# Semester-5

| RA-301A | DESIGN OF MACHINE ELEMENTS AND TRANSMISSION SYSTEMS | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | To understand the fundamentals for solving engineering problems relating to design of machine components and transmission systems. | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | The students will understand the design procedures and methods, properties of engineering materials and their selection, design against static and fluctuating loads. | | | | | | |
| **CO2** | The students will be able to solve the design problems of different types of joints i.e. bolted, riveted joint and welded joint and the problems related to the design of shafts and couplings under different loading conditions. | | | | | | |
| **CO3** | Students could solve the design problems of gears and springs. | | | | | | |
| **CO4** | Students will be able to select the bearings for a particular application. | | | | | | |

## UNIT-I

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

## UNIT-II

**Detachable and Permanent Joints:** Design of Bolts under Static Load, Design of Bolt with Tightening/Initial Stress, Design of Bolts subjected to Fatigue – Keys -Types, Selection of Square and Flat Keys-Design of Riveted Joints and Welded Joints

## UNIT–III

**Shafts and Coupling:** Design of Shaft –For Static and Varying Loads, For Strength and Rigidity-Design of Coupling-Types, Flange, Muff and Flexible Rubber Bushed Coupling

## UNIT–IV

**Gears and Belt Drives:** Design of Spur and Helical Gear Drives-Design of Belt Drives-Flat and V Belts
**Springs and Bearings:** Design of Helical Spring-Types, Materials, Static and Variable Loads-Design of Leaf Spring-Design of Journal Bearing -Antifriction Bearing-Types, Life of Bearing, Reliability Consideration, Selection of Ball and Roller Bearings

**TEXT BOOKS:**

1. Joseph Edward Shigley, Charles R. Mischke " Mechanical Engineering Design", McGraw Hill, International Edition, 1992
2. Bhandari. V.B., "Design of Machine Elements", Tata McGraw-Hill Publishing Company Limited, 2003.

**REFERENCE BOOKS:**

1. Sharma. C.S. and Kamlesh Purohit, "Design of Machine Elements", Prentice Hall of India Private Limited, 2003
2. Robert L. Norton, "Machin Design – An Integrated Approach", Prentice Hall International Edition, 2000.

| RA-303A | DIGITAL ELECTRONICS | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | To make the students understand the concepts of digital electronics and its applications in different fields. | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | Students will be able to understand the number systems and its arithmetic operations and Illustrate Use of Boolean algebra. | | | | | | |
| **CO2** | Students will be able to formulate and apply Karnaugh Map to reduce Boolean expressions and logic circuits to their simplest POS and SOP forms | | | | | | |
| **CO3** | Students will be able to design various combinational digital circuits using logic gates | | | | | | |
| **CO4** | Students will be able to do the analysis and design procedures for synchronous and asynchronous sequential circuits | | | | | | |

## UNIT-I

**Binary Codes and Boolean Algebra**

Signals: Analog and Digital, Binary Number System. Addition, Subtraction, Multiplication, Division of binary numbers, Subtraction using 2's complement method. Binary codes: weighted and non-weighted codes, self-complementary.

Codes, BCD, Excesses-3, Gray codes, Alphanumeric codes, ASCII Codes.

Boolean algebra: Boolean Laws and Expression using Logic Gates, Realization of different gates using Universal gates, De- Morgan's Theorem, Duality Theorems.

## UNIT-II

**Boolean Function Minimization Techniques:** Standard forms: SOP, POS, Simplification of Switching function & representation (Maxterm & Minterm), Boolean expression & representation using logic gates, Propagation delay in logic gate. Karnaugh map: K-map, mapping and minimization of SOP and POS expression, don't care condition, conversion from SOP to POS and POS to SOP form using K-map, Minimization of multiple output circuits,

## UNIT–III

**Combinational Circuits Design:** Adder & Subtractor (Half and Full), Parallel Binary adder, BCD Adder, Binary multipliers, Code Converters, parity bit generator, Comparators, Decoder, BCD to 7-segment Decoder, Encoders, Priority Encoders, Multiplexers, De- Multiplexers.

**Sequential Circuits Elements:** Introduction to Sequential Circuit, Flip-flop and Latch: SR latch, JK flip-flop, Master Slave JK Flip-flop, T flip-flop, D flip-flop and latch, Master-slave RS flip-flop, Master-slave JK flip-flop, asynchronous inputs.

## UNIT–IV

**Shift Registers and Counters:** Shift registers: buffer register, controlled buffer register. Data transmission in shift resistor SISO, SIPO, PISO, PIPO, Bidirectional shift register, universal shift registers. Counter: Classification, Ripple or asynchronous counter, Effect of propagation delay in ripple counters, up-down counter, Design of Mod-n counter, synchronous counter, Ring counter, Johnson counter.

**Text books:**


1. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.
2. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.
3. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition, 2006. 2012
4. Modern digital Electronics, 4rd Edition by R.P. Jain, Tata McGraw Hill, 2009.
5. VHDL, 4rd Edition by Douglas Perry, Tata McGraw Hill, 2002
6. Digital Electronics- An introduction to theory and practice, 2nd edition by W.H. Gothmann, PHI, 2012


**Reference Books:**


1. Digital Circuits and Systems, D.V. Hall, Tata McGraw Hill, 1989
2. Digital System Design using VHDL, 2nd edition, by Charles Roth, Tata McGraw Hill,


**Note: The paper setter will set the paper as per the question paper template provided.**

| RA-305A | HYDRAULICS AND PNEUMATICS | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | To provide student with knowledge on the application of fluid power in process, construction and manufacturing Industries and an understanding of the fluids and components utilized in modern industrial fluid power system.<br>To develop a measurable degree of competence in the design, construction and operation of fluid power circuits. | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | Students will be able to explain the fluid power and operation of different types of pumps | | | | | | |
| **CO2** | Students will be able to summarize the features and functions of hydraulic motors, actuators and flow control valves | | | | | | |
| **CO3** | Students will be able to explain the different types of hydraulic circuits and systems and Explain the working of different pneumatic circuits and systems | | | | | | |
| **CO4** | Students will be able to understand various trouble shooting methods and applications of hydraulic and pneumatic systems. | | | | | | |

## UNIT-I

**Fluid Power Principles and Hydraulic Pumps:** Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of Hydraulics – Pascal's Law – Principles of flow - Friction loss – Work, Power and Torque Problems, Sources of Hydraulic power : Pumping Theory – Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of Linear and Rotary – Fixed and Variable displacement pumps – Problems.

## UNIT-II

**Hydraulic Actuators and Control Components** Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Hydraulic motors - Control Components: Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Servo and Proportional valves – Applications – Accessories: Reservoirs, Pressure Switches – Applications – Fluid Power ANSI Symbols – Problems.

## UNIT–III

**Hydraulic Circuits and Systems** Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double- Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

## UNIT–IV

**Pneumatic And Electro Pneumatic Systems** Properties of air – Perfect Gas Laws – Compressor – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – Cascade method – Electro Pneumatic System – Elements – Ladder diagram – Problems, Introduction to fluidics and pneumatic logic circuits.

**Trouble Shooting and Applications** Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for Pick and Place applications and tool handling in CNC Machine tools – Low-cost Automation – Hydraulic and Pneumatic power packs.

**Text Books:**

1. Anthony Esposito, "Fluid Power with Applications", Pearson Education 2005.
2. Majumdar S.R., "Oil Hydraulics Systems- Principles and Maintenance", Tata McGraw-Hill, 2001.

**Reference Books**:

1. Anthony Lal, "Oil hydraulics in the service of industry", Allied publishers, 1982.
2. Dudelyt, A. Pease and John T. Pippenger, "Basic Fluid Power", Prentice Hall, 1987.
3. Majumdar S.R., "Pneumatic systems – Principles and maintenance", Tata McGraw Hill, 1995
4. Michael J, Prinches and Ashby J. G, "Power Hydraulics", Prentice Hall, 1989.
5. Shanmugasundaram.K, "Hydraulic and Pneumatic controls", Chand & Co, 2006

**Note: The paper setter will set the paper as per the question paper templates provided.**

| RA-307A | Microcontroller and Embedded System Design | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | To understand the architectures and the instruction set of different microcontrollers and interfacing of microprocessors and microcontrollers with various peripheral.<br>To introduce embedded systems, its hardware, software, devices and buses used for embedded networking. | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | Students will be able to interpret the architecture & instruction set of 8085, 8086, 8051 microcontroller to develop assembly language programs | | | | | | |
| **CO2** | Students will be able to understand the application of 8051 microcontroller on chip peripherals to implement the functions of I/O port, timer/Counter, serial port & interrupts. | | | | | | |
| **CO3** | Students will be able to know about the peripheral devices 8255 PPI and 8279 for integrating keyboard, 7 segment display, LCD display and traffic light controller & 8259 PIC for handling multiple interrupts I/O. | | | | | | |
| **CO4** | Students will be able to design 8051 Microcontroller based systems for measuring electrical and physical quantities & Motor control. Interpret the hardware and software components of an embedded system for an application and infer the architecture and programming model of ARM processor | | | | | | |

## UNIT I

INTEL 8085 MICROPROCESSOR

Intel 8085 Hardware - Architecture – Pin description and addressing modes; Intel 8086 Hardware – Pin description and addressing modes; Intel 8051 Microcontroller: Introduction – Architecture – Memory Organization – Special Function Registers – Pins and Signals – Timing and control – Port Operation – Memory and I/O interfacing – Interrupts – Instruction Set and Programming.

## UNIT II

ON-CHIP PERIPHERALS & PERIPHERAL DEVICES I/O Port Programming - Timer Registers -Timer Modes - Overflow Flags – Clocking Sources -Timer/ Counter Interrupts – Timer Programming - Baud Rate Generation – Serial Port Register -Modes of Operation - Serial Port Programming- Interrupt Organization Processing Interrupts - Interrupt Programming- Programmable Peripheral Interface (8255) - Keyboard / Display Controller (8279) - Programmable Interrupt Controller (8259).

## UNIT III

DESIGN OF MICROCONTROLLER BASED SYSTEM

Voltage, Current and Frequency Measurement - DC Motor Control - Stepper Motor control - Case Studies: Arduino Board Overview - Arduino IDE - Temperature Control.

## UNIT IV

EMBEDDED SYSTEMS & ARCHITECTURE OF ARM PROCESSOR

Processor Embedded into a system - Embedded Hardware units and devices in a system - Embedded Software in a System -Classification of Embedded Systems - Embedded Design Life Cycle - Design Example: Model Train Controller. ARM Embedded System - CISC and RISC Processors - ARM Architecture - Programming Model - Operating Modes.

ARM PROGRAMMING

ARM Instruction Set - ARM Instruction Types: Data Transfer, Data Processing and Control, Flow Instructions - Interrupts – Exceptions types - NVIC Registers for interrupt control.

**TEXT BOOKS:**


1. Krishna Kant, ―Microprocessors and Microcontrollers – Architectures, Programming and System Design 8085, 8086, 8051, 8096‖, PHI, 2014.
2. Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinley, "The 8051 Microcontroller and Embedded Systems Using Assembly and C ", 2nd Edition, Pearson Education 2013.
3. Kenneth J. Ayala, "The 8051 Microcontroller. Architecture, Programming and Applications", 3rd Edition, West publishing company 2014
4. Andrew N.Sloss, Dominic Symes and Chris Wright, "ARM System Developer's Guide: Designing and Optimizing System Software", Morgan Kaufmann Publishers, 1st Edition, 2004.
5. Raj Kamal, "Embedded Systems Architecture, Programming and Design", Tata McGraw Hill, 2nd Edition, 2009


**REFERENCE BOOKS:**


1. Soumitra Kumar Mandal "Microprocessors and Microcontrollers Architecture Programming and Interfacing using 8085, 8086 & 8051" Tata McGraw Hill Publishing Co Ltd, 1st Edition, 2011.
2. Myke Predko, "Programming and Customizing the 8051 Microcontroller", 1st Edition, 2012.
3. Chris Braith, "8051 Microcontroller Application based Introduction", Elsevier 2004.
4. Manish K Patel, "The 8051 Microcontroller Based Embedded Systems "Tata McGraw Hill Publishing Co Ltd, Ist Edition, 2014.
5. Jonathan W Valvano, "Embedded Systems: Introduction to Arm® Cortex TM-M Microcontrollers", 5th Edition, 2015.
6. Shibu K.V, "Introduction to Embedded Systems", Tata Mc Graw Hill, 1st Edition, 2009.
7. Jean J.Labrosse, "Embedded Systems Building Blocks", CMP Books, 2nd Edition, 2010.


**Note: The paper setter will set the paper as per the question paper templates provided.**

| RAP-301A | Robot Kinematics and Dynamics | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | To understand the basic knowledge about kinematics of machines.<br>To understand the basic components and layout of linkages in the assembly of a system/machine.<br>To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.<br>To understand the motion resulting from a specified set of linkages, design few linkage mechanisms and cam mechanisms for specified output motions.<br>To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components. | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | Students will be able to understand the basic knowledge of kinematics of machines | | | | | | |
| **CO2** | Students will be able to apply fundamentals of mechanism for the design of new mechanisms | | | | | | |
| **CO3** | Students will be able to know about the linkages, design few linkage mechanisms and cam mechanisms for specified output motions. | | | | | | |
| **CO4** | Students will be able to impart knowledge about the gears and gear trains. | | | | | | |

## UNIT I

### INTRODUCTION

Specifications of Robots- Classifications of robots – Work envelope - Flexible automation versus Robotic technology – Applications of Robots.

### DIRECT & INVERSE KINEMATICS

Dot and cross products, Co-ordinate frames, Rotations, Homogeneous Coordinates, Link coordinates, D-H Representation, Arm equation -Two axis, three axis, four axis, five axis and six axis robots. Inverse Kinematic problem, General properties of solutions, Tool configuration, Inverse Kinematics of Two axis Three axis, Four axis and Five axis robots.

## UNIT II

### WORKSPACE ANALYSIS

Workspace analysis of Four axis, Five axis and Six axis robots, Perspective transformation, structured illumination, Camera calibration, Work envelope of Four and Five axis robots, Workspace fixtures.

## UNIT III

### DIFFERENTIAL MOTION AND STATICS

The tool Configuration jacobian matrix for three axis and, four axis robots, joint space singularities, resolved motion rate control, manipulator jacobian for three and four axis joint space singularities, induced joint torques and forces.

## UNIT IV

### DYNAMIC ANALYSIS AND FORCES

Introduction, Langrangian mechanics, Effects of moments of Inertia, Dynamic equation for two axis planar articulated robot. Trajectory planning, Pick and place operations, Continuous path motion, Interpolated motion, Straight line motion.

**Text Books**

1. Robert J. Schilling, ―Fundamentals of Robotics Analysis and Control‖, PHI Learning, 2011.

2. Niku S B, ―Introduction to Robotics, Analysis, Systems, Applications‖, Prentice Hall, 2001.

**Reference Books**

1. John J Craig, ―Introduction to Robotics: Mechanics and control, Pearson, 2009,4th Ed, 2018.

2. Deb S R and Deb S, ―Robotics Technology and Flexible Automation‖, Tata McGraw Hill Education Pvt. Ltd, 2010.

3. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India P Ltd., 2006.

4. Saha S K, ―Introduction to Robotics‖, Tata McGraw Hill Education Pvt. Ltd,2010, 2nd Ed, 2014.

**Note: The paper setter will set the paper as per the question paper templates provided.**

| RAP-303A | Electrical Drives Control Systems | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | To understand the basic concepts of different types of electrical machines and their performance.<br>To study the different methods of starting D.C motors and induction motors.<br>To study the conventional and solid-state drives | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | Students will be able to know the basics of electrical drives, selection and applications. | | | | | | |
| **CO2** | Students will be able to know the drive motor characteristics. | | | | | | |
| **CO3** | Students will be able to understand different starting methods. | | | | | | |
| **CO4** | Students will be able to understand the speed control of DC drives and AC drives. | | | | | | |

## UNIT I

**INTRODUCTION**

Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives – heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors

## UNIT II

**DRIVE MOTOR CHARACTERISTICS**

Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors – Braking of Electrical motors – DC motors: Shunt, series and compound – single phase and three phase induction motors.

## UNIT III

**STARTING METHODS**

Types of D.C Motor starters – Typical control circuits for shunt and series motors – Three phase squirrel cage and slip ring induction motors.

## UNIT IV

**CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C. DRIVES**

Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control system – Using controlled rectifiers and DC choppers –applications.

**CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C. DRIVES**

Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme – Using inverters and AC voltage regulators – applications.

**Text Books:**


1. G.K. Dubey, Fundamentals of Electric Drives, Narosa publishing House.
2. S.K.Pillai, A First Course on Electric Drives, New Age International.
3. V Subrahmanyam, Electric Drives, Mcgrawhill Education.

**Reference Books:**


1. M.Chilkin, Electric Drives,Mir Publishers, Moscow.
2. Mohammed A. El-Sharkawi, Fundamentals of Electric Drives, Thomson Asia, Pvt. Ltd. Singapore.
3. N.K. De and Prashant K.Sen, Electric Drives, Prentice Hall of India Ltd.
4. V.Subrahmanyam, Electric Drives: Concepts and Applications, Tata McGraw Hill.


**Note: The paper setter will set the paper as per the question paper templates provided.**

| RA-305 A | INDUSTRIAL DESIGN AND APPLIED ERGONOMICS | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | To explain the general principles that governs the interaction of humans in their working environment for improving worker performance and safety.<br>To know about the environmental conditions in the industry.<br>To know about bio thermodynamics and bioenergetics<br>To know about the human factors in industrial aspects | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | Students will be able to know about ergonomic principles to design workplaces | | | | | | |
| **CO2** | Students will be able to improve human performance and judge the environmental conditions in the work place | | | | | | |
| **CO3** | Students will be able to know about bio thermodynamics and bioenergetics | | | | | | |
| **CO4** | Students will be able to implement latest occupational health and safety to the work place. | | | | | | |

**UNIT-I**

INTRODUCTION: Definition, human technological system, multidisciplinary engineering approach, human–machine system, manual, mechanical, automated system, human system reliability, conceptual design, advanced development, detailed design and development. INFORMATION INPUT: Input and processing, text, graphics, symbols, codes, visual display of dynamic information, auditory, tactual, olfactory displays, speech communications.

**UNIT-II**

HUMAN OUTPUT AND CONTROL: Physical work, manual material handling, motor skill, human control of systems, controls and data entry devices, hand tools and devices. WORKPLACE DESIGN: Applied anthropometry, workspace design and seating, arrangement of components within a physical space, interpersonal aspects of work place design, design of repetitive task, design of manual handling task, work capacity, stress, and fatigue.

**UNIT–III**

ENVIRONMENTAL CONDITIONS: Illumination, climate, noise, motion, sound, vibration, colour and aesthetic concepts. BIOMECHANICS: Biostatic mechanics, statics of rigid bodies, biodynamic mechanics, human body kinematics, kinetics, impact and collision.

**UNIT–IV**

BIOTHERMODYNAMICS AND BIOENERGETICS: Biothermal fundamentals, human operator heat transfer, human system bioenergetics, thermoregulatory physiology, human operator thermo regularity, passive operator, active operator, heat stress.
HUMAN FACTORS APPLICATIONS: Human error, accidents, human factors and the automobile, organizational and social aspects, steps according to ISO/DIS6385, OSHA‟s approach, virtual environments.

**Text Books:**

1. Chandler Allen Phillips, “Human Factors Engineering”, John Wiley and Sons, New York, 2000.

**Reference Books:**

1. Bridger R S, “Introduction to Ergonomics”, Taylor and Francis, London, 2003.
2. Mayall W H, “Indus trial Design for Engineers”, London ILIFFEE Books Ltd., UK, 1998.
3. Mark S Sanders, “Human Factors in Engineering and Design”, McGraw Hill, New York, 1993.

**Note: The paper setter will set the paper as per the question paper templates provided.**

| RA 309 LA | DIGITAL ELECTRONICS LAB | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credits** | **Major Test** | **Minor Test** | **Practical** | **Total** | **Time (Hrs.)** |
| **0** | **0** | **2** | **1** | **0** | **40** | **60** | **100** | **3** |
| **Purpose** | To impart the basic practical aspects of Digital Electronics.<br>To make a differentiation between the Analog Electronics and Digital electronics through practical modes.<br>To lay the foundation for the courses in electronics related to microprocessors, microcomputers and computers which are more advanced courses based on digital electronics and the revolution in electronics. | | | | | | | |
| **Course Outcomes** | | | | | | | | |
| **CO 1** | Students will be able to know the fundamentals and the parameters of digital components related to their fabrication and internal circuitry. | | | | | | | |
| **CO 2** | Students will be able to design various logic circuits. | | | | | | | |
| **CO 3** | Students will be able to design synchronous and asynchronous sequential circuits. | | | | | | | |
| **CO 4** | Students will be able to verify the Truth Table. | | | | | | | |

**LIST OF EXPERIMENTS:**

1. Digital Signals Interface Compare analog and digital electronics systems (Tutorial)
2. Realization of basic and universal logic gates using ICS 7400, 7432, 7402, 7408, 7486, 7404.
3. Derived Basic gate using NAND and NOR Gate
4. Verification of Demorgan's theorem.
5. Develop Verification of Truth Table of 4:1 mux & 1:4 demux using IC's.
6. Verification of Truth Table of flip flops
7. Verification of Truth Table of shift registers (7495)
   a. SISO
   b. SIPO
   c. PISO
   d. PIPO
8. Verification of 4-bit Asynchronous mod-10 (decade) counter (IC 7490)
9. Verification of 4-bit synchronous up/down counter ( (IC 74193)
10. Segment Display Decoder.

.**Note:** At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

| RA-311LA | Microcontroller and Embedded System Design Lab | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credits** | **Major Test** | **Minor Test** | **Practical** | **Total** | **Time (Hrs.)** |
| **0** | **0** | **2** | **1** | **0** | **40** | **60** | **100** | **3** |
| **Purpose** | To enable the students to program, simulate and test the 8085, 8051, PIC 18 and ARM processor based circuits and their interfaces | | | | | | | |
| **Course Outcomes** | | | | | | | | |
| **CO 1** | Students will be able to develop 8051 Assembly Language Programs for Arithmetic, Logic, Bit manipulation, String operations | | | | | | | |
| **CO 2** | Students will be able to demonstrate an application for 8051 microcontroller using Traffic light controller, ADC & DAC interfacing boards | | | | | | | |
| **CO 3** | Students will be able to perform 8051 Embedded C Coding for Programming the GPIO, Timer, Interrupts & Serial Port. | | | | | | | |
| **CO 4** | Students will be able to perform temperature monitoring using Arduino target board. | | | | | | | |

**LIST OF EXPERIMENTS:**

Microcontroller Lab:

Developing Assembly Language Programs using 8051 Microcontroller Kits

- Data manipulating Operations and Delay Routines
- String operations
- Interfacing Traffic light controller
- Interfacing ADC
- Interfacing DAC

Embedded Laboratory

1. Voltage Measurement with display

Designing a voltmeter to measure voltage from 0 to 5 volts and displaying the measured value using 7 segment displays

2. Design of Water Pump Controller to sense the water level in a tank
3. Digital Clock with LCD display
4. Temperature Measurement with 7 segment display
5. PC Communication

Interfacing the microcontroller to a PC through RS232 interface and displaying the messages sent by the microcontroller on the PC using Visual Basic program running in PC

6. Remote Control through FM Link

Establishing an FM link between two microcontrollers for data transfer.

7. Hot Chamber Controller to maintain the temperature at the set point.
8. Obstacle Detector using ultrasonic transmitter- receiver
9. Moisture sensor and sprinkler controller design
10. Designing a lamp controller having a light sensor and a timer

| RA-313LA | HYDRAULIC PNEUMATICS LAB | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credits** | **Major Test** | **Minor Test** | **Practical** | **Total** | **Time (Hrs.)** |
| **0** | **0** | **2** | **1** | **0** | **40** | **60** | **100** | **3** |
| **Purpose** | To develop required skills in the students so that they are able to acquire knowledge to Identify and solve various Hydraulic and Pneumatic problems. | | | | | | | |
| **Course Outcomes** | | | | | | | | |
| **CO 1** | Students will be able to acquire required learning out comes in cognitive, psychomotor and affective domain | | | | | | | |
| **CO 2** | Students will be able to operate different types of valves used in hydraulic systems. | | | | | | | |
| **CO 3** | Students will be able to maintain different valves and auxiliaries. | | | | | | | |
| **CO 4** | Students will be able to assemble pumps and motors to rectify problems | | | | | | | |

**LIST OF EXPERIMENTS:**

1. Demonstrate application of Pascal's law in hydraulic system
2. Demonstrate various accessories and their uses in hydraulic system.
3. Demonstrate use of directional control valves
4. Demonstrate use of pressure control valves
5. Demonstrate use of pressure intensifier
6. Demonstrate application of flow control valves
7. Demonstrate applications of various types of pumps
8. Demonstrate use of hydraulic motors
9. Demonstrate application of injection control circuit
10. Demonstrate use of clamp control and reciprocating screw circuits.
11. Demonstrate application of single stage compressors

**Note:** At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

| RA-315LA | PROJECT-I | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credits** | **Major Test** | **Minor Test** | **Practical** | **Total** | **Time (Hrs.)** |
| **0** | **0** | **4** | **2** | **--** | **-** | **100** | **100** | **3** |
| **Purpose:** | To implement the engineering principles and theories into innovative practical projects for solving real world problems. | | | | | | | |
| **Course Outcomes** | | | | | | | | |
| **CO1** | Students will be able to apply the theoretical knowledge into practical/software projects. | | | | | | | |
| **CO2** | Students will be able to design new products related to robotics and automation using latest technologies. | | | | | | | |

The project work could be done for the problem statement of an industry or practical project in the institute. The students may also opt for the analysis-based software projects with proper validation. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

**Note:** The maximum number of students in a group should not exceed four.

| RA-317A | INDUSTRIAL TRAINING-II | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credits** | **Major Test** | **Minor Test** | **Practical** | **Total** | **Time (Hrs.)** |
| **0** | **0** | **2** | **--** | **--** | **100** | **--** | **100** | **3** |
| | | | | | | | | |
| **Purpose** | To provide an industrial exposure to the students and enhance their skills and creative capability for conversion of their innovative ideas into physical reality. | | | | | | | |
| **Course Outcomes** | | | | | | | | |
| **CO 1** | Students will be able to self-improve through continuous professional development and life-long learning. | | | | | | | |
| **CO 2** | Students will be able to develop social, cultural, global and environmental responsibility as an engineer. | | | | | | | |
| **CO 3** | Students will be able to weigh all the latest changes in technological world. | | | | | | | |

**Note: INDUSTRIAL TRAINING-II** is a mandatory non-credit course in which the students will be evaluated for the industrial training undergone after 4th semester and students will be required to get passing marks to qualify.

The candidate has to submit a training report of his/her work/project/assignment completed in the industry during the training period. The evaluation will be made on the basis of submitted training report and viva-voce/presentation.

| MC 903A | ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credits** | **Major Test** | **Minor Test** | **Practical** | **Total** | **Time (Hrs.)** |
| **3** | **0** | **0** | **--** | **100** | **--** | **--** | **100** | **3** |
| | | | | | | | | |
| **Purpose** | To impart basic principles of thought process, reasoning and inferencing. | | | | | | | |
| **Course Outcomes** | | | | | | | | |
| **CO 1** | Students will be able to understand, connect up and explain basics of Indian traditional knowledge in modern scientific perspective. | | | | | | | |

**Course Contents**

- Basic structure of Indian Knowledge System: अष्टादशविद्या -४वेद,४उपवेद (आयुर्वेद, धनुर्वेद, गन्धर्ववेद, स्थापत्य आदि) ६वेदांग (शिक्षा, कल्प, निरुक्त, व्याकरण, ज्योतिष, छंद) ४ उपाङ्ग (धर्मशास्त्र, मीमांसा, पुराण, तर्कशास्त्र)
- Modern Science and Indian Knowledge System
- Yoga and Holistic Health care
- Case studies

**References**


- V. Sivaramakrishnan (Ed.), *Cultural Heritage of India-course material*, Bharatiya Vidya Bhavan, Mumbai. 5th Edition, 2014
- Swami Jitatmanand, *Modern Physics and Vedant*, Bharatiya Vidya Bhavan
- Swami Jitatmanand, *Holistic Science and Vedant*, Bharatiya Vidya Bhavan
- Fritzof Capra, *Tao of Physics*
- Fritzof Capra, *The Wave of life*
- VN Jha (Eng. Trans.), *Tarkasangraha of Annam Bhatta*, International Chinmay Foundation, Velliarnad, Arnakulam
- *Yoga Sutra of Patanjali*, Ramakrishna Mission, Kolkata
- GN Jha (Eng. Trans.), Ed. RN Jha, *Yoga-darshanam with Vyasa Bhashya*, Vidyanidhi Prakashan, Delhi 2016
- RN Jha, *Science of Consciousness Psychotherapyand Yoga Practices*, Vidyanidhi Prakashan, Delhi 2016
- P B Sharma (English translation), *Shodashang Hridayan*


**Pedagogy:** Problem based learning, group discussions, collaborative mini projects.

**Note: The paper setter will set the paper as per the question paper template provided.**

# Semester-6

| RA-302 A | PLC & Industrial Automation | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | To make the students understand about the PLC, PLC programming and SCADA and their applications. | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | Students will be able to know about the PLC, its architecture, selection and applications. | | | | | | |
| **CO2** | Students will be able to perform PLC programming. | | | | | | |
| **CO3** | Students will be able to know PLC networking standards. | | | | | | |
| **CO4** | Students will be able to know about SCADA and communication protocols. | | | | | | |

**UNIT-I**

Industrial Automation -review, Control elements of Industrial Automation-IEC/ ISA Standards for Control Elements, Selection criteria for control elements-Construction of relay logic circuits with different control elements-Need for PLC -PLC evolution. PROGRAMMABLE LOGIC CONTROLLERS: Architecture of PLC -Types of PLC –PLC modules, Input and Output modules –Digital and Analog Input/Output- examples of Digital and Analog Inputs/Outputs- PLC Configuration -Scan cycle -Capabilities of PLC-Selection criteria for PLC –PLC Communication with PC and software-PLC Wiring-Installation of PLC and its modules.

**UNIT-II**

PROGRAMMING OF PLC: – Ladder Programming –Realization of simple logic circuits, Timers and counters–arithmetic and logic functions- PTO / PWM generation-Programming examples- High Speed Counter –Analog Scaling –Encoder Interfacing-Servo drive control – Stepper Motor Control. Other programming types: Functional Block Diagram FBD (most commonly used in industries) -Sequential Flow Chart SFC -Structured Text (Textual) -Instruction List (Textual).

**UNIT-III**

NETWORKING: PLC Networking-Networking standards & IEEE Standards -Protocols –Ethernet- Process field bus (PROFIBUS)-CAN open, different methods of interfacing with a PLC.

Case studies- PLC based traffic light system, stepper motor & servo motor control using PLC, Analog sensor interfacing with PLC, encoder interfacing with PLC. HMI SYSTEMS: Need for HMI in Industrial Automation, Types of HMI –Configuration of HMI, Screen development and navigation, Configuration of HMI elements/objects and interfacing with PLC.

**UNIT-IV**

APPLICATIONS OF PLC: Case studies of manufacturing automation and process automation. ROBOTICS & AUTOMATION SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA):Overview –Developer and runtime packages –Architecture –Tools –Tags–Graphics -Alarm logging –Tag logging – Trends –History –Report generation, VB & C Scripts for SCADA application.

COMMUNICATION PROTOCOLS OF SCADA: Proprietary and open Protocols –OLE/OPC –DDE –Server/Client Configuration –Messaging –Recipe –User administration –Interfacing of SCADA with PLC, drive, and other field devices. DISTRIBUTED CONTROL SYSTEMS (DCS): DCS –architecture –local control unit programming language - communication facilities -operator interface -engineering interfaces. Case studies- Design of conveyor automation system using PLC, SCADA and Electrical drive; Design of inspection automation system using sensors, PLC, HMI/SCADA; Design of simple water management system using PLC, SCADA and Electrical drive.

**Text Books:**

1. Programmable Logic Devices and Logic Controllers, Enrique Mandado, Jorge Marcos, Serafin A. Peres, Prentice Hall, 1996.

2. Practical SCADA for industry, David Bailey, Edwin Bright, Newnes, Burlington, 2003.

**Reference Books:**

1. Introduction to Programmable Logic Controllers, Gray Dunning, Delamar Thomson Learning, 1998.
2. Programmable Controllers- AnEngineers's Guide, 2nd Edition, E.A. Parr, Newness, 1999.
3. Programmable controllers, Hardware, Software & Applications, George L. Batten Jr., McGrawHill, 2nd Edition, 1994.
4. Programmable logic controllers, W. Bolton, Elsevier Ltd, 2015.
5. Programmable logic controllers,Frank D Petruzella, McGraw-Hill, 2011.
6. Programmable Logic Controllers: Programming Methods and Applications. John R Hackworth and Fredrick D Hackworth Jr., Pearson Education, 2006.
7. Practical Modern SCADA Protocols: DNP3, 60870.5 and Related systems, Gordon Clarke, Deon Reyneders, Edwin Wright, Newnes Publishing, 2004.48
8. Designing SCADA Application Software, Stuart G McCrady, Elsevier, 2013.

| RA-304 A | PRINCIPLES OF ROBOTICS | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | To introduce the functional elements of Robotics.<br>To impart knowledge on the direct and inverse kinematics<br>To introduce the manipulator differential motion and control<br>To educate on various path planning techniques and to introduce the dynamics and control of manipulators | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | Students will be able to understand basic concept of robotics. | | | | | | |
| **CO2** | Students will be able to analyse the instrumentation systems and their applications to various and to know about the dynamics and control in robotics industries. | | | | | | |
| **CO3** | Students will be able to know about the differential motion, add statics in robotics | | | | | | |
| **CO4** | Students will be able to know about the various path planning techniques. | | | | | | |

## UNIT-I

**Basic Concepts:** Brief History-Types of Robots–Technology-Robot classifications and specifications-Design and control issues- Various manipulators – Sensors - work cell - Programming languages.

Coordinate Frames, Mapping and Transforms: Coordinate Frames, Description of Objects in Space, Transformation of Vectors, inverting a Homogeneous Transform, Inverting a Homogeneous Transform, Fundamental Rotation Matrices

## UNIT-II

**Direct and Inverse Kinematics:** Mathematical representation of Robots - Position and orientation – Homogeneous transformation- Various joints- Representation using the Denavit Hattenberg parameters - Degrees of freedom-Direct Kinematics-Inverse kinematics- SCARA robots- Solvability – Solution Methods-Closed form solution.

## UNIT–III

**Manipulator Differential Motion and Statics:** Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse -Wrist and arm singularity - Static analysis - Force and moment Balance. PATH PLANNING: Definition-Joint space technique-Use of p-degree polynomial-Cubic polynomial-Cartesian space technique - Parametric descriptions - Straight line and circular paths - Position and orientation planning.

## UNIT–IV

**Dynamics and Control:** Lagrangian mechanics-2DOF Manipulator-Lagrange Euler Formulation-Dynamic model – Manipulator control problem-Linear control schemes-PID control scheme-Force control of robotic manipulator

**Text Books:**

1. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi, 4th Reprint, 2005.
2. JohnJ.Craig, Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 2009.
3. M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, Industrial Robotics, McGraw-Hill Singapore, 1996.

**References Books:**

1. Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis', Oxford University Press, Sixth impression, 2010.
2. K. K.Appu Kuttan, Robotics, I K International, 2007.

3. Edwin Wise, Applied Robotics, Cengage Learning, 2003.
4. R.D.Klafter,T.A.Chimielewski and M.Negin, Robotic Engineering–An Integrated Approach, Prentice Hall of India, New Delhi, 1994.
5. B.K.Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998. 6. S.Ghoshal, "Embedded Systems & Robotics" – Projects using the 8051 Microcontroller", Cengage Learning, 2009.

**Note: The paper setter will set the paper as per the question paper templates provided.**

| RA-306 A | Digital Image Processing & Vision System | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | To impart the basic concepts of image segmentation and shaping<br>To apply different types signal processing techniques in image processing | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | Students will be able know basics of image formation and transformation using sampling and quantization | | | | | | |
| **CO2** | Students will be able to define different types of signal processing techniques used for image sharpening and smoothing | | | | | | |
| **CO3** | Students will be able to perform and demonstrate the compression and coding techniques used for image data | | | | | | |
| **CO4** | Students will be able to perform the shape analysis. | | | | | | |

## UNIT I

**Introduction to Image Processing**

Image formation, image geometry perspective and other transformation, sterio imaging elements of visual perception. Digital Image-sampling and quantization serial & parallel Image processing.

**Signal Processing**

Signal Processing – Fourier, Walsh-Hadmard discrete cosine and Hotelling transforms and their properties, filters, correlators and convolvers. Image enhancement-Contrast modification. Histogram specification, smoothing, sharpening, frequency domain enhancement, pseudo-colour Enhancement.

## UNIT II

**Image Restoration**

Image Restoration-Constrained and unconstrained restoration Wiener filter , motion blur remover, geometric and radiometric correction Image data compression-Huffman and other codes transform compression, predictive compression two tone Image compression, block coding, run length coding, and contour coding.

## UNIT III

**Segmentation Techniques**

Segmentation Techniques-thresholding approaches, region growing, relaxation, line and edge detection approaches, edge linking, supervised and unsupervised classification techniques, remotely sensed image analysis and applications.

## UNIT IV

**Shape Analysis**

Shape Analysis – Gestalt principles, shape number, moment Fourier and other shape descriptors, skelton detection, Hough transform, topological and texture analysis, shape matching. Practical Applications – Finger print classification, signature verification, text recognition, map understanding, bio-logical cell classification.

**Text Books**


1. Ganzalez and Wood, “Digital Image Processing”, Addison Wesley, 1993
2. Anil K.Jain, “Fundamental of Image Processing”, Prentice Hall of India

**Reference Books**


1. Rosenfeld and Kak, "Digital Picture Processing" vol.I & vol.II, Academic,1982
2. Ballard and Brown, "Computer Vision", Prentice Hall, 1982.
3. Wayne Niblack, "An Introduction to Digital Image Processing", Prentice Hall, 1986
4. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis and Machine Vision", Vikas Publications.


**Note: The paper setter will set the paper as per the question paper templates provided.**

| HM-302A | Research Methodology & IPR | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | To impart knowledge on formulation of research problem, research methodology, ethics involved in doing research and importance of IPR protection. | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | Students will be able to understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity. | | | | | | |
| **CO2** | Students will be able to understand research problem formulation & Analyze research related information and Follow research ethics | | | | | | |
| **CO3** | Students will be able to write a review article in the field of engineering. | | | | | | |
| **CO4** | Students will be able to appreciate the importance of IPR and protect their intellectual property. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits | | | | | | |

## UNIT I

### RESEARCH METHODOLOGY

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem, Approaches of investigation of solutions for research problem, data collection, analysis, Plagiarism, Research ethics.

## UNIT II

### RESULTS AND ANALYSIS

Importance and scientific methodology in recording results, importance of negative results, different ways of recording, industrial requirement, artifacts versus true results, types of analysis (Analytical, objective, subjective), outcome as new idea, hypothesis, concept, theory, model etc.

## UNIT III

### TECHNICAL WRITING

Effective technical writing, how to write a manuscript/ response to reviewers' comments, preparation of research article/ research report, Writing a Research Proposal - presentation and assessment by a review committee

## UNIT IV

### INTELLECTUAL PROPERTY RIGHTS

Nature of Intellectual Property: Patents, Designs, Trade Mark and Copyright. Process of Patenting and Development: technological research, innovation, patenting & development. Procedure for grants of patents,

Patenting under PCT.

**PATENT RIGTS AND NEW DEVELOPMENTS IN IPR**

Scope of Patent Rights. Licensing and transfer of technology, Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System.

**Text Books**

1. Ranjit Kumar, Research Methodology- A step by step guide for beginners, Pearson Education, Australia, 2005.

2. Ann M. Korner, Guide to Publishing a Scientific paper, Bioscript Press 2004.

3. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

**Reference Books**

**1**. Kothari, C. R. Research Methodology - Methods and Techniques, New Age International publishers, New Delhi, 2004.

2. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students', Juta & Company, 1996.

3. Robert P. Merges, Peter S. Menell and Mark A. Lemley, "Intellectual Property in New Technological Age", Aspen Publishers, 2016.

4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.

5. Mayall , "Industrial Design", McGraw Hill, 1992.

6. Niebel , "Product Design", McGraw Hill, 1974.

7. Asimov , "Introduction to Design", Prentice Hall, 1962.

**Note: The paper setter will set the paper as per the question paper templates provided.**

| RAP-302A | Neural Network and Fuzzy System | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | The purpose of this course is to familiarize with the Artificial Neural Networks & Fuzzy Logic and to understand the importance of tolerance of imprecision and uncertainty for design of robust & low cost intelligent machines. | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | Students will be able to identify and describe Fuzzy Logic and Artificial Neural Network techniques in building intelligent machines | | | | | | |
| **CO2** | Students will be able to apply Artificial Neural Network models to handle uncertainty and solve engineering problems | | | | | | |
| **CO3** | Students will be able to apply Fuzzy Logic models to handle uncertainty and solve engineering problems | | | | | | |
| **CO4** | Students will be able to recognize the feasibility of applying a Neuro-Fuzzy model for a particular problem | | | | | | |

## UNIT I

**Introduction to Artificial Neural Network**

Artificial neural networks and their biological motivation: Terminology, Models of neuron, Topology, characteristics of artificial neural networks, types of activation functions; learning methods: error correction learning, Hebbian learning, Perceptron: XOR Problem, Perception learning rule convergence theorem; Adaline.

## UNIT II

**Feedforward and Recurrent Neural Networks**

Architecture: perceptron model, solution, single layer artificial neural network, multilayer perceptron model; back propagation learning methods, effect of learning rule co-efficient ;back propagation algorithm, factors affecting backpropagation training, applications; Recurrent neural networks: Linear auto associator – Bi-directional associative memory – Hopfield neural network.

## UNIT III

**Fuzzy Logic & Fuzzy Sets**

Introduction to Fuzzy Logic, Classical and Fuzzy Sets, Membership Function, Membership Grade, Universe of Discourse, Linguistic Variables, Operations on Fuzzy Sets: Intersections, Unions, Negation, Product, Difference, Properties of Classical set and Fuzzy sets, Fuzzy vs Probability, Fuzzy Arithmetic, Fuzzy Numbers.

## UNIT IV

**Fuzzy Relations & Aggregations**

Essential Elements of Fuzzy Systems, Classical Inference Rule, Classical Implications and Fuzzy

Implications, Crisp Relation and Fuzzy Relations, Composition of fuzzy relations, Cylindrical Extension and

Projection. Fuzzy IF-THEN rules, Inference: Scaling and Clipping Method, Aggregation, Fuzzy rule-based Model: Mamdani Model, TSK model, Fuzzy Propositions, Defuzzification: MOM, COA

**Fuzzy Optimization and Neuro Fuzzy Systems**

Fuzzy optimization –one-dimensional optimization. Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks.

**Text Books**


1. Ross, Timothy J. Fuzzy logic with engineering applications. John Wiley & Sons, 2009.
2. Yegnanarayana, B. Artificial neural networks. PHI Learning Pvt. Ltd., 2004.


**Reference Books**


1. Zurada, Jacek M. Introduction to artificial neural systems, West St. Paul, 1992.
2. Hagan, Martin T., Howard B. Demuth, and Mark H. Beale. Neural network design. Boston: Pws Pub., 1996.
3. Haykin, Simon. Neural networks: a comprehensive foundation. Prentice Hall PTR, 1994.
4. Passino, Kevin M., and Stephen Yurkovich. Fuzzy control. Vol. 42. Menlo Park, CA: Addison-Wesley, 1998.


**Note: The paper setter will set the paper as per the question paper templates provided.**

| RAP-304A | SENSORS TECHNOLOGY | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | To make students familiar with the constructions and working principle of different types of sensors and transducers.<br>To make students aware about the measuring instruments and the methods of measurement and the use of different transducers. | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | Students will be able to use concepts in common methods for converting a physical parameter into an electrical quantity | | | | | | |
| **CO2** | Students will be able to use concepts in common methods for converting a physical parameter into an electrical quantity | | | | | | |
| **CO3** | Students will be able to choose a proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc. | | | | | | |
| **CO4** | Students will be able to predict correctly the expected performance of various sensors | | | | | | |

## UNIT-I

**Sensors:** Principles and classification of transducers, guidelines for selection and application of transducers, basic requirements of transducers. Different types of transducers,
displacement, strain gauge, LVDT, potentiometer, capacitive & inductive, Piezoelectric, temperature, optical, Hall effect transducers.
**Measurement of parameter:** Measurement of length, angle, area, temperature, pressure flow, speed force, torque, vibration, level, concentration (conductivity and ph.)
measurement- sensors in robotics-tactile sensors-proximity and range sensors- miscellaneous sensors and sensor based systems-use of sensors in robotics.

## UNIT-II

Fundamentals of Electric drives - Components of electric drives, factors affecting choice of drives, fundamental torque equation, speed-torque conventions, steady state stability, multi-quadrant operation of electric drives, load torque components, nature and classification of load torque, equivalent moment of inertia, modes of operation.

## UNIT–III

Control Speed control and drive classification, closed loop control, current limit control, speed control, position control, torque control, PLL control, multi-motor drive control, digital control. DC motor control, speed control, position control, proportional control, PID controllers.

## UNIT–IV

Merits of Fluid power & its utility for increasing productivity through Low-Cost Automation, Transmission of Fluid Power through various types of Cylinders), Symbolic representation of Pneumatic elements (CETOP), Compressors and Air supply system including airline installations, signalling & control system. Pneumatic control elements (control valves & remote-control system), Basic pneumatic circuits for controlling single & double acting cylinder, Basic pneumatic circuits, Advanced pneumatic circuits for controlling multi-cylinders (operable). Advanced pneumatic circuits for controlling multi-cylinders (inoperable circuits), Electro pneumatics with relay logic, and Pneumatics system with PID controls, Application of fluidics a non-moving part logic.

**Text Books**

1. Sensors And Transducers By D. Patranabi W. Shepherd, and L. N. Hully, "Power Electronics and Motor control", (2e), Cambridge University, 1995.
2. Gopal K. Dubbey,"Fundamentals of Electric Drives", (2e), Narosa Publishers, 2001.

**Reference Books**

1. R. Krishnan, "Electric Motor Drives Modeling, Analysis, and Control", (2e), Prentice Hall, 2001.

**Note: The paper setter will set the paper as per the question paper templates provided.**

| RAP-306A | INDUSTRIAL ROBOTICS AND MATERIAL HANDLING SYSTEMS | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | To introduce the basic concepts, parts of robots and types of robots.<br>• To make the student familiar with the various drive systems for robot, sensors and their applications in robots and programming of robots.<br>• To select the robots according to its usage.<br>• To discuss about the various applications of robot | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | Students will be able to learn about the basic concepts, parts of robots and types of robots. | | | | | | |
| **CO2** | Students will be able to design automatic manufacturing cells with robotic control using the principle behind robotic drive system, end effectors, sensor, machine vision robot kinematics and programming. | | | | | | |
| **CO3** | Students will be able to develop the ability in selecting the required robot and know various applications of robots | | | | | | |
| **CO4** | Students will be able to apply their knowledge in handling the materials. | | | | | | |

**UNIT-I**

**Introduction**: Types of industrial robots, Load handling capacity, general considerations in Robotic material handling, material transfer, machine loading and unloading, CNC machine tool loading, Robot centered cell.

**UNIT-II**

**Robots for Inspection**: Robotic vision systems, image representation, object recognition and categorization, depth measurement, image data compression, visual inspection, software considerations.

UNIT III OTHER APPLICATIONS: Application of Robots in continuous arc welding, Spot welding, Spray painting, assembly operation, cleaning, robot for underwater applications.

**UNIT–III**

**End Effectors**: Gripper force analysis and gripper design, design of multiple degrees of freedom, active and passive grippers.

**Selection Of Robot**: Factors influencing the choice of a robot, robot performance testing, economics of robotization, Impact of robot on industry and society.

**UNIT–IV**

**Material Handling**: Concepts of material handling, principles and considerations in material handling systems design, conventional material handling systems - industrial trucks, monorails, rail guided vehicles, conveyor systems, cranes and hoists, advanced material handling systems, automated guided vehicle systems, automated storage and retrieval systems (ASRS), bar code technology, radio frequency identification technology.

**TEXT BOOKS:**

1. Richaerd D Klafter, Thomas Achmielewski and Mickael Negin, "Robotic Engineering – An integrated Approach" Prentice HallIndia, New Delhi, 2001.
2. Mikell P. Groover,"Automation, Production Systems, and Computer Integrated Manufacturing", 2nd Edition, John Wiley & sons, Inc, 2007.

**REFERENCE BOOKS:**

1. James A Rehg, “Introduction to Robotics in CIM Systems”, Prentice Hall of India, 2002.
2. Deb S R, "Robotics Technology and Flexible Automation", Tata McGraw Hill, New Delhi, 1994

**Note: The paper setter will set the paper as per the question paper templates provided.**

| RA-308LA | ROBOTIC SIMULATION LAB | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credits** | **Major Test** | **Minor Test** | **Practical** | **Total** | **Time (Hrs.)** |
| **0** | **0** | **2** | **1** | **0** | **40** | **60** | **100** | **3** |
| **Purpose** | a) To impart the fundamental knowledge on using various analytical tools<br>b) To know various fields of engineering where these tools can be effectively used to improve the output of a product<br>c) To impart knowledge on how these tools are used in Industries by solving some real time problems using these tools | | | | | | | |
| **Course Outcomes** | | | | | | | | |
| **CO 1** | Students will be able to know the utility of the tools like robotics programming | | | | | | | |
| **CO 2** | Students will be able to use these tools for any engineering and real time applications | | | | | | | |
| **CO 3** | Students will be able to get the knowledge on utilizing these tools for a better project in their curriculum | | | | | | | |
| **CO 4** | Students will be able to handle industry problems with confidence when it matters to use these tools in their employment. | | | | | | | |

**LIST OF EXPERIMENTS:**

1. Open solution with an empty station, Import Robot and use the 3D window navigation
2. Creating a Robot system from layout and use Jog function.
3. Use Import tool and create path functions
4. Use Path and Targets, import and position training object
5. Create work-object
6. Create geometry and save station.
7. Create complete Arc welding cell structure, import CAD files, build station and save station.
8. Create a station, use Jogging menu.
9. Create collision and use collision detection functionality in the station.
10. Understand and measure cycle time in station.
11. Create backup file and restoring back up.
12. Understand and use CAD/CAM software.

**Note:** At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

| RA-310LA | PLC SCADA and HMI Lab | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credits** | **Major Test** | **Minor Test** | **Practical** | **Total** | **Time (Hrs.)** |
| **0** | **0** | **2** | **1** | **0** | **40** | **60** | **100** | **3** |
| **Purpose** | To familiarize the students with different applications of PLC, SCADA HMI. | | | | | | | |
| **Course Outcomes** | | | | | | | | |
| **CO 1** | Students will be able to perform different functions using PLC. | | | | | | | |
| **CO 2** | Students will be able to perform different operations using SCADA-HMI. | | | | | | | |

**List of Experiments**

1. To identify the given parts of the given PLC and front panel status indicators.
2. To develop the ladder program to test the START/STOP logic using two input and one output.
3. To develop the ladder program for blinking of LED.
4. To develop the ladder program for sequential ON-OFF control of lamps.
5. Use various functions of SCADA simulation editors to develop simple projects.
6. Develop a SCADA mimic diagram and tag database for ON-OFF control of lamps.
7. Develop a SCADA mimic diagram and tag database for traffic light control system.
8. To perform graphical animation of process data and alarming using SCADA-HMI.
9. To perform data logging, trending and report generation using SCADA-HMI

**Note:** At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

| RA-312LA | PROJECT-II | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credits** | **Major Test** | **Minor Test** | **Practical** | **Total Time** | **Time (Hrs.)** |
| **0** | **0** | **6** | **3** | **--** | **0** | **100** | **100** | **3** |
| **Purpose** | To implement the engineering principles and theories into innovative practical projects for solving real world problems. | | | | | | | |
| **Course Outcomes** | | | | | | | | |
| **CO1** | Students will be able to apply the theoretical knowledge into practical/software projects. | | | | | | | |
| **CO2** | Students will be able to design new products using latest technologies. | | | | | | | |

The project work could be done for the problem statement of an industry or practical project in the institute. The analysis-based software projects undergone in the previous semester can be extended to its fabrication i.e. functional machine/product in this semester. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

**Note:** The maximum number of students in a group should not exceed four.