Robotics for Industrial Automation [4-2-0]5

Sub Code: IAR1C01
Hrs/Week: 04
SEE Hrs: 3Hrs

Total: 52hrs

CIE: 50% Marks
SEE: 50% Marks
Max.Marks: 100

Course Prerequisites: None

Course Outcome:

After the successful completion of this course, the student will be able to:

1. Explain 3D translation and orientation representation & Illustrate the robot arm kinematics and use of Robot Operating System usage.
2. Design / Simulate a robot which meets kinematic requirements.
3. Apply localization and mapping aspects of mobile robotics.
4. To understand ROS applications.
5. To understand robot programming

Course Content

Module I:

Introduction: Definitions, Types of Robots, Application of Robots, Representing Position and Orientation, Representing Pose in 2-Dimensions, Representing Pose in 3-Dimensions, Representing Orientation in 3-Dimensions, Combining Translation and Orientation.

SLE: Matlab program for translation and orientation 8 hrs

Module II:

Time and Motion: Trajectories, Smooth One-Dimensional Trajectories, Multi-Dimensional Case, Multi-Segment Trajectories, Interpolation of Orientation in 3D, Cartesian Motion, Time Varying Coordinate Frames, Rotating Coordinate Frame, Incremental Motion, Inertial Navigation Systems. Mobile Robot Vehicles, Mobility, Car-like Mobile Robots, Moving to a Point, Following a Line, Following a Path, Moving to a Pose.

SLE: Flying Robots 8 hrs

Module III:

Localization, Dead Reckoning, Modeling the Vehicle, Estimating Pose, Using a Map, Creating a Map, Localization and Mapping, Monte-Carlo Localization.

**SLE:** Matlab programming of localization

**Module IV:**

**Robot Arm Kinematics:** Describing a Robot Arm, Forward Kinematics, A 2-Link Robot, A 6-Axis Robot, Inverse Kinematics, Closed-Form Solution, Numerical Solution, Under-Actuated Manipulator, Redundant Manipulator, Trajectories, Joint-Space Motion, Cartesian Motion, Motion through a Singularity.

**SLE:** Joint Angle Offsets, Determining Denavit-Hartenberg Parameter

**Module V:**

**Getting Started with ROS:** Installing ROS, Understanding the ROS Filesystem level, Packages, Stacks, Messages, Services, Understanding the ROS Computation Graph level, Nodes, Topics, Services, Messages, Bags, Master, Parameter Server, Creating workspace, Creating & Building an ROS package, Creating & Building the node, Visualization of images, Working with stereo vision, 3D visualization, Visualizing data on a 3D world using rviz.

**SLE:** Saving and playing back data in ROS

**Module VI:**


**SLE:** Goals of AI Research, AI Techniques

**Text Books:**

References:

Assessment Methods:
- Test 1, 2 and 3 are evaluated for 25 marks each, out of which sum of best two for 50 marks are taken.

Mapping of CO’s to PO’s and PSO’S:

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Industrial Automation (4-2-0)

Sub Code: IAR1CXX
Hrs/Week: 04
SEE Hrs: 3Hrs
CIE: 50% Marks
SEE: 50% Marks
Max.Marks: 100
Total Hrs= 52

Course Outcome:
After the successful completion of this course, the student will be able to:
1. Select & identify suitable automation hardware for the given application.
2. Describe & explain potential areas of automation, material handling, and Fluid power systems.
3. Analysis of Manufacturing systems & Mathematical models of production lines
4. To know Industrial Automated production lines and work part transfer mechanism and buffer storage analysis.
5. To understand Cellular Manufacturing, Flexible manufacturing Systems, planning implementation issues and implementation quality programs in production systems.

Course Content

Module I:
Material Handling: Introduction to Material Handling, Material Handling Equipments, Principles and Design Consideration in material handling, Material Transport Equipment, Automated Storage systems.
SLE: Lean Manufacturing 09Hrs

Module II:
Fluid Power and Pneumatic Systems:
Introduction to Fluid power, Pascal’s Law, Hydraulic Circuit Design and Analysis-Introduction, Control of A Single-Acting Hydraulic Cylinder Circuit, Control of a Double Acting Hydraulic Cylinder Circuit, Regenerative Cylinder Circuit.
Basic Pneumatic systems, Types of Cylinders-Single acting Cylinder- Double acting Cylinder, Direction Control Valves- Valve position, Shuttle Valve, Basic Pneumatic Circuits- Control of Single acting Cylinder Circuit- Control of Double acting circuit, Impulse operation- Pilot operation of single acting and Double acting cylinder.
SLE: Solenoid Operated Valve 10 hrs

Module III:
SLE: Alternative Assembly lines 08Hrs
Module IV:
Automated Production Lines and Assembly systems:
Fundamentals of Automated Production Lines, Applications Of Automated production lines, System configurations, Work Part Transfer Mechanisms, Storage Buffers, Power Transmission Systems- Gears, Power Screws(Linear Guideways), Other Transmissions Systems such as chains and ropes.
SLE: System Design Considerations. 09 Hrs

Module V:
Cellular Manufacturing and Flexible Manufacturing Systems:
SLE: Planning and implementation issues. 08 Hrs

Module VI:
Inspection and Quality control:
Introduction, Inspection, Specifying limits of variability, dimensions and tolerances, selection of gauging equipments, gauge control, quality control and quality assurance, statistical quality control, total quality management, six sigma, quality standards, Simple numerical problems.
SLE: Coordinate Measuring Machines. 08 Hrs

Text Book:

References:

Assessment Methods:
1. Written Tests (Test 1,2& 3) are Evaluated for 25 Marks each out of which sum of best two for 50 marks are taken.
Mapping of CO’s to PO’s and PSO’S:

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Drives and Control Systems for Automation [3-2-0]4

Sub Code: IAR1C03
Hrs/Week: 03
SEE Hrs: 3Hrs

Total: 39hrs

Course Prerequisites: None

Course Outcome:

After the successful completion of this course, the student will be able to:

1. Describe and analyze working principles of various types of motors, differences, characteristics and selection criteria, control methods, SCADA.
2. Apply the knowledge in selection of motors, heating effects and braking concepts in various industrial applications
3. Construct a program using PLC to problems pertaining to automation industries.
4. To understand visualization systems and its integrations

Course Content

Module I:


SLE: Current control (sensor less vector control) 07 hrs

Module II:

Industrials Drives: DC and AC motors operation and selection, method of control and application of brushless DC motor, PMSM, stepper motor, A.C servomotor, selection criteria for servo motor and servo amplifier, universal motor, electric drive, types of industrial drives, the characteristics of drive, advantages of drives over other prime movers, motor rating, heating effects, electric braking, rheostatic and regenerative braking principles in power converters.

SLE: The Hydraulic Motor 07 hrs
Module III:

Introduction to Programmable Logic Controllers: Definitions of PLC, basic structure of PLC, working principles, data storage methods, inputs / outputs flag processing’s, types of variables, definition of firmware, software, programming software tool and interfacing with PC (RS232 & TCP-IP), methods of PLC programming (LD, ST, FBD & SFC), What is logic, Conventional Ladder v/s PLC ladder, series and parallel function of OR, AND, NOT logic function blocks logical / mathematical operators & data types, array & data structure, PID, types of tasks and configuration, difference between relay logic and PLC, selection of PLC controller (case study) Centralized concept.

SLE: types of field bus systems 09 hrs

Module IV:

Application of PLC using Timers and Counters. Timer and Counter Instructions; on delay and Off delay and retentive timer instructions, retentive timers,. Programming examples, Counter-counter up and down instructions, combining counters and timers, Comparison and data handling instructions, Arithmetic functions, Sequencer instruction, PLC Safety, Commissioning, Testing.

Visualization Systems, Types of visualization system, HMIs, PC based Controller, HIM Types, Applications of HMI’s, and Interfacing of HMI with controllers. Programming of HMI.

SLE: Fault finding & Simulation, Implementation of HMI 08hrs

Module V

Supervisory control & data Acquisitions: Introduction to Supervisory control & data Acquisitions, distributed Control System (DCS): computer networks and communication in DCS. different BUS configurations used for industrial automation – GPIB, HART and OLE protocol, Industrial field bus – FIP (Factory Instrumentation Protocol), PROFIBUS (Process field bus), Bit bus. Interfacing of SCADA with controllers, Basic programming of SCADA, SCADA in PC based Controller / HMI,

SLE: Case study & implementation for different examples. 08hrs

Text Books:

2. Andrew Parr, Industrial drives, Butterworth – Heineamann  
3. G.K. Dubey, Fundamentals of electrical drives  
4. Programmable Logic Controllers by W. Bolton

References:
2. Instrumentation Engineers Hand Book - Process Control, Bela G Liptak, Chilton book company, Pennsylvania  
4. S.K. Pillai, A First course on electric drives – Wiley Eastern 1990  
5. Programmable Logic Controllers by Hugh Jack.

Assessment Methods:
- Test 1, 2 and 3 are evaluated for 25 marks each, out of which sum of best two for 50 marks are taken

Mapping of CO's to PO's and PSO'S:

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<td>CO4</td>
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Artificial Intelligence and Expert Systems in Automation
[3-0-0]3

Sub Code: IAR1E203
Hrs/Week: 03
SEE Hrs: 3Hrs

Total: 39hrs

CIE: 50% Marks
SEE: 50% Marks
Max.Marks: 100

Course Prerequisites: None.

Course Outcome:
After the successful completion of this course, the student will be able to:
1. Describe and explain the applications of AI,
2. select search strategies based on application requirement.
3. Explain knowledge representation methods, discuss architecture of expert systems.

Course Content

Module I:
Artificial Intelligence: What is AI?, The Foundations of Artificial Intelligence, The History of Artificial Intelligence,
Intelligent Agents: Agents and Environments, the Concept of Rationality, the Nature of Environments, the Structure of Agents.
SLE: State of the Art of AI applications

Module II:
SLE: Comparing uninformed search strategies
Module III:

**Beyond Classical Search:** Local Search Algorithms and Optimization Problems, Hill-climbing search, Simulated annealing, Local beam search, Genetic algorithms, Local Search in Continuous Spaces, Searching with Nondeterministic Actions, Searching with Partial Observations, Online Search Agents and Unknown Environments.

SLE: Simulated annealing 8 hrs

Module IV:

**Knowledge Representation:** Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, Semantic networks, Description logics, Reasoning with Default Information, Truth maintenance systems.

SLE: The Internet Shopping World 7 hrs

Module V:

**Uncertain knowledge and reasoning:** Quantifying Uncertainty, Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Bayes' Rule and Its Use, Probabilistic Reasoning, Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Exact Inference in Bayesian Networks, Approximate Inference in Bayesian Networks, and Inference by Markov chain simulation.

**Probabilistic Reasoning over Time:** Time and Uncertainty, Inference in Temporal Models, Hidden Markov Models, Kalman Filters, Dynamic Bayesian Networks, Expert system architecture.

SLE: Other Approaches to Uncertain Reasoning 10 hrs

Text Books:


References:


Assessment Methods:

Written Tests (Test 1, 2 & 3) are Evaluated for 25 Marks each out of which sum of best two for 50
marks are taken.

Mapping of CO’s to PO’s and PSO’S:

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Big Data Analytics For Automation [4-2-0]5

Sub code : IAR2C03      CIE : 50% Marks
Hrs / week : 04      SEE : 50% Marks
SEE Hrs : 3 Hours      Max. Marks: 100 Marks

Total Hrs: 52

Course Outcome

On successful completion of the course the students will be able to
1. Overview of Big Data and Related Technologies
2. Analyze Technologies for Handling Big Data and Hadoop Ecosystem
3. Acquire clear understanding of MapReduce Fundamentals and HBase
4. Acquire clear understanding of Virtualizing and Processing Data using MapReduce
5. Acquire a clear understanding of YARN and Mahout
6. Acquire a clear understanding of Hive

Module I
Getting an Overview of Big Data
SLE: Future of Big Data in Automation Industry 9 hrs

Module II
Introducing Technologies for Handling Big Data and Hadoop Ecosystem
SLE: Sqoop, Flume 9 hrs

Module III
Understanding MapReduce Fundamentals and HBase
The MapReduce Framework, Exploring the Features of MapReduce, Working of MapReduce, Exploring Map and Reduce Functions, Techniques to Optimize MapReduce Jobs, Hardware/Network Topology, Synchronization, File System, Uses of MapReduce, Role of HBase in Big Data Processing, Characteristics of HBase
SLE: Installation of HBase  

**Module IV**

*Understanding Big Data Technology Foundations and Processing your Data with MapReduce*

Exploring the Big Data Stack, Virtualization and Big Data, Virtualization Approaches, Developing a Simple MapReduce Application, Points to Consider while designing MapReduce.

**SLE:** Managing Virtualization with Hypervisor  

**Module V**

*Understanding Hadoop YARN Architecture and Mahout*

Background of YARN, YARN Architecture, Working of YARN, YARN Schedulers, Backward Compatibility with YARN, YARN Configurations, YARN Commands, What is Mahout?, Machine Learning, Collaborative Filtering, Clustering, Classification, Mahout Algorithms, Environment for Mahout.

**SLE:** YARN Containers  

**Module VI**

*Exploring Hive*

Introducing Hive, Hive Services, Data Types in Hive, Built-In Functions in Hive, Hive DDL, Data Manipulation in Hive, Data Retrieval in Hive, Using Joins in Hive.

**SLE:** Getting Started with Hive Installation  

**Textbook:**

1. Big Data: Black Book, DT Editorial Services, Wiley India Pvt Ltd, 2015 Edition (Chapters 1,2,3,4,5,6,8,11,12,17)

**Reference Books:**

2. Big Data Analytics with R and Hadoop, Vignesh Prajapati, -Packt Publishing 2013
6. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data EMC Education Services, Wiley India Pvt Ltd.

**Assessment Methods:**

Test 1, 2 and 3 are evaluated for 20 marks each, out of which sum of best two for 40 marks are taken. Assignment is evaluated for 10marks. Total CIE marks is evaluated for 50marks.
Mapping of CO’s to PO’s and PSO’S:

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Sensors Applications in Manufacturing [3-2-0]4

Sub Code: IAR2C02
Hrs/Week: 03
SEE Hrs: 3Hrs

Total: 39 hrs

CIE: 50% Marks
SEE: 50% Marks
Max.Marks: 100

Course Prerequisites: None

Course outcome:

After the successful completion of this course, the student will be able to:

1. Explain various signal condition devices used in electronic devices and use of appropriate method in signal conditions in various applications.

2. Describe impact of an RFID system on manufacturing, defense, distribution, retail and health sectors & abstract (“filter”) information in RFID.

3. Summaries the future advances to the quality and integrity of manufacturing and related sectors resulting from the use of RFID and other sensor technologies.

4. Analyze and choose appropriate sensors in different industrial applications.

Course Content

Module I:


Sensors and their applications: Inductive, capacitive, magnetic, various types of photo sensors, detection methods, through-beam detection, reflex detection & proximity detection, ultrasonic and microwave sensors. Applications and understanding of the above sensors, limit switches.

SLE: multiplexers and data acquisition systems 8 hrs

Module II:

Advanced Sensor Technologies: Laser production, characteristics of lasers, types of laser sensors, bar code sensors, benefits of bar coding, transponder, RFID (Radio Frequency Identification), electromagnetic identifier, optical encoders, color sensors, sensing principles, color theory, unit color measurement, colour comparator, color sensing algorithm, fuzzy logic color sensor, fuzzy logic for opt-electronic colour sensor in manufacturing.
Module III:

Flexible Manufacturing Systems: Introduction of FMS, types, sensors used in FMS, integration sensors-Vision sensors (image capturing, image transformations and analysis), detecting partially visible objects, overlap and defects using vision sensors.

SLE: edge detection and extraction.  

Module IV:

Sensors for Special Applications: Cryogenic manufacturing applications, semiconductor absorption sensors, semiconductor temperature detector using photoluminescence temperature detectors using point-contact, sensors in process manufacturing plants, measurement of high temperature, robot control through sensors, other sensors (predictive monitoring serving the CIM strategy, optical sensor quantifying acidity of solution, reflective strip imaging camera sensor, ultrasonic stress sensor for measuring dynamic changes in materials, acousto optical synthetic aperture radar, sensors for vibration measurement of structures), collection and generation of process signals in decentralized manufacturing system.

SLE: Non-contact Sensors (pyrometers) multi sensor applications

Module V:

Networking: Networking of sensors, control of manufacturing process- tracking- the mean time between operations interventions, tracking the yield, mean process time, detection of machining faults, diagnostic systems, resonance vibration analyzer, sensing motor current for signature analysis, temperature sensing (RTD, thermocouple).

SLE: acoustics ensing.

Text Books:
2. Mechatronics by W. Bolton,

References:
1. Sensor Technology Handbook by Jon S. Wilson
2. N.L.Buck&T.G.Buckwith, Mechanical measurement.
3. Sensors and Transducers by Ian Sinclair

Assessment Methods:
1. Test 1, Test2 and Test 3 will be conducted for 25 marks each, out of which best of two is considered

Mapping of CO’s to PO’s and PSO’S:

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Total Quality Management [3-0-0]3
Computer Vision & Image Processing [3-0-0]3

Sub Code: IAR2E302
Hrs/Week: 03
SEE Hrs: 3Hrs

CIE: 50% Marks
SEE: 50% Marks
Max.Marks: 100
Total Hrs: 39

Course Prerequisites: None
Course Outcome:
After the successful completion of this course, the student will be able to:
1. Understand the applications of computer vision in automation
2. Describe image processing techniques, feature detection and matching techniques.
3. Describe image segmentation and stereo correspondence techniques.
4. Demonstrate the use of multi view stereo.

Course Content

Module I: Introduction: Computer Vision, Brief History, Image formation, Geometric primitives and transformations, Geometric primitives, 2D transformation, 3D transformation, 3D rotation, 3D to 2D projection, Lens distortion, Photometric image formation, Lighting, the digital camera, sampling and aliasing, color.

SLE: Image compression 8 hrs

Module II: Image processing: Point operators, Pixel transforms, color transforms, compositing and matting, histogram equalization, Linear filtering, separable filtering, examples of linear filtering, band pass and steerable filter, More neighbourhood operators, non-linear filtering, morphology, distance transform, Fourier transforms, Fourier transform pairs, two dimensional Fourier transforms, wiener filtering, Geometric transformations, parametric transformation, mesh based warping, Global optimization, regularization, Markov random fields.

SLE: Image restoration 10hrs


SLE: Rectangle detection. 7hrs
Module IV: Segmentation: Active contours, snakes, dynamic snake and condensation, scissors, level sets, Split and merge, watershed, region splitting, region merging, graph based segmentation, probabilistic aggregation, Mean shift and mode finding, K-means and mixtures of Gaussians, mean shift, Normalized cuts, Graph cuts and energy-based methods.

SLE: Medical image segmentation 7hrs

Module V: Stereo correspondence: Epipolar geometry, rectification, plane sweep, Sparse correspondence, 3D profiles and curves, Dense correspondence, similarity measures, Local methods, sub-pixel estimation and uncertainty, Global optimization, dynamic programming, segmentation based techniques, Multi-view stereo

SLE: Volumetric and 3D surface reconstruction 7hrs

Text Books:

Reference Books:

Assessment Methods: Written Tests (Test 1,2 & 3) are evaluated for 25 Marks each out of which sum of best two for 50 marks are taken.

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**Automotive Electronics [3-0-0]**
Sub Code: IAR2E401
Hrs/Week: 04
SEE Hrs: 3Hrs
CIE: 50% Marks
SEE: 50% Marks
Max.Marks:100
Total Hrs: 39

Course Prerequisites: None

Course outcome:

After the successful completion of this course, the student will be able to:
1. Describe and explain various sensors
2. Describe communications & Instrumentation used in automobile.
4. Analyze the importance of engine performance data for automobile.

Course Content

Module I:
SLE: Starting System. 9 hrs

Module II:
SLE: Fuel Injector, and Ignition Actuator. 9 hrs

Module III:
SLE: EGR Control. 8 hrs

Module IV:
Communication – Serial Data, Communication Systems, Protection, Body and Chassis Electrical
Systems, Remote Keyless Entry, GPS Vehicle Motion Control – Cruise Control, Chassis, Power Brakes, Antilock Brake System (ABS), Electronic Steering Control, Power Steering, Traction Control.

**SLE:** Electronically controlled suspension.

**Module V:**

**Automotive Instrumentation** – Sampling, Measurement & Signal Conversion of various parameters

**SLE:** Advance Driver Information System.

**Reference Books:**


**Assessment Methods:**

Written Tests (Test 1, 2 & 3) are Evaluated for 25 Marks each out of which sum of best two for 50 marks are taken.

**Mapping of CO’s to PO’s and PSO’S:**

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<td>CO4</td>
<td>PO2,PO4,PO5</td>
<td>PSO2,PSO2</td>
</tr>
</tbody>
</table>

**Additive Manufacturing [3-0-0]3**

**Sub Code:** IAR2E402

**Hrs/Week:** 03

**CIE:** 50% Marks

**SEE:** 50% Marks
Engineering Management [3-0-0] 3

Sub Code: IAR3C01
Hrs/Week: 03
SEE Hrs: 3Hrs

Total: 39 Hrs

Course Outcomes

After successful completion of course, student will be able to:

1. Assess organization culture and understand ethical issues
2. Evaluate products based on PLC phase and formulate marketing strategy
3. Describe microeconomic concepts and estimate time value of money
4. Explain Financial statements and compare sources of finance
5. Prepare Project Management plans


SLE: HRM in Organizations 7 hrs


SLE: Measuring Market Demand 6 hrs


SLE: Replacement Analysis 10 hrs

SLE: Financial Ratios 6 hrs


SLE: Project Integration Management 10 hrs

Reference Books:

1. Management: Edition 9, Hellriegel, Jackson, Thomson
5. Marketing Management by Philip Kotler, Kevin Lane Keller, Pearson publication.
7. Project Management Book of Knowledge. (PMBOK), PMI
8. Industrial Management, D K Bhattacharyya Vikas Publishing

Assessment Methods: Written Tests (Test 1,2& 3) are Evaluated for 25 Marks each out of which sum of best two for 50 marks are taken.

Mapping of CO’s to PO’s and PSO’S:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Programme Outcomes that are satisfied by the CO’s</th>
<th>Programme Specific Outcomes that are satisfied by the CO’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>PO2,PO5</td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>PO1,PO2,PO3</td>
<td>PSO1</td>
</tr>
<tr>
<td>CO3</td>
<td>PO2,PO5</td>
<td>PSO1</td>
</tr>
<tr>
<td>CO4</td>
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</tr>
<tr>
<td>CO5</td>
<td>PO2,PO5</td>
<td>PSO2</td>
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