UNITED INSTITUTE OF TECHNOLOGY

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Periyanaickenpalayam, Coimbatore – 641020

DEPARTMENT OF ROBOTICS AND AUTOMATION

QUESTION BANK

II - YEAR

EVEN SEMESTER

ACADEMIC YEAR 2024 – 2025

INDEX

RA3401

DESIGN OF ROBOT ELEMENTS

UNIT 1

FUNDAMENTALS OF MECHANICAL DESIGN

Fundamentals of Machine Design-Engineering Design, Phases of Design, Design Consideration - Standards and Codes - Design against Static and Dynamic Load -Modes of Failure, Factor of Safety, Principal Stresses, Theories of Failure-Stress Concentration, Stress Concentration Factors, Variable Stress, Fatigue Failure, Endurance Limit, Design for Finite and Infinite Life, Soderberg and Goodman Criteria.

Q.No	Question	CO	BTL	Marks
	Part A			
1.	List and briefly describe the phases of design in engineering.	1	1	2
2.	What are standards and codes in design? Give two examples.	1	1	2
3.	Differentiate between static load and dynamic load with examples.	1	2	2
4.	What are the modes of failure in machine elements?	1	1	2
5.	Define factor of safety (FoS) and its significance in mechanical design.	1	1	2
6.	Explain stress concentration and its effect on mechanical components.	1	2	2
7.	Define fatigue failure and explain its causes.	1	1	2
8.	Explain the Soderberg and Goodman criteria for fatigue failure.	1	2	2
	Part B			
1.	Explain Soderberg and Goodman criteria.	1	5	16
2.	Discuss the different failure theories and specify which are suitable for ductile and brittle materials.	1	6	16
3.	Discuss how do stress concentration factors affect fatigue failure? Describe methods to reduce stress concentration.	1	6	16
4.	Explain design against static and dynamic load.	1	5	16

Unit 2

DESIGN OF LINKS AND JOINTS

Loads and Forces on Links and Joints - Design of solid and hollow shafts - Rigid and flexible couplings -Threaded fasteners - rolling contact bearings- Links Design: Path and Motion Synthesis - Cognate Linkages - Design of Spherical Joints.

Q.No	Question	CO	BTL	Marks
	Part A			
1.	Define links and joints	2	1	2
2.	What is meant by path synthesis in link design?	2	1	2
3.	Explain the difference between solid and hollow shafts in terms of strength and weight.	2	2	2
4.	Differentiate between rigid and flexible couplings with examples.	2	2	2
5.	Define cognate linkages and their significance in motion synthesis.	2	1	2
6.	Explain the term stress concentration in threaded fasteners.	2	2	2
7.	What are the factors affecting the fatigue life of a shaft?	2	1	2
8.	What is a spherical joint? Give an example of its application.	2	1	2
	Part B			
1.	Discuss the forces acting on links and joints in a mechanical system with an example.	2	6	16
2.	Compare the design aspects of solid and hollow shafts and derive an expression for the strength of a hollow shaft.	2	4	16
3.	Discuss are the different types of rigid and flexible couplings? Explain their applications.	2	6	16
4.	a) Explain the design considerations for selecting threaded fasteners in mechanical assemblies.	2	5	16
	b) Discuss the concept of cognate linkages and their application in machine design.	2	5	16

Unit 3
FUNDAMENTALS OF COMPUTER GRAPHICS

Product cycle- Design process - Computer Aided Design - Computer graphics - co-ordinate systems- 2D and 3D transformations- homogeneous coordinates - graphic primitives (point, line, circle drawing algorithms) - Clipping- viewing transformation.

Q.No	Question	CO	BTL	Marks
	Part A			
1.	Define the product cycle in engineering design.	3	1	2
2.	What are the main phases of the design process?	3	1	2
3.	Define Computer-Aided Design (CAD) and its advantages.	3	1	2
4.	What is a homogeneous coordinate system? Why is it used?	3	1	2
5.	What are graphic primitives? Give examples.	3	1	2
6.	Define clipping in computer graphics.	3	1	2
7.	What is the difference between window-to-viewport transformation and viewing transformation?	3	1	2
8.	List and describe the basic 2D transformations.	3	1	2
	Part B			
1.	Discuss various clipping algorithms used in computer graphics.	3	6	16
2.	Compare 2D and 3D transformations with examples.	3	4	16
3.	Explain homogeneous coordinates, and how do they help in geometric transformations?	3	5	16
4.	Explain viewport transformation? Explain with a diagram.	3	5	16

Unit 4

CURVES AND MODELLING

Representation of curves - Hermite cubic spline curve, Bezier curve, B-spline curves, Fundamentals of solid modeling, Different solid representation schemes, Half -spaces, Boundary representation (B-rep), Constructive solid geometry (CSG), Sweep representation, Analytic solid modeling, Perspective, Parallel projection, Hidden line removal algorithms.

Q.No	Question	CO	BTL	Marks
	Part A			
1.	Define a Hermite cubic spline curve.	4	1	2
2.	What are the properties of a Bezier curve?	4	1	2
3.	Define B-spline curves and their advantages.	4	1	2
4.	Define Constructive Solid Geometry (CSG) and list its advantages.	4	1	2
5.	What are the different solid representation schemes?	4	1	2
6.	What is Boundary Representation (B-rep)?	4	1	2
7.	Differentiate between perspective and parallel projection.	4	2	2
8.	What is sweep representation in solid modeling?	4	1	2
	Part B			
1.	Explain the concept of sweep representation with diagrams.	4	5	16
2.	Explain are the advantages and disadvantages of Boundary Representation (B-rep) and Constructive Solid Geometry (CSG)?	4	5	16
3.	Discuss the perspective projection with the help of a diagram.	4	6	16
4.	Compare Bezier curves and B-spline curves in terms of flexibility and continuity.	4	4	16

Unit 5

DESIGN OF GRIPPERS

Grippers - Types of Grippers Mechanisms - Gripping Methods - Gripping Force analysis - Gripper Design - Two Finger gripper - Three Finger Gripper - Magnetic Gripper Design - Vacuum Gripper Design- Hooks - Scoops - Spools - Miscellaneous Grippers

Q.No	Question	CO	BTL	Marks
	Part A			
1.	Define a gripper and its role in automation.	5	1	2
2.	What are the main types of grippers used in robotic systems?	5	1	2
3.	List two advantages of mechanical grippers over vacuum grippers.	5	1	2
4.	Define vacuum grippers and their applications	5	1	2
5.	Explain the function of hooks and scoops in material handling.	5	2	2
6.	What are spool-based grippers used for?	5	1	2
7.	List two miscellaneous types of grippers and their applications.	5	1	2
8.	How does a magnetic gripper work?	5	1	2
	Part B			
1.	Explain the different types of gripping mechanisms with examples.	5	5	16
2.	Compare vacuum grippers and magnetic grippers in terms of design and application.	5	4	16
3.	Explain the working of a magnetic gripper and provide a case study where it is used in an industrial application	5	5	16
4.	Discuss the design considerations and applications of hooks, scoops, and spools in material handling systems.	5	6	16

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ME3493

MANUFACTURING TECHNOLOGY

UNIT I

MECHANICS OF METAL CUTTING

Mechanics of chip formation, forces in machining, Types of chip, cutting tools – single point cutting tool nomenclature, orthogonal and oblique metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and machinability.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	Write Taylor's tool life equation?	1	1	2
2.	Compare orthogonal and oblique cutting in lathe operation.	1	2	2
3.	List the essential characteristics of a cutting fluid?	1	1	2
4.	Define the term machinability	1	1	2
5.	Define tool life.	1	1	2
6.	List the types of cutting tool materials.	1	1	2
7.	Explain about the types of chips.	1	2	2
8.	What are the factors affects the surface finish?	1	1	2
	PART B			
1.	Explain about the formation of different types of chips and also about the types of cutting fluids.	1	4	16
2.	(i) Describe effect of temperature on tool life	1	4	8
	(ii) Compare orthogonal and oblique cutting with neat sketch.			8
3.	Explain about the tool wear, tool life and surface finish.	1	4	16
4.	(i) What are the different cutting tool materials available?	1	4	8
	(ii) Explain about the nomenclature of single point cutting tool.			8

UNIT II

TURNING MACHINES

Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, surface roughness in turning, machining time and power estimation. Special lathes - Capstan and turret lathes- tool layout – automatic lathes: semi-automatic – single spindle: Swiss type, automatic screw type – multi spindle.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	Compare capstan and turret lathe in terms of machining process.	2	2	2
2.	Compare single spindle and multi spindle lathe.	2	2	2
3.	What is a centre lathe?	2	1	2
4.	Explain the methods of taper turning on lathe.	2	2	2
5.	What is a swiss type lathe?	2	1	2
6.	What is are the operations can be performed on a lathe?	2	1	2
7.	What are the types of chucks used in machine shop?	2	1	2
8.	What are the advantages of automatic lathes?	2	1	2
	PART B			
1.	Explain about the centre lathe with neat sketch	2	4	16
2.	Compare the working of capstan and turret lathe with neat sketch.	2	4	16
3.	Explain the principle of operation of the swiss-type automatic screw machine with advantages and limitations.	2	4	16
4.	Explain any four work holding devices in the lathe with neat sketch.	2	4	16

UNIT III

RECIPROCATING MACHINE TOOL

Reciprocating machine tools: shaper, planer, slotter: Types and operations- Hole making: Drilling, reaming, boring, tapping, type of milling operations-attachments - types of milling cutters– machining time calculation - Gear cutting, gear hobbing and gear shaping – gear finishing methods. Abrasive processes: grinding wheel – specifications and selection, types of grinding process - cylindrical grinding, surface grinding, centreless grinding, internal grinding - micro finishing methods.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	Write down any four operations that can be performed in a drilling machine?	3	1	2
2.	What is broaching process?	3	1	2
3.	Compare shaper and planar machine.	3	2	2
4.	What is meant by up-milling and down-milling?	3	1	2
5.	What are the different micro finishing methods available?	3	1	2
6.	What are the different hole making operations?	3	1	2
7.	What is grinding process?	3	1	2
8.	Explain the types of grinding process.	3	2	2
	PART B			
1.	Explain the various types of hole making operations.	3	4	16
2.	Explain about the shaper and planar machines with neat sketch.	3	4	16
3.	Enumerate about the types of grinding process.	3	4	16
4.	Describe the different types of cutters used in milling operations and give an application of each type.	3	4	16

UNIT IV
CNC MACHINES

Computer Numerical Control (CNC) machine tools, constructional details, special features - Drives, Recirculating ball screws, tool changers; CNC Control systems – Open/closed, point-to-point/continuous - Turning and machining centres – Work holding methods in Turning and machining centres, coolant systems, safety features.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	Compare NC and CNC machines.	4	2	2
2.	Compare open and closed loop system and its significance.	4	2	2
3.	What is the purpose of an Automatic Tool Changer (ATC)?	4	1	2
4.	What is a point-to-point (PTP) system?	4	1	2
5.	What are the different types of drives used in CNC machine?	4	1	2
6.	Define Continuous system	4	1	2
7.	What is the use of coolant system in CNC machines?	4	1	2
8.	Explain about the safety features in CNC machines.	4	2	2
	PART B			
1.	Explain the constructional features of CNC machine tools.	4	4	16
2.	With a neat sketch explain about the Automatic Tool Changer (ATC).	4	4	16
3.	Explain open-loop and closed-loop control circuits with sketch.	4	4	16
4.	Explain about the work holding methods in turning and machining centres.	4	4	16

UNIT V

PROGRAMMING OF CNC MACHINE TOOLS

Coordinates, axis and motion, Absolute vs Incremental, Interpolators, Polar coordinates, Program planning, G and M codes, Manual part programming for CNC machining centers and Turning centers – Fixed cycles, Loops and subroutines, Setting up a CNC machine for machining.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	Define Subroutine.	1	1	2
2.	Compare absolute and incremental system.	1	2	2
3.	What are G codes? Give examples.	1	1	2
4.	What are M codes? Give examples.	1	1	2
5.	Define Interpolators.	1	1	2
6.	Define Polar Coordinates	1	1	2
7.	What is fixed cycle in CNC machines?	1	1	2
8.	What is Impedance Operators?	1	1	2
	PART B			
1.	Discuss about the fixed cycles, loops and subroutine in computer numerical control machine.	1	4	16
2.	Explain about the Absolute and incremental systems.	1	4	8
	Explain about the Interpolators and their types.			8
3.	Enumerate G codes and M codes with any two dimensional design.	1	4	16
4.	Explain with flow chart of setting up a CNC machine for machining operations.	1	4	8

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MR3491

SENSORS AND INSTRUMENTATION

UNIT I

INTRODUCTION

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	What is instrument?	1	1	2
2.	Compare accuracy and precision	1	1	2
3.	Define static calibration.	1	1	2
4.	List three sources of possible errors in instrument.	1	1	2
5.	Define average deviation.	1	1	2
6.	Define standards.	1	1	2
7.	Classify the types of transducers.	1	1	2
8.	What is secondary transducer?	1	1	2
	PART B			
1.	Describe the functional elements of an instrument with its block diagram.	1	3	16
2.	What are the three categories of systematic errors in the instrument and explain in detail.	1	3	16
3.	Discuss in detail the various static and dynamic characteristics of a measurement system.	1	3	16
4.	What is standard? Explain the different types of standards?	1	3	16

UNIT II

MOTION, PROXIMITY AND RANGING SENSORS

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

Q.No	Question	CO	BTL	Marks
	PART A			
1.	What are the disadvantages of capacitive transducers?	1	1	2
2.	What is Accelerometer?	1	1	2
3.	What is microphone?	1	1	2
4.	Define motion sensor.	1	1	2
5.	What is synchro?	1	1	2
6.	List out the applications of GPS.	1	1	2
7.	What is Bluetooth?	1	1	2
8.	List out the advantages and disadvantages of Bluetooth.	1	1	2
	PART B			
1.	With fundamentals distinguish between DC and AC potentiometer, and give any two specific applications for each.	1	3	16
2.	Explain in detail about working of encoder and its applications.	1	3	16
3.	Explain the basic structure of LVDT and its operation.	1	3	16
4.	Define Synchro, construction and working.	1	3	16

UNIT III

FORCE, MAGNETIC AND HEADING SENSORS

Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	What is gauge factor?	1	1	2
2.	What is young's modulus?	1	1	2
3.	Enumerate use of load cell.	1	1	2
4.	Enumerate some of the applications of magneto resistive sensor.	1	1	2
5.	Mention applications of current sensors.	1	1	2
6.	What is Hall Effect sensor?	1	1	2
7.	List the applications of inclinometer.	1	1	2
8.	Define compass.	1	1	2
	PART B			
1.	Describe the construction and working of load cell.	1	3	16
2.	Explain the details about resistive sensors and its application.	1	3	16
3.	Define Hall Effect, draw and explain the Hall Effect sensor.	1	3	16
4.	Explain the basic principle of gyroscope and its types.	1	3	16

UNIT IV

OPTICAL, PRESSURE AND TEMPERATURE SENSORS

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors-flow and level measurement, Radiation Sensors - Smart Sensors-Film sensor, MEMS & Nano Sensors, LASER sensors.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	What is digital transducer?	1	1	2
2.	What are resistive thermometers?	1	1	2
3.	What are tactile sensors?	1	1	2
4.	What is fiber optic sensor?	1	1	2
5.	Mention the materials used for thermistors.	1	1	2
6.	What is piezo electric effect?	1	1	2
7.	Define thermocouple.	1	1	2
8.	Give any applications of smart sensors.	1	1	2
	PART B			
1.	Explain the construction and working of photo voltaic with near sketch.	1	3	16
2.	Explain the various types of temperature transducer.	1	3	16
3.	Describe the piezo electric transducer and give the formula for coupling coefficient.	1	3	16
4.	Explain the construction and working of RTD.	1	3	16

UNIT V

SIGNAL CONDITIONING AND DAQ SYSTEMS

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi-channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	List out the applications DAS in home appliances.	1	1	2
2.	What are the classifications of encoder?	1	1	2
3.	What is digitizer?	1	1	2
4.	What are the types of data acquisition system?	1	1	2
5.	What are the different transfer characteristics of the transducer?	1	1	2
6.	Define environmental monitoring.	1	1	2
7.	What are the types of data acquisition system?	1	1	2
8.	Draw the simple sample and hold circuit?	1	1	2
	PART B			
1.	Explain the construction and working of amplification and its types.	1	3	16
2.	Explain the construction and working of single channel and multi-channel dataacquisition system.	1	3	16
3.	List out the applications DAS in automobile industry.	1	3	16
4.	List out the applications DAS in home appliances.	1	3	16

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GE3451

ENVIRONMENTAL SCIENCE AND SUSTAINABILITY

UNIT 1
ENVIRONMENT, ECO SYSTEM AND BIO-DIVERSITY

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

PART - A

S.NO	QUESTION	CO	BTL	Marks
1.	State the significance of environmental education.	1	1	2
2	What are biotic and abiotic components of an ecosystem?	1	1	2
3.	How does a biome differ from ecosystem?	1	1	2
4.	Identify any two major threats to biodiversity	1	1	2
5.	Define Ecological succession.	1	1	2
6.	Distinguish between endangered and endemic species	1	1	2
7.	Define primary succession and secondary succession	1	2	2
8.	Mention the disadvantages of Exsitu Conservation..	1	2	2

PART - B

1.	Analyse the structure and function of an ecosystem with real examples.	1	4	16
2.	Explain the values of the biodiversity(8) “India is a mega diversity nation”–Discuss.(8)	1	1	16
3.	Identify the major threats to biodiversity(10) Write a note on Hot Spot Biodiversity (6)	1	6	16
4	Explain the conservation plan of biodiversity by integrating In-Situ and Ex-Situ.	1	5	16

UNIT 2
ENVIRONMENTAL POLLUTION

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts.

PART – A

S.NO	QUESTION	CO	BTL	Marks
1.	Classify air pollutants into primary and secondary category.	2	2	2
2	State the pollutant responsible for photo chemical smog.	2	1	2
3.	Compare point and non point sources of water pollutants.	2	4	2
4.	Define e-Waste Management	2	1	2
5.	Write the objectives of environmental acts.	2	1	2
6.	Define hazardous waste management	2	1	2
7.	What are the effects of noise pollution	2	2	2
8.	Identify the major cause of soil pollution.	2	1	2

PART – B

1.	Describe the role of individual in the prevention of pollution. Explain the sources, effects and control methods of noise pollution.	2	2	16
2.	Design a flow sheet and explain the steps involved in Solid Waste Management.	2	5	16
3.	Examine the Occupational Health and Safety Management System (OHASMS) with a relevant case study.	2	5	16
4.	Develop a schematic representation of an Industrial Waste Water treatment technique.	2	5	16

UNIT 3
RENEWABLE SOURCES OF ENERGY

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

PART - A

S.NO	QUESTION	CO	BTL	Marks
1.	Mention the objectives of energy management.	3	1	2
2	Assess the significance of OTE.	3	6	2
3.	Investigate the role of Artificial intelligence in energy sector.	3	1	2
4.	What is Bio-mass energy?	3	1	2
5.	Give any five applications of tidal energy conservation.	3	1	2
6.	Specify some important applications of GTE	3	2	2
7.	State the term DESS? Mention its components	3	1	2
8.	Mention the applications of hydrogen energy	3	1	2

PART - B

1.	Explain the applications of Ocean energy and Tidal Energy..	3	5	16
2.	Elaborate the principle and various steps involved in the energy management.	3	5	16
3.	Analyse the role of new energy sources in global energy demands.	3	4	16
4	Develop a detail report on the origin, concept and advantage and disadvantages Geo-Thermal energy.	3	5	16

UNIT 4
SUSTAINABILITY AND MANAGEMENT

Development GDP Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

PART – A

S.NO	QUESTION	CO	BTL	Marks
1.	Define the term GDP.	4	1	2
2	Identify any four millennium development goals.	4	2	2
3.	What is meant by carbon credit?	4	1	2
4.	What are the sources of carbon foot print?	4	2	2
5.	Define environmental management.	4	2	2
6.	Mention any five important needs of sustainability.	4	2	2
7.	Write some advantages of carbon credits.	4	1	2
8.	Mention some effects of climate change.	4	1	2

PART B

1.	Summarise the Millennium Development Goals and Sustainabilty protocols.	4	4	16
2.	Explain the various steps of environmental management.	4	2	16
3.	Elaborate the goal and aim of sustainable development.	4	4	16
4	Describe the causes, effects and possible solutions of climate change?	4	5	16

UNIT 5
SUSTAINABILITY PRACTICES

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio economic and technological change.

Q.NO	QUESTION	CO	BTL	Marks
1.	What is zero waste and R concept?	5	1	2
2	Define circular economy.	5	2	2
3.	Identify key elements of ISO14000.	5	2	2
4.	Mention the objectives of EIA	5	1	2
5.	State the term green engineering.	5	1	2
6.	What is meant by energy cycles?	5	1	2
7.	Give an idea about the concept sustainable urbanization.	5	1	2
8.	Define carbon sequestration.	5	1	2

PART B

1.	Explain the various steps to achieve zero waste? Mention advantages and	5	2	16
2.	Analyse the 3R concept and suggest improvements for better sustainability	5	4	16
3.	Assess the role of green building materials and sustainable transport in urban planning.	5	6	16
4	Brief the rules to develop sustainable urbane.	5	3	16

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MR3452

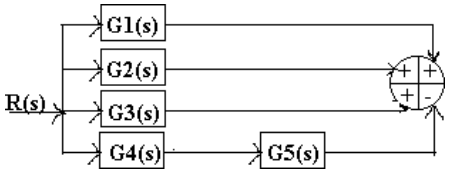
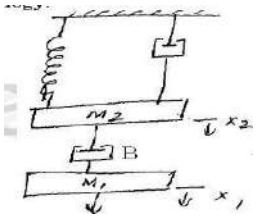
CONTROL SYSTEM ENGINEERING

UNIT - I

SYSTEMS COMPONENTS AND THEIR REPRESENTATION

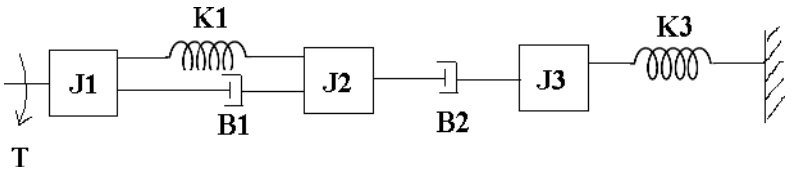
PART – A

Control System: Terminology and Basic Structure-Feed forward and Feedback control theory- Electrical and Mechanical Transfer Function Models-Block diagram Models-Signal flow graphs.

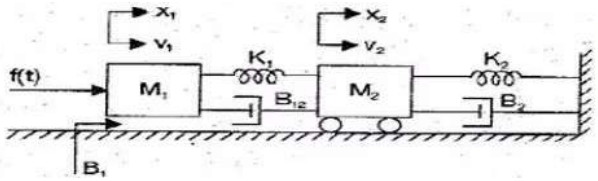
S.No	Question	CO	BTL	Marks
1.	What is system and control system?	1	1	2
2.	What is feedback? What type of feedback is employed in control system?	1	1	2
3.	What are block diagram? What are its basic components?	1	1	2
4.	Write down the transfer function of the system whose block diagram is shown below. 	1	1	2
5.	State Mason's gain formula	1	1	2
6.	What are the properties of signal flow graphs?	1	1	2
7.	Define resistance and capacitance of liquid level system?	1	1	2
8.	Draw the analogous electrical network for the mechanical system in figure using force voltage analogy. 	1	1	2

PART B

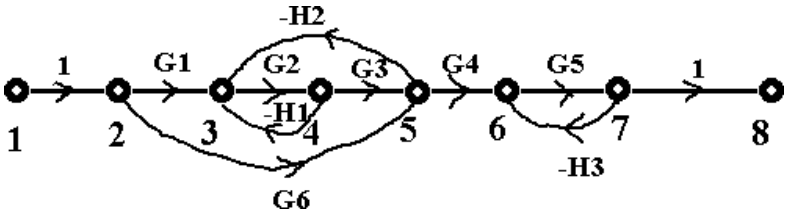
S.No	Question	CO	BTL	Marks
1	Write the differential equations governing the mechanical translations systems as shown in figure. Draw the Torque-Voltage and Torque-Current electrical analogous circuits and verify by mesh and node equations.	1	3	16



2	Write the differential equations governing the mechanical translations systems as shown in figure. Draw the Force-Voltage and Force-Current electrical analogous circuits and verify by mesh and node equations. Draw the analogous electrical network for the mechanical system in figure using force voltage analogy.	1	3	16

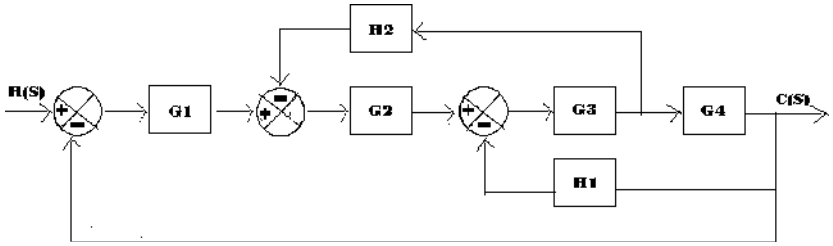


3	The signal flow graph for a feedback control system is shown in figure. Determine the closed loop transfer function C(S)/R(S).	1	3	16



Or

4	Using block diagram reduction technique Determine the transfer function of the system shown in given block diagram below.	1	3	16

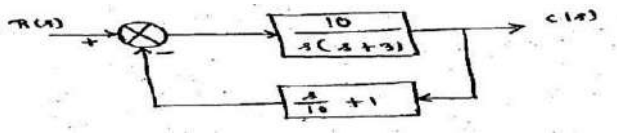


UNIT - II

TIME RESPONSE ANALYSIS

Transient response-steady state response-Measures of performance of the standard first order and second order system-effect on an additional zero and an additional pole-steady error constant and system- type number-PID control-Analytical design for PD, PI, PID control systems

PART – A

S.No	Question	CO	BTL	Marks
1.	State some standard test signals used in time domain analysis	2	1	2
2.	Determine the unit impulse response of system H(s) = 5s/(s+2) with zero initial conditions.	2	1	2
3.	What are the various time domain specifications?	2	1	2
4.	What are the units of K_p, K_v and K_a?	2	1	2
5.	What is meant by steady state error?	2	1	2
6.	Determine the error coefficients for the system having $G(s)H(s) = \frac{(s+2)}{s(1+0.5s)+(1+0.2s)}$	2	1	2
7.	Determine the unit step response of the control system shown below. 	2	1	2
8.	List the advantages of generalized error coefficients.	2	1	2

PART B

S.No	Question	CO	BTL	Marks
1	The open loop transfer function of a unity feedback control system is given by $$G(s) = \frac{K}{s(sT+1)}$$ Where K and T positive constants. By what factor should amplifier gain be reduced so that peak overshoot of unit response of the system is reduced from 75% to 25%.	2	3	16
2	A unity feedback system is characterized by an open loop transfer function $$G(s)H(s) = \frac{(s+2)}{s(1+0.5s)+(1+0.2s)}$$ Determine the steady state errors for Unit-step, Unit-ramp, and Unit-acceleration unit. Also determine damping ratio and natural frequency of the dominant roots.	2	3	16
3	Explain in detail the system performance with PI, PD and PID controllers.	2	3	16
4	Derive the time domain specification of a second order system for step input.	2	3	16

UNIT – III
FREQUENCY RESPONSE AND SYSTEM ANALYSIS

Closed loop frequency response-Performance specification in frequency domain-Frequency response of standard second order system- Bode Plot - Polar Plot-Design of compensators using Bode plots- Cascade lead, lag and lag-lead compensation.

PART – A

S.No	Question	CO	BTL	Marks
1.	Name the parameters which constitute frequency domain specifications.	3	1	2
2.	What are the specifications used in frequency domain analysis?	3	1	2
3.	Write the MATLAB command for plotting Bode diagram Y(s)/U(s) =4s+6/s3+3s2+8s+6.	3	1	2
4.	What is Nichols Chart?	3	1	2
5.	Derive the transfer function of a lead compensator network	3	1	2
6.	Draw the polar plot of type zero first order system.	3	1	2
7.	What is resonant peak, resonant frequency? Give its expression.	3	1	2
8.	What is series compensation?	3	1	2

PART B

S.No	Question	CO	BTL	Marks
1	Given $G(s) = \frac{Ke^{-0.2s}}{S\,(S+2)\,(S+8)}$ Find K for the following two cases: a) Gain margin equal to 2 db. b) Phase margin equal to 45^0.	3	3	16
2	Sketch the bode magnitude plot for the transfer function $G((s) = \frac{10}{s(1+0.4s)\,(1+0.1s)}$	3	3	16
3	Draw the pole Zero diagram of a lead compensator. Propose lead compensation using electrical network. Derive the transfer function. Draw the bode plots.	3	3	16
4	Explain in detail the design procedure of lag compensator using Bode plot. Write short notes on parallel feedback compensation.	3	3	16

UNIT – IV

CONCEPTS OF STABILITY ANALYSIS

Concept of stability-Bounded - Input Bounded - Output stability-Routh stability criterion-Relative stability-Root locus concept-Guidelines for sketching root locus-Nyquist stability criterion.

PART – A

S.No	Question	CO	BTL	Marks
1.	State Routh Stability criterion.	4	1	2
2.	State the rule for finding out the root loci on the real axis.	4	1	2
3.	What is angle criterion for root locus?	4	1	2
4.	Using Routh criterion, determine the stability of the system represented by the characteristic equation $S^4+8S^3+18S^2+16S+5=0$. Comment on the location of the roots of characteristics equation.	4	1	2
5.	What are the difficulties faced while applying Routh- Hurwitz criterion?	4	1	2
6.	State Nyquist stability criterion for a closed loop system when the open loop system is stable.	4	1	2
7.	What is meant by BIBO stability?	4	1	2
8.	What is Hurwitz's criterion?	4	1	2

PART B

S.No	Question	CO	BTL	Marks
1	Consider the sixth order system with the characteristic equation $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$. Use Routh- Hurwitz criterion to examine the stability of the system.	4	3	16
2	The open loop transferfunction of a unity feedback control systemis given by $G(s) = \frac{k}{(s+2)(s+4)(s2+6s+25)}$. By applying the Routh criterion, discuss the stability of the closed loop system as a function of K.	4	3	16
3	State the rules for construction of the Root – Locus for a feedback system.	4	3	16
4	Sketch the Nyquist plot for a system with open loop transfer function is $G((s)H(s) = \frac{K}{s\,(s+2)\,(s+10)}$ Determine the range of K for which the close loop system is stable.	4	3	16

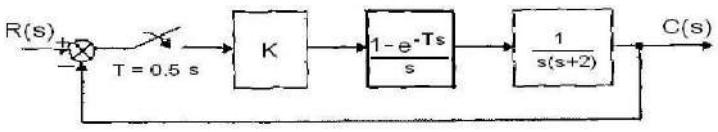
UNIT V
CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHODS

State variable 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

PART – A

S.No	Question	CO	BTL	Marks
1.	Give the concept of controllability	5	1	2
2.	What are the properties of State Transition matrix?	5	1	2
3.	Draw the circuit diagram of sample and hold circuit.	5	1	2
4.	State Shannon's sampling theorem.	5	1	2
5.	How the modal matrix is determined?	5	1	2
6.	How can you obtain the transfer function of a system from its state model?	5	1	2
7.	What are the difference between state space analysis and Transfer function analysis?	5	1	2
8.	What is the characteristics equation in state space representation?	5	1	2

PART B

S.No	Question	CO	BTL	Marks
1	The state space representation of a system is given below: $\begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} = \begin{pmatrix} -2 & 1 & 0 \\ 0 & -3 & 1 \\ -3 & -4 & -5 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} + \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix} u \quad y - (0 \quad 1 \quad 0) \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix}$ Obtain the transfer function.	5	3	16
2	Determine the state model in canonical form. Draw the block diagram.	5	3	16
3	A sampled data control systems is shown in the figure below 	5	3	16
4	Find the open loop pulse transfer function, if the controller gain is unity with sampling time 0.5 seconds.	5	3	16

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MR3591
FLUID POWER SYSTEMS AND INDUSTRIAL AUTOMATION

UNIT I**UNIT II**

FLUID POWER SYSTEM GENERATION AND ACTUATORS

Need For Automation, Classification of Drives - Hydraulic, Pneumatic and Electric – Comparison – ISO Symbols for their Elements, Selection Criteria. Generating Elements- Hydraulic Pumps and Motor Gears, Vane, Piston Pumps – Motors - Selection and Specification - Drive Characteristics – Utilizing Elements - Linear Actuator – Types, Mounting Details, Cushioning – Power Packs – Accumulators.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	Why is automation necessary in manufacturing systems?	1	1	2
2.	List the three main classifications of drives.	1	1	2
3.	What are the primary differences between hydraulic and pneumatic drives?	1	2	2
4.	What is the significance of ISO symbols in drive elements?	1	1	2
5.	What is the function of a hydraulic pump in a hydraulic system?	1	1	2
6.	Name two types of linear actuators and their applications.	1	1	2
7.	What is the role of accumulators in a hydraulic system?	1	1	2
8.	What are power packs in hydraulic systems?	1	1	2
	PART B			
1.	Discuss the need for automation and compare hydraulic, pneumatic, and electric drives.	1	2	16
2.	Explain hydraulic pumps and motors, their types, selection, and specifications.	1	2	16
3.	Describe linear actuators, their types, mounting details, and cushioning mechanisms.	1	2	16
4.	Explain power packs and accumulators in hydraulic systems with their design and applications.	1	2	16

UNIT II

CONTROL AND REGULATING ELEMENTS

Control and Regulating Elements — Direction, Flow and Pressure Control Valves -Methods of Actuation, Types, Sizing of Ports. Spool Valves - Operating Characteristics -Electro Hydraulic Servo Valves - Types - Characteristics and Performance.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	What is the function of direction control valves in hydraulic systems?	2	1	2
2.	List the types of flow control valves.	2	1	2
3.	What is the purpose of pressure control valves?	2	1	2
4.	What are the methods of actuating control valves?	2	1	2
5.	What are spool valves, and how do they function?	2	1	2
6.	What is the importance of sizing valve ports?	2	1	2
7.	What is an electro-hydraulic servo valve?	2	1	2
8.	List two characteristics of electro-hydraulic servo valves.	2	1	2
	PART B			
1.	Explain the functions and types of direction, flow, and pressure control valves in hydraulic systems.	2	2	16
2.	Discuss the different methods of valve actuation and the importance of sizing valve ports.	2	2	16
3.	Describe the operating characteristics of spool valves and their role in hydraulic systems.	2	2	16
4.	Explain the working, types, and characteristics of electro-hydraulic servo valves.	2	2	16

UNIT III

CIRCUIT DESIGN FOR HYDRAULIC AND PNEUMATICS

Typical Design Methods – Sequencing Circuits Design - Combinational Logic Circuit Design - Cascade Method – KV Mapping - Electrical Control of Pneumatic and Hydraulic Circuits - Use of Relays, Timers, Counters and PLC in pneumatics and hydraulics

Q.No	Question	CO	BTL	Marks
	PART A			
1.	What is the purpose of sequencing circuits in hydraulic and pneumatic systems?	3	1	2
2.	Define combinational logic circuit design.	3	1	2
3.	What is the cascade method used for circuit design?	3	1	2
4.	What is KV mapping, and why is it used in circuit design?	3	1	2
5.	How are relays used in pneumatic and hydraulic circuits?	3	1	2
6.	What is the role of timers in electrical control systems?	3	1	2
7.	What is the significance of counters in pneumatic and hydraulic systems?	3	1	2
8.	What is a PLC, and why is it used in hydraulic and pneumatic systems?	3	1	2
	PART B			
1.	Explain the design methods for sequencing circuits and their application in hydraulic and pneumatic systems.	3	2	16
2.	Design and explain the fluid power circuit for a drilling machine to perform the following functions: (i) Clamping the workpiece, (ii) Drilling the workpiece, and (iii) Unclamping the workpiece.	3	5	16
3.	Design an electro pneumatic circuit using cascade method for the following sequence A+ B+ C+ B- A- C-, Where A, B and C stands for cylinders, (+) indicates extension and (-) indicates retraction of cylinders.	3	5	16
4.	Analyze the role of relays, timers, and counters in the electrical control of pneumatic and hydraulic systems.	3	4	16

UNIT IV

PROGRAMMABLE LOGIC CONTROLLER

Industrial Automation - Programmable Logic Controller - Functions of PLCs - Features of PLC - Selection of PLC - Architecture – IEC61131-3 programming standard and types - Basics of PLC Programming – Ladder Logic Diagrams – Communication in PLC – Programming Timers and Counters – Data Handling - PLC modules – Advanced motion controlled Multi Axis PLC

Q.No	Question	CO	BTL	Marks
	PART A			
1.	What is a Programmable Logic Controller (PLC)?	4	1	2
2.	List two main functions of PLCs in industrial automation.	4	1	2
3.	What are two key features of a PLC?	4	1	2
4.	What factors should be considered when selecting a PLC for an application?	4	1	2
5.	What is the IEC61131-3 standard?	4	1	2
6.	What is a ladder logic diagram?	4	1	2
7.	How are timers used in PLC programming?	4	1	2
8.	What are PLC modules, and why are they important?	4	1	2
	PART B			
1.	Explain the architecture and features of a PLC in industrial automation.	4	2	16
2.	Develop a ladder logic program that could be used to operate the simplified task of the automatic drilling of work pieces. The drill motor and the pump for the air pressure for the pneumatic valves has to be started to the required depth. Then the drill has to be retracted and the work piece unclamped.	4	5	16
3.	Design the program for a pneumatic system for control by a PLC to give the cylinder sequence A+, B+, B-, A- and which will give a LED display indicating, in the presence of a fault such as a sticking cylinder at which point in the cycle the fault occurred. Explain the action of all elements in the system	4	5	16
4.	Discuss advanced motion control using multi-axis PLCs and their applications.	4	2	16

UNIT V

DATA COMMUNICATION AND SUPERVISORY CONTROL SYSTEMS

Industrial Data Communications -– Modbus – HART – DeviceNet – Profibus – Fieldbus – RS232- RS485- Modbus/ Modbus TCP/IP - mechatrolink – CAN – Ether CAT - Introduction to Supervisory Control Systems – SCADA - Distributed Control System (DCS) – Safety Systems human machine interfaces - Total Integrated Automation (TIA) – Industry 4.0.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	What is Modbus, and where is it commonly used?	5	1	2
2.	What is the difference between RS232 and RS485 communication standards?	5	2	2
3.	What is the purpose of HART in industrial data communication?	5	1	2
4.	What is the function of a Fieldbus network in automation?	5	1	2
5.	What does SCADA stand for, and what is its role in automation?	5	1	2
6.	What is the importance of Total Integrated Automation (TIA)?	5	1	2
7.	What is Industry 4.0?	5	1	2
8.	What is the role of EtherCAT in data communication?	5	1	2
	PART B			
1.	Explain the working and applications of Modbus, Modbus TCP/IP, and Mechatrolink in industrial data communication.	5	2	16
2.	Describe Supervisory Control Systems with an emphasis on SCADA and Distributed Control Systems (DCS).	5	2	16
3.	Compare various industrial communication protocols like Profibus, DeviceNet, Fieldbus, and EtherCAT.	5	2	16
4.	Discuss the significance of Industry 4.0, Total Integrated Automation (TIA), and safety systems in modern industrial automation.	5	2	16

--------THE END---------