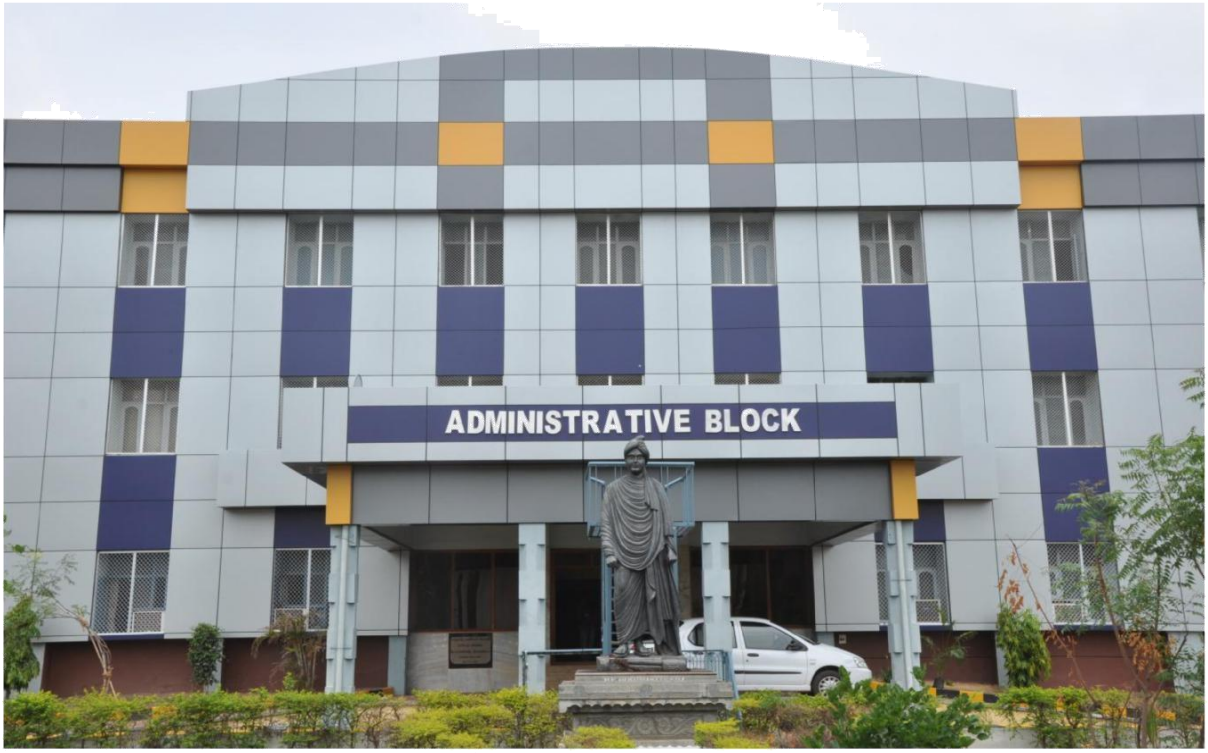


# Scheme – 2022

## Electrical & Electronics Engineering Department

### G. Pulla Reddy Engineering College (Autonomous): Kurnool

## Accredited by NBA of AICTE and NAAC of UGC

## Affiliated to JNTUA, Anantapuramu

# Scheme and Syllabus for

# TWO YEAR M.Tech. Degree Course in

# AUTOMATION AND ROBOTICS

(With Effect from the Batch Admitted in 2022-23)

**DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING**

**Two Year M.Tech Degree Program**

**Scheme of Instruction and Examination**

**(Effective from 2022-23)**

**M.Tech I SEMESTER Automation and Robotics (AR) Scheme-2022**

| S. No | Category | Course Code | Course Title | L | T | P | Credits | End Exam Marks | CIA Marks | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| **I** | | | **Theory** | | | | | | | |
| 1 | PC | EE851 | Programmable Logic Controllers | 3 | | | 3 | 60 | 40 | 100 |
| 2 | PC | EE852 | Introduction to Robotics | 3 | | | 3 | 60 | 40 | 100 |
| 3 | PC | EE853 | Microcontrollers and Embedded Systems | 3 | | | 3 | 60 | 40 | 100 |
| 4 | PC | EE854 | Advanced Control Systems | 3 | | | 3 | 60 | 40 | 100 |
| 5 | PE | | Professional Elective-I | 3 | | | 3 | 60 | 40 | 100 |
| 6 | MC | | Research Methodology and IPR | 2 | | | 2 | | 100 | 100 |
| 7 | AC | | Audit Course-I | 2 | | | 0 | | | |
| **II** | | | **Practical** | | | | | | | |
| 8 | PCL | EE855 | Programmable Logic Controller Laboratory | | | 3 | 2 | 60 | 40 | 100 |
| 9 | PCL | EE856 | Microcontrollers and Embedded Systems Laboratory | | | 3 | 2 | 60 | 40 | 100 |
| | Total | | | 19 | | 6 | 21 | 420 | 380 | 800 |

**M.Tech II SEMESTER - Automation and Robotics (AR) Scheme-2022**

| S. No | Category | Course Code | Course Title | L | T | P | Credits | End Exam Marks | CIA Marks | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| **I** | | | **Theory** | | | | | | | |
| 1 | PC | EE857 | Industrial Automation Systems | 3 | | | 3 | 60 | 40 | 100 |
| 2 | PC | EE858 | Robotics and Control | 3 | | | 3 | 60 | 40 | 100 |
| 3 | PE | | Professional Elective-II | 3 | | | 3 | 60 | 40 | 100 |
| 4 | PE | | Professional Elective-III | 3 | | | 3 | 60 | 40 | 100 |
| 5 | PE | | Professional Elective-IV | 3 | | | 3 | 60 | 40 | 100 |
| 6 | AC | | Audit Course-II | 2 | | | 0 | | | |
| **II** | | | **Practical** | | | | | | | |
| 7 | PCL | EE859 | Industrial Automation Laboratory | | | 3 | 2 | 60 | 40 | 100 |
| 8 | PCL | EE860 | Robotics Laboratory | | | 3 | 2 | 60 | 40 | 100 |
| | Total | | | 17 | 0 | 6 | 19 | 420 | 280 | 700 |

**M.Tech III SEMESTER - Automation and Robotics (AR) Scheme-2022**

| S. No | Category | Course Title | L | T | P | Credits | End Exam Marks | CIA Marks | Total |
|---|---|---|---|---|---|---|---|---|---|
| 1 | OE | Open Elective* | 2 | | | 2 | | | |
| 3 | PR | Technical Seminar & Dissertation Phase - I | | | 20 | 10 | | 100 | 100 |
| 4 | CAA | Co- Academic Activities | | | | 2 | | 100 | 100 |
| | Total | | 2 | | 20 | 14 | | 200 | 200 |

***Open Elective Course shall be done through MOOCs.**

**M.Tech IV SEMESTER - Automation and Robotics (AR) Scheme-2022**

| S. No | Category | Course Title | L | T | P | Credits | End Exam Marks | CIA Marks | Total |
|---|---|---|---|---|---|---|---|---|---|
| 1 | PR | Dissertation Phase - II | | | 32 | 16 | 60 | 40 | 100 |

## List of Professional Elective Courses

| Description | Course Code | Subject Title |
|---|---|---|
| PE-I | EE861 | (i) Measurement Techniques, Transducers and Sensors |
| | EE862 | (ii) Power Electronics and Drives |
| | EE863 | (iii) Neural Networks and Fuzzy Logic |
| PE-II | EE864 | (i) Mobile and Autonomous Robotics |
| | EE865 | (ii) Mechatronics |
| | EE866 | (iii) Internet of Things |
| PE-III | EE867 | (i) Process Control and Instrumentation |
| | EE868 | (ii) Industry 4.0 |
| | EE869 | (iii) Digital Signal Processing |
| PE-IV | EE870 | (i) Machine Learning |
| | EE871 | (ii) Digital Control Systems |
| | EE872 | (iii) Digital Image Processing |

## Open Elective

| | |
|---|---|
| OE | Open electives will be selected through MOOC's |

## List of Audit Course

| Category | Course Code | Course Title |
|---|---|---|
| Audit Course-I | AU101 | English for Research Paper Writing |
| | AU102 | Disaster Management |
| | AU103 | Sanskrit for Technical Knowledge |
| Audit Course-II | AU201 | Stress Management by Yoga |
| | AU202 | Pedagogy Studies |
| | AU203 | Personality Development through Life Enlightenment Skills |

# PROGRAMMABLE LOGIC CONTROLLERS (PLC)

| I Semester : Automation and Robotics | | | | | Scheme : 2022 | | | |
|---|---|---|---|---|---|---|---|---|
| Course Code | Category | Hours/Week | | | Credits | Maximum Marks | | |
| EE851 | Professional Core | L | T | P | C | Continuous Internal Assessment | End Exam | TOTAL |
| | | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| Sessional Exam Duration : 2 Hrs | | | | | End Exam Duration: 3 Hrs | | | |

**Course Outcomes :** At the end of the course the student will be able to

**CO1:** Understand the basics of PLC programming.

**CO2:** Understand the digital logic gates and ladder diagrams

**CO3:** Understand the registers and functions in PLC programming

**CO4:** Understand the data handling functions in PLC

**CO5:** Understand the Analog PLC operation and human machine interface systems

| | |
|---|---|
| **UNIT - I** | |
| **PLC Basics** | PLC system, I/O modules and interfacing, CPU processor, programming Equipment, programming formats, construction of PLC ladder diagrams, Devices connected to I/O modules. |
| **PLC Programming** | Input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill press operation. |
| **UNIT - II** | |
| **PLC based digital logic gates and Ladder diagrams** | Digital logic gates, programming in the Boolean algebra system, conversion examples Ladder Diagrams for process control: Ladder diagrams & sequence listings, ladder diagram construction and flowchart for spray process system. |
| **UNIT - III** | |
| **PLC Registers and functions** | Characteristics of Registers, module addressing, holding registers, Input Registers, Output Registers.<br>Timer functions & Industrial applications, counters, counter function industrial applications, Arithmetic functions, Number comparison functions, number conversion functions |
| **UNIT - IV** | |
| **Data Handling functions** | SKIP, Master control Relay, Jump, Move, FIFO, FAL, ONS, CLR & Sweep functions and their applications. Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two-axis & three axis Robots with PLC, Matrix functions. |
| **UNIT - V** | |
| **Analog PLC operation** | Analog modules& systems, Analog signal processing, Multi bit Data Processing, Analog output Application Examples, PID principles, position indicator with PID control, PID Modules, PID tuning, PID functions. |
| **Human machine interface systems** | Introduction to HMI and need for using HMI. Different features of HMI and its methods of configuration. Use of HMI to above mentioned applications. |

**Text Books :**


1. John W. Webb & Ronald A. Reiss, “Programmable Logic Controllers- Principles and Applications” Fifth Edition, PHI

2. JR. Hackworth & F.D. Hackworth Jr. , “Programmable Logic Controllers- Programming Method and Applications”, Pearson. 2004


**Reference Books :**


1. Alireza H. Fassih "Programmable Logic Controllers", New Generation publication 2014

2. Madhuchhanda Mitra and Samarjit Sen Gupta, “PLC and Industrial Applications an Introduction”, Pernram International Pub. (India) Pvt.Ltd., 2011

3. Frank D. Petruzella, “Programmable Logic Controllers”, 5th Edition, McGraw- Hill, New York, 2016.

| **Web References:** |
| --- |
| https://www.electrical4u.com/programmable-logic-controllers |
| https://www.watelectrical.com/industrial-applications-of-programmable-logic-controller/ |
| https://nptel.ac.in/content/storage2/courses/112103174/ |
| **Question Paper Pattern:** |
| **Sessional Exam**<br>The question paper for sessional examination shall consist of **Six** questions for 7.5 marks each and the student has to answer any **Four** questions.<br><br>**End Exam**<br>The question paper for end examination shall consist of **Eight** questions for 12 marks each and the student shall answer any **Five** questions. |

# INTRODUCTION TO ROBOTICS (IR)

| I Semester : Automation and Robotics | | | | | | Scheme : 2022 | | |
|---|---|---|---|---|---|---|---|---|
| Course Code | Category | Hours/Week | | | Credits | Maximum Marks | | |
| EE852 | Professional Core | L | T | P | C | Continuous Internal Assessment | End Exam | Total |
| | | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| Sessional Exam Duration : | | | | | | End Exam Duration: 3 Hrs | | |

**Course Outcomes :** At the end of the course the student will be able to

**CO1:** Understand the basics and need of robotics.

**CO2:** Understand various end effectors and actuators.

**CO3:** Understand various sensors for robotic applications.

**CO4:** Understand different vision systems.

**CO5:** Understand different applications of robot.

| | |
|---|---|
| | **UNIT – I** |
| **Introduction to Robotics** | Robotics and Programmable Automation, Historical Background, Laws of Robotics, Robot Definitions, Robotics Systems and Robot Anatomy, Human Systems and Robotics, Specifications of Robots, Present Application Status, Machine Intelligence, Computer and Robotics—Future Trends, Flexible Automation Versus Robotics Technology, Safety Measures in Robotics. |
| | **UNIT - II** |
| **End effectors** | Definition, General Aspects, Types of End effectors, Classification, Electric, Hydraulic, Pneumatic grippers, Selection of Motors and Grippers. |
| **Actuators** | Introduction, fluid power-general aspects, hydraulic actuators, pneumatic actuators, electrical actuators. |
| | **UNIT – III** |
| **Robotic Sensors** | Characteristics, Types, Tactile sensor, Position and display sensor, Force sensor, proximity sensor, Range sensor, Selection of a sensor. |
| | **UNIT - IV** |
| **Robot Vision** | Introduction, Robot vision systems- functions-components- Advantages, lightning devices, A to D conversion, image storage, illumination, Feature extraction, object inspection, procedure of robot vision. |
| | **UNIT - V** |
| **Applications of Robots** | Introduction, robot in industry, robots in handling, machine loading and unloading, material transfer, palletizing, welding, arc welding, spot welding, compliance, assembly injection moulding. |

**Text Books**


1. Saha S, "Introduction to Robotics", MGH, 2nd Ed.
2. R. K. Rajput, "Robotics And Industrial Automation", S. Chand, 2nd Ed.
3. S.R.Deb, Sankha Deb , "Robotics Technology and Flexible Automation", MGH, 2017.
4. Ramachandran nagarajan, "Introduction to industrial robotics", pearson India education services, 2016.


**Reference Books**


1. D. K. Pratihar, "Fundamentals of robotics", Narosa publishing house pvt Limited, 2017.
2. RK Mittal, IJ nagrath, "Robotics and control", McGraw Hill Education, 2003.


**Web References:**

1. Introduction to Robotics | Stanford Onlinehttps://online.stanford.edu
2. Learn Robotics with Online Courses, Classes, & Lessons | edX https://www.edx.org

**Question Paper Pattern:**

**Sessional Exam**

The question paper for sessional examination shall consist of **Six** questions for 7.5 marks each and the student has to answer any **Four** questions.

**End Exam**

The question paper for end examination shall consist of **Eight** questions for 12 marks each and the student shall answer any **Five** questions.

## MICROCONTROLLERS AND EMBEDDED SYSTEMS (MC&ES)

| I Semester : Automation and Robotics | | | | | | Scheme : 2022 | | |
|---|---|---|---|---|---|---|---|---|
| Course Code | Category | Hours/Week | | | Credits | Maximum Marks | | |
| EE853 | Professional Core | L | T | P | C | Continuous Internal Assessment | End Exam | Total |
| | | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| Sessional Exam Duration : | | | | | | End Exam Duration: 3 Hrs | | |

**Course Outcomes :** At the end of the course the student will be able to

**CO1:** Understand the architectural features and I/O functions of MSP430.

**CO2**: Understand the data types, control structure, arrays and pointers for programming of MSP430.

**CO3:** Understand the pin configuration and I/O functions of Node MCU,ESP32

**CO4:** Understand the architectural features and I/O functions of Raspberry Pi**.**

**CO5:** Understand fundamentals of python for programming Raspberry Pi.

| | |
|---|---|
| **UNIT – I** | |
| **Introduction to MSP430 Microcontroller** | MSP430 CPU Architecture-General layout-Central Processing Unit - I/O Subsystem Organization - Oscillators and Clocks, Pin layout of MSP430 and Configuring of GPIO Ports. |
| **UNIT - II** | |
| **MSP430 Programming with Embedded C** | Memory management- Embedded C Data Types-Arithmetic and Logic Operations-Control Structures-Arrays and Pointers. |
| **UNIT – III** | |
| **NODEMCU Controller** | Board Description - Pin layout of NODEMCU Development Board. |
| **ESP32 Controller** | Board Description - Pin layout of ESP32 Development Board. |
| **UNIT - IV** | |
| **Introduction to Raspberry Pi** | Raspberry Pi board and its processor, General purpose IO Pins - Communication facilities on Raspberry Pi (I2C, SPI, UART). |
| **UNIT - V** | |
| **Basics of Python Programming for Raspberry Pi** | Python on Raspberry Pi- Control statements, Functions, Module, basic programs. |

**Text Books**

1. John H Davies, "MSP430 Microcontroller Basics", Newnes Publications, Elsevier, 2008.
2. S. Monk, "Programming the Raspberry Pi" McGraw-Hill Education, 2013.
3. Vijay Madisetti, Arshdeep Bahga, "Internet of Things: A Hands-On Approach", Orient Blackswan Private Limited - New Delhi; First edition.

**Reference Books**

1. Chris Nagy, "Embedded Systems Design using TI MSP430 Series", Newnes Publications, Elsevier, 2003.
2. Cem Unsalan, H.Deniz Gurham, "Programmable Microcontrollers with Applications: MSP430 LaunchPad with CCS and Grace" McGraw-Hill Education, 2014.
3. Alex Bradbury and Ben Everard, "Learning Python with Raspberry Pi", Feb 2014, JohnWiley & Sons.

**Web References:**

1. https://www.ti.com/
2. https://www.raspberrypi.org/learn/

**Question Paper Pattern:**

**Sessional Exam**

The question paper for sessional examination shall consist of **Six** questions for 7.5 marks each and the student has to answer any **Four** questions.

**End Exam**

The question paper for end examination shall consist of **Eight** questions for 12 marks each and the student shall answer any **Five** questions.

## ADVANCED CONTROL SYSTEMS (ACS)

| I Semester : Automation and Robotics | | | | | | Scheme : 2022 | | |
|---|---|---|---|---|---|---|---|---|
| Course Code | Category | Hours/Week | | | Credits | Maximum Marks | | |
| EE854 | Professional Core | L | T | P | C | Continuous Internal Assessment | End Exam | Total |
| | | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| Sessional Exam Duration : 2Hrs | | | | | | End Exam Duration: 3 Hrs | | |

**Course Outcomes :** At the end of the course the student will be able to

**CO1:** Design of compensators with root locus and frequency response approach.

**CO2**: Understand behaviour of non-linear systems.

**CO3:** Analyze stability of open loop and closed loop systems.

**CO4:** Design of control systems in state space.

**CO5:** Understand the optimal control systems.

| UNIT – I | |
|---|---|
| **Linear system Design** | Introduction to design using compensators, Root locus approach to control system Design, Frequency response approach to control system Design, Lag compensator, Lead compensator, Lag –Lead compensators, PI,PD,PID controllers, Feedback compensation. |
| **UNIT - II** | |
| **Nonlinear Systems** | Behaviour of non-linear systems, Jump resonance, sub-harmonic oscillation, limit cycles, common physical non linearities, singular points, phase plane method. |
| **UNIT – III** | |
| **Stability** | Liapunov's stability criteria, Theorems. The direct method of Liapunov for linear systems. Methods of constructing Liapunov function Krasovski's method, variable gradient method. |
| **UNIT - IV** | |
| **Analysis and design of control system in state space** | Eigen values and Eigen Vectors, Similarity Transformation, Cayley-Hamilton theorem, Transformation of state model, Concept of controllability and observability, Controllable phase variable form of state model, Control system design via pole placement by state feedback, Observable phase variable form of state model, State observers. |
| **UNIT - V** | |
| **Optimal Control** | Concept of optimal control, Performance Indices ,Minimum time problem, Minimum energy problem, Minimum terminal error problem, State regulator problem, output regulator problem, Tracking, Relation between Quadratic performance index and Lyapunov function, State regulator design using Lyapunov equation, riccati equation. |

**Text Books**


1.A.Nagoor Kani, "Advaced control Theory", RBA Publications, 2nd edition, 1999

2.KR Varmah, "Modern Control Theory",CBS Publishers& Distributors Pvt Ltd 1st Edition 2017

3.Gopal M (1993), "Modern Control System Theory", New Age International Publishers.


**Reference Books**


1.Nagrath I.J and Gopal M. (1982), "Control System Engineering", Wiley Eastern Publishers

2.K. Ogata, "Modern Control Engineering", Prentice Hall, 5th edition, 2010


**Web References:**

1. https://www.javatpoint.com/control-system-compensators
2. https://tutorial.math.lamar.edu/classes/alg/nonlinearsystems.aspx
3. https://web.stanford.edu/class/ee363/lectures/lyap.pdf
4. https://www.tutorialspoint.com/control_systems/control_systems_state_space_analysis.htm
5. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.701.8402&rep=rep1&type=pdf

**Question Paper Pattern:**

**Sessional Exam**

The question paper for sessional examination shall consist of **Six** questions for 7.5 marks each and the student has to answer any **Four** questions.

**End Exam**

The question paper for end examination shall consist of **Eight** questions for 12 marks each and the student shall answer any **Five** questions.

## RESEARCH METHODOLOGY AND IPR (RM&IPR)

| I Semester : Automation and Robotics | | | | | | Scheme : 2022 | | |
|---|---|---|---|---|---|---|---|---|
| Course Code | Category | Hours/Week | | | Credits | Maximum Marks | | |
| MC 101 | Mandatory Course | L | T | P | C | Continuous Internal Assessment | End Exam | Total |
| | | 2 | 0 | 0 | 2 | 100 | - | 100 |
| Sessional Exam Duration : 2Hrs | | | | | | End Exam Duration: 3 Hrs | | |

**Course Outcomes :** At the end of the course the student will be able to

**CO1:** Analyze research related information

**CO2:** Follow research ethics

**CO3:** Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity

**CO4:** Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasise the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular

**CO5:** 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

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, interpretation, Necessary instrumentations

### UNIT - II

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

### UNIT – III

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT

### UNIT - IV

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

### UNIT - V

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

**Text Books**

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"

2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

**Reference Books**

1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"

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

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

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

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

6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016

## PROGRAMMABLE LOGIC CONTROLLER LABORATORY (PLC(P))

| I Semester : Automation and Robotics | | | | | Scheme : 2022 | | |
|---|---|---|---|---|---|---|---|
| Course Code | Hours/Week | | | Credits | Maximum Marks | | |
| EE855 | L | T | P | C | Continuous Internal Assessment | End Exam | TOTAL |
| | - | - | 3 | 2 | 40 | 60 | 100 |

**End Exam Duration: 3 Hrs**

**Course Outcomes :** At the end of the course students will be able to

**CO1:** Understand the functions of PLC

**CO2:** Apply ladder programming for various applications

**CO3:** Understand different starting methods of induction motor using contactors and sensors

**CO4:** Understand and control of conventional and special machines

**List of Experiments**

Note : At least 8 of the following experiments shall be conducted

1. Verification of logic gates, timer and counter with PLC
2. Traffic Light Control using PLC
3. Automatic water level control system using PLC
4. Conveyor belt based automatic water bottle filling system using PLC
5. Direct On line (DOL) Starting of Induction Motor with/without latching
6. Reverse Direct On line (RDOL) Starting of Induction Motor with/without latching
7. Star Delta Starting of Induction Motor
8. Speed Control of DC Motor using POT
9. PLC based Pneumatic machine control
10. Servo motor control using PLC

## MICROCONTROLLERS AND EMBEDDED SYSTEMS LABORATORY (MES (P))

| I Semester : Automation and Robotics | | | | | | Scheme : 2022 | | |
|---|---|---|---|---|---|---|---|---|
| Course Code | Category | Hours/Week | | | Credits | Maximum Marks | | |
| EE856 | Professional Core | L | T | P | C | Continuous Internal Assessment | End Exam | Total |
| | | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| | | | | | | End Exam Duration: 3 Hrs | | |

**Course Outcomes :** At the end of the course the student will be able to

**CO1:** Apply embedded C programming method for MSP 430 microcontroller using Code Composer Studio.

**CO2:** Understand configuration of GPIO, serial ports, ADC and DAC for MSP430 microcontroller.

**CO3:** Understand interfacing of sensors, actuators with ESP32, NodeMCU and Raspberry PI.

**List of Experiments**

Note : At least 8 of the following experiments shall be conducted

1. Configure GPIO ports of MSP430 to drive a DC Motor.
2. Configure GPIO ports of MSP430 to drive a stepper Motor.
3. Configure GPIO ports of MSP430 to generate variable duty cycle PWM. (Without and with timer)
4. On/Off control of DC Motor using temperature and humidity sensor and ESP32.
5. Display the PIR sensor values on serial monitor using ESP32.
6. On/Off control of DC Motor using IR sensor and NODEMCU.
7. Interface 16X2 LCD to NodeMCU and display the given input string.
8. Display the PIR sensor values on serial monitor using NODEMCU.
9. On/Off control of DC Motor using ultrasonic sensor and Rasberry pi.
10. Object detection system by using a PIR sensor, buzzer and Rasberry PI.

# INDUSTRIAL AUTOMATION SYSTEMS (IAS)

| II Semester: Automation and Robotics | | | | | Scheme : 2022 | | | |
|---|---|---|---|---|---|---|---|---|
| Course Code | Category | Hours/Week | | | Credits | Maximum Marks | | |
| EE857 | Professional Core | L | T | P | C | Continuous Internal Assessment | End Exam | TOTAL |
| | | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| Sessional Exam Duration : 2 Hrs | | | | | End Exam Duration: 3 Hrs | | | |

**Course Outcomes :** At the end of the course the student will be able to

**CO1:** Understand the basics of Automation concepts in manufacturing industries

**CO2:** Understand the concepts of Pneumatic systems

**CO3:** Understand the concepts of Hydraulic systems

**CO4:** Understand the Control Technologies in Automation

**CO5:** Understand the automated testing and inspection methods in industry

| UNIT - I | |
|---|---|
| **Automation in Manufacturing Industries** | Introduction- Automation in production system, Principles and strategies of automation, Basic elements of an automated system, Advanced automation functions, Levels of automations, Automated flow lines and transfer mechanisms, Analysis of transfer lines without storage, Automated flow lines with storage buffers. |
| **UNIT - II** | |
| **Pneumatic Systems** | Introduction to pneumatic systems: advantages and limitations, applications, structure and signal flow of pneumatic systems; pneumatic power pack: air generation and distribution, air reservoir, constructional details and working of filter, lubricator, pressure regulator, actuators, direction control valves, check valves, flow control valves, pneumatic counter.<br>Symbols of pneumatic valves, traverse time diagram, design of manually operated circuits: direct and indirect control of actuators, control of single and multiple actuators. |
| **UNIT - III** | |
| **Introduction to Hydraulic systems:** | Advantages and limitations, physical principles of oil hydraulics, hydraulic power pack, hydraulic fluids, filters, types of hydraulic pumps, pump performance calculations, hose size calculations, hydraulic actuators and accessories, accumulator, hydraulic valves, pressure control valves, flow control valves, open-center and closed-center hydraulic systems. |
| **UNIT - IV** | |
| **Control Technologies in Automation** | Industrial Control Systems, Process Industries Verses Discrete-Manufacturing Industries, Continuous Verses Discrete Control, Computer Process Control and its Forms. Computer Based Industrial Control: Introduction & Automatic Process Control, Building Blocks of Automation System: LAN, Analog & Digital I/O Modules, SCADA System & RTU. |
| **UNIT - V** | |
| **Automated Inspection and Testing** | Inspection and testing, Statistical Quality Control, Automated Inspection Principles and Methods, Sensor Technologies for Automated Inspection, Coordinate Measuring machines, Other Contact Inspection Methods, Machine Vision, Other optical<br>Inspection Methods. |

**Text Books :**


1. Mikell-P.-Groover "Automation-Production-Systems-and-Computer-Integrated-Manufacturing"-Ed-4-2015, Pearson publishers
2. Majumdar S.R., "Pneumatic Systems Principles and Maintenance", Tata McGraw Hill, New Delhi.
3. Peter Croser and Frank Ebel, "Pneumatics Basic Level TP 101" Festo Didactic GMBH & Co, Germany.

4. Hasebrink J.P. and Kobler R., “Fundamentals of Pneumatic Control Engineering”, Festo Didactic GMBH & Co, Germany.
5. Krishna Kant “Computer Based Industrial Control” -PHI
6. Groover M. P., "Industrial Robotics, Technology, Programming and Application", McGraw Hill Book and Co., 2012.

**Reference Books :**

1. Merkle D.,Schrader B. and Thomes M., "Hydraulics Basic Level TP 501" Festo Didactic GMBH & Co, Germany.
2. Peter Rohner, “Industrial Hydraulic Control” John Wiley and Sons, Brisbane
3. Tiess Chiu Chang & Richard A. Wysk “An Introduction to Automated Process Planning Systems”
4. Amber G.H & P.S. Amber “Anatomy of Automation” PrenticeHall
5. Srinivas Medida, "Pocket Guide on Industrial Automation", First Edition, IDC Technologies, 2008

**Web References:**

1. https://www.electrical4u.com/industrial-automation/
2. https://conceptsystemsinc.com/what-is-industrial-automation-types-of-industrial-automation
3. https://www.thomasnet.com/articles/automation-electronics/general-automation-systems

**Question Paper Pattern:**

**Sessional Exam**

The question paper for sessional examination shall consist of **Six** questions for 7.5 marks each and the student has to answer any **Four** questions.

**End Exam**

The question paper for end examination shall consist of **Eight** questions for 12 marks each and the student shall answer any **Five** questions.

# ROBOTICS AND CONTROL (RC)

| II Semester : Automation and Robotics | | | | | | Scheme : 2022 | | |
|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Category** | **Hours/Week** | | | **Credits** | **Maximum Marks** | | |
| **EE858** | **Professional Core** | **L** | **T** | **P** | **C** | **Continuous Internal Assessment** | **End Exam** | **Total** |
| | | **3** | **0** | **0** | **3** | **40** | **60** | **100** |
| **Sessional Exam Duration :** | | | | | | **End Exam Duration: 3 Hrs** | | |

**Course Outcomes :** At the end of the course the student will be able to

**CO1:** Understand the direct and inverse kinematics.

**CO2**: Understand the dynamics of the robot.

**CO3:** Understand the linear control methods of robot.

**CO4:** Understand the non-linear and force control methods of robot.

**CO5:** Understand robot motion and programming methods.

| | |
|---|---|
| **UNIT – I** | |
| **Direct kinematics** | Mechanical structures and notations, link and joints, kinetic modelling of the manipulator, Denavit- hartenberg notation, relationship between adjacent links manipulator transformation matrix- examples. |
| **Inverse kinematics** | Manipulator workspace, solvability of the model, solution techniques, closed form solution and guidelines- examples |
| **UNIT - II** | |
| **Robotic dynamics** | Inertia properties, Euler- Lagrange formulation, Newton- Euler formulation, recursive Newton- Euler algorithm, dynamic recursive modelling, analytical expressions, recursive inverse dynamics of robo analyzer, recursive forward dynamics |
| **UNIT – III** | |
| **Linear control** | Control techniques, dynamic systems, transfer function and state space representation, robotic joint, performance and stability of feedback control, PID control of moving block, Selection of PID controller gains, State feedback control, Joint controllers. |
| **UNIT - IV** | |
| **Nonlinear and force controls** | Control of moving block, multivariable control, stability of multi Degree of Freedom (DOF) robot, linearized control, PD position control, inverse dynamics control, feedforward control, robust control, adaptive control, Cartesian control, force control, hybrid control. |
| **UNIT - V** | |
| **Robot motion planning** | Introduction, motion planning scheme, drawbacks of traditional methods robot motion planning. |
| **Robot programming** | Methods to programme the robot's work cycle, robot programming languages, requirements, and problems associated with programming languages, computer control and robot software, comparison of various existing robot control languages. |

**Text Books**


1. Saha S, “Introduction to Robotics”, MGH, 2nd Ed.
2. R. K. Rajput, “Robotics And Industrial Automation”, S. Chand, 2nd Ed.
3. S.R.Deb, Sankha Deb, “Robotics Technology and Flexible Automation”, MGH, 2017.
4. Ramachandran nagarajan, “Introduction to industrial robotics”, pearson India education services, 2016.


**Reference Books :**


1. D. K. Pratihar, “Fundamentals of robotics”, Narosa publishing house pvt Limited, 2017.
2. RK Mittal, IJ Nagrath, “Robotics and control”, McGraw Hill Education, 2003.


**Web References:**

1. Stanford Onlinehttps://online.stanford.edu
2. Learn Robotics with Online Courses, Classes, & Lessons | edX https://www.edx.org

**Question Paper Pattern:**

**Sessional Exam**

The question paper for sessional examination shall consist of **Six** questions for 7.5 marks each and the student has to answer any **Four** questions.

**End Exam**

The question paper for end examination shall consist of **Eight** questions for 12 marks each and the student shall answer any **Five** questions.

## INDUSTRIAL AUTOMATION LABORATORY (IA (P))

| II Semester : Automation and Robotics | | | | | Scheme : 2022 | | |
|---|---|---|---|---|---|---|---|
| Course Code | Hours/Week | | | Credits | Maximum Marks | | |
| EE859 | L | T | P | C | Continuous Internal Assessment | End Exam | TOTAL |
| | - | - | 3 | 2 | 40 | 60 | 100 |

**End Exam Duration: 3 Hrs**

**Course Outcomes :** At the end of the course students will be able to

**CO1:** Understand automation systems and symbols

**CO2:** Understand PLC based DOL, RDOL and Star Delta starting of Induction motor

**CO3:** Understand sensor based starting of Induction motor

**CO4:** Understand PLC based DC motor control

**CO5:** Understand PLC based Pneumatic and special machines control

**List of Experiments**

Note : At least 8 of the following experiments shall be conducted

1. Study of automation systems and symbols
2. Direct online (DOL) and Reverse Direct online (RDOL) starting of Induction motor
3. PLC based DOL and RDOL starting of Induction motor
4. PLC based Star Delta starting of an induction motor
5. Sensor based Star Delta starting of an induction motor
6. Sensor based DOL and RDOL starting of Induction motor
7. PLC based speed control of DC Motor
8. PLC based Pneumatic machine control
9. PLC based Servo motor control
10. PLC based Stepper Motor control

## ROBOTICS LABORATORY (ROB (P))

| II Semester : Automation and Robotics | | | | | | Scheme : 2022 | | |
|---|---|---|---|---|---|---|---|---|
| Course Code | Category | Hours/Week | | | Credits | Maximum Marks | | |
| EE860 | Professional Core | L | T | P | C | Continuous Internal Assessment | End Exam | Total |
| | | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| | | | | | | End Exam Duration: 3 Hrs | | |

**Course Outcomes :** At the end of the course the student will be able to

**CO1:** Understand configuration of GPIO, serial ports, ADC and DAC for Fire Bird V

**CO2:** Understand configuration of GPIO, serial ports, ADC and DAC for Spark V.

**CO3:** Understand interfacing of sensors, and activators with Fire Bird V

**CO4:** Understand interfacing of sensors, and activators with Spark V

**List of Experiments**

Note : At least 8 of the following experiments shall be conducted

1. Configure the buzzer to Fire Bird V robot with given delay.
2. Interface the LCD of Fire Bird V robot.
3. Configure the ADC sensor to Fire Bird V robot to display the sensor output values on LCD.
4. Configure the acceleration sensor to Fire Bird V robot for simple motion control.
5. Adaptive Cruise Control of Fire Bird V robot.
6. Control the velocity of Fire Bird V robot Using PWM.
7. Configure Fire Bird V robot to track the white line.
8. Configure the buzzer to Spark V robot with given delay.
9. Configure the acceleration sensor to Spark V robot for simple motion control.
10. Control the velocity of Spark V robot Using PWM.

**List of Professional Elective Courses**

| Description | Course Code | Subject Title |
|---|---|---|
| PE-I | EE861 | (i) Measurement Techniques, Transducers and Sensors |
| | EE862 | (ii) Power Electronics and Drives |
| | EE863 | (iii) Neural Networks and Fuzzy Logic |
| PE-II | EE864 | (i) Mobile and Autonomous Robotics |
| | EE865 | (ii) Mechatronics |
| | EE866 | (iii) Internet of Things |
| PE-III | EE867 | (i) Process Control and Instrumentation |
| | EE868 | (ii) Industry 4.0 |
| | EE869 | (iii) Digital Signal Processing |
| PE-IV | EE870 | (i) Machine Learning |
| | EE871 | (ii) Digital Control Systems |
| | EE872 | (iii) Digital Image Processing |

## MEASUREMENT TECHNIQUES, TRANSDUCERS AND SNNENSORS (MTTS)

| I Semester : Automation and Robotics | | | | | Scheme : 2022 | | | |
|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Category** | **Hours/Week** | | | **Credits** | **Maximum Marks** | | |
| | | **L** | **T** | **P** | **C** | **Continuous Internal Assessment** | **End Exam** | **TOTAL** |
| **EE861** | **Professional Elective - I** | **3** | **0** | **0** | **3** | **40** | **60** | **100** |
| **Sessional Exam Duration : 2 Hrs** | | | | | **End Exam Duration: 3 Hrs** | | | |

**Course Outcomes :** At the end of the course the student will be able to

**CO1:** Understand the basic concepts of measuring electrical parameters

**CO2:** Understand the measurement techniques of resistance, inductance and capacitance

**CO3:** Understand the operation of inductive , capacitive, optical sensors and limit switches

**CO4:** Understand the operation of Laser, Ultrasonic, Radar type Sensors for distance and level measurement

**CO5:** Understand the operation of various feedback sensors

| | |
|---|---|
| **UNIT – I** | |
| **Measurement of electrical parameters** | Method of measuring voltage using PTs, Method of measuring current using CTs, Interposing CTs, Shunt and Hall effect sensor. Advantages/Disadvantages of CTs over shunts. True RMS voltmeter, simple methods of measurement of power in DC and AC systems. Method of electrical isolation. Voltage and current transducers. |
| **UNIT – II** | |
| **Measurement of Resistance, Inductance and capacitance** | Wheatstone bridge-sensitivity analysis, limitations, kelvin's double bridge, Maxwells bridge, schering Bridge, source and detectors, minimization of AC bridge errors, problems. |
| **UNIT – III** | |
| **Inductive, capacitive, optical Sensors and limit switches** | Inductive proximity sensors and its working principle. Different types like flush, non flush, ring type. Various industry applications (like end travel sensing, metal sensing). Capacitive type proximity sensors and its working principle, various industry applications (like rice mill etc.,) Limit switches and its industry applications (like dead stop). Photo sensors (diffused beam, through beam, slotted sensor) working principle and industry application. |
| **UNIT – IV** | |
| **Laser, Ultrasonic, Radar type Sensors for distance and level measurement** | Ultrasonic sensor for distance and level measurement (ON/OFF type, Analog type). Laser and Radar sensor for distance and level measurement with its industrial use application. Advantage and disadvantages. Conventional conductive sensor used in water tanks for level measurement. Light curtains for industrial safety. Touch and color sensors and its working principles and industrial applications. |
| **UNIT – V** | |
| **Feedback Transducers** | Introduction, feedback fundamentals, inverse transducers, temperature balance systems, self balancing potentiometers and bridges, heat flow and beam balance systems, Servo operated manometer and electromagnetic flow meter, feedback pneumatic load cell and accelerometer systems, Automatic measurement of dew point, non contact position measurement, bimorph position control system and integrating servo. |

**Text Books :**


1. E.W.Golding and F.C.Widdis, "Electrical Measurements and measuring Instruments", Wheeler Publishers
2. A.K.Sawhney, "Electrical & Electronic Measurement & Instruments", Dhanpat Rai & Co. Publishers
3. J. B. Gupta: "A Course in Electrical and Electronic Measurements and Instrumentation", S.K. Kataria & Sons
4. DVS Murthy, Transducers and Instrumentation PHI publications


**Reference Books :**

| |
|---|
| 1. Buckingham and Price, “Electrical Measurements”, Prentice – Hall |
| 2. Reissland, M.U, “Electrical Measurements: Fundamentals, Concepts, Applications”, New Age International (P) Limited Publishers |
| 3. H.S.Kalsi, “Electronic Instrumentation”, Tata MCGraw-Hill Edition |
| **Web References:** |
| 1 https://archive.nptel.ac.in/courses/108/108/108108147/ |
| 2.https://www.researchgate.net/publication/329682377_Measurement_techniques_Sensors_and_transducers |
| 3. https://gmw.com/transducers/ |
| **Question Paper Pattern:** |
| **Sessional Exam**<br>The question paper for sessional examination shall consist of **Six** questions for 7.5 marks each and the student has to answer any **Four** questions.<br><br>**End Exam**<br>The question paper for end examination shall consist of **Eight** questions for 12 marks each and the student shall answer any **Five** questions. |

## POWER ELECTRONICS AND DRIVES (PED)

| I Semester : Automation and Robotics | | | | | Scheme : 2022 | | | |
|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Category** | **Hours/Week** | | | **Credits** | **Maximum Marks** | | |
| | | **L** | **T** | **P** | **C** | **Continuous Internal Assessment** | **End Exam** | **TOTAL** |
| **EE862** | **Professional Elective - I** | **3** | **0** | **0** | **3** | **40** | **60** | **100** |
| **Sessional Exam Duration : 2 Hrs** | | | | | **End Exam Duration: 3 Hrs** | | | |

**Course Outcomes :** At the end of the course the student will be able to

**CO1:** Understand the working and characteristics of power semi conductor devices like diode, SCR, TRIAC, MOSFET and IGBT.

**CO2:** Understand the principle of operation of AC to DC converters

**CO3:** Understand the principle of operation of DC to AC converters

**CO4:** Understand the principle of operation of AC to AC and DC to DC converters

**CO5:** Understand the performance of converter controlled DC motors and AC motors

**CO6** : Understand the performance of converter controlled special machines

| | |
|---|---|
| **UNIT – I** | |
| **Basics of Power Electronics** | Concept of power electronics, Power Semiconductor Switches (Diodes, SCR, TRIAC, BJT, MOSFET and IGBT), types of power converters, Realisation of semi conductor devices as switches. 1-phase and 3-phase AC to DC converters. |
| **UNIT – II** | |
| **Converters-I** | DC to AC converters, 1-phase and 3-phase VSI, 1-phase CSI, PWM techniques for inverters, UPS. |
| **UNIT – III** | |
| **Converters-II** | DC to DC to converters (step up and step down converters), AC to AC converters, Switch Mode power supply. |
| **UNIT – IV** | |
| **Conventional Drives** | Converter controlled separately excited DC Motor Drives, Converter controlled induction motor drives. Self controlled synchronous motor drives. |
| **UNIT – V** | |
| **Special machine Drives** | Principle, operation, converters and control techniques for BLDC, stepper, Switched Reluctance and servo motor drives. |

**Text Books :**


1. M.H. Rasheed, “Power Electronics Circuits Devices and Applications”, 3rd Edition, PHI publishers. 2004
2. P.S. Bimbhra , “Power Electronics”, 4th Edition, Khanna publishers. 2010
3. G.K. Dubey, “Fundamentals of Electrical drives” 2 nd Edition, Narosa Publishers. 2001.


**Reference Books :**


1. Ashfaq Ahmed, “Power Electronics for Technology” First Indian Reprint, Pearson Education
2. M.D. Singh and K.B. Khanchandani, “Power Electronics”, 2nd Edition, Tata McGraw Hill Publishers. 2002.


**Web References:**

1. https://nptel.ac.in/downloads/108105066/
2. https://nptel.ac.in/courses/108101126/
3. https://www.youtube.com/watch?v=Coy-WRCfems

**Question Paper Pattern:**

**Sessional Exam**

The question paper for sessional examination shall consist of **Six** questions for 7.5 marks each and the student has to answer any **Four** questions.

**End Exam**

The question paper for end examination shall consist of **Eight** questions for 12 marks each and the student shall answer any **Five** questions.

## NEURAL NETWORKS AND FUZZY LOGIC (NNFL)

| I Semester : Automation and Robotics | | | | | Scheme : 2022 | | | |
|---|---|---|---|---|---|---|---|---|
| Course Code | Category | Hours/Week | | | Credits | Maximum Marks | | |
| | | L | T | P | C | Continuous Internal Assessment | End Exam | TOTAL |
| EE863 | Professional Elective - I | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| Sessional Exam Duration : 2 Hrs | | | | | End Exam Duration: 3 Hrs | | | |

**Course Outcomes :** At the end of the course the student will be able to

**CO1:** Understand the basic concepts of Neural networks

**CO2:** Analyze Supervised Learning feedback networks

**CO3:** Analyze Unsupervised Learning feedback networks.

**CO4:** Understand concepts of Fuzzy logic and Fuzzy set theory

**CO5:** Apply the knowledge of Neural Networks and Fuzzy logic to real time systems.

### UNIT – I

**Introduction to Neural Networks and its Basic Concepts**

Biological neurons and McCulloch and Pitts models of neuron, Types of activation functions, Neural networks architectures, Linearly separable and linearly non-separable systems and their examples, Features and advantages of neural networks over statistical techniques, Knowledge representation, learning process, error-correction learning, concepts of supervised, learning, and unsupervised learning..

### UNIT – II

**Supervised Learning Neural Networks**

Single layer perceptron and multilayer perceptron neural networks, their architecture, Back propagation algorithm, generalized delta rule, learning factors, step learning, Momentum learning, Concept of training, testing and cross-validation data sets for design and validation of the Networks

### UNIT – III

**Unsupervised Learning Neural Networks**

Competitive Learning networks, kohenen self-organizing networks, K-means and LMS algorithms, RBF neural network and its structure, Hybrid training algorithm for RBF neural networks, Comparison of RBF and MLP networks Learning, Hebbian learning, Hopfield networks.

### UNIT – IV

**Fuzzy logic**

Basic Fuzzy logic theory, sets and their properties, Operations on fuzzy set, Fuzzy relation and operations on fuzzy relations and extension principle, Fuzzy membership functions and linguistic variables, Fuzzy rules and fuzzy reasoning, Fuzzification and defuzzification and their methods, Fuzzy inference systems

### UNIT – V

**Applications of Neural Networks & Fuzzy systems**

Applications of Neural Networks: Pattern classification, Handwritten character recognition, Face recognition.

**Applications of Fuzzy Logic & Fuzzy System:** Fuzzy pattern recognition, Fuzzy image processing, Simple applications of Fuzzy controllers, Traffic regulations, and Lift control

**Text Books :**


1. Timothy J. Ross, Fuzzy Logic with Engineering Applications, John Wiley and sons, 3/e, 2010.
2. S. Haykin, Neural Networks, A Comprehensive Foundation, Pearson Education Inc.3/e, 2008.
3. Jacek. M. Zurada, -Introduction to Artificial Neural Systems, Jaico Publishing House, 2006.
4. LaureneFausett, Fundamentals of Neural Networks-Architectures, algorithms and applications, Pearson Education Inc., 2004.
5. J.S.R. Jang, C.T. Sun, E. Mizutani,, -Neuro Fuzzy and Soft Computing - A computational Approach to Learning and Machine Intelligence, Pearson Education Inc., 2002.
6. Bart Kosko, Neural networks and Fuzzy Systems, Pearson Education


**Reference Books :**


1. S. Rajsekaran and G. A. VijaylakshmiPai, ―Neural Networks, Fuzzy Logic, andGenetic Algorithms,PHI

2. N. Sivanandam, S. Sumathi, and S. N. Deepa, ―Introduction to Neural NetworkUsing MATLAB, Tata McGraw-HillPublications

3. S.N.Sivanandam. M.PaulRaj, - Introduction to Artificail Neural Networks, VikasPublicationHouse Pvt.Ltd, NewDelhi.

4. T.Pradeep, Nano: The Essentials Understanding Nano Science and Nano Technology, Tata McGraw Hill, 2013.

5. Richard Booker and earl Boyson, Nanotechnology: The Fun and Easy Way to Explore the Science of Matters Smallest Particle, Wiley Publications, 2011.

**Question Paper Pattern:**

**Sessional Exam**

The question paper for sessional examination shall consist of **Six** questions for 7.5 marks each and the student has to answer any **Four** questions.

**End Exam**

The question paper for end examination shall consist of **Eight** questions for 12 marks each and the student shall answer any **Five** questions.

# MOBILE AND AUTONOMOUS ROBOTICS (MAR)

| II Semester : Automation and Robotics | | | | | | Scheme : 2022 | | |
|---|---|---|---|---|---|---|---|---|
| Course Code | Category | Hours/Week | | | Credits | Maximum Marks | | |
| EE864 | Professional Elective - II | L | T | P | C | Continuous Internal Assessment | End Exam | Total |
| | | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| Sessional Exam Duration : | | | | | | End Exam Duration: 3 Hrs | | |

**Course Outcomes :** At the end of the course the student will be able to

**CO1:** Understand basics of mobile robots.

**CO2**: Understand the kinematics and its models in mobile robots

**CO3:** Understand architecture, learning and perception.

**CO4:** Understand localization, planning and navigation of robots.

**CO5:** Understand functionality of camera systems and image processing.

| | |
|---|---|
| **UNIT – I** | |
| **Introduction of Mobile Robotics** | Mechanics and Locomotion: A brief history of mobile robotics, applications and market. Recent advances in the mobile robotics for RISE (Risky Intervention and Surveillance Environment) applications, Locomotion, Key issues in locomotion, legged, wheeled and aerial mobile robots. |
| **UNIT - II** | |
| **Mobile Robot Kinematics** | Introduction, kinematic models and constrains, mobile robot workspace, beyond basic kinematics, motion control (kinematic control). |
| **UNIT – III** | |
| **Perception, robotics architectures and Robot Learning** | Sensors Classification, sensor characterization, wheel/motor encoders, heading/orientation sensors, ground based beacons, active ranging, motion/speed sensors, vision based sensors. Low level control, Control architectures, software frameworks, Robot Learning, case studies of learning robots. |
| **UNIT - IV** | |
| **Mobile Robot Localization** | Introduction, the challenge of localization: Noise and aliasing, to localize or not to localize: localization based navigation versus programmed solutions, map representation, probabilistic map, map based localization, autonomous map building. |
| **Planning and navigation** | Planning and reaction, obstacle avoidance, D* algorithm, Navigation Architecture, case studies. |
| **UNIT - V** | |
| **Introduction to image processing** | Introduction to computer vision, Image processing: Point operators, Linear Filters, More neighbourhood operators, Fourier transforms, Pyramids and wavelets, Geometric transformations. |
| **Camera Systems in Machine** | Camera Technology, History in Brief, Machine Vision versus closed Circuit Television (CCTV), Sensor Technologies, spatial Differentiation: 1D and 2D, CCD Technology, Full Frame Principle, Frame Transfer Principle, Interline Transfer, Interlaced Scan Interline Transfer, Frame Readout. |

**Text Books**


1. Roland Siegwart & Illah R. Nourbakhsh, “Introduction to autonomous mobile robots”, Prentice Hall of India, 2004.
2. George A. Bekey “Autonomous Robots” MIT Press.
3. Howie Choset, Kevin M. Lynch, Seth Hutchinson, George A. Kantor, Wolfram Burgard, Lydia E. Kavrakiand Sebastian Thrun, "Principles of Robot motion: Theory, Algorithm and Implementations", MIT Press.


**Reference Books**


1. Richard Szeliski: “Computer Vision: Algorithms and Applications”, 2010 Springer.
2. Alexander Hornberg: “Handbook of Machine Vision”, Wiley-VCH.


**Web References:**

1. Stanford Onlinehttps://online.stanford.edu

2. Learn Robotics with Online Courses, Classes, & Lessons | edX https://www.edx.org

**Question Paper Pattern:**

**Sessional Exam**

The question paper for sessional examination shall consist of **Six** questions for 7.5 marks each and the student has to answer any **Four** questions.

**End Exam**

The question paper for end examination shall consist of **Eight** questions for 12 marks each and the student shall answer any **Five** questions.

## MECHATRONICS (MCT)

| II Semester : Automation and Robotics | | | | | | Scheme : 2022 | | |
|---|---|---|---|---|---|---|---|---|
| Course Code | Category | Hours/Week | | | Credits | Maximum Marks | | |
| | | L | T | P | C | Continuous Internal Assessment | End Exam | Total |
| EE865 | Professional Elective - II | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| Sessional Exam Duration : | | | | | | End Exam Duration: 3 Hrs | | |

**Course Outcomes :** At the end of the course the student will be able to

**CO1:** Understand the Mechatronics systems and Process used for industrial automation.

**CO2:** Understand the concept of electronic devices used for industrial automation.

**CO3:** Understand the concept of electrical drive used for industrial automation.

**CO4:** Understand the concept of hydraulics and Pneumatics system used for industrial automation.

**CO5:** Understand the concept of PID control, CNC machines and Part programming.

| | |
|---|---|
| **UNIT – I** | |
| **Introduction to Mechatronics** | Definition of Mechatronics, Mechatronics in manufacturing, Products, and design. Comparison between Traditional and Mechatronics approach. |
| **UNIT - II** | |
| **Electronics and Controllers** | Review of fundamentals of electronics. Data conversion devices, sensors, microsensors, transducers, signal processing devices, relays, contactors and timers. Microprocessors controllers and PLCs. |
| **UNIT – III** | |
| **Electrical and Mechanical Drives** | Stepper motors, servo drives. Ball screws, linear motion bearings, cams, systems controlled by camshafts, electronic cams, indexing mechanisms, tool magazines, and transfer systems. |
| **UNIT - IV** | |
| **Hydraulic systems** | Flow, pressure and direction control valves, actuators, and supporting elements, hydraulic power packs, and pumps. Design of hydraulic circuits. |
| **Pneumatics** | Production, distribution and conditioning of compressed air, system components and graphic representations, design of systems. |
| **UNIT - V** | |
| **CNC and Part Programming** | Description of PID controllers. CNC machines and part programming. Industrial Robotics. |

**Text Books**

1. HMT ltd. Mechatronics, Tata Mcgraw-Hill, New Delhi, 1988.
2. G.W. Kurtz, J.K. Schueller, P.W. Claar . II, "Machine design for mobile and industrial applications", SAE, 1994.

**Reference Books**

1. R. Iserman, "Mechatronic Systems: Fundamentals", Springer, 1st Edition, 2005
2. Musa Jouaneh, "Fundamentals of Mechatronics", 1st Edition, Cengage Learning, 2012.

**Web References:**

1. https://www.edx.org/course/mechatronics
2. https://www.udemy.com/course/robotics-and-mechatronics-a-basic-guide-to-begin-with/

**Question Paper Pattern:**

**Sessional Exam**

The question paper for sessional examination shall consist of **Six** questions for 7.5 marks each and the student has to answer any **Four** questions.

**End Exam**

The question paper for end examination shall consist of **Eight** questions for 12 marks each and the student shall answer any **Five** questions.

# INTERNET OF THINGS (IoT)

| II Semester : Automation and Robotics | | | | | | Scheme : 2022 | | |
|---|---|---|---|---|---|---|---|---|
| Course Code | Category | Hours/Week | | | Credits | Maximum Marks | | |
| EE866 | Professional Elective - II | L | T | P | C | Continuous Internal Assessment | End Exam | Total |
| | | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| Sessional Exam Duration : | | | | | | End Exam Duration: 3 Hrs | | |

**Course Outcomes :** At the end of the course the student will be able to

**CO1:** Understand the characteristics, terminology in IoT like, physical and logical design, functional, Communication models and IoT Levels,

**CO2:** Understand working of software define network, concept of Machine to Machine

**CO3:** Understand the domain specific applications in IoT

**CO4:** Understand the Industrial Networks and IIoT.

**CO5:** Understand Automation Trends in Industrial Networks and IIoT

| UNIT – I | |
|---|---|
| **Introduction to IoT** | Introduction to IoT, Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs., IoT Levels |
| **UNIT - II** | |
| **IoT & Machine to Machine** | Machine to Machine, Difference between IoT and M2M, Software define Network. Network Function Virtualization. |
| **UNIT – III** | |
| **Domain specific applications of IoT** | Home automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry Health and Life style |
| **UNIT - IV** | |
| **Industrial Networks and IoT** | Introduction, Challenges in Industrial Networks, Future Trends in Industrial Networks, Enabling Technologies for Industrial Networks. |
| **UNIT - V** | |
| **Automation Trends in Industries** | Introduction, Industrial Revolutions, Enabling Technologies for New Productive Model, Automation Network in Smart Industries. |

**Text Books**


1. Vijay Madisetti, ArshdeepBahga, “Internet of Things: A Hands-On Approach”, VPT; 1 edition.
2. Ismail Butun "Industrial IoT Challenges, Design Principles, Applications, and Security", Springer Nature Switzerland AG, 2020.
3. Anand Sharma, Sunil Kumar Jangir, Manish Kumar, Dilip Kumar Choubey, Tarun Shrivastava,S. Balamurugan, "Industrial Internet of Things Technologies and Research Directions", CRC, Taylor & Francis Group, LLC, 2020


**Reference Books**


1. A. Suresh, Malarvizhi Nandagopal, Pethuru Raj, E. A. Neeba, Jenn-Wei Lin, "Industrial IoT Application Architectures and Use Cases", CRC Press, Taylor & Francis Group, 2020


**Web References:**

1. https://www.electricaltechnology.org/2016/07/internet-of-things-iot-and-its-applications-in-electrical-power-industry.html
2. http://www.nptelvideos.in/2012/11/internet-technologies.html

**Question Paper Pattern:**

**Sessional Exam**

The question paper for sessional examination shall consist of **Six** questions for 7.5 marks each and the student has to answer any **Four** questions.

**End Exam**

The question paper for end examination shall consist of **Eight** questions for 12 marks each and the student shall answer any **Five** questions.

## PROCESS CONTROL AND INSTRUMENTATION (PCI)

| II Semester : Automation and Robotics | | | | | Scheme : 2022 | | | |
|---|---|---|---|---|---|---|---|---|
| Course Code | Category | Hours/Week | | | Credits | Maximum Marks | | |
| EE867 | Professional Elective - III | L | T | P | C | Continuous Internal Assessment | End Exam | TOTAL |
| | | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| Sessional Exam Duration : 2 Hrs | | | | | End Exam Duration: 3 Hrs | | | |

**Course Outcomes :** At the end of the course the student will be able to

**CO1:** Understand the concepts of performance characteristics of sensors

**CO2:** Understand the concepts and techniques of pressure measurements

**CO3:** Understand the concepts and techniques of flow measurement using sensors

**CO4:** Understand the techniques of temperature measurements

**CO5:** Understand the techniques of liquid level measurements

| UNIT – I | |
|---|---|
| **Performance characteristics** | True Value, Errors (Gross, Systematic, Random); Static Characteristic of Instruments (Accuracy, Precision, Sensitivity, Resolution & threshold); Error Analysis-Simple problems; Statistical treatment of data-Simple problems. |
| **UNIT – II** | |
| **Pressure Measurement** | Definition and Various Units of Pressure. Various Methods of Pressure Measurement. Manometers. Electric types:- bellows, diaphragm. Electrical types:-LVDT, Using resistance, Strain gauge, capacitance type pressure gauge. Vacuum Measurement: Mechanical type:-Mcleod gauge. Electrical type:- Thermal (Pirani gauge) |
| **UNIT – III** | |
| **Flow Measurement** | Head Type Measurement: (a) Basic concept (Principle) (b) Various measuring elements (orifice, Venturi, pilot tube, flow nozzle). Area type flow meters: (a) Principle (b) Rota meter. Variable area piston type. Types of flow meters. Flow meter of Mass flow meter. Electromagnet of flow meter. Ultrasonic of flow meter. |
| **UNIT – IV** | |
| **Temperature measurement and transducers** | Methods of temperature measurement using RTD and its characteristics. Methods of temperature measurement using Thermocouple and thermistors and its characteristics. Thermal expansions in solids, and bimetallic thermal strip activated relay for electrical protection. (like Over load relay, MCB). Temperature transducers and its characteristics. |
| **UNIT – V** | |
| **Liquid Level Measurement** | Mechanical type (Flow Type). Hydrostatic types (Air purge systems). Electrical Methods of level Measurement. Ultrasonic Methods |

**Text Books :**


1. E.W.Golding and F.C.Widdis, “Electrical Measurements and measuring Instruments”, Wheeler Publishers
2. Curtis D. Johnson "Process Instrumentation and Control" Pearson Publishers
3. A.K.Sawhney, “Electrical & Electronic Measurement & Instruments”, Dhanpat Rai & Co. Publishers
4. Vishnu Priye Janardan Prasad, M.N. Jayaswal, “Instrumentation and Process Control” Wiley publishers


**Reference Books :**


1. Buckingham and Price, “Electrical Measurements”, Prentice – Hall
2. Reissland, M.U, “Electrical Measurements: Fundamentals, Concepts, Applications”, New Age International (P) Limited Publishers
3. H.S.Kalsi, “Electronic Instrumentation”, Tata MCGraw-Hill Edition
4. T. R. Padmanabhan, ―Industrial Instrumentation – Principles and Design‖, Springer


**Web References:**

| |
|---|
| 1 https://nptel.ac.in/courses/103103037 |
| 2. https://instrumentationtools.com/process-control-instrumentation/ |
| 3. http://www.pc-education.mcmaster.ca/Instrumentation/go_inst.htm |
| **Question Paper Pattern:** |
| **Sessional Exam**<br>The question paper for sessional examination shall consist of **Six** questions for 7.5 marks each and the student has to answer any **Four** questions.<br><br>**End Exam**<br>The question paper for end examination shall consist of **Eight** questions for 12 marks each and the student shall answer any **Five** questions. |

## INDUSTRY 4.O (I4O)

| II Semester : Automation and Robotics | | | | | Scheme : 2022 | | | |
|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Category** | **Hours/Week** | | | **Credits** | **Maximum Marks** | | |
| | | **L** | **T** | **P** | **C** | **Continuous Internal Assessment** | **End Exam** | **Total** |
| **EE868** | **Professional Elective - III** | **3** | **0** | **0** | **3** | **40** | **60** | **100** |
| **Sessional Exam Duration :** | | | | | **End Exam Duration: 3 Hrs** | | | |

**Course Outcomes :** At the end of the course the student will be able to

**CO1:** Understand the Characteristics, Sensors, Actuators and Communication models for industry 4.0.

**CO2**: Understand Fourth revolution and Industry operations.

**CO3:** Understand the Cyber-Physical Systems, Sensors, platforms of Industrial IoT.

**CO4:** Understand the Cyber security, Industrial Internet Systems.

**CO5:** Understand Business Models and Architecture, Key enablers in Industrial IoT.

| **UNIT – I** | |
|---|---|
| **Introduction to IoT, Sensing and Actuators, Communication** | Introduction, Transducer, Definition, Sensor – static and Dynamic characteristics, Types, Actuator – Features, Types, Communication protocol, Standards, Features, Variants, IoT Networking - introduction, Proprietary non-IP based solution, IP based solutions. |
| **UNIT - II** | |
| **Industry 4.0: The Fourth Revolution** | Introduction, Sustainability Assessment of Manufacturing Industry, Lean Production System, Smart and Connected Business Perspective, Smart Factories |
| **UNIT – III** | |
| **Cyber-Physical Systems, Sensors, Platforms** | Cyber-Physical Systems and Next-Generation Sensors, Collaboration Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis. |
| **UNIT - IV** | |
| **Cybersecurity, Industrial Internet Systems** | Cybersecurity – Introduction, challenges, Industrial Internet Systems, Industrial Sensing & Actuation, Industrial Processes and systems. |
| **UNIT - V** | |
| **Business Models and Architecture, Key Enablers** | Industrial Business Models, Reference Architecture for Industrial Business Models of IIoT, Key Enablers of Industrial IoT in Sensing, Key Enablers of Industrial IoT in Connectivity, Key Enablers of Industrial IoT in Connectivity. |

**Text Books**


1. Vijay Madisetti, Arshdeep Bahga, "Internet of Things: A Hands-On Approach", VPT; 1 edition.
2. Industrial IoT Challenges, Design Principles, Applications, and Security, Ismail Butun, Springer Nature Switzerland AG, 2020.
3. Industrial Internet of Things Technologies and Research Directions, Anand Sharma, Sunil Kumar Jangir, Manish Kumar, Dilip Kumar Choubey, Tarun Shrivastava,S. Balamurugan, CRC, Taylor & Francis Group, LLC, 2020.


**Reference Books**


1. Industrial IoT Application Architectures and Use Cases, A. Suresh, Malarvizhi Nandagopal, Pethuru Raj, E. A. Neeba, Jenn-Wei Lin, CRC Press, Taylor & Francis Group, 2020.
2. "Introduction to Industry 4.0 and Industrial Internet of Things", Prof. Sudip Misra, IIT kharagpur


**Web References:**

1. https://www.electricaltechnology.org/2016/07/internet-of-things-iot-and-its-applications-in-electrical-power-industry.html
2. http://www.nptelvideos.in/2012/11/internet-technologies.html

**Question Paper Pattern:**

**Sessional Exam**

The question paper for sessional examination shall consist of **Six** questions for 7.5 marks each and the student has to answer any **Four** questions.

**End Exam**

The question paper for end examination shall consist of **Eight** questions for 12 marks each and the student shall answer any **Five** questions.

## DIGITAL SIGNAL PROCESSING (DSP)

| II Semester : Automation and Robotics | | | | | Scheme : 2022 | | | |
|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Category** | **Hours/Week** | | | **Credits** | **Maximum Marks** | | |
| | | **L** | **T** | **P** | **C** | **Continuous Internal Assessment** | **End Exam** | **TOTAL** |
| **EE869** | **Professional Elective - III** | **3** | **0** | **0** | **3** | **40** | **60** | **100** |
| **Sessional Exam Duration : 2 Hrs** | | | | | **End Exam Duration: 3 Hrs** | | | |

**Course Outcomes :** At the end of the course the student will be able to

**CO1:** Understand the classification of discrete time systems, Linear constant coefficient difference equation and Discrete time Fourier transform.

**CO2:** Apply Discrete Fourier transform technique to digital signals.

**CO3:** Apply Fast Fourier transform techniques to digital signals.

**CO4:** Design of IIR &FIR digital filters.

**CO5:** Understand the realization of IIR and FIR digital filters.

**CO6:** Understand the internal architecture, addressing modes of TMS320C67XX digital signal Processor.

| | |
|---|---|
| **UNIT – I** | |
| **Introduction to Digital Signal Processing** | Discrete time signals & sequences, Static & dynamic systems, linear shift invariant systems, stability, and causality. Linear constant coefficient difference equations. Frequency domain representation of discrete time signals and systems. Discrete Time Fourier Transforms (DTFT). |
| **Discrete Fourier Transform** | Discrete Fourier Transform, Properties of DFT, Computation of DFT, linear convolution of sequences using DFT. |
| **UNIT – II** | |
| **Fast Fourier Transform** | Fast Fourier transform (FFT) - Radix-2 decimation in time and decimation in frequency FFT Algorithms, Inverse FFT, comparison of DFT and FFT computations. |
| **UNIT – III** | |
| **IIR Digital Filters** | Analog filter approximations –Design of Butter worth and Chebyshev filters, Analog-Digital transformations -Design of IIR Digital filters from analog filters. |
| **FIR Digital Filters** | Characteristics of FIR Digital Filters, frequency response. Design of FIR Digital Filters using Window Techniques, Comparison of IIR & FIR filters. |
| **UNIT – IV** | |
| **Realization Of Digital Filters** | Basic structures of IIR systems-Direct form I & II, Cascade, parallel forms. Basic structures of FIR systems. |
| **UNIT – V** | |
| **Architecture of TMS 320C67XX** | Introduction to DSP processor, Internal architecture, addressing modes, peripherals. |

**Text Books :**


1. John G. Proakis, Dimitris G. Manolakis , “Digital Signal Processing, Principles, Algorithms, and Applications”, Pearson Education / PHI. 2007.
2. A.V.Oppenheim and R.W. Schaffer, “Discrete Time Signal Processing”, PHI.
3. . B.Venkataramani, M. Bhaskar , “Digital Signal Processors – Architecture, Programming and Applications”, TATA McGraw Hill. 2002.
4. Emmanuel C.Ifearchar, Barrie W.Jervis, “DSP A Practical Approach”, Pearson Ed.


**Reference Books :**


1. Andreas Antoniou , “Digital Signal Processing”, TATA McGraw Hill. 2006
2. Robert J. Schilling, Sandra L. Harris, “Fundamentals of Digital Signal Processing using Matlab”, Thomson,. 2007.
3. C. Britton Rorabaugh, "DSP Primer”, Tata McGraw Hill, 2005.


**Web References:**

1. https://nptel.ac.in/courses/nptel_download.php?subjectid=117102060
2. https://lecturenotes.in/subject/44/digital-signal-processing-dsp

3. https://www.dspguide.com/ch28/1.htm

**Question Paper Pattern:**

**Sessional Exam**

The question paper for sessional examination shall consist of **Six** questions for 7.5 marks each and the student has to answer any **Four** questions.

**End Exam**

The question paper for end examination shall consist of **Eight** questions for 12 marks each and the student shall answer any **Five** questions.

## MACHINE LEARNING (ML)

| II Semester : Automation and Robotics | | | | | Scheme : 2022 | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **Category** | **Hours/Week** | | | **Credits** | **Maximum Marks** | |
| | | **L** | **T** | **P** | **C** | **Continuous Internal Assessment** | **End Exam** | **Total** |
| **EE870** | **Professional Elective - IV** | **3** | **0** | **0** | **3** | **40** | **60** | **100** |
| **Sessional Exam Duration : 2 Hrs** | | | | | **End Exam Duration: 3 Hrs** | | |

**Course Outcomes :** At the end of the course the student will be able to

**CO1:** Understand basic concepts of machine learning

**CO2**: Understand basic supervised learning algorithms

**CO3:** Understand advanced supervised learning algorithms

**CO4:** Compare the learning methodologies and dimensionality concepts

**CO5:** Understand the applications of supervised learning techniques.

| | |
|---|---|
| **UNIT – I** | |
| **Introduction to Machine Learning** | Machine learning, Varieties of Machine learning, Learning Input, Output functions: Types of learning, Input Vectors, Outputs, Training regimes, Noise, Performance Evaluation. |
| **UNIT - II** | |
| **Foundations of Supervised Learning** | Decision trees and inductive bias, Geometry and nearest neighbours, Logistic regression, Perceptron, Binary classification. |
| **UNIT – III** | |
| **Advanced Supervised Learning** | Linear models and gradient descent, Support Vector machines, Naïve Bayes models and probabilistic modelling, Model selection and feature selection, Model Complexity and Regularization. |
| **UNIT - IV** | |
| **Unsupervised Learning** | Curse of dimensionality, Dimensionality Reduction, PCA, Clustering, K-means, Expectation Maximization Algorithm, Mixtures of latent variable models, Supervised learning after clustering, Hierarchical clustering |
| **UNIT - V** | |
| **Case Studies** | Line following using Supervised Learning techniques, A simulation model for understanding both regression and classification techniques, Study of the effectiveness of the Bias-variance. |

**Text Books**

1. Michalski, Carbonell, Tom Mitchell, 'Machine Learning', Springer, 2014
2. Peter Flach, 'Machine Learning: The Art and Science of Algorithms that make sense of data', Cambridge, 2014.

**Reference Books**

1. Hal Daume III, 'A Course in Machine Learning', Todo, 2015.
2. David MacKay, 'Information Theory, Inference and Learning Algorithms', Cambridge, 2003
3. Bruno Apolloni, Ashish Ghosh, Ferda Alpasian, "Machine Learning and Robot Perception", Springer, 2005
4. Ethem Alpaydin, "Introduction to Machine Learning', The MIT Press, 2004
5. Judy Franklin, Tom Mitchell, Sebastin Thrun, "Recent Advances in Robot Learning: Machine Learning", Springer, 2012

**Web References:**

1. https://www.geeksforgeeks.org/machine-learning/
2. https://ml-ops.org/content/references.html
3. https://www.techtarget.com/searchenterpriseai/definition/machine-learning-ML

**Question Paper Pattern:**

**Sessional Exam**

The question paper for sessional examination shall consist of **Six** questions for 7.5 marks each and the

student has to answer any **Four** questions.

**End Exam**

The question paper for end examination shall consist of **Eight** questions for 12 marks each and the student shall answer any **Five** questions.

# DIGITAL CONTROL SYSTEMS (DCS)

| II Semester : Automation and Robotics | | | | | | Scheme : 2022 | | |
|---|---|---|---|---|---|---|---|---|
| Course Code | Category | Hours/Week | | | Credits | Maximum Marks | | |
| EE871 | Professional Elective - IV | L | T | P | C | Continuous Internal Assessment | End Exam | Total |
| | | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| Sessional Exam Duration : 2 Hrs | | | | | | End Exam Duration: 3 Hrs | | |

**Course Outcomes :** At the end of the course the student will be able to

**CO1:** Understand discrete representation of LTI systems and basics of Z- Transforms.

**CO2:** Understand state space representation of discrete time systems.

**CO3:** Analyze stability of open loop and closed loop discrete-time systems.

**CO4:** Understand time domain analysis discrete time system.

**CO5:** Design of pole placement dead beat response and state observers.

| UNIT – I | |
|---|---|
| **Introduction to Digital Control Systems** | Basics of Digital Control Systems, Discrete representation of continuous systems, sample and hold circuit. Mathematical Modeling of sample and hold circuit. Block diagram of typical digital control system - advantages of sampling in control systems - examples of discrete data and digital control systems - reconstruction of sampled signals, ZOH. |
| **Z-Transforms** | Definition and evaluation of Z-transforms, inverse Z-transform, theorems of Z-transforms - limitation of Z-transform, pulse transfer function, pulse transfer function of closed loop systems. Mapping from s-plane to z plane. |
| **UNIT - II** | |
| **State Space Analysis** | State space modeling of digital systems with sample and hold - state transition equation of digital time in variant systems - solution of time in variant discrete state equation by the Z-transformation - transfer function from the state model, Eigen values, Eigen vectors and diagonalisation of the A-matrix, Jordan canonical form, computation of state transition matrix. |
| **UNIT – III** | |
| **Stability** | Definition of stability, stability tests, Stability analysis using bilinear transformation. Stability analysis by Jury test, Liapunov stability analysis, the second method of Liapunov.. |
| **UNIT - IV** | |
| **Time Domain Analysis** | Time response of discrete time system.Comparison of time responses of continuous data and digital control systems - correlation between time response and root locus in the s-plane and z-plane - root loci for digital control systems - steady state error analysis of digital control systems. |
| **UNIT - V** | |
| **Design of PID Controller, Dead Beat Response** | Theorems on controllability - theorems on observability (time invariant systems) Digital PID controller - pole placement through state feedback, Dead Beat Response**,** Practical issues with dead beat response design, Full order state observer. |

**Text Books**


1. B. C. Kuo, “Digital Control Systems”, Oxford University Press, USA, 2nd edition, 1995
2. M. Gopal, “Digital Control Engineering”, Wiley Eastern, 1988.


**Reference Books**


1. G. F. Franklin, J. D. Powell and M. L. Workman, “Digital Control of Dynamic Systems”, 3 rd Edition Addison-Wesley, 1998.
2. K. Ogata, “Modern Control Engineering”, Prentice Hall, 5th edition, 2010


**Web References:**

1. https://nptel.ac.in/courses/108/103/108103008

**Question Paper Pattern:**

**Sessional Exam**

The question paper for sessional examination shall consist of **Six** questions for 7.5 marks each and the student has to answer any **Four** questions.

**End Exam**

The question paper for end examination shall consist of **Eight** questions for 12 marks each and the student shall answer any **Five** questions.

## DIGITAL IMAGE PROCESSING (DIP)

| II Semester : Automation and Robotics | | | | | | Scheme : 2022 | | |
|---|---|---|---|---|---|---|---|---|
| Course Code | Category | Hours/Week | | | Credits | Maximum Marks | | |
| EE872 | Professional Elective - IV | L | T | P | C | Continuous Internal Assessment | End Exam | Total |
| | | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| Sessional Exam Duration : 2Hr | | | | | | End Exam Duration: 3 Hrs | | |

**Course Outcomes :** At the end of the course the student will be able to

**CO1:** Understand the basic concepts of 2-D image acquisition and quantization

**CO2:** Analyze the properties image transforms.

**CO3:** Apply image enhancement and image restoration algorithms on digital images.

**CO4:** Understand image compression and image segmentation methods.

**CO5:** Apply the color image concepts on digital images.

| | |
|---|---|
| **UNIT – I** | |
| **Introduction to Digital Image Processing** | Digital image processing definition and its applications, fundamentals of digital image processing, components of an image processing system, image sampling and quantization, some basic relationships between pixels, array versus matrix operations, linear versus nonlinear operations, arithmetic operations, set and logic operations |
| **UNIT - II** | |
| **Image Transforms** | Study analysis with examples of Fourier transforms, Walsh transform, Hadamard transform, Discrete cosine transform, Hotelling transform and Hough transform |
| **UNIT – III** | |
| **Image Enhancement** | Basic intensity transformation functions, histogram equalization, histogram specification, fundamentals of spatial filtering, smoothing and sharpening spatial filters, smoothing frequency domain filtering fundamentals, smoothing and sharpening frequency domain filters. |
| **Image Restoration** | Degradation/Restoration model, algebraic approach to restoration, inverse filtering Wiener filter, constrained least square restoration |
| **UNIT - IV** | |
| **Image Compression** | Fundamentals, some basic compression models- Huffman coding, arithmetic coding, LZW coding, bit plane coding, block transform coding and predictive coding. |
| **Image Segmentation** | Detection of discontinuities, edge linking and boundary detection- local processing, regional processing, global processing via Hough transform and graph theoretic technique, region based segmentation. |
| **UNIT - V** | |
| **Color Image Processing** | Color fundamentals, Color models- RGB, CMY and CMYK, HSI, Converting colors from RGB to HIS, HIS to RGB manipulating HIS component images, Pseudo color Image Processing, Full Color Image Processing |

**Text Books**


1. Rafael Gonzalez & Richard Woods, *"Digital Image Processing"*, 3rd Edition. Pearson publications", 2012.

2. Anil K. Jain, "*Fundamental of Digital Image Processing"*, PHI publication", 2013.


**Reference Books**


1. Pratt, *Digital Image Processing*, 2nd Edition, Wiley Publication, 1991.

2. S. Jayaraman, S. Esakkirajan & T. Veera Kumar, "*Digital Image Processing"*, Mc. Graw Hill, 2011.

3. S. Sridhar, "*Digital Image Processing"*, Oxford University Press, 2011.


**Web References:**

1.https://nptel.ac.in/courses/117105079/

2. https://nptel.ac.in/courses/117104069/

3. https://nptel.ac.in/courses/106105032/

**Sessional Exam**

The question paper for sessional examination shall consist of **Six** questions for 7.5 marks each and the student has to answer any **Four** questions.

**End Exam**

The question paper for end examination shall consist of **Eight** questions for 12 marks each and the student shall answer any **Five** questions.

**List of Audit Course**

| Category | Course Code | Course Title |
|---|---|---|
| Audit Course-I | AU101 | English for Research Paper Writing |
| | AU102 | Disaster Management |
| | AU103 | Sanskrit for Technical Knowledge |
| Audit Course-II | AU201 | Stress Management by Yoga |
| | AU202 | Pedagogy Studies |
| | AU203 | Personality Development through Life Enlightenment Skills |

## ENGLISH FOR RESEARCH PAPER WRITING (ERPW)

| II Semester : Automation and Robotics | | | | | | Scheme : 2022 | | |
|---|---|---|---|---|---|---|---|---|
| Course Code | Category | Hours/Week | | | Credits | Maximum Marks | | |
| AU101 | Audit Course-I | L | T | P | C | Continuous Internal Assessment | End Exam | Total |
| | | 2 | 0 | 0 | | | | |
| Sessional Exam Duration : 2Hr | | | | | | End Exam Duration: 3 Hrs | | |

**Course Outcomes :** At the end of the course the student will be able to

**CO1:** Understand the significance of writing skills and the level of readability

**CO2:** Analyze and write title, abstract, different sections in research paper

**CO3:** Develop the skills needed while writing a research paper

**UNIT – I**

1Overview of a Research Paper- Planning and Preparation- Word Order- Useful Phrases - Breaking up Long Sentences-Structuring Paragraphs and Sentences-Being Concise and Removing Redundancy - Avoiding Ambiguity

**UNIT - II**

Essential Components of a Research Paper- Abstracts- Building Hypothesis-Research Problem - Highlight Findings- Hedging and Criticizing, Paraphrasing and Plagiarism, Cauterization

**UNIT – III**

Introducing Review of the Literature – Methodology - Analysis of the Data-Findings - Discussion-Conclusions-Recommendations

**UNIT - IV**

Key skills needed for writing a Title, Abstract, and Introduction

**UNIT - V**

Appropriate language to formulate Methodology, incorporate Results, put forth Arguments and draw Conclusions

**Reference Books**


1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books) Model Curriculum of Engineering & Technology PG Courses [Volume-I]
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

## DISASTER MANAGEMENT (DM)

| II Semester : Automation and Robotics | | | | | Scheme : 2022 | | | |
|---|---|---|---|---|---|---|---|---|
| Course Code | Category | Hours/Week | | | Credits | Maximum Marks | | |
| AU102 | Audit Course-I | L | T | P | C | Continuous Internal Assessment | End Exam | Total |
| | | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| Sessional Exam Duration : 2Hr | | | | | End Exam Duration: 3 Hrs | | | |

**Course Outcomes :** At the end of the course the student will be able to

**CO1:** Learn to demonstrate critical understanding of key concepts in disaster risk reduction and humanitarian response

**CO2:** Critically evaluate disaster risk reduction and humanitarian response policy and practice from Multiple perspectives

**CO3:** Developanunderstandingofstandardsofhumanitarianresponseandpracticalrelevanceinspecific types of disasters and conflict situations

**CO4:** Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

| UNIT – I | |
|---|---|
| **Introduction** | Disaster:Definition,FactorsandSignificance;DifferenceBetweenHazardandDisaster;Natural and<br>Manmade Disasters: Difference, Nature, Types and Magnitude |
| **Disaster Prone Areas in India** | Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post- Disaster Diseases and Epidemics |
| **UNIT - II** | |
| **Repercussions of Disasters and Hazards** | Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts |
| **UNIT – III** | |
| **Disaster Preparedness and Management** | Preparedness: Monitoring of Phenomena Triggering A Disasteror Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness |
| **UNIT - IV** | |
| **Risk Assessment Disaster Risk** | Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival |
| **UNIT - V** | |
| **Disaster Mitigation** | Meaning,ConceptandStrategiesofDisasterMitigation,EmergingTrendsInMitigation.Structural<br>Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India |

**Reference Books**


1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies
2. New Royal book Company. Sahni, PardeepEt.Al.(Eds.),"Disaster Mitigation Experiences And Reflections", PrenticeHall Of India, New Delhi
3. GoelS.L., Disaster Administration And Management Text And Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi

## SANSKRIT FOR TECHNICAL KNOWLEDGE (STK)

| II Semester : Automation and Robotics | | | | | Scheme : 2022 | | | |
|---|---|---|---|---|---|---|---|---|
| Course Code | Category | Hours/Week | | | Credits | Maximum Marks | | |
| AU103 | Audit Course-I | L | T | P | C | Continuous Internal Assessment | End Exam | Total |
| | | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| Sessional Exam Duration : 2Hr | | | | | End Exam Duration: 3 Hrs | | | |

**Course Outcomes :** At the end of the course the student will be able to

**CO1:** Understanding basic Sanskrit language

**CO2:** Ancient Sanskrit literature about science &technology can be understood

**CO3:** Being a logical language will help to develop logic in students

**UNIT – I**

Alphabets in Sanskrit,

**UNIT - II**

Past/Present/Future Tense, Simple Sentences

**UNIT – III**

Order, Introduction of roots

**UNIT - IV**

Technical information about Sanskrit Literature

**UNIT - V**

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

**Reference Books**


1.“Abhyaspustakam” –Dr.Vishwas, Sanskrit-Bharti Publication, New Delhi

2.“Teach Yourself Sanskrit” Prathama Deeksha- Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication

3.“India’s Glorious Scientific Tradition” Suresh Soni, Ocean books (P) Ltd.,New Delhi

## STRESS MANAGEMENT BY YOGA (SMY)

| II Semester : Automation and Robotics | | | | | | Scheme : 2022 | | |
|---|---|---|---|---|---|---|---|---|
| Course Code | Category | Hours/Week | | | Credits | Maximum Marks | | |
| AU201 | Audit Course-II | L | T | P | C | Continuous Internal Assessment | End Exam | Total |
| | | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| Sessional Exam Duration : 2Hr | | | | | | End Exam Duration: 3 Hrs | | |

**Course Outcomes :** At the end of the course the student will be able to

**CO1:** Develop healthy mind in a healthy body thus improving social health also

**CO2:** Improve efficiency

**UNIT – I**

Definitions of Eight parts of yog.(Ashtanga)

**UNIT - II**

Yam and Niyam.

**UNIT – III**

Do`s and Don't sin life.
i) Ahinsa, satya, astheya,bramhacharya and aparigraha
ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

**UNIT - IV**

Asan and Pranayam

**UNIT - V**

i) Various yoga poses and their benefits for mind &body
ii) Regularization of breathing techniques and its effects-Types of pranayam

**Reference Books**

1.'Yogic Asanas for Group Training-Part-I": Janardan Swami Yogabhyasi Mandal, Nagpur

2."Rajayogaor conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

# PEDAGOGY STUDIES (PS)

| II Semester : Automation and Robotics | | | | | | Scheme : 2022 | | |
|---|---|---|---|---|---|---|---|---|
| Course Code | Category | Hours/Week | | | Credits | Maximum Marks | | |
| AU202 | Audit Course-II | L | T | P | C | Continuous Internal Assessment | End Exam | Total |
| | | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| Sessional Exam Duration : 2Hr | | | | | | End Exam Duration: 3 Hrs | | |

**Course Outcomes :** At the end of the course the student will be able to

**CO1:** What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?

**CO2:** What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?

**CO3:** How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

| | |
|---|---|
| **UNIT – I** | |
| **Introduction and Methodology** | Aims and rationale, Policy back ground, Conceptual frame work and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching |
| **UNIT - II** | |
| **Thematic overview** | Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education |
| **UNIT – III** | |
| **Pedagogical Approaches** | Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies |
| **UNIT - IV** | |
| **Professional development** | Alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriersto learning: limited resources and large class sizes |
| **UNIT - V** | |
| **Research gaps and future directions** | Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact |

**Reference Books**


1. AckersJ, HardmanF (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. AgrawalM (2004) Curricularre form in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379
3. AkyeampongK(2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, LussierK, PryorJ, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.


**Web References:**


1. www.pratham.org/images/resource%20working%20paper%202.pdf.

## PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS (PDS)

| II Semester : Automation and Robotics | | | | | | Scheme : 2022 | | |
|---|---|---|---|---|---|---|---|---|
| Course Code | Category | Hours/Week | | | Credits | Maximum Marks | | |
| AU203 | Audit Course-II | L | T | P | C | Continuous Internal Assessment | End Exam | Total |
| | | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| Sessional Exam Duration : 2Hr | | | | | | End Exam Duration: 3 Hrs | | |

**Course Outcomes :** At the end of the course the student will be able to

**CO1:** StudyofShrimad-Bhagwad-Geetawillhelpthestudentindevelopinghispersonalityand achieve the highest goal in life

**CO2:** The person who has studied Geeta will lead the nation and mankind to peace and prosperity

**CO3:** Study of Neetishatakam will help in developing versatile personality of students

**UNIT – I**

Neetisatakam- Holistic development of personality
Verses-19,20,21,22(wisdom)
Verses-29,31,32(pride &heroism)
Verses-26,28,63,65(virtue)

**UNIT - II**

Neetisatakam- Holistic development of personality
Verses-52,53,59(dont's)
Verses-71,73,75,78(do's)

**UNIT – III**

Approach to day to day work and duties.
Shrimad Bhagwad Geeta: Chapter2-Verses41,47,48,
Chapter3-Verses13,21,27,35,Chapter6-Verses5,13,17,23,35,
Chapter18-Verses45,46,48

**UNIT - IV**

Statements of basic knowledge.
ShrimadBhagwadGeeta:Chapter2-Verses 56,62,68
Chapter12 -Verses13,14,15,16,17,18
Personality of Rolemodel. Shrimad Bhagwad Geeta

**UNIT - V**

Chapter2-Verses 17,Chapter3-Verses36,37,42,
Chapter4-Verses18,38,39
Chapter18– Verses37,38,63

**Reference Books**


1. "SrimadBhagavadGita"bySwamiSwarupanandaAdvaitaAshram(PublicationDepartment), Kolkata
2. Bhartrihari'sThree Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.