**PAAVAI ENGINEERING COLLEGE**
**(AUTONOMOUS)**
**B.E. ROBOTICS AND AUTOMATION**
**REGULATIONS - 2023**
**CURRICULUM**
**(CHOICE BASED CREDIT SYSTEM)**
**(For the candidates admitted during the Academic Year 2023-2024 onwards)**

**SEMESTER III**

| S.No | Category | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|---|
| **Theory** | | | | | | | |
| 1 | BS | MA23301 | Transform Techniques and Partial Differential Equations | 3 | 1 | 0 | 4 |
| 2 | PC | RA23301 | Fluid Power System | 3 | 0 | 0 | 3 |
| 3 | PC | RA23302 | Robot Kinematics | 3 | 0 | 0 | 3 |
| 4 | PC | RA23303 | Digital Electronics | 3 | 0 | 0 | 3 |
| 5 | MC | MC23302 | Human Values and Gender Equality | 2 | 0 | 0 | 0 |
| **Theory with Practical** | | | | | | | |
| 6 | ES | EE23307 | Electrical Drives and Actuators | 3 | 0 | 2 | 4 |
| **Practical** | | | | | | | |
| 7 | PC | RA23304 | Digital Electronics Laboratory | 0 | 0 | 4 | 2 |
| 8 | PC | RA23305 | Fluid Power System Laboratory | 0 | 0 | 4 | 2 |
| 9 | EE | GE23301 | Professional Development I | 0 | 0 | 2 | 1 |
| | | | **TOTAL** | **17** | **1** | **12** | **22** |

**SEMESTER IV**

| S.No | Category | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|---|
| **Theory** | | | | | | | |
| 1 | BS | MA23401 | Statistics and Numerical Methods | 3 | 1 | 0 | 4 |
| 2 | PC | RA23401 | Mechanics of Solids | 3 | 0 | 0 | 3 |
| 3 | PC | RA23402 | Control Systems Engineering | 3 | 0 | 0 | 3 |
| 4 | PC | RA23403 | Sensors and Instrumentation | 3 | 0 | 0 | 3 |
| 5 | MC | MC23401 | Environmental Sciences and Sustainability | 2 | 0 | 0 | 0 |
| **Theory with Practical** | | | | | | | |
| 6 | PC | RA23404 | Manufacturing Technology | 3 | 0 | 2 | 4 |
| **Practical** | | | | | | | |
| 7 | PC | RA23405 | Mechanics of Solids Laboratory | 0 | 0 | 4 | 2 |
| 8 | PC | RA23406 | Sensors and Instrumentation Laboratory | 0 | 0 | 4 | 2 |
| 9 | EE | GE23401 | Professional Development II | 0 | 0 | 2 | 1 |
| | | | **TOTAL** | **17** | **1** | **12** | **22** |

PAAVAI ENGINEERING COLLEGE, NAMAKKAL
Approved
BOARD OF STUDIES
Robotics and Automation
AUTONOMOUS

| MA23301 | TRANSFORM TECHNIQUES AND PARTIAL DIFFERENTIAL EQUATIONS | 3 | 1 | 0 | 4 |
|---|---|---|---|---|---|

(Common to Aero, Agri, BME, Biotech, Civil, Chemical, EEE, Food, Pharma, Mech, MCT, R&A)

**COURSE OBJECTIVES**

To enable the students to

| | |
|---|---|
| 1. | develop the knowledge of periodic and non-periodic functions and their representations using fourier series. |
| 2. | acquaint the student with Fourier transform techniques used in wide variety of situations. |
| 3. | introduce the basic concepts of PDE for solving standard partial differential equations. |
| 4. | acquaint the student with Fourier series techniques in solving heat flow problems used in various situations. |
| 5. | develop Z transform techniques for discrete time systems. |

| UNIT I | FOURIER SERIES | 12 |
|---|---|---|

Dirichlet's conditions; General Fourier series; Odd and even functions; Half range series; Statement of Complex form of Fourier Series; Parseval's identity; Harmonic Analysis.

| UNIT II | FOURIER TRANSFORMS | 12 |
|---|---|---|

Fourier integral theorem (without proof); Fourier transform pair; Sine and Cosine transform - Properties; Transforms of elementary functions; Convolution theorem; Parseval's identity.

| UNIT III | PARTIAL DIFFERENTIAL EQUATIONS | 12 |
|---|---|---|

Formation of partial differential equations; Lagrange's linear equation; Solutions of four standard types of first order partial differential equations; Linear partial differential equations of second order with constant coefficients.

| UNIT IV | FOURIER SERIES SOLUTION TO PARTIAL DIFFERENTIAL EQUATIONS | 12 |
|---|---|---|

Solutions of One-dimensional wave and heat equation; Steady state two-dimensional heat equation.

| UNIT V | Z -TRANSFORMS AND DIFFERENCE EQUATIONS | 12 |
|---|---|---|

Z-transforms - Elementary properties; Inverse Z-transform; Method of partial fraction ; Residue method; Convolution theorem; Solution of difference equations by Z-transform.

| | TOTAL PERIODS | 60 |
|---|---|---|

| COURSE OUTCOMES<br>At the end of this course, the students will be able to | | BT MAPPED<br>(Highest Level) |
|---|---|---|
| CO1 | classify the properties of periodic and non-periodic vibrations with the help of fourier series. | Applying (K3) |
| CO2 | apply the fourier transform to convert the function from frequency domain to time domain. | Applying (K3) |

| | | |
|---|---|---|
| **CO3** | demonstrate partial differential equations that occur in many engineering applications. | Applying (K3) |
| **CO4** | apply Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations. | Applying (K3) |
| **CO5** | apply knowledge of Z transform to analyse linear time invariant systems. | Applying (K3) |

**TEXT BOOKS**

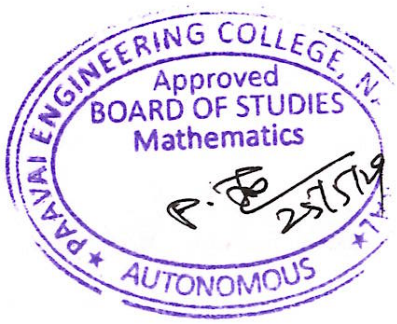
1. Veerarajan T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
2. Grewal. B.S, "Higher Engineering Mathematics", 44th Edition, Khanna Publications, New Delhi, (2018).

**REFERENCES**

1. Erwin Kreyszig , "Advanced Engineering Mathematics ", 10th Edition, Wiley Publications, New Delhi, India, 2016.
2. Ramana. B.V., "Higher Engineering Mathematics", Tata Mc-Graw Hill Publishing Company limited, New Delhi (2010).
3. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education (2007).
4. Wylie. R.C. and Barrett. L.C., "Advanced Engineering Mathematics", Tata Mc-Graw Hill Publishing Company limited, 6th Edition, New Delhi, 2012.

**CO PO MAPPING:**

| **Mapping of Course Outcomes with Programme Outcomes (3/2/1 indicates strength of correlation) 3- Strong, 2-Medium, 1-Weak** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **Programmes Outcomes(POs)** | | | | | | | | | | | | | |
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| **CO1** | 3 | 3 | 2 | 2 | - | - | - | - | - | - | - | 3 | 1 | 1 |
| **CO2** | 2 | 3 | 3 | 2 | - | - | - | - | - | - | - | 3 | 2 | 1 |
| **CO3** | 3 | 3 | 3 | 2 | - | - | - | - | - | - | - | 2 | 2 | 2 |
| **CO4** | 3 | 3 | 3 | 2 | - | - | - | - | - | - | - | 2 | 2 | 2 |
| **CO5** | 2 | 3 | 2 | 2 | - | - | - | - | - | - | - | 2 | 2 | 2 |



| RA23301 | FLUID POWER SYSTEM | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**COURSE OBJECTIVES**

To enable the students to

| | |
|---|---|
| 1 | acquire the concepts of fluid power. |
| 2 | understand the fundamentals of control and regulating elements. |
| 3 | impart knowledge on hydraulic and pneumatic actuators. |
| 4 | familiarize with the circuit design for hydraulic and pneumatic system. |
| 5 | learn about basics of fluid logic control and applications. |

**UNIT I** **BASICS OF FLUID POWER SYSTEM AND FLUID CHARACTERISTICS** **9**

Introduction to Fluid power - Advantages and Applications; Fluid Power ANSI Symbols; Types of fluids - Properties of fluids; Pascal's law and Applications, Darcy's equation, Frictional losses. Losses in valves and fittings , Basics of Hydraulics , Principles of flow ; Pump Classification - Gear Pump ,Vane pump-Piston pump , characteristics , Construction, Working, Selection criteria of pumps, Advantages, Disadvantages.

**UNIT II** **CONTROL AND REGULATIING ELEMENTS** **9**

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.

**UNIT III** **HYDRAULIC ACTUATORS AND PNEUMATIC ACTUATORS** **9**

Introduction, Classification of actuators, Hydraulic pumps and supply sources, Hydraulic actuators - Linear actuator, Types - Single acting, Double acting special cylinders - tandem, Rod less, Telescopic, mounting details, cushioning mechanism, Rotary actuators, power packs ; accumulators and types ; Air filter, regulator, lubricator; Pneumatic cylinders-Pneumatic motors, Stroke Speed Regulation of Pneumatic Actuators.

**UNIT IV** **CIRCUIT DESIGN FOR HYDRAULIC AND PNEUMATIC SYSTEMS** **9**

Industrial hydraulic circuits - Regenerative, Pump Unloading, Double-pump, Counter balance valve application, Pressure Intensifier, Air - over oil, Reciprocation, Synchronization, Sequencing, Fail-safe circuit, Speed Control circuit ; Design of pneumatic circuit - Cascade method, Electro pneumatic circuits; Accumulators-types and applications.

**UNIT V** **FLUID LOGIC CONTROL SYSTEM AND PLC** **9**

Introduction-Moving part logic control system,MPL control of fluid power system, sequence control of two double acting cylinder ; Introduction to Boolean Algebra ; Advanced electrical controls for fluid power system-Introduction, Components of an Electrohydraulic servo system ; Programmable Logic Controllers-Introduction,PLC control of a Hydraulic Cylinder , PLC Control of Electrohydraulic Servo System and Jackknife Car loader.

**TOTAL PERIODS** **45**

| COURSE OUTCOMES | | |
|---|---|---|
| At the end of this course, students will be able to | | **BT Mapped (Highest Level)** |
| **CO1** | show symbols and various pumps utilized in hydraulic and pneumatic systems | Remembering (K1) |
| **CO2** | recognize suitable components for hydraulic and pneumatic systems and valves | Understanding (K2) |
| **CO3** | manage and uphold diverse hydraulic and pneumatic actuators in industrial settings | Applying (K3) |
| **CO4** | create a hydraulic and pneumatic circuit for a straightforward application | Applying (K3) |
| **CO5** | elaborate on fluid logic control systems and plc | Analyzing (K4) |

**TEXT BOOKS**


1. Anthony Esposito, "Fluid power with applications", 7th edition. Pearson Education Inc. 2018.
2. Cassi Piccuillo, "Pneumatic System: Principle and Maintenance: Pneumatic", Independently Published, 2021.


**REFERENCES**

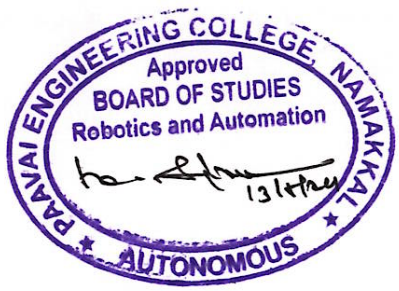

1. Majumdar S.R., "Pneumatic Systems - Principles and Maintenance", Tata McGraw Hill, 2017.
2. James L.Johnson, "Introduction to Fluid Power", Delmar Thomson Learning, 2018.
3. Avinash G. patil,Vinayak K.Gaikwad and Dr.Vikas V.Shinde, " Hydraulic and Pneumatic",2nd edition, Technical Publications.2019.
4. Ilango,Sivaraman, "Introduction to Hydraulics and Pneumatics", 3rd edition, PHI Learning.2017.


**CO-PO MAPPING :**

**Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's**

**(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

| CO's | PO's | | | | | | | | | | | | PSO's | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO1 | 2 | 2 | 2 | 2 | 2 | - | - | - | - | 2 | - | 3 | 2 | 2 |
| CO2 | 3 | 3 | 2 | 2 | 2 | - | - | - | - | 2 | - | 3 | 3 | 2 |
| CO3 | 2 | 2 | 2 | 2 | 2 | - | - | - | - | 2 | - | 3 | 2 | 2 |
| CO4 | 3 | 3 | 2 | 2 | 2 | - | - | - | - | 2 | - | 3 | 3 | 2 |
| CO5 | 2 | 3 | 2 | 2 | 3 | - | - | - | - | 2 | - | 2 | 3 | 2 |



| RA23302 | ROBOT KINEMATICS | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**COURSE OBJECTIVES**

To enable the students to

| | |
|---|---|
| 1 | get a brief exposure to Robots history, terminologies, classification and configurations. |
| 2 | learn the concepts of basic Geometrical and Algebraic approach to solve forward kinematics of serial manipulator. |
| 3 | know about advanced forward kinematics of serial manipulator. |
| 4 | understand the inverse kinematics of various serial manipulator. |
| 5 | acquire knowledge in the fundamentals of 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 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 KINEMATICS MODELING | 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 PERIODS | 45 |
|---|---|---|

| COURSE OUTCOMES | | |
|---|---|---|
| At the end of this course, students will be able to | | **BT Mapped (Highest Level)** |
| **CO1** | describe the importance of the history, classifications, and basic terminologies of robotics and various configuration of robots. | Remembering (K1) |
| **CO2** | evaluate forward kinematic model for planar and spatial robot manipulator. | Understanding (K2) |
| **CO3** | apply the working principle of forward kinematic model for multi-DOF robot manipulators. | Applying (K3) |
| **CO4** | apply the inverse kinematic model for multi-DOF robot manipulators. | Applying (K3) |
| **CO5** | assess the forward kinematic model for differential drive mobile robot. | Analyzing (K4) |

**TEXT BOOKS**


1. Mikell P. Groover, "Industrial Robotics", McGraw Hill, 2nd edition, 2019.
2. John J. Craig, "Introduction to Robotics", 3rd Edition, Addison Wesley, ISE 2018.

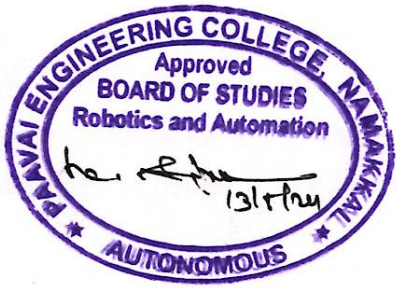

**REFERENCES**


1. Lynch, Kevin M., and Frank C. Park. Modern Robotics: Mechanics, Planning, and Control 1st edition Cambridge University Press, 2017.
2. S K Saha, Introduction to Robotics, Tata McGraw-Hill, Second Edition, 2019.
3. Yore Koran, "Robotics for Engineers", McGraw-Hill Book Co., 2020.
4. Richard. K. Miller, "Industrial Robot Handbook", Springer, 2019.


**CO-PO MAPPING:**

**Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's**
**(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

| | PO's | | | | | | | | | | | | PSO's | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO's** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** |
| **CO1** | 3 | 2 | - | - | - | - | - | - | - | - | - | 2 | 1 | 1 |
| **CO2** | 2 | 3 | 1 | 1 | - | - | - | - | - | - | - | 2 | 1 | 1 |
| **CO3** | 2 | 3 | 1 | 1 | - | - | - | - | - | - | - | 2 | 1 | 1 |
| **CO4** | 2 | 3 | 1 | 2 | - | - | - | - | - | - | - | 2 | 1 | 1 |
| **CO5** | 2 | 2 | 3 | 2 | - | - | - | - | - | - | - | 2 | 2 | 2 |



| RA23303 | DIGITAL ELECTRONICS | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**COURSE OBJECTIVES**

To enable the students to

| | |
|---|---|
| 1 | acquire the knowledge of digital logic and minimization technique. |
| 2 | understand the combinational circuits. |
| 3 | understand the combinational circuits converters. |
| 4 | know the various synchronous sequential circuits. |
| 5 | study the basics of asynchronous circuits. |

| UNIT I | LOGIC GATES AND MINIMIZATION CIRCUITS | 9 |
|---|---|---|

Basic digital circuits AND - OR - NAND - NOR - EX-OR operations; Boolean Algebra- Simplification of Boolean functions - minterm (SoP) - maxterm (PoS); K Map representation of functions - simplification of logic functions using K Map - Don't care conditions (upto 4 variables), Quine - McCluskey method of minimization (upto 4 variables).

| UNIT II | COMBINATIONAL CIRCUITS I | 9 |
|---|---|---|

Half and Full Adders -Half and Full Subtractors; Binary/ BCD adders, Parallel adder, parallel subtractor, binary multiplier, parity generator, parity checker.

| UNIT III | COMBINATIONAL CIRCUITS II | 9 |
|---|---|---|

Encoder – 4 to 2, 8 to 3 line encoder; Decoder –BCD to seven segment decoder; Multiplexer-Demultiplexer, 2 bit Magnitude Comparator, Code converters.

| UNIT IV | SYNCHRONOUS SEQUENTIAL CIRCUITS | 9 |
|---|---|---|

Introduction to Sequential circuits - flip-flops - SR flip flops - JK flip flops - D flip flops - T flip flops - master slave flip flops; State diagram - state table - State minimization - State assignment - Excitation table and maps - shift registers - Ring counter.

| UNIT V | ASYNCHRONOUS SEQUENTIAL CIRCUITS | 9 |
|---|---|---|

Asynchronous sequential logic - Primitive flow table, minimization of Primitive flow table, State assignment, Excitation table; Cycles- Race Free State Assignment; Hazards in combinational circuits, Hazards elimination.

| | TOTAL PERIODS | 45 |
|---|---|---|

**COURSE OUTCOMES**

| At the end of this course, students will be able to | | BT Mapped (Highest Level) |
|---|---|---|
| CO1 | understand boolean algebra principles and explain various digital logic families. | Understanding (K2) |
| CO2 | design combinational circuits using logic gates. | Applying (K3) |
| CO3 | construct synchronous sequential circuits using basic flip flops. | Applying (K3) |
| CO4 | design the asynchronous logic families & its hazards. | Applying (K3) |
| CO5 | analyze the various Programmable Logic Devices. | Analyzing (K4) |

**TEXT BOOKS**

1. M. Morris Mano, Michel D. Ciletti,"Digital Design", Pearson Education, New Delhi, 6th edition, 2018.
2. Ronald J. Tocci Neal S. Widmer and Gregory L. Moss, "Digital Systems: Principles and Applications", Prentice Hall of India, New Delhi, 12th Edition, 2018.

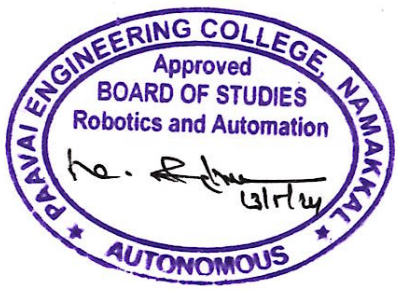
**REFERENCES**


1. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, Fourth Edition, 2016.
2. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, Fifth Edition, 2022.
3. Thomas L Floyd, "Digital Fundamentals", Pearson Education Limited, Eleventh Edition, Reprint 2020.
4. Tocci R.J, Neal S. Widmer, "Digital Systems: Principles and Applications", Pearson Education Asia, Tenth Edition, 2014.


**CO-PO MAPPING:**

**Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's**
**(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

| CO's | PO's | | | | | | | | | | | | PSO's | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO1 | 3 | 2 | - | - | - | - | - | - | 2 | - | - | 1 | 3 | 3 |
| CO2 | 3 | 2 | 2 | 1 | - | - | - | - | 2 | - | - | 1 | 3 | 3 |
| CO3 | 3 | 2 | 2 | 1 | - | - | - | - | 2 | - | - | 1 | 3 | 3 |
| CO4 | 3 | 2 | 2 | 1 | - | - | - | - | 2 | - | - | 2 | 3 | 3 |
| CO5 | 3 | 1 | 1 | - | - | - | - | - | 2 | - | - | 2 | 3 | 3 |



| MC23302 | HUMAN VALUES AND GENDER EQUALITY | 2 | 0 | 0 | 0 |
|---|---|---|---|---|---|

| COURSE OBJECTIVES | |
|---|---|
| To enable the students to | |
| 1 | define different types of human values and their impact on individual behavior and societal norms. |
| 2 | apply principles of personal development such as self-confidence, self-discipline, and resilience to navigate modern challenges effectively. |
| 3 | evaluate the role of values in shaping professional ethics, civic sense and global citizenship. |
| 4 | examine the socio-economic factors influencing gender inequality and explore avenues for empowerment and advocacy. |
| 5 | critically analyze prevalent issues and challenges faced by women, including gender-based violence, discrimination, and cultural biases, and propose measures for their eradication. |

| UNIT I | HUMAN VALUES | 6 |
|---|---|---|

Value Education - Definition, Types of values; Human values - Acceptance, Consideration. Appreciation, Listening. Empathy, Sympathy, Honesty, Integrity, Wisdom, Decision making, Self- actualization, Character formation towards positive personality, Contentment; - Religious Values - Humility, Compassion, Gratitude. Peace, Justice, Freedom, Equality.

| UNIT II | PERSONALITY DEVELOPMENT | 6 |
|---|---|---|

Personal Development - Introspection, Self-confidence, Self-discipline; Flexibility -Peer pressure - Sensitization towards Gender Equality; Reliability; Unity; Modern Challenges of Adolescent Emotions and behavior - Comparison and Competition, Positive and Negative attitudes; Family values; Self- improvement - Physical exercises, Meditation ,Yoga.

| UNIT III | VALUE EDUCATION TOWARDS NATIONAL AND GLOBAL DEVELOPMENT | 6 |
|---|---|---|

Professional Values -. Integrity, Responsibility, Punctuality, Dedication - Perseverance - Competence; Civic sense and Responsibility; Global Values - Computer Ethics, Moral Leadership, Code of Conduct; Corporate Social Responsibility; Aesthetic values; National Integration and International understanding of Religious Values – Spirituality, thought process.

| UNIT IV | GENDER EQUALITY | 6 |
|---|---|---|

Gender Equality - Definition, Empowerment, Economic Equality; Condition of Women in India - Education, Healthcare, Political Representation, Gender-based Violence; Challenging Stereotypes: Parental and Caregiving Responsibilities; Legal and Policy Reform; Cultural Shifts; Global Perspective; Male Chauvinism; Sustainable Development.

| UNIT V | WOMEN ISSUES AND CHALLENGES | 6 |
|---|---|---|

Women Issues and Challenges - female feticide, violence against women; Domestic violence- dowry related abuse and deaths, Physical violence, Emotional abuse; Sexual assault; Honour killing; Eve-teasing- Stalking, e-stalking (cyber-crime).

| | TOTAL PERIODS | 30 |
|---|---|---|

| COURSE OUTCOMES<br>At the end of this course, the students will be able to | | BT MAPPED<br>(Highest Level) |
|---|---|---|
| CO1 | discuss the concept of human values and their significance in personal and societal development. | Understanding (K2) |
| CO2 | demonstrate introspective skills to enhance personal growth and self-awareness. | Applying (K3) |
| CO3 | recognize the importance of gender equality in promoting a just and equitable society. | Understanding (K2) |
| CO4 | cultivate a sense of social responsibility and ethical conduct towards achieving national and global development. | Analyzing (K4) |
| CO5 | analyse the challenges faced by women in various spheres and identify strategies for addressing them. | Analyzing (K4) |

**TEXT BOOKS**

1. A Foundation Course in Human Values and Professional Ethics: Presenting a Universal Approach to Value Education - Through Self-exploration. New Delhi, 2016.
2. Aurther, John. Personality Development. Lotus Press, 2018.

**REFERENCES**

1. Joshi, Dhananjay. Value Education in Global Perspective. Lotus Press, 2014.
2. Mahrotra, Mamta. Gender Inequality in India: Challenging Social Norms. Prabhat Books, 2015.

**CO PO MAPPING:**

| *CO-PO & PSO Matrix Correlation :: Put if, Strong :3, Moderate : 2, Weak : 1, Nil : - | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | - | 1 | - | 1 | 1 | 1 | 2 | 3 | 2 | 1 | 1 | 3 | 1 | 1 |
| CO2 | - | 1 | - | 1 | 1 | 1 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 |
| CO3 | - | 1 | - | 1 | 1 | 1 | 2 | 3 | 1 | 1 | 1 | 3 | 1 | 1 |
| CO4 | - | 1 | - | 1 | 1 | 1 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2 |
| CO5 | - | 1 | - | 1 | 1 | 1 | 1 | 3 | 2 | 2 | 1 | 3 | 2 | 2 |

| EE23307 | ELECTRICAL DRIVES AND ACTUATORS (Common to MCT and R&A) | 3 | 0 | 2 | 4 |
|---|---|---|---|---|---|

**COURSE OBJECTIVES**

To enable the students to

1. outline the representation of electrical drives.
2. get a knowledge on electric drive and their characteristics.
3. obtain the knowledge on DC motors drives by using power electronics converter.
4. study about AC motors drives controlling technique.
5. know about the special electrical motor construction and operation.

**UNIT I** **FUNDAMENTALS OF ELECTRICAL DRIVES** **9**

Basic elements; types of electric drives; Factors influencing the choice of electrical drives; classes of duty; Selection power rating of drive motors; Load equalization.

**UNIT II** **DRIVE CHARACTERISTICS** **9**

Characteristics of DC motor; Multi-quadrant operation; Three-phase induction motor - Construction, types, principle of operation, torque-slip characteristics, applications.

**UNIT III** **DC MOTORS AND DRIVES** **9**

DC Motors and their performance -Ward Leonard drive; Methods of braking; Speed control - Single phase fully controlled rectifier fed DC drives, four quadrant operation of chopper controlled DC drives.

**UNIT IV** **AC MOTORS AND DRIVES** **9**

Speed control of three phase induction motor - Stator voltage control, stator frequency control, stator voltage and frequency control, static rotor resistance control, static slip power recovery control.

**UNIT V** **SPECIAL ELECTRICAL MOTOR DRIVES** **9**

Stepper motors -Variable reluctance stepper motor, permanent magnet stepper motor; Switched reluctance motor - Construction and modes of operation; Construction and operation of BLDC motor, servo motor.

**LIST OF EXPERIMENTS**

1. Load test on DC shunt motor.
2. Load test on three phase squirrel cage induction motor.
3. Speed control of DC shunt motor (Armature and Field control).
4. Speed control of slip ring induction motor.
5. DSP based chopper fed DC motor drive.
6. Speed control of 3 phase induction motor using PWM inverter.
7. DSP based closed loop drive for induction motor.
8. Speed control of brushless DC motor.

**TOTAL PERIODS** **75**

| COURSE OUTCOMES | | |
|---|---|---|
| At the end of this course, students will be able to | | **BT Mapped (Highest Level)** |
| **CO1** | infer the operations of electric drives. | Understanding (K2) |
| **CO2** | explain the working and characteristics of various drives. | Applying (K3) |
| **CO3** | apply the solid state switching circuits to operate various types of DC motors and drivers. | Understanding (K2) |
| **CO4** | interpret the performance of AC motors and drives. | Understanding (K2) |
| **CO5** | describe the concept special electrical motors drivers for applications. | Understanding (K2) |

**TEXT BOOKS**

1. Nagrath .I.J. & Kothari .D.P, "Electrical Machines", Tata McGraw-Hill, Fourth Edition, Reprint 2019.
2. Vedam Subrahmaniam, "Electric Drives (concepts and applications)", Tata McGraw- Hill, 2016.

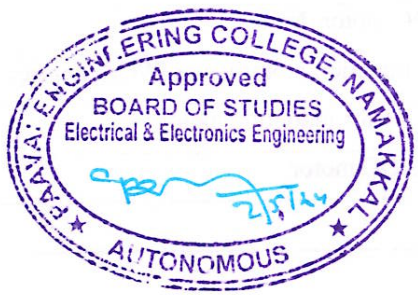
**REFERENCES**

1. Gobal K. Dubey, "Fundamentals of Electrical Drives", Narosal Publishing House, New Delhi, Second Edition, Reprint 2018.
2. Theraja B.L and Theraja A.K., "A Text book of Electrical Technology", Volume – II, S,Chand Co., 2016.
3. M.D.Singh, K.B.Khanchandani, "Power Electronics", Tata McGraw-Hill, 2014.
4. Bimal K Bose, "Modern Power Electronics and AC Drives", Prentice-Hall of India Pvt. Ltd., 2013.

**CO-PO MAPPING:**

**Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's**
**(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

| CO's | Programme Outcomes PO's | | | | | | | | | | | | PSO's | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO1 | 3 | 1 | 1 | - | - | - | - | - | 2 | - | - | 1 | 2 | 3 |
| CO2 | 3 | - | 1 | - | 2 | 1 | - | - | 2 | - | - | 1 | 1 | 3 |
| CO3 | 3 | 1 | 1 | - | 2 | 1 | - | - | - | - | - | 1 | 1 | 3 |
| CO4 | 3 | 1 | 1 | - | 2 | 1 | - | - | 2 | - | - | 1 | 2 | 3 |
| CO5 | 3 | 1 | 1 | - | 2 | 1 | - | - | - | - | - | 1 | 2 | 3 |



| RA23304 | DIGITAL ELECTRONICS LABORATORY | 0 | 0 | 4 | 2 |
|---|---|---|---|---|---|

**COURSE OBJECTIVES**

To enable the students to

| | |
|---|---|
| 1 | understand the concept of boolean theorems. |
| 2 | know the concept of combinational circuits using digital logic gates. |
| 3 | design and implement the combinational and sequential logic circuits using MSI devices |
| 4 | acquire knowledge on shift registers and counter. |

**LIST OF EXPERIMENTS**

1. Verification of Boolean theorems using digital logic gates.
2. Simplification and realization of Boolean expression using logic gates/ universal gates.
3. Design and implementation of half and full adders using logic gates.
4. Design and implementation of half and full subtractors using logic gates.
5. Design and implementation of code converter: Binary to Gray code and Gray code to Binary code.
6. Design and implementation of 2-bit magnitude comparator.
7. Design and implementation of encoder and decoder using basic gates.
8. Design and implementation of multiplexers and Demultiplexers using basic gates.
9. Implementation of Flip Flops: SR, D, T, JK Flip Flops using basic gates.
10. Design and implementation of Shift registers.

| | |
|---|---|
| **TOTAL PERIODS** | **60** |

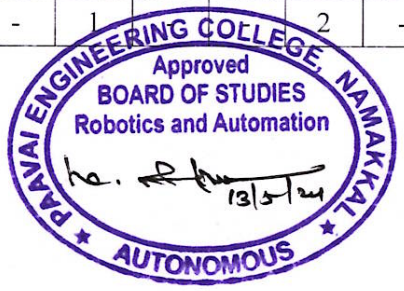
**COURSE OUTCOMES**

| At the end of this course, students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| **CO1** | design adders and subtractors using basic logic gates and karnaugh map. | Applying (K3) |
| **CO2** | create code converters using basic logic gates. | Analyzing (K4) |
| **CO3** | implement the combinational logic circuits like MUX, DEMUX, encoder, decoder. | Analyzing (K4) |
| **CO4** | design different types counters and shift registers. | Applying (K3) |

**CO-PO MAPPING:**

**Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's**
**(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

| CO's | PO's | | | | | | | | | | | | PSO's | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO1 | 3 | 2 | - | - | 1 | - | - | - | 2 | - | - | 1 | 3 | 3 |
| CO2 | 3 | 2 | 2 | 1 | - | 1 | - | - | 2 | - | - | 1 | 3 | 3 |
| CO3 | 3 | 2 | 2 | 1 | 1 | - | - | - | 2 | - | - | 1 | 3 | 3 |
| CO4 | 3 | 2 | 2 | 1 | - | 1 | - | - | 2 | - | - | 2 | 3 | 3 |



| RA23305 | FLUID POWER SYSTEM LABORATORY | 0 | 0 | 4 | 2 |
|---|---|---|---|---|---|

**COURSE OBJECTIVES**

To enable the students to

| | |
|---|---|
| 1 | understand the role of pneumatic and hydraulic systems in a complex mechatronics system. |
| 2 | analyze pneumatic and hydraulic circuits, and identify basic components. |
| 3 | invent and provide hand on experience to students to design and test hydraulic circuit to control press. |
| 4 | design and test hydraulic, pneumatic circuits to perform basic operations. |

**LIST OF EXPERIMENTS**

1. Fluid power standards.
2. Study of hydraulics and pneumatics systems components.
3. Design of sequence operation by using of CAM valve hydraulic circuit.
4. Design of meter in circuit and meter out circuit.
5. Design of speed control circuit for double acting pneumatic cylinder.
6. Design of hydraulic operation of vertical milling machine circuit.
7. Design of hand operated pneumatic double acting cylinder using fluid power simulation software.
8. Design of hydraulic cylinder reciprocating system using fluid power simulation software.
9. Design and testing of pneumatic double acting cylinder sequencing circuit (A+ B+ B- A- C+ C-) using fluid power simulation software
10. Design and testing of pneumatic double acting cylinder synchronization circuits (cylinders connected in series and parallel) using fluid power simulation software.
11. Design of pneumatic circuit for a drilling operation and simulate the operation in a fluid power simulation software.
12. Design fluid power circuits for an industrial application.
13. Design of hydraulic circuits with multi cylinders using fluid power simulation software.

| | |
|---|---|
| **TOTAL PERIODS** | **60** |

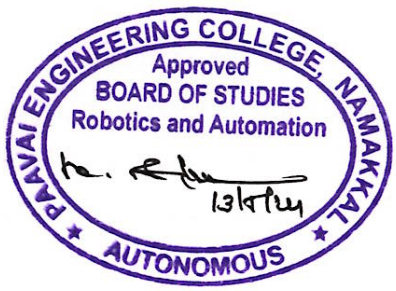
**COURSE OUTCOMES**

| At the end of this course, students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| **CO1** | discover the usage of typical hydraulic and pneumatic machines in industries. | Remembering (K1) |
| **CO2** | create fluid systems for diverse applications. | Understanding (K2) |
| **CO3** | contrast hydraulic, pneumatic, and mechanical systems. | Applying (K3) |
| **CO4** | develop a hydraulic or pneumatic system circuit using relevant software and conduct simulations. | Analyzing (K4) |

**CO-PO MAPPING :**

**Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's**
**(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

| CO's | PO's | | | | | | | | | | | | PSO's | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO1 | 3 | 3 | 1 | 3 | 2 | - | 3 | 2 | 2 | 2 | - | 2 | 3 | 2 |
| CO2 | 1 | 2 | 2 | 2 | 2 | - | 2 | 3 | 2 | 2 | - | 2 | 1 | 1 |
| CO3 | 2 | 2 | 2 | 2 | 1 | - | 2 | 1 | 2 | 3 | - | 1 | 2 | 2 |
| CO4 | 2 | 2 | 1 | 2 | 3 | - | 1 | 2 | 3 | 2 | - | 2 | 2 | 3 |



| GE23301 | PROFESSIONAL DEVELOPMENT I | 0 | 0 | 2 | 1 |
|---|---|---|---|---|---|

**COURSE OBJECTIVES**

To enable students to

| | |
|---|---|
| 1 | enhance and evaluate the student's potential strength, personality skills and reduce weakness to survive. |
| 2 | enhance and develop the students behavioral, speaking and listening skills to face the interview. |
| 3 | solve the quantitative aptitude problems and improve their problem-solving skills. |
| 4 | improve their reasoning skills to get placed in reputed companies. |

| UNIT I | SELF - UNDERSTANDING AND PERSONALITY ENHANCEMENT SKILLS | 7 |
|---|---|---|

Introduction: Self Exploration, SWOT Analysis - Types and Barriers - Effective Communication in Workplace - Leadership Skills - Decision Making - Problem Solving - Goal Setting - Critical, Strategic and Lateral Thinking, JAM Level - 1, Basic Resume Building Level – 1.

| UNIT II | BEHAVIOURAL SKILLS, LISTENING AND SPEAKING SKILLS | 7 |
|---|---|---|

Behavioral Skills : Time Management - Emotional Intelligence - Analytical Thinking; Listening - Listening and Hearing - Self Introduction - Group Discussion: Types and Importance - Evaluation Criteria - Do's and Don'ts of GD - GD Level-1.

| UNIT III | QUANTITATIVE APTITUDE | 8 |
|---|---|---|

Number System - LCM and HCF - Simple Interest and Compound Interest - Average - Pipes and Cisterns - Area - Profit and Loss.

| UNIT IV | LOGICAL REASONING | 8 |
|---|---|---|

Logical Sequence - Analogy - Classification - Causes and Effect - Making Judgment – Directions.

| TOTAL PERIODS | 30 |
|---|---|

| COURSE OUTCOMES<br>At the end of this course, the students will be able to | | BT MAPPED<br>(Highest Level) |
|---|---|---|
| CO1 | define and analyze soft skills to improve the leadership skills. | Analyzing (K4) |
| CO2 | demonstrate the behavioral skills through various activities. | Applying (K3) |
| CO3 | develop the problem solving skills through quantitative aptitude. | Applying (K3) |
| CO4 | illustrate the logical reasoning Skills to solve real world problems. | Analyzing (K4) |

**TEXTBOOKS**

- Agarwal, R.S. "Objective General English", S.Chand&Co.2021.
- Agarwal, R.S. "Quantitative Aptitude", S.Chand&Co.2021.

**REFERENCES**

- Abhijit Guha, "Quantitative Aptitude ", Tata-Mcgraw Hill.2023.
- Agarwal, R.S." A Modern approach to Verbal & Non Verbal Reasoning", S.Chand & Co Ltd, newdelhi.2021
- Word Power Made Easy By Norman Lewis, Wr.Goyal Publications.2021.

**CO/PO MAPPING:**

**Mapping of Course Outcome (CO's) with Programme Outcomes (PO's)**
**(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

| CO's | Programme Outcomes (PO's) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | P01 | P02 | P03 | PO4 | P05 | P06 | P07 | P08 | P09 | P010 | P011 | P012 | PSO1 | PSO2 |
| CO1 | - | - | - | - | - | - | 3 | 3 | 2 | 3 | - | 3 | 1 | 1 |
| CO2 | - | - | - | - | - | - | 2 | 3 | 2 | 3 | - | 3 | 1 | 1 |
| CO3 | 3 | 2 | 2 | 2 | - | - | 1 | - | - | - | - | - | 2 | 2 |
| CO4 | 2 | 3 | 3 | 2 | - | 3 | 3 | 1 | - | 1 | 2 | - | 2 | 2 |

| MA23401 | STATISTICS AND NUMERICAL METHODS | 3 | 1 | 0 | 4 |
|---|---|---|---|---|---|
| | (Common to Civil, Chemical, Mech, MCT, R&A) | | | | |

**COURSE OBJECTIVES**

To enable the students to

| | |
|---|---|
| 1. | determine the concepts of hypotheses testing, its need and applications. |
| 2. | equip with statistical techniques for designing experiments, analyzing, interpreting and presenting research data. |
| 3. | apply various numerical techniques for solving algebraic/transcendental equations and system of linear equations. |
| 4. | develop the knowledge of numerical differentiation and numerical integration techniques. |
| 5. | acquaint the knowledge of various techniques and methods of solving ordinary differential equations. |

| UNIT I | TESTING OF HYPOTHESIS | 12 |
|---|---|---|

Sampling theory; Large sample - Tests for single mean, proportion and difference of means; Small sample - Test for single mean and difference of means; Test equality of variances; Chi square test - Goodness of fit, Independence of attributes.

| UNIT II | DESIGN OF EXPERIMENTS | 12 |
|---|---|---|

Completely randomized design; Randomized block design; One way and two way classifications- Latin square design - $2^2$ factorial design.

| UNIT III | SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS | 12 |
|---|---|---|

Solution of algebraic and transcendental equations; Fixed point iteration method; Newton Raphson method; Solution of linear system of equations; Gauss elimination method – Pivoting; Gauss Jordan method; Iterative methods of Gauss Jacobi and Gauss Seidel; Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

| UNIT IV | INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION | 12 |
|---|---|---|

Interpolations - Newton's forward and backward difference interpolation; Approximation of interpolation polynomials; Divided differences; Lagrangian methods for equal and unequal intervals; Numerical differentiation and integration by trapezoidal and Simpson's 1/3 rules.

| UNIT V | NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS | 12 |
|---|---|---|

Single step methods: Taylor's series method; Euler's method, Modified Euler's method; Fourth order Runge-Kutta method for solving first order differential equations; Multi step methods: Milne's and Adams - Bash forth predictor corrector methods for solving first order differential equations.

| | TOTAL PERIODS | 60 |
|---|---|---|

| COURSE OUTCOMES<br>At the end of this course, the students will be able to | | BT MAPPED (Highest Level) |
|---|---|---|
| CO1 | apply the concept of testing of hypothesis for small and large samples in real life problems | Applying (K3) |
| CO2 | analyse the principles to be adopted for designing the experiments. | Analysing(K4) |

| | | |
|---|---|---|
| **CO3** | apply various numerical techniques to solve algebraic and transcendental equations. | Applying(K3) |
| **CO4** | derive the concepts of numerical differentiation and integration. | Applying (K3) |
| **CO5** | compute the solution of first order ordinary differential equations by numerical techniques. | Applying (K3) |

**TEXT BOOKS**

1. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.
2. Sankar Rao K " Numerical Methods for Scientists and Engineers –3rd Edition Princtice Hall of India Private, New Delhi, 2007.

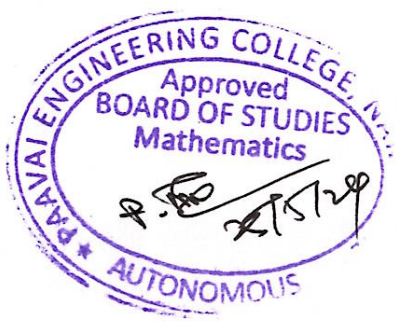
**REFERENCES**

1. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
2. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 7th Edition, 2007.
3. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics", Tata McGraw Hill Edition, 4th Edition, 2012.
4. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

**CO PO MAPPING:**

**Mapping of Course Outcomes with Programme Outcomes**
**(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium,1-Weak**

| COs | Programmes Outcomes (POs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 2 | 3 | - | - | - | - | - | - | - | 3 | 2 | 1 |
| CO2 | 3 | 3 | 2 | 3 | - | - | - | - | - | - | - | 3 | 1 | 1 |
| CO3 | 3 | 3 | 2 | 3 | - | - | - | - | - | - | - | 2 | 1 | 2 |
| CO4 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | - | 2 | 1 | 1 |
| CO5 | 3 | 3 | 2 | 2 | - | - | - | - | - | - | - | 2 | 1 | 2 |



| RA23401 | MECHANICS OF SOLIDS | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**COURSE OBJECTIVES**

To enable the students to

| | |
|---|---|
| 1 | know about how a solid behaves when it is exposed to forces and deformations. |
| 2 | know the concept stress acting on the beams. |
| 3 | learn different types of load for an appropriate beams and column. |
| 4 | understand the torsion for the machine elements like springs. |
| 5 | understand the concept of perfect frames |

**UNIT I** **STRESS - STRAIN, AXIAL LOADING** **9**

Stress and strain-elastic limit , Hooke's law, factor of safety; shear stress- shear strain, relationship between elastic constants; Stresses in stepped bars- uniformly varying sections, composite bars due to axial force; Lateral strain-Poisson's ratio, volumetric strain, changes in dimensions and volume; Thermal stresses and impact loading.

**UNIT II** **STRESSES IN BEAMS** **9**

Beam - Definition, types of end supports, types of beams, types of loading, Shear force diagram and bending moment diagram for cantilever; simply supported and overhanging beams under point load, UDL, UVL and moments; Euler beam theory - Bending equation, section modulus, Bending stress in beams , Shear stress in beams.

**UNIT III** **DEFLECTION OF BEAMS AND COLUMNS** **9**

Governing differential equation - Problems on Double integration method, Macaulay's Method, Moment area method, Concepts of Conjugate Beam method and Method of superposition; Columns - different end conditions, buckling load, Euler's theory, Rankine's formula.

**UNIT IV** **TORSION AND SPRINGS** **9**

Theory of torsion and assumptions - torsion equation, polar modulus, Stresses in solid and hollow circular shafts, power transmitted by a shaft, shafts in series and parallel, deflection in shafts fixed at the both ends; Springs - types, Deflection expression coiled helical spring - stress in springs -design of springs.

**UNIT V** **ANALYSIS OF PERFECT FRAMES** **9**

Introduction - Types of frames, Assumptions made in finding out the forces in a frame; Reactions of supports of a frame, Analysis of a frame.

**TOTAL PERIODS** **45**

**COURSE OUTCOMES**

| At the end of this course, students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| **CO1** | analyse stress, strain, and the modulus of elasticity when subjected to varying loads. | Remembering (K1) |
| **CO2** | create shear force and bending moment diagrams for typical beams. | Understanding (K2) |

| | | |
|---|---|---|
| **CO3** | determine the critical load for a column considering various end conditions. | Applying (K3) |
| **CO4** | investigate the varied loads acting on shafts and springs. | Analyzing (K4) |
| **CO5** | resolve issues pertaining to the analysis of ideal frames. | Analyzing (K4) |

**TEXT BOOKS**

1. R. K. Bansal, A text book of Strength of Materials, Laxmi Publications (P) Limited, New Delhi, 2019.
2. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India Learning. Ltd., New Delhi, 2018.

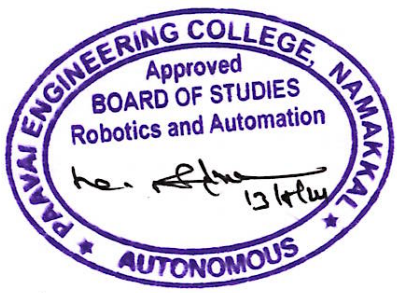
**REFERENCES**

1. R.K.Rajput, Engineering Materials, S. Chand and Company Ltd, New Delhi, 2018.
2. P. Purushothama Raj and V. Ramasamy, Strength of Materials, Pearson Education, India, 2019.
3. S.Rattan, Strength of Materials, 3rd edition.Tata McGraw-Hill Education.2017.
4. J.K Gupta and S.K.Gupta, Strength of Materials: Mechanics of Solids. 1st Edition, Cengage Learning India Pvt.Ltd, 2019.

**CO-PO MAPPING :**

**Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's**
**(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

| CO's | PO's | | | | | | | | | | | | PSO's | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO1 | 3 | 3 | 2 | 3 | - | - | - | - | - | - | - | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 2 | - | - | - | - | - | - | - | 3 | 3 | 3 |
| CO3 | 3 | 3 | 2 | 1 | - | - | - | - | - | - | - | 3 | 2 | 3 |
| CO4 | 3 | 3 | 2 | 2 | - | - | - | - | - | - | - | 3 | 3 | 3 |
| CO5 | 3 | 3 | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 | 3 |



| RA23402 | CONTROL SYSTEMS ENGINEERING | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**COURSE OBJECTIVES**

To enable students to

| | |
|---|---|
| 1 | understand the methods of representation of systems and to obtain system transfer function models. |
| 2 | provide knowledge on time response of systems and steady state error analysis. |
| 3 | acquaint basic knowledge in obtaining the closed–loop frequency responses of systems. |
| 4 | learn the concept of stability of control system. |
| 5 | understand the concept of state variable analysis. |

| UNIT I | SYSTEMS REPRESENTATION | 9 |
|---|---|---|

Basic elements in control systems - open loop and closed loop with applications - Transfer functions of mechanical, electrical and analogous systems - Block diagram reduction - signal flow graphs.

| UNIT II | TIME RESPONSE ANALYSIS | 9 |
|---|---|---|

Time response - Time domain specifications - Types of test input - I and II order system response - Error coefficients - Steady state error, error constants. PID control-Analytical design for PD, PI, PID control systems.

| UNIT III | FREQUENCY RESPONSE AND SYSTEM ANALYSIS | 9 |
|---|---|---|

Closed loop frequency response-Performance specification in frequency domain-Frequency response of standard second order system- Bode Plot - Polar Plot.

| UNIT IV | STABILITY ANALYSIS OF CONTROL SYSTEMS | 9 |
|---|---|---|

Characteristics equation - Location of roots in S plane for stability - Routh Hurwitz criterion - Root locus construction - Effect of pole, zero addition.

| UNIT V | SYSTEM ANALYSIS USING STATE VARIABLE MODELS AND STATE EQUATION | 9 |
|---|---|---|

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.

| | TOTAL PERIODS | 45 |
|---|---|---|

**COURSE OUTCOMES**

| At the end of this course, the students will be able to | | BT MAPPED (Highest Level) |
|---|---|---|
| CO1 | develop a mathematical model of a physical system and compute the transfer function using block diagram reduction technique and signal flow graph. | Remembering(K1) |
| CO2 | analyze the transient response of control systems in using time domain. | Understanding (K2) |
| CO3 | evaluate and analyze control systems using frequency domain methods. | Applying (K3) |
| CO4 | check the stability of systems using routh hurwitz criterion and root locus | Applying (K3) |
| CO5 | design various state variable models in control system using state variable. | Analyzing (K4) |

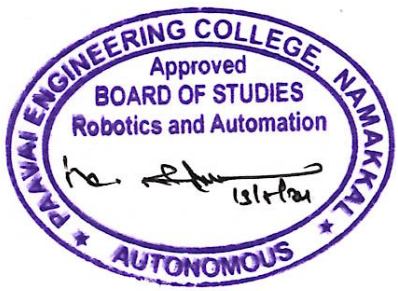
| TEXT BOOKS |
|---|
| 1. I.J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International Publishers, 2017. |
| 2. A.Nagoorkani, "Control Systems", RBA Publications, 2018. |
| **REFERENCES** |
| 1. B.C. Kuo, "Automatic Control Systems", Prentice Hall of India Ltd., 2017. |
| 2. M. Gopal, "Control Systems, Principles & Design", Tata McGraw Hill, 2017. |
| 3. K. Ogata, "Modern Control Engineering", Pearson Education, 2015. |
| 4. S.K.Bhattacharya, "Control System Engineering", Pearson, 2018. |

**CO-PO MAPPING:**

**Mapping of Course Outcomes with Programme Outcomes:**

**(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak**

| COs | Programme Outcomes(POs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | - | - | - | 2 |
| CO2 | 1 | 2 | 3 | 2 | - | - | - | - | - | - | - | - | - | 2 |
| CO3 | 1 | 3 | 3 | - | - | - | - | - | - | - | - | - | 1 | 2 |
| CO4 | 1 | 2 | 3 | 2 | - | - | - | - | - | - | - | - | 1 | 2 |
| CO5 | 1 | 2 | 1 | 3 | - | - | - | - | - | - | - | - | - | 2 |



| RA23403 | SENSORS AND INSTRUMENTATION | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**COURSE OBJECTIVES**

To enable the students to

| | |
|---|---|
| 1 | gain knowledge in units, standards, error analysis and characteristics of measurement systems. |
| 2 | understand the basic laws used in the operation of temperature and pressure sensors. |
| 3 | familiarize with principles, construction and working of optical, force and heading sensors. |
| 4 | understand the construction, working principles and characteristics of displacement, flow and magnetic sensors. |
| 5 | learn a signal conditioning circuit and data acquisition system. |

| UNIT I | INTRODUCTION | 9 |
|---|---|---|

Basics of Measurement; Classification of errors; Error analysis; Static and dynamic (first and second order transducers) characteristics of transducers; Classification of transducer; Sensor calibration techniques; generalized measurement system.

| UNIT II | TEMPERATURE AND PRESSURE SENSORS | 9 |
|---|---|---|

Temperature - Principle of operation, Bimetallic thermometer, Resistance Temperature Detectors, Thermistors, Thermocouples; Pressure - Bourdon gauge, Diaphragm gauge; Ionization gauge; Piezoelectric transducer; Capacitive transducer.

| UNIT III | OPTICAL, FORCE AND HEADING SENSORS | 9 |
|---|---|---|

Force - Strain Gauge, Load Cell; Optical sensor- Photo conductive cell, photo voltaic, Photo resistive, Fiber optic sensors; Heading sensor – Compass, Gyroscope, Inclinometers.

| UNIT IV | DISPLACEMENT, FLOW AND MAGNETIC SENSORS | 9 |
|---|---|---|

Displacement – Angular Resistance potentiometer, Linear Resistance potentiometer, LVDT; Flow measurement- Electro-Magnetic flow meter, turbine flow meter, hot wire anemometer; Magnetic measurement - hall effect transducer.

| UNIT V | SIGNAL CONDITIONING AND DAQ SYSTEMS | 9 |
|---|---|---|

Amplification; Filtering; Sample and Hold circuits; Data Acquisition - Single channel and multi-channel data acquisition; Data logging - Manufacturing, Environmental monitoring; Digital Transmission system.

| | TOTAL PERIODS | 45 |
|---|---|---|

**COURSE OUTCOMES**

| At the end of this course, students will be able to | | BT Mapped (Highest Level) |
|---|---|---|
| CO1 | define the units and standards, their conversions, characteristics and error analysis of systems. | Remembering (K1) |
| CO2 | infer the different application using temperature and pressure sensor. | Understanding (K2) |
| CO3 | select optical, force and heading sensors to create simple robotic system. | Applying (K3) |

| | | |
|---|---|---|
| **CO4** | discover the different application using displacement, flow and magnetic sensors. | Analyzing (K4) |
| **CO5** | construct a signal conditioning circuit and data acquisition system. | Applying (K3) |

**TEXT BOOKS**


1. Ernest O Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill, 2018.
2. Sawney A K and PuneetSawney, "A Course in Mechanical Measurements and Instrumentation and Control", DhanpatRai&Co, 12th edition New Delhi, 2017.

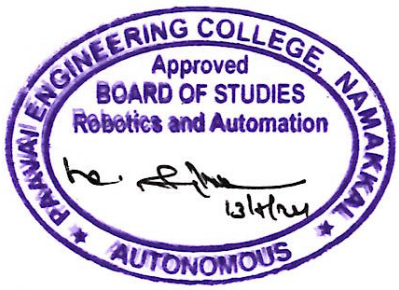

**REFERENCES**


1. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 2011.
2. Patranabis D, "Sensors and Transducers", PHI, New Delhi, 2021.
3. Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press, 2017.
4. R. K. Rajput, "Mechanical Measurements and Instrumentation", Reprint 2013 edition, S.K. Kataria & Sons, 2013.


**CO-PO MAPPING :**

**Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's**
**(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

| CO's | PO's | | | | | | | | | | | | PSO's | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO1 | 3 | 2 | 2 | 3 | - | 2 | - | - | - | - | - | 2 | 2 | 3 |
| CO2 | 2 | 2 | 3 | 2 | - | 3 | - | - | - | - | - | 3 | 2 | 2 |
| CO3 | 3 | 3 | 2 | 1 | - | 3 | - | - | - | - | - | 2 | 3 | 1 |
| CO4 | 2 | 3 | 2 | 2 | - | 2 | - | - | - | - | - | 1 | 3 | 2 |
| CO5 | 3 | 2 | 3 | 1 | - | 3 | - | - | - | - | - | 2 | 3 | 1 |



| MC23401 | ENVIRONMENTAL SCIENCES AND SUSTAINABILITY | 2 | 0 | 0 | 0 |
|---|---|---|---|---|---|

**COURSE OBJECTIVES**

To enable the students to

| | |
|---|---|
| 1 | establish the knowledge of precious resources of the environment and their various impacts. |
| 2 | create awareness on ecosystem and biodiversity preserve. |
| 3 | learn scientific and technological solutions to current day pollution issues. |
| 4 | analyze climate changes, concept of carbon credit and the challenges of environmental management. |
| 5 | understand green materials, energy cycles and the role of sustainable urbanization. |

**UNIT I** **ENVIRONMENT AND NATURAL RESOURCES** **6**

Definition, scope and importance of Environment. Forest resources: Use and over-exploitation, deforestation, - mining, dams and their effects on forests and tribal people. Water resources: Use and over-utilization of surface and ground water, dams-benefits and problems. Food resources: effects of modern agriculture, fertilizer-pesticide problems. Role of an individual in conservation of natural resources.

**UNIT II** **ECOSYSTEMS AND BIODIVERSITY** **6**

Concept of an ecosystem: Structure and function of an ecosystem - ecological succession - food chains and food webs. Ecosystems- Types of ecosystem: Introduction - forest ecosystem and lake ecosystems. Biodiversity: Introduction - definition (genetic - species - ecosystem). Diversity - Value of biodiversity - Hotspots of biodiversity - Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

**UNIT III** **ENVIRONMENTAL POLLUTION** **6**

Pollution: Définition - air pollution - water pollution - marine pollution - noise pollution. Solid waste management: Causes - effects - control measures of urban and industrial wastes. Role of an individual in prevention of pollution - Electronic waste -Sources-Causes and its effects- Pollution case studies-Field study of local polluted site – Industrial/Agricultural

**UNIT IV** **SUSTAINABILITY AND ENVIRONMENT** **6**

Sustainability - from unsustainability to sustainability-millennium development goals, and protocols. Sustainable development goals-targets, indicators and intervention areas. Climate change— acid rain - ozone layer depletion. Regional and local environmental issues and possible solutions-case studies. Concept of carbon credit, carbon footprint. Environmental management in industry-A case study.

**UNIT V** **SUSTAINABILITY PRACTICES** **6**

Zero waste and R concept, Circular economy, ISO 14000 Series, Environmental Impact Assessment - Sustainable energy: Non-conventional Sources, Green materials, Energy Cycles - carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio economical and technological change.

| | |
|---|---|
| **TOTAL PERIODS** | **30** |

**COURSE OUTCOMES**

| At the end of this course, students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| **CO1** | find the method of conservation of natural resources. | Understanding (K2) |
| **CO2** | understand ecosystem and the conservation of biodiversity. | Understanding (K2) |

| | | |
|---|---|---|
| **CO3** | aware of environmental pollution and interpret its effects. | Understanding (K2) |
| **CO4** | apply sustainable development for technological advancement and societal development. | Applying (K3) |
| **CO5** | measure the sustainability practices for green energy cycles. | Analyzing (K4) |

**TEXT BOOKS**

1. Benny Joseph, "Environmental Science and Engineering", Tata McGraw Hill, 1st edition, 2017.
2. Gilbert M. Masters, Wendell P. Ela " Introduction to Environmental Engineering and Science", 3rd edition, Pearson, 2022.

**REFERENCES**

1. William P. Cunningham and Mary Ann Cunningham, "Environmental Science: A Global Concern", McGraw Hill, 16th edition, 2023.
2. C. S. Rao, "Environmental Pollution and Control Engineering", New Age International (P) ltd Publication, New Delhi, 4th edition, 2021.
3. Erach Bharucha, "Textbook of Environmental Studies", Universities Press Pvt. Ltd., edition, 2020.
4. Rajagopalan, R, "Environmental Studies-From Crisis to Cure", Oxford University Press, 4th Edition, 2015.

**CO-PO MAPPING :**

**Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's**
**(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

| CO's | PO's | | | | | | | | | | | | PSO's | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO1 | - | 1 | - | - | - | 2 | - | - | 1 | 1 | - | - | 1 | 1 |
| CO2 | - | 2 | - | - | 1 | 1 | - | 1 | - | - | - | - | 2 | 2 |
| CO3 | 2 | - | 1 | 1 | - | - | - | 2 | - | - | - | 2 | 2 | 2 |
| CO4 | - | 2 | - | - | 1 | - | 3 | 1 | 1 | - | 1 | 1 | 2 | 2 |
| CO5 | 2 | 2 | - | 1 | - | - | 2 | 1 | - | - | - | 1 | 2 | 2 |

| RA23404 | MANUFACTURING TECHNOLOGY | 3 | 0 | 2 | 4 |
|---|---|---|---|---|---|

**COURSE OBJECTIVES**

To enable the students to

| | |
|---|---|
| 1 | know the concepts and basic mechanics of metal cutting and the factors affecting machinability. |
| 2 | learn working of basic and advanced turning machines. |
| 3 | understanding the basics of machine tools with reciprocating and rotating motions and abrasive finishing processes. |
| 4 | learn the basic concepts of cnc of machine tools and constructional features of cnc. |
| 5 | know the basics of non-conventional concepts to develop the part programme for machine center and turning center. |

**UNIT I MECHANICS OF METAL CUTTING** **9**

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.

**UNIT II TURNING MACHINES** **9**

Centre lathe - constructional features, specification, operations taper turning methods, thread cutting methods, special attachments and 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.

**UNIT III RECIPROCATING MACHINE TOOLS** **9**

Reciprocating machine tools - shaper, planer; type of milling operations-attachments- types of milling cutters; Abrasive processes - grinding wheel specifications and selection, types of grinding process cylindrical grinding, surface grinding, center less grinding, internal grinding; micro finishing methods.

**UNIT IV CNC MACHINES** **9**

Computer Numerical Control (CNC) machine tools - constructional details, special features Drives, recirculating all screws, tool changers; CNC Control systems - Open/closed, point-to point /continuous, Turning and machining centers, Work holding methods in Turning and machining centers, Coolant systems, Safety features.

**UNIT V NON-CONVENTIONAL MACHINING** **9**

General principles and applications - Water jet machining (WJM), Abrasive Jet Machining (AJM), Electro Discharge Machining (EDM), Electro Chemical Machining (ECM) and Laser Beam Machining (LBM), Ultrasonic Machining (USM) Processes, Advantages and Disadvantages.

**LIST OF EXPERIMENTS**

1. Study on measurement (Linear measurements).
2. Step Turning.
3. Taper Turning.
4. Thread cutting operation.

5. Knurling operation.
6. Boring operation
7. Gear Cutting operation.
8. Grinding operation (surface).
9. Shaping operation.

| | TOTAL PERIODS | 75 |
|---|---|---|

**COURSE OUTCOMES**

| At the end of this course, the students will be able to | | BT Mapped (Highest Level) |
|---|---|---|
| CO1 | recognize how metal is removed during machining and identify factors that enhance machinability. | Remembering (K1) |
| CO2 | explain the structural components and operational characteristics of center lathes and specialized lathe machines. | Understanding (K2) |
| CO3 | examine the design and operational attributes of reciprocating machine tools. | Apply (K3) |
| CO4 | evaluate the constructional elements and operational principles of cnc machine tools. | Apply (K3) |
| CO5 | determine the appropriate non-conventional machining process based on the characteristics of the base metal. | Analyze (K4) |

**TEXT BOOKS**


1. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Edu Ind.edition, 2019.
2. Michael Fitzpatrick, Machining and CNC Technology, McGraw-Hill Edu; 3rd edition, 2021.


**REFERENCES**


1. Roy. A. Lindberg, Processes and materials of manufacture, PHI / Pearson education, 2019.
2. Geofrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", Mc Hill, 2021.
3. Rao. P.N "Manufacturing Technology," Metal Cutting and Machine Tools, Tata McGraw- Hill, New Delhi, 2020.
4. Peter Smid, CNC Programming Handbook, Industrial Press Inc.Third edition, 2019.


**CO-PO MAPPING :**

**Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's**
**(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

| CO's | PO's | | | | | | | | | | | | PSO's | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO1 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | - | - | 3 | - | 2 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | - | - | 3 | - | 2 | 2 | 2 |
| CO3 | 3 | 3 | 3 | 1 | 2 | 2 | 3 | - | - | 3 | - | 2 | 2 | 2 |
| CO4 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | - | - | 3 | - | 2 | 2 | 2 |
| CO5 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | - | - | 3 | - | 2 | 2 | 3 |

PAAVAI ENGINEERING COLLEGE, NAMAKKAL
Approved
BOARD OF STUDIES
Robotics and Automation
AUTONOMOUS

| RA23405 | MECHANICS OF SOLIDS LABORATORY | 0 | 0 | 4 | 2 |
|---|---|---|---|---|---|

**COURSE OBJECTIVES**

To enable the students to

| | |
|---|---|
| 1 | understand the basic operation of UTM machine. |
| 2 | familiarize the hardness of materials. |
| 3 | impart the knowledge of strength of materials. |
| 4 | learn about the compression and deflection test on materials. |

**LIST OF EXPERIMENTS**

1. Determine the BHN using Brinell hardness test.
2. Determine the RHN using Rockwell hardness test.
3. Determine the shear modulus of mild steel rod using tension test.
4. Determine the young's modulus of mild steel rod using torsion test.
5. Determine the impact strength value by using Izod impact test.
6. Determine the impact strength value by using Charpy impact test.
7. Perform the double shear test on metal.
8. Perform the compression test on helical spring.
9. Perform the deflection test on carriage spring.
10. Perform the compression test for various materials.

| | |
|---|---|
| **TOTAL PERIODS** | **60** |

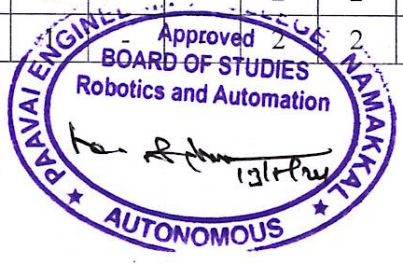
**COURSE OUTCOMES**

| At the end of this course, students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| **CO1** | test the hardness of aluminum and brass without altering the meaning. | Remembering (K1) |
| **CO2** | verify the tensile strength of materials without altering the meaning. | Understanding (K2) |
| **CO3** | determine the mechanical properties of materials through impact testing. | Applying (K3) |
| **CO4** | perform the compression and deflection test on materials. | Analyzing (K4) |

**CO-PO MAPPING :**

**Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's**
**(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

| CO's | PO's | | | | | | | | | | | | PSO's | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO1 | 2 | 2 | 2 | 1 | 1 | - | - | 2 | 1 | 2 | - | 2 | 3 | 2 |
| CO2 | 2 | 2 | 3 | 2 | 2 | - | - | 2 | 2 | 2 | - | 2 | 3 | 2 |
| CO3 | 2 | 2 | 2 | 3 | 2 | - | - | 2 | 2 | 2 | - | 2 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 3 | 2 | - | - | 2 | 2 | 2 | - | 2 | 3 | 2 |



| RA23406 | SENSORS AND INSTRUMENTATION LABORATORY | 0 | 0 | 4 | 2 |
|---|---|---|---|---|---|

**COURSE OBJECTIVES**

To enable the students to

| | |
|---|---|
| 1 | understand the concept of temperature measurement devices. |
| 2 | know the working of displacement measurement devices. |
| 3 | understand the concept of strain and torque measurement devices. |
| 4 | learn skills needed in PC based data acquisition system. |

**LIST OF EXPERIMENTS**

1. Measurement of temperature using thermocouple.
2. Measurement of temperature using thermistor.
3. Measurement of temperature using RTD.
4. Measurement of linear and rotary displacement using potentiometer.
5. Measurement of displacement using LVDT.
6. Strain measurement using strain gauge.
7. Torque measurement using torque sensor.
8. Speed and Position control of D.C servo motor.
9. Digital comparator.
10. Voltage to frequency and frequency to voltage converter.
11. Study on the application of LabView.

| | |
|---|---|
| **TOTAL PERIODS** | **60** |

**COURSE OUTCOMES**

| At the end of this course, students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| **CO1** | choose the sensors for the measurement of temperature. | Remembering (K1) |
| **CO2** | show how displacement measurement devices are used for position control. | Understanding (K2) |
| **CO3** | select the suitable devices for strain and torque measurements. | Apply (K3) |
| **CO4** | examine the data acquisition system for various industrial applications. | Analyzing (K4) |

**CO-PO MAPPING :**

**Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's**
**(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

| CO's | PO's | | | | | | | | | | | | PSO's | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO1 | 3 | 2 | 2 | 2 | - | - | - | - | 3 | - | - | 2 | 2 | 3 |
| CO2 | 3 | 2 | 2 | 2 | - | - | - | - | 3 | - | - | 2 | 3 | 2 |
| CO3 | 3 | 3 | 2 | 2 | - | - | - | - | 3 | - | - | 2 | 2 | 3 |
| CO4 | 3 | 3 | 2 | 2 | - | - | - | - | 3 | - | - | 3 | 3 | 2 |

| GE23401 | PROFESSIONAL DEVELOPMENT II | 0 | 0 | 2 | 1 |
|---|---|---|---|---|---|

**COURSE OBJECTIVES**

To enable students to

| | |
|---|---|
| 1 | enhance their own behavioral skills to survive in corporate world. |
| 2 | evaluate their listening and speaking skills to face the interviews in a successful way. |
| 3 | solve the quantitative aptitude problems and improve their problem-solving skills. |
| 4 | improve their reasoning skills to get placed in reputed companies |

| UNIT I | WRITING SKILLS | 7 |
|---|---|---|

Email Writing - fixing and cancelling appointments, paper submission for seminars and conferences - Business communication, Stress Management - Body Language - Dress Code - Self Introduction II - Update Resume Building II - JAM Level - 3.

| UNIT II | PRESENTATION SKILLS | 7 |
|---|---|---|

Presentation Skills: Types and Methods of Delivering Presentation - Ways and Methods to improve Presentation Skills; Mini Presentation in smaller groups - Situational Role Play; Face to Face interview, Group Discussion Level II - JAM Level - 4.

| UNIT III | QUANTITATIVE APTITUDE | 8 |
|---|---|---|

Simplification - Time, Speed and Distance - Trains - Boats and Streams - Ratio and Proportion - Partnership - Percentage.

| UNIT IV | LOGICAL REASONING | 8 |
|---|---|---|

Seating Arrangement - Arithmetic Reasoning - Character Puzzle - Syllogisms - Matching - Definitions - Statements and Arguments.

| TOTAL PERIODS | 30 |
|---|---|

| COURSE OUTCOMES<br>At the end of this course, the students will be able to | | BT MAPPED<br>(Highest Level) |
|---|---|---|
| CO1 | interpret the personality development through various activities. | Understanding (K2) |
| CO2 | examine speaking and Listening Skills to excel in their jobs. | Analyzing (K4) |
| CO3 | develop the quantitative skills and analytical skills to face the interview | Applying (K3) |
| CO4 | extend the reasoning abilities by scoring exceeded percentage to get placed in reputed companies | Understanding (K2) |

**TEXTBOOKS**

- Agarwal, R.S. "Objective General English", S.Chand&Co., 2021.
- Agarwal, R.S. "Quantitative Aptitude", S.Chand&Co., 2021.

**REFERENCES**

- Abhijit Guha, "Quantitative Aptitude ", Tata-Mcgraw Hill., 2023.
- Agarwal, R.S." A Modern approach to Verbal & Non Verbal Reasoning", S.Chand & Co Ltd, newdelhi., 2021.
- Word Power Made Easy By Norman Lewis, Wr.Goyal Publications., 2021.

**CO/PO MAPPING:**

**Mapping of Course Outcome (CO's) with Programme Outcomes (PO's)**
**(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**

| CO's | Programme Outcomes (PO's) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | - | - | - | - | - | - | 3 | 3 | 2 | 3 | - | 3 | 1 | 1 |
| CO2 | - | - | - | - | - | - | 2 | 3 | 2 | 3 | - | 3 | 1 | 1 |
| CO3 | 3 | 2 | 2 | 2 | - | - | 1 | - | - | - | - | - | 2 | 2 |
| CO4 | 2 | 3 | 3 | 2 | - | 3 | 3 | 1 | - | 1 | 2 | - | 1 | 1 |