number of teeth for helical gears, Proportion for helical gears, Strength of helical gears, Design of helical gears.

Bevel Gears

Introduction, Classification of Bevel gear, Terminology of Bevel gear, Strength of bevel gear, Force acting on bevel gear, Design of a shaft for bevel gear.

UNIT-III

Worm Gear

Introduction, Types of worms, Types of worm gears, Terminology of worm gear, Proportion for worms, Proportion of worm gear, Efficiency of worm gearing, Strength of worm gear teeth,



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wear tooth load analysis for worm gear, Heat dissipation in worm gearing, Forces acting on worm gears, Design of worm gear system.

UNIT-IV

Sliding Contact Bearing

Introduction on bearing and sliding contact bearing, Classification bearing, Terminology of sliding, Classification of sliding contact bearing, McKee's Investigation, Hydrostatic bearing, Difference between hydrostatic and hydrodynamic bearing, Bearing materials, Sommerfeld number, Heat generation and Dissipation of bearing.

Rolling Contact Bearing

Introduction, Advantages and disadvantages of Rolling contact bearing over sliding contact bearing, Classification of rolling contact bearing: Ball bearings, Roller bearings; Load life relation, Dynamic load rating for rolling contact bearing under variable loads, Lubrication of Ball and roller bearing.

UNIT-V

Power Screws

Introduction, Advantage and disadvantage of power screw, Application of power screw, Types of thread, Designation of screw, Multiple threaded screw, Terminology of power screw, Torque requirement for lifting and lowering by square threaded screws, Efficiency and Maximum efficiency of square threaded screws, Coefficient of friction, Acme or trapezoidal threads and their efficiency, Design of screw jack.

Clutches

Introduction, Types of Clutches, Friction clutches, Properties of material used for friction clutches, Advantage of friction clutch, Considerations in designing a friction clutch, Types of friction clutches, Designation of Single Disc or plate clutch and multiple disc clutch, Designation of Cone clutch, Designation of Centrifugal clutch.

Note: Design data book is allowed in the examination

Text /Reference Books:

1. Shigley's Mechanical Engineering Design" by Richard G. Budynas and Keith J. Nisbett - Published by McGraw-Hill Education in 2021.
2. "Machine Design: An Integrated Approach" by Robert L. Norton - Published by Pearson in 2020.
3. "Design of Machinery: An Introduction to the Synthesis and Analysis of Mechanisms and Machines" by Robert L. Norton - Published by McGraw-Hill Education in 2021.
4. "Machine Elements in Mechanical Design" by Robert L. Mott and Edward M. Vavrek - Published by Pearson in 2018.
5. "Mechanical Design: An Integrated Approach" by Ansel C. Ugural and Saul K. Fenster - Published by Wiley in 2020.



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Paper Code- ME-604
Credit- 4

DYNAMICS OF MACHINE

Course Outcomes:

1. Understand the principles of dynamics of machines.
2. Ability to calculate the power required in flywheel operation.
3. Apply the concept of vibration, with a single and multi-degree of freedom system.
4. Apply the concept of damped and undamped vibration, and determine the effort required in the governor.
5. Understand the gyroscope and its applicability on ships and automobile.

UNIT I

Force Analysis

Dynamic force analysis - Inertia force and inertia torque- D Alemberts principle -Dynamic Analysis in reciprocating engines Gas forces inertia effect of connecting rod Bearing - Crankshaft torque, Turning moment diagrams Fly Wheels - Flywheels of punching presses-dynamics of cam-follower mechanism.

UNIT II

Balancing

Static and dynamic balancing, Balancing of rotating masses - Balancing a single cylinder engine - Balancing of Multi-cylinder inline, V-engines Partial balancing in engines Balancing of linkages, Balancing machines-Field balancing of discs and rotors.

UNIT III

Single Degree Free Vibration:

Basic features of vibratory systems Degrees of freedom single degree of freedom Free vibration- Equations of motion Natural frequency - Types of Damping - Damped vibration torsional vibration of shaft - Critical speeds of shafts Torsional vibration - Two and three rotor torsional systems.

UNIT IV

Forced Vibration

Response of one-degree freedom systems to periodic forcing harmonic disturbances -Disturbance caused by unbalance - Support motion -transmissibility Vibration isolation vibration measurement.

UNIT V

Mechanism for Control

Governors - Types - Centrifugal governors Gravity controlled and spring controlled centrifugal governors - Characteristics - effect of friction - Controlling force curves. Gyroscopes-Gyroscopic forces and torques - Gyroscopic stabilization Gyroscopic effects in Automobiles ships and airplanes.

References

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1. "Mechanisms and Dynamics of Machinery" by Hamilton H. Mabie, Charles F. Reinholtz, and Joseph E. Shigley - Published by Wiley in 2019.
2. "Theory of Machines and Mechanisms" by John J. Uicker, Gordon R. Pennock, and Joseph E. Shigley - Published by Oxford University Press in 2019.
3. "Mechanical Design of Machine Elements and Machines: A Failure Prevention Perspective" by Jack A. Collins and Henry R. Busby - Published by Wiley in 2018.
4. "Engineering Dynamics: A Comprehensive Introduction" by Nai Yuen Chen - Published by Springer in 2019.
5. "Mechanical Vibrations: Theory and Applications" by S. Graham Kelly - Published by Cengage Learning in 2018.

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भाषा विश्व विद्यालय



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Paper Code- AR-601
Credit- 4

POWER ELECTRONICS AND DRIVES

Course Outcomes:

1. To understand the operations of power semiconductor devices.
2. To analyse the performance of the single phase and three phase converters.
3. To study the basics of the inverters and choppers.
4. To understand the operation of electric drives.
5. To analyse the performance drives used for automation.

UNIT-I

Power Semiconductor Devices

Power diodes - Power transistors - Characteristics of SCR - TRIAC - Power MOSFET - IGBT - Thyristor protection circuits - Thyristor triggering circuits- Selection of device.

UNIT-II

Converters

Single phase - Three phase - Fully controlled rectifiers - Effect of source and load inductance -single phase- Three phase AC voltage controller -Control Circuits for AC to DC and AC to AC converters.

UNIT-III

Inverters and Choppers

Voltage Source inverters - bridge inverters- 120° and 180° conduction - Pulse Width Modulation - Single and Multiple PWM - SPWM - Generation of pulses for SPWM - DC choppers: Buck- Boost - Buck Boost -Generation of timing pulses for DC choppers - Applications (Block diagram approach) Uninterrupted power supplies - SMPS - Basics of Magnetic design for power electronics.

UNIT- IV

Introduction To Drives

Basic elements-types of electric drives-factors influencing electric drives-heating and cooling curves - loading conditions and classes of duty-Selection of power rating for drive motors with regard to thermal overloading and load variation factors.



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UNIT- V

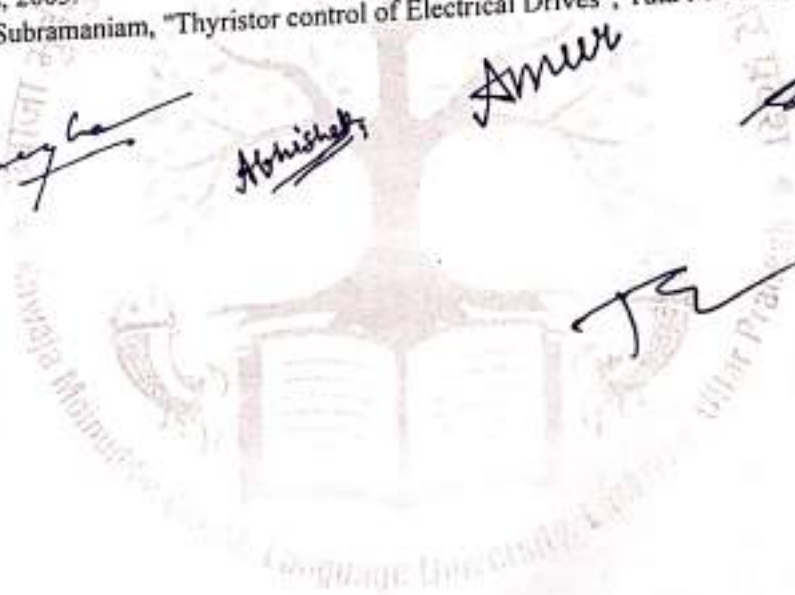
Drives For Automation

Operating modes - quadrant operation of chopper - Closed loop control of DC drives. Stator and rotor voltage control - frequency and voltage control - Current Control - Basics of vector control- Block diagram - Stepper Motor Drive - BLDC Motor Drive - PMSM Drive-protection devices for drives

Text Book (s):

1. Rashid M H , "Power Electronics –Circuits, Devices and Applications", 4th edition Pearson Education India, 2017.
2. Ramu Krishnan, "Electric Motor Drives: Modeling, Analysis, and Control", Prentice Hall, 2002.
3. Bimal K Bose, "Modern Power Electronics and AC Drives", Pearson Education, 2002.
4. Roger C Dugan, Surya Santoso, Mark F McGranaghan, "Electrical Power Systems. Quality", 3rd edition McGraw Hill, 2012.
5. 2. Mohan, Undel, "Power Electronics", John Wiley and sons, 2003.
6. Vedam Subramaniam, "Thyristor control of Electrical Drives", Tata McGraw-Hill, 1998

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भाषा विश्व मोल्यमति



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Paper Code- MGT-601
Credit-2

MANAGERIAL ECONOMICS

Course Outcome:

1. The student will be able to understand the basics and scope and methods of managerial economics and optimization techniques.
2. The student will understand the demand analysis and forecasting methods and associated terminologies and concepts.
3. The student will develop a basic understanding towards the market structure and the related fluctuations associated with it.
4. The student will develop a basic knowledge about the budget and impact of various policies.
5. The student will understand the terminologies associated with the income and its other aspects.

UNIT I

The Scope and Methods of Managerial Economics, Risk, Uncertainty and Probability Analysis. Optimization techniques: Total, Average and Marginal Relationships, Optimization Analysis. Multivariate Optimization - Partial Derivatives; Constraint Optimization by substitution, by Lagrangian Multiplier Method. Approach to Managerial Decision Making and the theory of firm.

UNIT II

Demand Analysis, Basic Concepts, and tools of analysis for demand forecasting. Use of business indicators; Demand forecasting for consumer, Consumer Durable and Capital Goods. Concepts in resource allocation, cost analysis; break even analysis, short run and long run cost functions; production functions; cost-price output relations - Capital Investment Analysis. Economics of size and capacity utilization; Input-Output Analysis.

UNIT III

Market Structure, Pricing and output; General Equilibrium. Pricing - Objectives - Pricing Methods and Approaches Product Line Pricing - Differential Pricing. Advertising - Contribution of Economic Theory, Methods of Determining Total Advertising Budget, Cyclical Fluctuations of Advertising, Measuring the Economic Effects of Advertising

UNIT IV

Capital Budgeting - Capital Management and Financial Policy - Monopoly Policy - Restive Agreements - Price Discrimination - Measurement of Economic Concentration - Policy against Monopoly and Restrictive Trade Practices.



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UNIT V

National Income and Product. Saving Consumption, Investment, the theory of income determination.

Text book/References

1. Dominick Salvatore, Managerial Economics in a Global Economy, 4th Edition, Thomson, 2001
2. H. Craig Petersen, W. Cris Lewis, Managerial Economics, 4th Edition, Pearson Education, Asia, 2001.
3. Joel Dean, Managerial Economics, Prentice Hall India Ltd., 2001.
4. O.P. Chopra, Managerial Economics, New Delhi, Tata McGraw Hill 1985.
5. Paul A. Samuelson and William D. Nordhans, Economics, Tata McGraw Hill, New Delhi 1998
6. Maheswari : Managerial Economics, PHI, 2002.





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PROFESSIONAL ELECTIVE –2

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Paper Code- PE-021
Credit- 4

MOBILE ROBOTICS

Course Outcomes:

At the end of the course students will be able to:

1. Identify and design a suitable manufacturing process for micro robots.
2. Understand the importance of visual perception and recognition for cybernetic view.
3. Program a robot for wandering and teleoperation.

UNIT-I

Introduction to Mobile Robots - Tasks of mobile robots, robots manufacturers, type of obstacles and challenges, tele-robotics, philosophy of robotics, service robotics, types of environment representation. Ground Robots: Wheeled and Legged Robots, Aerial Robots, Underwater Robots and Surface Robots.

UNIT-II

Kinematics and Dynamics of Wheeled Mobile Robots (two, three, four - wheeled robots, omnidirectional and macanum wheeled robots). Sensors for localization: magnetic and optic position sensor, gyroscope, accelerometer, magnetic compass, inclinometer, GNSS and Sensors for navigation: tactile and proximity sensors, ultrasound rangefinder, laser scanner, infrared rangefinder, visual system.

UNIT-III

Localization and Mapping in mobile robotics. Motion Control of Mobile Robots (Model and Motion based Controllers): Lyapunov-based Motion Control Designs and Case Studies. Understand the current application and limitations of Mobile Robots. Introduction to Mobile Manipulators and Cooperative Mobile Robots.

UNIT-IV

Micro-robotics: Introduction, Task specific definition of micro-robots - Size and Fabrication Technology based definition of micro-robots - Mobility and Functional-based definition of microrobots - Applications for MEMS based micro-robots. Implementation of Micro-robots: Arrayed actuator principles for micro-robotic applications - Micro-robotic actuators.



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UNIT-V

Design of locomotive micro-robot devices based on arrayed actuators. Micro-robotics devices: Micro-grippers and other micro-tools - Micro-conveyors - Walking MEMS Micro-robots - Multirobot system: Micro-robot powering, Micro-robot communication. Microfabrication and Microassembly: Micro-fabrication principles - Design selection criteria for micromachining - Packaging and Integration aspects - Micro-assembly platforms and manipulators.

Reference Books:

1. Roland Siegwart, Illah Reza Nourbakhsh, Davide Sacramuzza, Introduction to Autonomous Mobile Robots, MIT press, 2nd edition, 2011
2. Howie Choset, Kevin Lynch Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki, and Sebastian Thrun, —Principles of Robot Motion-Theory, Algorithms, and Implementation, MIT Press, Cambridge, 2020.
3. Atnaik, Srikanta, "Robot Cognition and Navigation: An Experiment with Mobile Robots", Springer-Verlag Berlin and Heidelberg, 2021.
4. Spyros G. Tzafestas, "Introduction to Mobile Robot Control", Elsevier, 2021.
5. Margaret E. Jefferies and Wai-Kiang Yeap, "Robotics and Cognitive Approaches to Spatial Mapping", Springer-Verlag Berlin Heidelberg, 2022.

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Abhishek Anur TE



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OPEN ELECTIVE -2

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Paper Code- OE-021
Credit- 3

SOFTWARE ENGINEERING

Course Outcomes:

1. Understand and apply fundamental software engineering principles and practices in the design, development, and maintenance of software systems.
2. Develop and analyze software requirements specifications, ensuring they are complete, consistent, and feasible.
3. Design software architecture and components using appropriate modelling techniques, such as UML, to create effective and efficient software solutions.
4. Implement software systems using modern programming languages and development environments while adhering to best coding practices.
5. Conduct software testing and debugging to ensure software reliability, performance, and correctness.

UNIT-I

Introduction to Software Engineering, Software Components, Software Characteristics, Software Crisis, Software Engineering Processes.
Software Development Life Cycle (SDLC) Models: Water Fall Model, Prototype Model, Spiral Model, Evolutionary Development Models, Iterative Enhancement Models.

UNIT-II

Software Requirement Specifications (SRS). Requirement Engineering Process: Elicitation, Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Information Modeling, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables, SRS Document, IEEE Standards for SRS. Software Quality Attributes, Software Quality Assurance (SQA): Verification and Validation, SQA Plans, Software Quality Frameworks, ISO 9000 Models, SEI-CMM Model.

UNIT-III

Software Design: Basic Concept of Software Design, Architectural Design, Low Level Design: Modularization, Design Structure Charts, Pseudo Codes, Flow Charts, Coupling and Cohesion Measures, Design Strategies: Function Oriented Design, Object Oriented Design, Top-Down and Bottom-Up Design. Software Measurement and Metrics: Various Size Oriented Measures: Halstead's Software Science, Function Point (FP) Based Measures, Cyclomatic Complexity Measures: Control Flow Graphs.

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UNIT-IV

Software Testing: Testing Objectives, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Testing for Functionality and Testing for Performance, Top-Down and Bottom-Up Testing Strategies: Test Drivers and Test Stubs, Structural Testing (White Box Testing), Functional Testing (Black Box Testing), Test Data Suit Preparation, Alpha and Beta Testing of Products. Static Testing Strategies: Formal Technical Reviews (Peer Reviews), Walk Through, Code Inspection, Compliance with Design and Coding Standards.

UNIT-V

Software Maintenance and Software Project Management, Software as an Evolutionary Entity, Need for Maintenance, Categories of Maintenance: Preventive, Corrective and Perfective Maintenance, Cost of Maintenance, Software Re-Engineering, Reverse Engineering. Software Configuration Management Activities, Change Control Process, Software Version Control, An Overview of CASE Tools. Estimation of Various Parameters such as Cost, Efforts, Schedule/Duration, Constructive Cost Models (COCOMO), Resource Allocation Models, Software Risk Analysis and Management.

Text Book (s):

1. Software Engineering: A Practitioner's Approach, Pressman Roger, TMH, 2020.
2. An Integrated Approach to Software Engineering, Pankaj Jalote, Narosa Pub, 2021.
3. Software Engineering Concepts: Richard Fairly, Tata McGraw Hill, 2021.
4. Schaum's Series, "Software Engineering", TMH
5. Ghezzi, Carlo and Others, "Fundamentals of Software Engineering", PHI
6. Alexis, Leon and Mathews Leon, "Fundamental of Software Engineering", Vikas
7. Sommerville, Ian, "Software Engineering", AWL

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भाषा विश्व सोजयति



ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)
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Paper Code- OE-022
Credit- 3

COMPUTER NETWORKS

Course Outcomes:

1. Understand fundamental concepts of computer network technology.
2. Comprehend various network topologies and protocols.
3. Examine the roles and functions of different network devices.
4. Analyze the architecture and principles underlying contemporary computer networks.
5. Understand future Internet requirements and their implications for computer network architecture.

UNIT-I

Computer Networks and The Internet: Networks, Internet, Network Components, Network Categories, network edge, Network Core, Delay, Loss and throughput in Packet-Switched Networks, Protocol Layers and their Service Models.

UNIT-II

Data Link Layer: Introduction to the link layer, Error Detection and Correction Techniques; Multiple Access links and Protocols; Switched local area networks.

UNIT-III

Network Layer: Introduction; Virtual circuit and datagram networks; Router, Internet Protocol (IP): Forwarding and Addressing in the Internet, Routing Algorithms; Routing in the Internet, Broadcast and Multicast Routing.

UNIT-IV

Transport Layer: Introduction and Transport-Layer Services; Multiplexing and Demultiplexing; Connectionless Transport: UDP; Principles of Reliable of Data Transfer; Connection-Oriented Transport: TCP; Principles of Congestion Control, TCP Congestion Control.

UNIT-V

Application Layer: Principles of Network Applications, WWW and HTTP, Non-Persistent and Persistent Connections, Cookies, Web Caching, File Transfer, Remote Logging, Electronic Mail in the Internet, Domain Name System, Security: Introduction, Cryptography and Cryptanalysis, Public Key Cryptography Algorithms, RSA Algorithm, DES, Authentication and Authorization.

Text Book (s):

1. A.S. Tanenbaum, DJ Wetherall, Computer Networks, Prentice-Hall, 2010. .
2. LL Peterson, BS Davie, Computer Networks: A Systems Approach, Morgan-Kauffman, 2011.
3. G. Keiser, "Local Area Networks", 2nd Edition, TMH 2002
4. D. Bertsekas and R. Gallager, "Data Networks", 2nd Edition, PHI 2000
5. William Stallings, "Data & Computer Communication", PHI, 10th Edition 2013
6. B.A. Forouzan, "Data communications and networking", TMH, 5th Edition 2012
7. B.A. Forouzan, "TCP/IP Protocol Suite", TMH. 2004.

Abhishek *Amur*

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Paper Code- ME-651
Credit- 1

MACHINE DESIGN-II LAB

Course Outcomes:

1. Apply the principles of Gear designation and bearing for industrial purpose.
2. Apply practical lifting force for different element by the designation of screw jack and clutch performance for automobile engineering.

List of Experiments

1. Design of Spur Gear
2. Design of Helical Gear
3. Design of Bevel Gear
4. Design & select suitable Rolling Contact Bearing for a shaft with given specifications.
5. Design of Journal Bearing
6. Selection of rolling element bearing
7. Design and Drawing of Screw jack.
8. Design of clutches.

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0 0 2

Paper Code- AR-651
Credit- 1

POWER ELECTRONIC DEVICES LAB

Course Outcomes:

After completion of this course, the student is able to

1. Understand the operating principles of various power electronic converters.
2. Use power electronic simulation packages & hardware to develop the power converters.
3. Analyze and choose the appropriate converters for various applications.

List of Experiments

1. V-I characteristics of semiconductor diodes
 - a) PN Junction diode
 - b) Point contact diode
 - c) Zener diode
2. Characteristics of BJT in CE configuration
 - a) Determination of input and output characteristics
 - b) Determination of voltage gain, current gain, input and output resistances from the characteristics
3. Characteristics of JFET
 - a) Determination of output and transfer characteristics Determination of pinch off voltage, r_d , g_m and μ from the characteristics
4. Characteristics of MOSFET
 - a) Determination of output and transfer characteristics
 - b) Determination of pinch off voltage, r_d , g_m and μ from the characteristics
5. Characteristics of UJT, SCR and TRIAC
6. To study the application of Op-amp IC741 as
 - a) Inverting amplifier
 - b) Non-inverting amplifier
 - c) Voltage follower
 - d) Summer Subtractor
7. To study the op-amp performance as differentiator and integrator for various time constants

B.Tech. Automation and Robotics

5th SEMESTER



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Paper Code- ME-501
Credit- 4

MACHINE DESIGN-I

Course Outcomes:

1. Recall the basic concepts of Solid Mechanics to understand the subject and classify various machine elements based on their functions and applications.
2. Apply the principles of solid mechanics to machine elements subjected to static and fluctuating loads.
3. To understand the riveting/bolted/welded methodology for the industrial application.
4. To understand the energy absorbing phenomena by the spring.
5. To understand the power transmission, locking and holding devices as shaft, keys and coupling for machine parts.

UNIT-I

Introduction to machine design, Definition, Classifications, Design requirements of machine elements, Design procedure, Standards in design, Selection of preferred sizes, Indian Standards designation of carbon & alloy steels, Classification of engineering materials, Selection materials for static and fatigue loads. Mechanical property of metals.

UNIT-II

Design for Static Loading: Modes of failure, Factor of safety, Principal stresses, Stresses due to bending and torsion, Theory of failure.

Design for Dynamic Loading: Cyclic loading, Type of cyclic stress, Terminology of stress cycle, static loading v/s dynamic loading, Fatigue and fatigue failure, Finite and infinite life, log S-log N curve, Endurance limit, Stress concentration, Stress concentration factor and stress concentration for various machine parts, Soderberg, Goodman & Gerber criteria, Notch sensitivity factor.

UNIT-III

Riveted Joints

Riveting methods, materials, Types of rivet heads, Types of riveted joints, Terminology of riveted joints, Caulking and Fullering, Mode of failure of riveted joint, Efficiency of riveted joint, Eccentric loaded riveted joint.

Bolted Joints

Threaded Fasteners and Power Screws Stresses in threaded fasteners, Effect of initial tension, Design of threaded fasteners under static loads, Design of eccentrically loaded bolted joints. Types of power screws, efficiency and self-locking, Design of power screw, Design of screw jack

Welded Joints

Introduction, Advantage and disadvantage, Type of welded joints, Strength of parallel fitted lap joint and Transverse fitted lap joint, Special cases of fillet welded joints.



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UNIT-IV

Mechanical Springs

Definitions, Types of spring, Advantages of helical spring, Terminology of spring, End connections for compression helical spring, Stresses and deflection in helical springs of circular wire, Connection of spring: Spring in series and parallel.

UNIT-V

Shafts:

Cause of failure in shafts, Materials for shaft, Stresses in shafts, Design of shafts subjected to twisting moment, bending moment and combined twisting and bending moments, Shafts subjected to fatigue loads.

Keys and Couplings

Types of keys, splines, Selection of square & flat keys, Strength of sunk key, Couplings, Requirement of good shaft coupling, Types of Shaft coupling, Design of rigid and flexible couplings.

Note: Design data book is allowed in the examination

Text /Reference Books:

1. Design of Machine Elements, V.B. Bhandari, TataMcGraw Hill Co, 2020.
2. Machine Design-Sharma and Agrawal, S.K. Kataria&Sons, 2018.
3. Machine Design, U C Jindal, Pearson Eductaion, 2013.
4. Design of Machine Elements, Sharma and Purohit, PHI, 2013.
5. Design of Machine Elements-M.F. Spott, Pearson Eductaion, 2019.
6. Mechanical Engineering Design, 9e - Joseph E. Shigely, McGraw Hill Education, 2024.
7. Elements of Machine Component Design, Juvinal & Marshek, John Wiley & Sons, 2017.

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Paper Code- ME-502
Credit- 4

KINEMATICS OF MACHINE

Course Outcomes:

1. Understand the principles of kinematics of machines.
2. Calculate the velocity and acceleration for 4-bar and slider crank mechanism and Develop cam profile for followers executing various types of motions.
3. Apply the concept of gear, gear train and flywheel for power transmission.
4. Apply force analysis for slider crank mechanism and balance rotating & reciprocating masses in machines.
5. Apply the concepts of governors in fluctuation of load and brake & dynamometer in power transmission.

UNIT- I

Introduction, mechanisms and machines, kinematics and kinetics, types of links, kinematic pairs and their classification, types of constraint, degrees of freedom of planar mechanism, Grubler's equation, mechanisms, inversion of four bar chain, slider crank chain and double slider crank chain. Velocity analysis: Introduction, velocity of point in mechanism, relative velocity method, velocities in four bar mechanism. Instantaneous center. Acceleration analysis: Introduction, acceleration of a point on a link, acceleration diagram, Coriolis component of acceleration, crank and slotted lever mechanism.,

UNIT- II

Cams Introduction, classification of cams and followers, cam profiles for knife edge, roller and flat faced followers for uniform velocity, uniform acceleration, Gears and gear trains Introduction, classification of gears, law of gearing, tooth forms and their comparisons, systems of gear teeth, length of path of contact, contact ratio, minimum number of teeth on gear and pinion to avoid interference, simple, compound, reverted and planetary gear trains, sun and planet gear train.

UNIT- III

Force analysis: Static force analysis of mechanisms, D'Alembert's Principle, dynamics of rigid link in plane motion, dynamic force analysis of planar mechanisms, piston force and crank effort. Turning moment on crankshaft due to force on piston, Turning moment diagrams single cylinder double acting steam engine, four stroke IC engine and multi-cylinder e Fluctuation of speed, Flywheel.

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UNIT- IV

Balancing Introduction, static balance, dynamic balance, balancing of rotating masses, two plane balancing, graphical and analytical methods, balancing of reciprocating masses, Governors: Introduction, types of governors, characteristics of centrifugal governors, gravity controlled and spring controlled centrifugal governors, hunting of centrifugal governors, inertia governors. Effort and Power of governor

UNIT -V

Brakes and dynamometers: Introduction, Law of friction and types of lubrication, types of brakes, effect of braking on rear and front wheels of a four-wheeler, dynamometers, belt transmission dynamometer, torsion dynamometer, hydraulic dynamometer

Reference Books:

1. Kinematics and dynamics of machinery: Wilson and Sadler, Third edition, Pearson, 2002.
2. Theory of Mechanisms and Machines: Amitabha Ghosh and Ashok Kumar Mallik, Third Edition Affiliated East-West Press, 2008.
3. Theory of Machines and Mechanisms: Joseph Edward Shigley and John Joseph Uicker, Jr. Oxford University Press, 2014.
4. Kinematics and dynamics of machinery: R L Norton, McGraw Hill, 2017
5. Theory of Machines: S.S. Rattan, McGraw Hill, 2019

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Paper Code- AR-501
Credit- 4

PROGRAMMABLE LOGIC CONTROL

Course Outcome (CO):

The student will be able to

1. Understand the basics of automation and PLC along with its evolution.
2. Learn about PLC, its architecture and modules.
3. Program PLC by developing an understanding various parameters associated with it.
4. Understand HMI system and its need in industrial automation
5. Learn networking of PLC and its application.

UNIT-I

Introduction to factory & process automation: Industrial version- control elements of industrial automation- IEC/ISA standards for control elements, selection criteria for control elements, construction of relay ladder logic with different control elements, need for PLC, PLC evolution.

UNIT-II

Programmable logic controllers: Architecture of PLC, types of PLC, PLC modules, PLC configuration, scan cycle, capabilities of PLC, selection criteria for PLC, PLC communication with PC and software, PLC wiring, installation of PLC and its modules.

UNIT-III

Programming of PLC: Types of programming, bit instructions, timers and counters, PLC arithmetic functions PTO/PWM generation, high speed counter, analog scaling, encoder interfacing, servo drive control, stepper motor control.

UNIT-IV

HMI system: Need for HMI in industrial automation, types of HMI, configuration of HMI, screen development and navigation, configuration of HMI elements/ object and interfacing with PLC

UNIT-V

Networking: PLC networking, networking standards & IEEE standard protocols, field bus, process bus and ethernet CAN open.

Application of PLC: Case studies of manufacturing automation and process automation.

Textbooks/Reference Books:

1. W. Bolton- Programmable Logic Controllers Elsevier Ltd. 2020
2. Frank D Petruzella- programmable logic controllers, McGraw Hill, 5th edition 2022
3. John R Hackworth and Fredrick D Hackworth Jr.- Programmable logic Controllers: Programming methods and Applications, Pearson Education, 2021
4. SIMATIC Programming with STEP 7, SIEMENS Manual 2014.

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PROFESSIONAL ELECTIVE-1

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Paper Code- PE- 011
Credit- 4

MACHINE LEARNING

Course Outcomes (COs):

1. Understand and explain the fundamental concepts of machine learning, including supervised, unsupervised, and reinforcement learning, and their applications in solving real-world problems.
2. Apply various machine learning algorithms to build predictive models using appropriate datasets.
3. Analyze and evaluate the performance of machine learning models using various metrics and improve model accuracy through various techniques.
4. Implement and utilize machine learning libraries and frameworks to develop and deploy machine learning solutions in practical scenarios.
5. To optimize the models learned and report on the expected accuracy that can be achieved by applying the models.

UNIT-I

Basic Concepts, Introduction to Machine Learning, Applications of ML, Design Perspective and Issues in ML, Supervised, Unsupervised, Semi-supervised learning with applications and issues, A Formal Learning Model, The Runtime of Learning.

UNIT-II

Model (or hypothesis) representation, decision boundary, cost function, gradient descent, regularization, Diagnostic: debugging a learning algorithm, evaluating a hypothesis (Model selection), training/validating/testing procedures, diagnosing bias versus variance and vice versa, regularization and bias/variance, learning curves, Accuracy and Error measures: classifier accuracy measures, predictor error measure, evaluating the accuracy of a classifier or predictor, Confusion metric, precision, recall, tradeoff between both, accuracy.

UNIT-III

Decision Tree: representation, hypothesis, issues in Decision Tree Learning, Pruning, Rule extraction from Tree, Learning rules from Data, Probabilistic classifier: Bayes rule, Maximum Likelihood Estimation, case study, Support Vector Machine, Nearest Neighbor.

UNIT-IV

Clustering: Unsupervised learning technique, Similarity and Distance Measures, k-means and k-medoids algorithm, optimization objective, random initialization, choosing value of k, EM algorithm Bayesian networks, bag of words classifiers, N-gram models; Markov and Hidden Markov models, Graphical Models, Combining Multiple Learners.



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UNIT-V

Reinforcement Learning: Elements of Reinforcement Learning, Model-Based Learning, Temporal Difference Learning, Generalization, Design and Analysis of Machine Learning Experiments.

Text Book(s):

1. Ethem Alpaydin, Introduction to Machine Learning, PHI, 2021.
2. H. Witten and E. Frank, Data Mining: Practical Machine Learning Tools and Techniques Morgan Kaufmann 2020.
3. Tom Mitchell, Machine Learning, McGraw-Hill, 1997.

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OPEN ELECTIVE-1

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Paper Code- OE-011
Credit- 3

DATABASE MANAGEMENT SYSTEM

Course Outcome (CO):

1. Apply knowledge of database for real life applications.
2. Apply query processing techniques to automate the real time problems of databases.
3. Identify and solve the redundancy problem in database tables using normalization.
4. Understand the concepts of transactions, their processing so they will know with broad range of database management issues together with data integrity, security and recovery.

UNIT - I

Introduction: An overview of database management system, database system vs. file system, Database system concepts an architecture, data model schema and instances, data independence and database language and interfaces, data definitions language, DML, Overall Database Structure.

Data Modeling using the Entity Relationship Model: ER model concepts, notation for ER diagram, mapping constraints, keys, Concepts of Super Key, candidate key, primary key, Generalization, aggregation, reduction of an ER diagrams to tables, extended ER model, relationship of higher degree.

UNIT - II

Relational data Model and Language: Relational data model concepts, integrity constraints, entity integrity, referential integrity, Keys constraints, Domain constraints, relational algebra, relational calculus, and tuple and domain calculus.

Introduction on SQL: Characteristics of SQL, advantage of SQL. SQL data type and literals, Types of SQL commands, SQL operators and their procedure, Tables, views and indexes, Queries and sub queries, Aggregate functions. Insert, update and delete operations, Joins, Unions, Intersection, Minus, Cursors, Triggers and Procedures in SQL/PLSQL.

UNIT - III

Data Base Design & Normalization: Functional dependencies, normal forms, first, second, third normal forms, BCNF, inclusion dependence, loss less join decompositions, normalization using FD, MVD, and JDs, alternative approaches to database design.

UNIT - IV

Transaction Processing Concept: Transaction system, Testing of serializability, serializability of schedules, conflict & view serializable schedule, recoverability, Recovery from transaction failures, log-based recovery, checkpoints, deadlock handling.

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UNIT - V

Distributed Database: distributed data storage, Concurrency Control Techniques: Concurrency control, Locking Techniques for concurrency control, Time stamping protocols for concurrency control, validation-based protocol, multiple granularities, Multi version schemes, Recovery with concurrent transaction, case study of Oracle.

Text Book (s):

1. "Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill, 2018.
2. "Principles of Database and Knowledge – Base Systems", Vol I by J. D. Ullman, Computer Science Press, 2021.
3. "Fundamentals of Database Systems", 5th Edition by R. Elmasri and S. Navathe, Pearson Education, 2022
4. "Foundations of Databases", Reprint by Serge Abiteboul, Richard Hull, Victor Vianu, Addison-Wesley

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Paper Code- ME-551
Credit- 1

MACHINE DESIGN LAB-1

Course Outcomes:

1. Apply the principles of solid mechanics to design various machine Elements subjected to static and fluctuating loads.
2. To understand the basics of riveted joint and perform the strength testing
3. To design spring for industrial purpose.
4. To understand the basics of power transmission elements.

List of Experiments: (At least 8 of the following)

1. Design a knuckle joint subjected to given tensile load.
2. Design and drawing of riveted joint.
3. Design a transverse fillet welded joint subjected to given tensile load.
4. Design of leaf spring.
5. Design of helical spring.
6. Design of Flat and square keys.
7. Design of shafts subjected to torsion, bending moment and combined bending and torsion.
8. Design of shaft subjected to fluctuating loading.
9. Design of rigid coupling.
10. Design of flexible coupling.

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Paper Code- ME-552
Credit- 1

THEORY OF MACHINE LAB

Course Outcomes:

1. Demonstrate various mechanisms, their inversions and brake and clutches in Automobiles.
2. Apply cam-follower mechanism to get desired motion of follower.
3. Apply the concepts of gears and gear train to get desired velocity ratio for power transmission.
4. Apply the concept of governors to control the fuel supply in engine.
5. Determine the balancing load in static and dynamic balancing problem.

List of Experiments: (At least 8 of the following)

1. Study of simple linkage models/mechanisms
2. Study of inversions of four bar linkage
3. Study of inversions of single/double slider crank mechanisms
4. Experiment on Gears tooth profile, interference etc.
5. Experiment on Gear trains
6. Experiment on longitudinal vibration
7. Experiment on transverse vibration
8. Experiments on dead weight type governor
9. Experiment on spring controlled governor
10. Experiment on critical speed of shaft
11. Experiment on gyroscope
12. Experiment on static/dynamic balancing
13. Experiment on Brake
14. Experiment on clutch

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Paper Code- AR-551
Credit- 1

PROGRAMMABLE LOGIC CONTROL LAB

Course Outcome:

1. Identify and understand key control elements like sensors, actuators, and controllers in automation systems.
2. Design and implement relay ladder logic circuits for basic control functions.
3. Comprehend the evolution and significance of PLCs in replacing traditional relay-based systems.
4. Configure and wire PLC systems, ensuring proper communication between input/output devices.
5. Develop and troubleshoot PLC programs using timers, counters, arithmetic functions, and analog scaling for precise control.

Practical Task

1. To identify and understand the various control elements such as sensors, actuators, and controllers used in industrial automation systems.
2. To design and construct relay ladder logic circuits that perform basic control functions, demonstrating the principles of industrial automation.
3. To explore the historical development of Programmable Logic Controllers (PLCs) and comprehend their necessity in modern industrial automation over traditional relay-based systems.
4. To familiarize students with the architecture of a PLC, including its CPU, I/O modules, power supply, and communication ports, and understand their functions.
5. To learn how to configure and wire a PLC system, connecting input/output devices and establishing communication for proper operation.
6. To understand the PLC scan cycle, including input reading, program execution, and output updating, and observe its impact on system performance.
7. To establish communication between a PLC and a PC, using PLC programming software.
8. To develop basic ladder logic programs that perform simple ON/OFF control operations, reinforcing the fundamentals of PLC programming.
9. To implement timers and counters in PLC programs, utilizing TON, TOF timers, and counters for event counting and time-based control.
10. To use arithmetic functions such as ADD, SUB, MUL, and DIV in PLC programming to perform mathematical operations for control applications.

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11. To generate Pulse Width Modulation signals using PLC, controlling motor speed or other processes requiring variable output.
12. To implement high-speed counters in PLC programs, enabling the counting of high-frequency pulses from sensors for precise control.
13. To scale analog signals in PLC systems, converting raw sensor data into meaningful units for process control.
14. To interface encoders with PLCs, reading position feedback signals for precise control of motors and other actuators.
15. To control servo and stepper motors using PLC, programming for speed, position, and direction control in automation systems.

Note: The instructor may add/ modify the list as per his/her wisdom for better hands on the students.

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