SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA3351	Transforms and Partial Differential Equations	BSC	3	1	0	4	4
2.	ME3351	Engineering Mechanics	ESC	3	0	0	3	3
3.	MR3351	Fluid Mechanics and Thermal Systems	ESC	4	0	0	4	4
4.	MR3391	Digital Electronics and Microprocessor	PCC	3	0	0	3	3
5.	MR3392	Electrical Drives and Actuators	PCC	3	0	0	3	3
6.	RA3301	Robot Kinematics	PCC	3	0	0	3	3
PRACTICALS								
7.	MR3361	Electrical Drives and Actuators Laboratory	PCC	0	0	4	4	2
8.	RA3311	Robot Modelling and Simulation Laboratory	PCC	0	0	4	4	2
9.	GE3361	Professional Development $	EEC	0	0	2	2	1
			TOTAL	**19**	**1**	**10**	**30**	**25**

$ **Skill Based Course**

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	ME3493	Manufacturing Technology	PCC	3	0	0	3	3
2.	RA3401	Design of Robot Elements	PCC	3	0	0	3	3
3.	MR3491	Sensors and Instrumentation	PCC	3	0	0	3	3
4.	MR3452	Control Systems Engineering	PCC	3	0	2	5	4
5.	MR3591	Fluid Power Systems and Industrial Automation	PCC	3	0	0	3	3
6.	GE3451	Environmental Sciences and Sustainability	BSC	2	0	0	2	2
7.		NCC Credit Course Level 2#		3	0	0	3	3#
PRACTICALS								
8.	ME3382	Manufacturing Technology Laboratory	PCC	0	0	4	4	2
9.	MR3461	Sensors and Instrumentation Laboratory	PCC	0	0	4	4	2
			TOTAL	**17**	**0**	**10**	**27**	**22**

NCC Credit Course level 2 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA

MA3351 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS L T P C
3 1 0 4

OBJECTIVES:

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 9+3

Formation of partial differential equations –Solutions of standard types of first order partial differential equations - First order partial differential equations reducible to standard types- Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II FOURIER SERIES 9+3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root mean square value – Parseval's identity – Harmonic analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9+3

Classification of PDE – Method of separation of variables - Fourier series solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (Cartesian coordinates only).

UNIT IV FOURIER TRANSFORMS 9+3

Statement of Fourier integral theorem– Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS 9+3

Z-transforms - Elementary properties – Convergence of Z-transforms - – Initial and final value theorems - Inverse Z-transform using partial fraction and convolution theorem - Formation of difference equations – Solution of difference equations using Z - transforms.

TOTAL: 60 PERIODS

OUTCOMES:

Upon successful completion of the course, students should be able to:

- Understand how to solve the given standard partial differential equations.
- Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
- Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
- Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", 44thEdition, Khanna Publishers, New Delhi, 2018.
2. Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, India, 2016.

REFERENCES:

1. Andrews. L.C and Shivamoggi. B, "Integral Transforms for Engineers" SPIE Press, 1999.
2. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 10th Edition, Laxmi Publications Pvt. Ltd, 2015.
3. James. G., "Advanced Modern Engineering Mathematics", 4thEdition, Pearson Education, New Delhi, 2016.
4. Narayanan. S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.
6. Wylie. R.C. and Barrett . L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

ME3351	ENGINEERING MECHANICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1 To Learn the use scalar and vector analytical techniques for analysing forces in statically determinate structures
2 To introduce the equilibrium of rigid bodies, vector methods and free body diagram
3 To study and understand the distributed forces, surface, loading on beam and intensity.
4 To learn the principles of friction, forces and to determine the apply the concepts of frictional forces at the contact surfaces of various engineering systems.
5 To develop basic dynamics concepts – force, momentum, work and energy;

UNIT I STATICS OF PARTICLES **9**

Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles - Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force, Unit Vectors. Equilibrium of a Particle- Newton's First Law of Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space.

UNIT II EQUILIBRIUM OF RIGID BODIES **9**

Principle of Transmissibility, Equivalent Forces, Vector Product of Two Vectors, Moment of a Force about a Point, Varignon's Theorem, Rectangular Components of the Moment of a Force, Scalar Product of Two Vectors, Mixed Triple Product of Three Vectors, Moment of a Force about an Axis, Couple - Moment of a Couple, Equivalent Couples, Addition of Couples, Resolution of a Given Force into a Force -Couple system, Further Reduction of a System of Forces, Equilibrium in Two and Three Dimensions - Reactions at Supports and Connections.

UNIT III DISTRIBUTED FORCES **9**

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration, Theorems of Pappus-Guldinus, Distributed Loads on Beams, Centre of Gravity of a Three-

Dimensional Body, Centroid of a Volume, Composite Bodies, Determination of Centroids of Volumes by Integration. Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration, Polar Moment of Inertia, Radius of Gyration of an Area, Parallel-Axis Theorem, Moments of Inertia of Composite Areas, Moments of Inertia of a Mass - Moments of Inertia of Thin Plates, Determination of the Moment of Inertia of a Three-Dimensional Body by Integration.

UNIT IV FRICTION **9**

The Laws of Dry Friction, Coefficients of Friction, Angles of Friction, Wedge friction, Wheel Friction, Rolling Resistance, Ladder friction.

UNIT V DYNAMICS OF PARTICLES **9**

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton's Second Law of Motion -Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods - Work of a Force, Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact of bodies.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Illustrate the vector and scalar representation of forces and moments
2. Analyse the rigid body in equilibrium
3. Evaluate the properties of distributed forces
4. Determine the friction and the effects by the laws of friction
5. Calculate dynamic forces exerted in rigid body

TEXTBOOKS:

1. Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 12thEdition, 2019.
2. Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.

REFERENCES:

1. Boresi P and Schmidt J, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.
2. Hibbeller, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition, Prentice Hall, 2013.
3. Irving H. Shames, Krishna Mohana Rao G, Engineering Mechanics – Statics and Dynamics, 4thEdition, Pearson Education Asia Pvt. Ltd., 2005.
4. Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, 7th edition, Wiley student edition, 2013.
5. Timoshenko S, Young D H, Rao J V and SukumarPati, Engineering Mechanics, 5thEdition, McGraw Hill Higher Education, 2013.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	1	2							2	3	1	1
2	3	2	2	1	2							2	3	1	1
3	3	2	3	1	2							2	3	1	2
4	3	2	3	1	2							2	3	1	2
5	3	2	3	1	2							2	3	1	2
Low (1); Medium (2); High (3)															

MR3351 FLUID MECHANICS AND THERMAL SYSTEMS L T P C
4 0 0 4

COURSE OBJECTIVES:

1. To knowledge in Fluid Properties and Statics
2. To understand the concept of fluid kinematics and Dynamics.
3. To learn about the flows in fluid, Viscous flows and flow through pipes
4. To understand the basics laws of thermodynamics
5. To understand the second law of thermodynamics and entropy

UNIT I FLUID PROPERTIES AND FLUID STATICS 12

Fluid Definition and Classification – Properties of fluids: Density, Specific Weight, Specific Volume, Specific Gravity, Viscosity, Compressibility, Bulk Modulus, Capillary and Surface Tension – Fluid statics: Concept of fluid static pressure – Pascal's law –Absolute and Gauge pressures – Manometers: Types and Pressure measurement – Concept of Buoyancy and Floatation.

UNIT II FLUID KINEMATICS AND FLUID DYNAMICS 12

Fluid Kinematics: Types of fluid flow – Continuity equation in two and three dimensions – Velocity and Acceleration of fluid particle – Velocity potential function and Stream function. Fluid dynamics: Euler's equation along a streamline –Bernoulli's equation and applications – Venturi meter, Orifice meter and Pitot tube.

UNIT III VISCOUS FLOW, FLOW THROUGH PIPES AND DIMENSIONAL ANALYSIS 12

Viscous flow: Shear stress, pressure gradient relationship – Flow of viscous fluid through circular pipe – Flow through pipes: Loss of head due to friction – Minor head losses – Hydraulic gradient and Total energy lines – Flow through pipes in series and in parallel – Power transmission through pipes. Dimensional analysis: Buckingham's theorem.

UNIT IV BASICS OF THERMODYNAMICS AND FIRST LAW OF THERMODYNAMICS 12

Thermodynamics – Microscopic and macroscopic point of view – Systems, properties, process, path, cycle. Thermodynamic equilibrium – Zeroth law of Thermodynamics – internal energy, enthalpy, specific heat capacities CV and CP, Relationship between CV and CP. First law of Thermodynamics – Application to closed and open systems – Steady Flow Energy Equation (SFEE) – Simple problems.

UNIT V SECOND LAW OF THERMODYNAMICS AND ENTROPY 12

Second Law of thermodynamics – Kelvin Planck and Clausius Statements – Equivalents of Kelvin Planck and Clausius statements. Reversibility – Irreversibility, reversible cycle – Heat engine, heat pump and refrigerator. Carnot cycle and Clausius theorem, the property of entropy, the inequality of Clausius – Entropy principle – General expression for entropy – Simple problems in entropy.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the student able to:

CO1: Recognize the fluid properties, fluid statics and laws of thermodynamics
CO2: Interpret the problems related to kinematics and dynamics of fluids and thermal systems

CO3: Review the energy losses in flow through pipes and steady flow equation in thermal systems.
CO4: Analyse the fluid flow and thermal process
CO5: Solve the problems related to fluid and thermal systems.

Mapping of COs with POs and PSOs															
COs/POs&PSOs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2		1						1	1	2	2	1
CO2	3	3	2		1						1	1	2	2	1
CO3	2	2	3	2	2	3					1	1	3	3	1
CO4	2	2	3	2	1	2					1	1	3	3	1
CO5	3	3	2	2	2	2					1	1	2	2	1
CO/PO & PSO Average	2.6	2.6	2.4	2	1.4	2.3					1	1	2.4	2.4	1
1 – Slight, 2 – Moderate, 3 – Substantial															

TEXT BOOK:

1. Bansal R.K., —Fluid Mechanics and Hydraulic Machinesll, 9th Edition, Laxmi Publications, New Delhi, 2015.

REFERENCES:

1. Nag P.K., —Engineering Thermodynamicsll, 5th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2013.
2. Cengel Yunus A. and Boles Michael A., —Thermodynamics: An Engineering Approachll, 7th Edition, McGraw-Hill, New York, 2011.
3. Frank M. White., —Fluid Mechanicsll, 7th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2009.

MR3391 DIGITAL ELECTRONICS AND MICROPROCESSOR L T P C 3 0 0 3

COURSE OBJECTIVES:

1. To present the Digital fundamentals, Boolean algebra and its applications in digital systems
2. To familiarize with the design of various combinational digital circuits using logic gates
3. To introduce the analysis and design procedures for synchronous and asynchronous sequential circuits
4. To explain the various semiconductor memories and related technology
5. To introduce the electronic circuits involved in the making of logic gate

UNIT I DIGITAL FUNDAMENTALS 9

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1‘s and 2‘s complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine-McCluskey method of minimization.

UNIT II COMBINATIONAL & SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder -Multiplexer, Demultiplexer, Decoder, Priority Encoder. Flip flops – SR, JK, T, D, design of clocked sequential circuits – Design of Counters- Shift registers, Universal Shift Register

UNIT III ASYNCHRONOUS SEQUENTIAL CIRCUITS AND MEMORY DEVICES 9

Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits. Basic memory structure – ROM -PROM – EPROM – EEPROM –EAPROM, RAM – Static and dynamic RAM - Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA).

UNIT IV 8085 PROCESSOR 9

Hardware Architecture, pin diagram – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts.

UNIT V PROGRAMMING PROCESSOR 9

Instruction - format and addressing modes – Assembly language format – Data transfer, data manipulation& control instructions – Programming: Loop structure with counting & Indexing – Look up table - Subroutine instructions – stack -8255 architecture and operating modes

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student able to:

CO1: State the fundamental operating concepts behind digital logic circuits and microprocessors.

CO 2: Recognize the use of various digital logic circuits and sub units in microprocessors.

CO 3: Interpret the information flow in digital logic circuits and the architectures of microprocessors.

CO 4: Design the DLC and Microprocessor for the standard applications.

CO 5: Create the circuits using DLC and Microprocessor for given applications

Mapping of COs with POs and PSOs

COs/Pos&PSOs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1	1		1						1	3	3	3
CO2	3	2	1	1		1						1	3	2	3
CO3	3	2	1	1		1						1	3	2	3
CO4	3	2	1	1		1						1	3	2	3
CO5	3	2	1	1		1						1	3	2	3
CO/PO & PSO Average	3	2	1	1		1						1	3	2	3
1 – Slight, 2 – Moderate, 3 – Substantial															

TEXT BOOKS:

1. M. Morris Mano and Michael D. Ciletti, “Digital Design”, 5th Edition, Pearson, 2014.
2. Krishna Kant, “Microprocessor and Microcontrollers”, Eastern Company Edition, Prentice Hall of India, New Delhi, 2007.

REFERENCES:
1. Charles H.Roth. “Fundamentals of Logic Design”, 6th Edition, Thomson Learning, 2013.
2. Thomas L. Floyd, “Digital Fundamentals”, 10th Edition, Pearson Education Inc, 2011
3. Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely ‘The 8051 Micro Controller and Embedded Systems’, PHI Pearson Education, 5th Indian reprint, 2003.
4. R.S. Gaonkar, ‘Microprocessor Architecture Programming and Application’, with 8085, Wiley Eastern Ltd., New Delhi, 2013

MR3392 ELECTRICAL DRIVES AND ACTUATORS L T P C
3 0 0 3

COURSE OBJECTIVES:
1. To familiarize a relay and power semiconductor devices
2. To get a knowledge on drive characteristics
3. To obtain the knowledge on DC motors and drives.
4. To obtain the knowledge on AC motors and drives.
5. To obtain the knowledge on Stepper and Servo motor.

UNIT I RELAY AND POWER SEMI-CONDUCTOR DEVICES 9
Study of Switching Devices – Relay and Types, Switching characteristics -BJT, SCR, TRIAC, GTO, MOSFET, IGBT and IGCT-: SCR, MOSFET and IGBT - Triggering and commutation circuit - Introduction to Driver and snubber circuits

UNIT II DRIVE CHARACTERISTICS 9
Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, torque, and Direction starting & stopping – Selection of motor.

UNIT III DC MOTORS AND DRIVES 9
DC Servomotor - Types of PMDC & BLDC motors - principle of operation- emf and torque equations - characteristics and control – Drives- H bridge - Single and Three Phases – 4 quadrant operation – Applications

UNIT IV AC MOTORS AND DRIVES 9
Introduction – Induction motor drives – Speed control of 3-phase induction motor – Stator voltage control – Stator frequency control – Stator voltage and frequency control – Stator current control – Static rotor resistance control – Slip power recovery control.

UNIT V STEPPER AND SERVO MOTOR 9
Stepper Motor: Classifications- Construction and Principle of Operation – Modes of Excitation-Drive System-Logic Sequencer - Applications. Servo Mechanism – DC Servo motor-AC Servo motor – Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES
At the end of the course, the student able to:
CO 1: Recognize the principles and working of relays, drives and motors.
CO 2: Explain the working and characteristics of various drives and motors.
CO 3: Apply the solid state switching circuits to operate various types of Motors and Drivers
CO 4: Interpret the performance of Motors and Drives.
CO 5: Suggest the Motors and Drivers for given applications.

Mapping of COs with POs and PSOs															
COs/Pos & PSOs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	1	2	1							1	1		3
CO2	3	1	2	2	1							1	1		3
CO3	3	1	2	2	1							1	1		3
CO4	3	1	1	2	2							1	1		3
CO5	3	1	1	2	2							1	1		3
CO/PO & PSO Average	3	1	1.4	2	1.4							1	1		3
1 – Slight, 2 – Moderate, 3 – Substantial															

TEXT BOOKS:

1. Bimbhra B.S., "Power Electronics", 5th Edition, Kanna Publishers, New Delhi, 2012.
2. Mehta V.K. & Rohit Mehta, "Principles of Electrical Machines", 2nd Edition, S.Chand& Co. Ltd., New Delhi, 2016.

REFERENCES:

1. Gobal K. Dubey, "Fundamentals of Electrical Drives", 2nd Edition, Narosal Publishing House, New Delhi, 2001.
2. Theraja B.L. &Theraja A.K., "A Text Book of Electrical Technology", 2nd Edition, S.Chand& Co. Ltd., New Delhi, 2012.
3. Singh M.D. &Kanchandhani K.B., "Power Electronics", McGraw Hill, New Delhi, 2007

RA3301 ROBOT KINEMATICS L T P C
3 0 0 3

COURSE OBJECTIVES

1. To introduce Robots history, terminologies, classification and configurations.
2. To get knowledge about basic Geometrical and Algebraic approach to solve forward kinematics of serial manipulator.
3. To get knowledge about advanced forward kinematics of serial manipulator.
4. To get knowledge about inverse kinematics of various serial manipulator.
5. To get knowledge about Jacobian aspects and infinitesimal motion of robot mechanisms.

UNIT I OVERVIEW OF ROBOTICS 9

Introduction to Robotics - History - Definitions - Law of Robotics – Terminologies - Classifications Overview – Links & Joints - Degrees of Freedoms - Coordinate Systems - Work Volume - Precision, Repeatability & Accuracy - Position and Orientation of Objects - Roll, Pitch and Yaw Angles - Joint Configuration of Five Types of Serial Manipulators - Wrist Configuration- Overview of end effector - Selection and Application of Serial Manipulators.

UNIT II FORWARD KINEMATICS - GEOMETRICAL AND ALGEBRAIC APPROACH 9

Need for forward and Inverse Kinematics Equation – Parameters in Design and Control – Methods of forward and inverse kinematics- Geometrical and Algebraic Approach in Forward Kinematics Solution, 1 DOF - 2 DOF Planar Robot (2P and 2R); 3DOF 2RP Spatial Robot.

UNIT III FORWARD KINEMATIC MODELING – DENAVIT-HARTEBERG (DH) APPROACH 9

Unit Circle Trigonometry - Translation Matrix - Rotation matrix, Euler Angles - Quaternion Fundamental - Dot and Cross Products - Frames and Joint Coordinates - Homogeneous Transformation - D-H and Modified D-H Convention and Procedures – Forward kinematics Solution using D-H Convention: 3 DOF wrist , RR Planar, 3 DOF RRP, Cartesian, Cylindrical, Spherical , SCARA and Articulated 3 DOF robots - 3 DOF robot with wrist.

UNIT IV INVERSE KINEMATICSMODELING 9

Introduction to inverse kinematics -Issues in inverse kinematics - Inverse kinematics of 2 DOF Planar robot - 2 and 3DOF planar and Spatial robot - Tool configuration - Inverse kinematics of 3 axis robot and 6 axis Robot - Inverse kinematics Computation- Closed loop solution

UNIT V KINEMATIC MODELING OF DIFFERENTIAL DRIVE ROBOT 9

Degree of Mobility, Steerability and Maneuverability- Mobile Robot kinematics - Kinematic model and constraints, Mobile robot workspace – Representation of robot position – Kinematic models of differential wheel drive - Fixed wheel and steered wheel - Mobile manipulators and its applications – swarm robots.

TOTAL : 45 PERIODS

COURSE OUTCOMES

At the end of the course students able to

CO1: Explain the history, classifications, and basic terminologies of robotics and various configuration of robots.

CO 2: Evaluate forward kinematic model for planar and spatial robot manipulator.

CO 3: Evaluate forward kinematic model for multi-DOF robot manipulators.

CO 4: Evaluate inverse kinematic model for multi-DOF robot manipulators.

CO 5: Evaluate forward kinematic model for differential drive mobile robot.

TEXT BOOKS:

1. Mikell P. Groover, "Industrial Robotics", McGraw Hill, 2nd edition, 2012.
2. John J. Craig, “Introduction to Robotics”, 3rd Edition, Addison Wesley, ISE 2008.
3. Lynch, Kevin M., and Frank C. Park. Modern Robotics: Mechanics, Planning, and Control 1st ed. Cambridge University Press, 2017.

REFERENCES:

1. S K Saha, Introduction to Robotics, Tata McGraw-Hill, Second Edition, 2017
2. Mikell P. Groover, "Industrial Robotics", McGraw Hill, 2nd edition, 2017
3. Arthor Critchlow, “Introduction to Robotics”, 1st edition, Macmillan, 2009.
4. Mohsen Shahinpoor, “A Robot Engineering Text Book”, 1st edition, Harper and Row, 2004.
5. Deb S.R., “Robotics Technology and Flexible Automation”, 2nd edition, Tata McGraw - Hill Publis Robotics: Control and Programming.
6. J. Srinivas, R. V. Dukkipati, K., “Robotics: Control and Programming”, Narosa Publishing House, 2009.
7. Tsuneo Yohikwa, Foundations of Robotics Analysis and Control, Prentice Hall of India Pvt. Ltd., 2001
8. Bijay K. Ghosh, Ning Xi, T.J. Tarn, Control in Robotics and Automation Sensor - Based integration, Academic Press, 1999.

Mapping of COs with POs and PSOs															
COs/Pos &PSOs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1	1								1	1	1	3
CO2	3	2	1	1								1	1	1	3
CO3	3	2	1	1								1	1	1	3
CO4	3	3	1	2								1	1	1	3
CO5	3	1	1	2								1	1	1	3
CO/PO & PSO Average	3.0	2.0	1.0	1.4								1.0	1.0	1.0	3.0
1 – Slight, 2 – Moderate, 3 – Substantial															

MR3361 ELECTRICAL DRIVES AND ACTUATORS LABORATORY **L T P C**
0 0 4 2

COURSE OBJECTIVES:

1. To impart knowledge on Performance of the fundamental control practices associated with AC and DC machines (starting, reversing, braking, plugging, etc.) using power electronics To impart industry oriented learning
2. To evaluate the use of computer-based analysis tools to review the major classes of machines and their physical basis for operation

LIST OF EXPERIMENTS:

(i) Load test on DC Motor
(ii) Load test on 3 Phase Induction Motor
(iii) Load test on 3 Phase Synchronous Motor.
(iv) Rheostat based Speed control of motors (AC and DC)
(v) Switching circuits of MOSFET, IGBT, SCR and TRAIC.
(vi) Gate pulsation generation using PWM signals.
(vii) Speed control of DC motor using Power Electronic Drive.
(viii) Position and direction control DC servomotor using Power Electronic Drive.
(ix) Position, direction and speed control of BLDC and PMDC motors using Power Electronic Drive.
(x) Position, Direction and speed control of stepper Motor.
(xi) Four quadrant operation of three-phase Induction Motor using Power Electronic Drive.
(xii) VFD control of single phase and three-phase induction motor using Power Electronic Drive.
(xiii) AC servomotor position, direction and speed control using Power Electronic Drive.

(Any 10 experiments)

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the student able to:

CO1: Practice the basic working of AC, DC motor, stepper motor, servo motor and synchronous motor using power electronic drive
CO2: Demonstrate the control of AC, DC motor, stepper motor, servo motor and synchronous motor using power electronic drive

CO 3:Analyze the performance of AC, DC motor, stepper motor, servo motor and synchronous motor using power electronic drive

Mapping of COs with POs and PSOs															
COs/POs & PSOs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1	1	1							1	2	2	3
CO2	3	2	1	1	1							1	2	2	3
CO3	3	2	1	1	1							1	2	2	3
CO/PO & PSO Average	3	2	1	1	1							1	2	2	3
1 – Slight, 2 – Moderate, 3 – Substantial															

List of Equipment's:

1. DC Motor with load – 1. N.o.
2. 3 Phase Induction Motor with load – 1. N.o.
3. 3 Phase Synchronous Motor with load – 1. N.o.
4. Rheostat based Speed control of motors (AC and DC) with load – 1. N.o.
5. MOSFET, IGBT, SCR and TRAIC – 1. N.o.
6. DC motor with speed control Drive. – 1. N.o.
7. DC servomotor with Power Electronic Drive (Position, Direction and speed). – 1. N.o.
8. BLDC and PMDC motors with Power Electronic Drive (Position, Direction and speed). – 1. N.o.
9. Stepper Motor with Power Electronic Drive (Position, Direction and speed). – 1. N.o.
10. Three-phase Induction Motor with Power Electronic Drive. – 1. N.o.
11. VFD with single phase and three-phase induction motor. – 1. N.o.
12. AC servomotor with Power Electronic Drive (Position, Direction and speed). – 1. N.o.

RA3311	ROBOT MODELLING AND SIMULATION LABORATORY	L	T	P	C
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COURSE OBJECTIVES

1. Make the students knowledgeable in modeling the basic components of a robot
2. Make the students knowledgeable in modeling some common joints, links and transmission assembly for a robot.
3. Make the students knowledgeable in modeling a robot and its end effector.

LIST OF EXPERIMENTS

1. 2D Sketch of a Gear.
2. 2D Sketch and 3D modelling of Sheet Metal Components
3. 3D Modelling Mounting clamp for motor.
4. 3D Modeling of GT2 pulley and belt drive system
5. 3D Modelling Ball Screw and Nut assembly.
6. 3D Modelling and motion simulation of Rotational Joint assembly.
7. 3D Modelling and motion simulation of Prismatic Joint assembly.
8. 3D modelling and simulation of Cartesian Robot
9. 3D modelling and simulation of Articulated / Spherical / Cylindrical Robot.
10. 3D modelling and motion simulation of 2 fingered gripper assembly.