*Shri Shamrao Patil (Yadravkar) Educational & Charitable Trust's*

**Sharad Institute of Technology College of Engineering**

**(An Autonomous Institute)**

Yadrav (Ichalkaranji)-416121, Dist. – Kolhapur

# Teaching and Evaluation Scheme for T Y B. Tech.

## Department of Automation and Robotics Engineering

**Semester:** V





HEAD
Dept. Of Automation And

**Department:** Automation & Robotics Engineering **Rev:** Course Structure/00/2022-23

**Class:** T.Y. B. Tech **Semester:** V

| Course Code | Course Type | Course | Teaching Scheme | | | | Evaluation Scheme | | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Total Hrs. | CA1 | CA2 | MSE | ESE | Total | |
| AR501 | PCC | Industrial Automation | 3 | - | - | 3 | 10 | 10 | 30 | 50 | 100 | 3 |
| AR502 | PCC | Robot Kinematics and Dynamics | 3 | - | - | 3 | 10 | 10 | 30 | 50 | 100 | 3 |
| AR503 | PCC | Internet of Things (IoT) | 3 | - | - | 3 | 10 | 10 | 30 | 50 | 100 | 3 |
| AR504 | PEC | Elective-I | 3 | - | - | 3 | 10 | 10 | 30 | 50 | 100 | 3 |
| AR505 | ESC | Fluid and Thermal Engineering | 3 | - | - | 3 | 10 | 10 | 30 | 50 | 100 | 3 |
| AR506 | PCC | Industrial Automation Laboratory | - | - | 2 | 2 | 15 | 15 | - | 20 | 50 | 1 |
| AR507 | PCC | Robot Kinematics and Dynamics Laboratory | - | - | 2 | 2 | 25 | 25 | - | - | 50 | 1 |
| AR508 | PCC | IoT Laboratory | - | - | 2 | 2 | 15 | 15 | - | 20 | 50 | 1 |
| AR509 | PCC | Fluid and Thermal Engineering Laboratory | - | - | 2 | 2 | 25 | 25 | - | - | 50 | 1 |
| AR510 | PCC | Java Programming Laboratory | - | - | 2 | 2 | 15 | 15 | - | 20 | 50 | 1 |
| AR 511 | PCC | Linear Integrated Circuits | 1 | - | - | 1 | 25 | 25 | - | - | 50 | Audit |
| MDC03 | MC | Industrial Safety | 2 | - | - | 2 | 25 | 25 | - | - | 50 | Audit |
| HMS05 | HSMC | Aptitude Skills-III | 1 | - | - | 1 | 25 | 25 | - | - | 50 | 1 |
| HMS06 | HSMC | Language Skills-III | - | - | 2 | 2 | 25 | 25 | - | - | 50 | Audit |
| PRJ03 | PROJ | Mini Project-IV | - | - | 2 | 2 | 25 | 25 | - | - | 50 | Audit |
| | | Total | 19 | | 14 | 33 | 270 | 270 | 150 | 310 | 1000 | 21 |

Elective –I

A. Factory Automation
B. Computer Integrated Manufacturing
C. Applied Robotics
D. Electrical Drives and system



HEAD
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**Industrial Automation**

| | | | | |
|---|---|---|---|---|
| AR501 | PCC | Industrial Automation | 3-0-0 | 3 Credits |

| Teaching Scheme | Examination Scheme |
|---|---|
| Lecture: 3 hrs/week<br>Tutorial: 1hr/week | Continuous Assessment –I :10 Marks<br>Continuous Assessment –II :10 Marks<br>Mid Semester Exam: 30 Marks<br>End Semester Exam: 50 Marks |

**Pre-Requisites**: CAD/CAM-Automation

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

| | |
|---|---|
| CO1 | Identify the automation need, type, automation technologies and control systems |
| CO2 | Develop Hydraulics and Pneumatics circuits used for automatic process controls of industrial systems. |
| CO3 | Develop the Electro-Pneumatic circuits used for automatic process controls of industrial systems. |
| CO4 | Create ladder diagrams from process control techniques. |
| CO5 | Illustrate the SCADA System |
| CO6 | Organize the SCADA System with application |

**Course Contents:**

| | |
|---|---|
| **Unit 1: Factory Automation and Integration and Control system**<br>Basic concepts, Elements of Automation , Advanced Automation system, Level of Automation, automation principles and strategies ,types of automation, Reasons for automation ,Automation Technologies used in manufacturing Industry, Automation in manufacturing .Benefits of Manufacturing Automation. Introduction to Programmable Logic Controllers (PLC), Human Machine Interface (HMI) & Supervisory Control and Data Acquisition System (SCADA); motion controller RFID technology | [7] |
| **Unit 2: Design and Operation of Logic Control Circuits for Hydraulics and Pneumatics**<br>Basic elements of hydraulics/pneumatics, Application of Hydraulic system, Various elements with their function, Properties of hydraulic fluid ,Various types of pump, | [7] |



HEAD

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| Hydraulic actuator, Design consideration for hydraulic cylinder, Rotary Actuator ,Hydraulic Motor, Fluid Power control unit-Pressure control valve, flow control valve & direction control, General layout of Pneumatic System, Compressor, selection of air compressor, Pneumatic Valve ,FRL Unit, Circuit design approach and real time examples; sequence operation of two cylinders as per the design requirement to automate the system, Comparison between Hydraulic, Pneumatic and Electrical system | |
| **Unit 4: Design and Operation of Electro-Pneumatic Logic Control Circuits**<br>Electro-pneumatic systems, solenoid valves, different sensors, factory automation sensors, process automation sensors, Electro pneumatic systems using relay logic circuits ,Direct control and Indirect control, Logic operations-OR circuit, AND circuit, Multi-track gravity Feed Magazine, Sorting devices, Circuit protection against high pressure and low pressure, Sequencing circuit /Cascade circuit-,Electro-hydraulic circuit Double acting cylinder with reed switch | [8] |
| **Unit 5: Programmable Logic Controllers (PLC)**<br>Introduction, Definition, PLC system and components of PLC Input output module, PLC advantages and disadvantages. Ladder diagram and PLC programming fundamentals: Basic components and other symbols, Fundamentals of ladder diagram, Light control example, Internal relays, Disagreement circuit, Majority circuit, Holding (sealed or latches) contacts, Always ON always OFF contacts, Fail safe circuits, PLC timer counters functions and its industrial applications | [7] |
| **Unit 5: Basics of SCADA System**<br>Industrial automation Hierarchy, Typical SCADA Architecture, Components of SCADA system-Master Terminal Unit, Remote Terminal Unit, HMI-Operator Interface, Communication Interface , Commercially available SCADA Softwares-InTouch, Vijeo Citec | [6] |
| **Unit 6: SCADA Network Communication**<br>Network topologies and Cable, Network Topology, Modes of Network communication, Modbus, Profibus. Foundation field bus ,Database and DDE connectivity, SCADA System with application | [6] |

**Text Books:**

1. Antony Espossito, "Fluid power with Applications ", Pearson, Sixth Edition., 2003.
2. W. Bolton, "Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering" - PrenticeHall - 2013 - 5 th Edition Singh, Shio Kumar.
3. Industrial Instrumentation & Control, Tata McGraw-Hill Education, 2010
4. Mikell P Groover, "Automation Production Systems and Computer- Integrated Manufacturing"Pearson Education, New Delhi, 2001.

**Reference Books:**

1. Mechatronics – W. Bolton, Pearson education
2. Mechatronics – Mahalik, TATA McGraw Hill
3. Mikell P Groover, "Industrial Robots – Technology Programmes and Applications", McGraw Hill,New York, USA. 2000.
4. Mechatronics – Appu Kuttam, Oxford publications



HEAD
Dept. Of Automation And Robotics

5. Introduction to PLC programming, NIIT,
6. Programmable logical controller, Hackworth, Pearson Education
7. Programmable logical controller, Reis Webb, Prentice Hall
8 Mechatronics and Microprocessor by Ramachandran Willey India
9 Mechatronics : Integrated Mechanical Electronic System by Ramachandran Willey India
10. Programmable logical controller,3e Gary Dunning Cengage Learning
11.Mechatronics Source Book by N C Braga Cengage Learning
12. Fluid Power with Applications by Anthony Esposito - Pearson Education 2000.
13. Power Hydraulics by Michael J, Prinches and Ashby J. G, - Prentice Hall, 1989.



HEAD
Dept. Of Automation And

**Robot Kinematics and Dynamics**

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|---|---|---|---|---|
| AR502 | PCC | Robot Kinematics and Dynamics | 3-0-0 | 3 Credits |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lecture: 3 Hrs/week | Continuous Assessment –I :10 Marks<br>Continuous Assessment –II :10 Marks<br>Mid Semester Exam: 30 Marks<br>End Semester Exam: 50 Marks |

**Pre-Requisites**: Principles of Robotics, Kinematics and Theory of Machines

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

| | |
|---|---|
| CO1 | Explain the various components and basics of a robotics system |
| CO2 | Explain the classification, application, and specifications of robots |
| CO3 | Solve the problems related to rotation, translation, and transformation in robotics |
| CO4 | Solve the problems related to forward and inverse kinematics in robotic systems |
| CO5 | Explain the concepts of trajectory and motion planning in the robotics system. |
| CO6 | Explain the basics of dynamics analysis in the robotics system. |

**Course Contents:**

| | |
|---|---|
| **Unit 1:Introduction**<br>Kinematics and dynamics, Kinematic joints, Link, Kinematic pair, Constrained motion, Mechanism and machines, Robotics system, Robot joints, Robotic Terminology, components of robotics, Robot manipulation, Future of robotics | [7] |
| **Unit 2:Robot Kinematics Basics**<br>Robot configurations, Classification of robots, Robot End-effectors, Workspace, Specification of Robot, Application of Robots, Robotics sensors, sensor calibration, Grubler's Formula, Degrees of Freedom of robot manipulators | [7] |
| **Unit 3:Kinematics Representation of Robot Manipulator**<br>Representation of planer motion, Representation of spatial motion, Descriptions: Positions, Orientations, and Frames, Representation: Rotation, translation, transformation, Homogeneous transformation, Rolling, Pitching, and Yawing | [7] |



HEAD

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|---|---|
| **Unit 4: Kinematics Analysis of robotic manipulators**<br>Forward and Inverse kinematics of robotic manipulators, Denavit Hartenberg Parameters, Rules for coordinate assignments, Robot coordinate system. | [7] |
| **Unit 5: Trajectory and Motion Planning**<br>Trajectory, General Considerations in Path Generation, work envelope of a robot, Cartesian space technique, Joint space technique- Cubic polynomial, Fifth order polynomial, Linear trajectory function, Robot motion planning, Sequence of robotic action, Motion planning approaches, classification of Robot motion planning | [6] |
| **Unit 6: Basics of Robotic Dynamics (Theory)**<br>Key aspects of the dynamics of robotics systems, Forces in Manipulator, Robot dynamics – Rigid body dynamics, Newton-Euler, Lagrange-Euler, generalized D'Alembert equations of motion. | [6] |

**Text Books:**

1. Craig, John J. Introduction to robotics. Pearson Education, 2006.
2. Renfrew, Alasdair. "Introduction to robotics: Mechanics and control." International Journal of Electrical Engineering & Education 41.4 (2004): 388.
3.Lumelsky, Vladimir J. Sensing, intelligence, motion: how robots and humans move in an unstructured world. John Wiley & Sons, 2005.
4. Vukobratovic, Miomir. Introduction to robotics. Springer Science & Business Media, 2012.

**Reference Books:**

1. Hartenberg and Denavit, "Kinematics and Synthesis of Linkages", McGraw Hill Book Co.
2. J. E. Shigley and J.J.Uicker Jr., Theory of Machines and Mechanism, McGraw Hill [ISBN019515598X]
3. G K Grover', "Mechanical Vibration", Nemchand and brothers. [ISBN8185240752]
4. S.S.Ratan , Theory of Machines, Tata McGraw Hill [ISBN0070591202]
5. Deb S.R., —Roboticsl, Tata McGraw Hill Publications, New Delhi.
6. YoramKoren, "Robotics for Engineers", McGraw Hill Book Co.
7. Groover M.P., Weiss M., Nagel R.N., Odrey N.G., "Industrial Robotics Technology-Programming and Applications", McGraw Hill Book Co.elhi
6.Shah and Jadhawani, Theory of Machines, DhanpatRai& Sons
7.Robert J. Schilling, Fundamentals of Robotics Analysis and Control, PHI Learning, 2009.
8.Lewis, Frank L., Darren M. Dawson, and Chaouki T. Abdallah. Robot manipulator control: theory and practice. CRC Press, 2003.
9.Robotics: Modelling, Planning and Control, Lorenzo Sciavicco, Luigi Villani, Giuseppe Oriolo, Springer Science & Business Media, 07-Nov-2008 - Technology & Engineering - 632 pages
10.Mueller, Andreas. "Modern robotics: Mechanics, planning, and control [bookshelf]." IEEE Control Systems Magazine 39.6 (2019): 100-102.



HEAD
Dept. Of Automation And

**Internet of Things (IoT)**

| | | | | |
|---|---|---|---|---|
| AR503 | PCC | Internet of Things (IoT) | 3-0-0 | 3 Credits |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lecture: 3 hrs/week | Continuous Assessment –I :10 Marks<br>Continuous Assessment –II :10 Marks<br>Mid Semester Exam: 30 Marks<br>End Semester Exam: 50 Marks |

**Pre-Requisites**:

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

| | |
|---|---|
| CO1 | Explain basic fundamentals of IoT |
| CO2 | Explain System Design concept of hardware and their interfacing |
| CO3 | Apply various protocols for design of IoT systems |
| CO4 | Explain Various IP protocols for IoT |
| CO5 | Discuss Programming concepts and their challenges |
| CO6 | Develop applications based on IoT |

**Course Contents:**

| | |
|---|---|
| **Unit 1: Introduction to IoT**<br>Definitions & Characteristics of IoT, IoT Architectures, Physical & Logical Design of IoT, Enabling Technologies in IoT, History of IoT, About Things in IoT, The Identifiers in IoT, About the Internet in IoT, IoT frameworks, IoT and M2M | [7] |
| **Unit 2: Hardware for IoT**<br>Definition, Types of Sensors, Types of Actuators, Examples and Working, RFID Principles and components, Wireless Sensor Networks: History and Context, The node, Connecting nodes, Networking Nodes, WSN and IoT.. | [7] |
| **Unit 3: Network & Communication aspects in IoT**<br>WPAN Technologies for IoT: IEEE 802.15.4, Zigbee, HART, NFC, Z-Wave, BLE, Bacnet, Modbus. | [7] |



HEAD
Dept. Of Automation And

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|---|---|
| **Unit 4: IoT Data Protocols**<br>Message Queue Telemetry Transport, Constrained Application Protocol, Advanced Message Queuing Protocol Data Distributed Services, Representational State Transfer, Extensible Messaging and Presence Protocol. | [7] |
| **Unit no 5: Challenges in IoT Design**<br>Development Challenges, Security Challenges, Other challenges. | [6] |
| **Unit 6: IoT Applications**<br>Home Automation, Smart Cities, Energy, Retail Management, Logistics, Agriculture, Health and Lifestyle, Industrial IoT, IoT design Ethics, IoT in Environmental Protection. | [6] |

**Text Books:**

1. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things key applications and protocols", willey
2. Jeeva Jose, Internet of Things, Khanna Publishing House
3. Michael Miller "The Internet of Things" by Pearson
4. Raj Kamal "INTERNET OF THINGS", McGraw-Hill, 1ST Edition, 2016
5.. Hakima Chaouchi, — The Internet of Things Connecting Objects to the Web‖ ISBN : 978-1-84821-140-7, Wiley Publications
6. Vijay Madisetti and ArshdeepBahga, —Internet of Things (A Hands-on-Approach)‖, 1st Edition,VPT, 2014.

**Reference Books:**

1. Arshdeep Bahga, Vijay Madisetti " Internet of Things( A hands on approach)" 1ST edition, VPI publications,2014
2. Adrian Mc Ewen, Hakin Cassimally "Designing the Internet of Things" Wiley India References
3. Daniel Minoli, —Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications‖, ISBN: 978-1-118-47347-4, Willy Publications
4. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press



HEAD
Dept. Of Automation

## A. Factory Automation

| | | | | |
|---|---|---|---|---|
| AR504A | PEC | Factory Automation | 3-0-0 | 3Credits |

| Teaching Scheme | Examination Scheme |
|---|---|
| Lecture: 3 hrs/week | Continuous Assessment –I :10 Marks<br>Continuous Assessment –II :10 Marks<br>Mid Semester Exam: 30 Marks<br>End Semester Exam: 50 Marks |

**Pre-Requisites**: CAD/CAM-Automation, Manufacturing Technology

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

| | |
|---|---|
| CO1 | Identify potential areas for automation and justify need for automation |
| CO2 | Apply suitable major control components required to automate a process or an activity |
| CO3 | Organize application of automation to translate and simulate a real time activity using |
| CO4 | Evaluate suitable automation hardware for the given application |
| CO5 | Illustrate Automated Material Movement and Storage System |
| CO6 | Illustrate Automatic Material Handling and Storage systems-II |

**Course Contents:**

| | |
|---|---|
| **Unit 1: Introduction**<br>Introduction: Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automation. Flow lines & Transfer Mechanisms, Fundamentals of Transfer Lines. | [6] |
| **Unit 2: Material handling and Identification Technologies**<br>Overview of Material Handling Systems, Principles and Design Consideration, Material Transport Systems, Storage Systems, Overview of Automatic Identification Methods. | [7] |
| **Unit 3: Automated Manufacturing Systems**<br>Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS, FMS and its Planning and Implementation. Quality Control Systems: Traditional and Modern Quality Control Methods, SPC Tools, Inspection Principles and Practices, Inspection Technologies. capabilities of a Machining Centers | [6] |



HEAD
Dept. Of Automation and Robotics

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|---|---|
| **Unit 4: Control Technologies in Automation:**<br>Control Technologies in Automation: Industrial Control Systems, Process Industries versus Discrete Manufacturing Industries, continuous Versus Discrete Control, Computer Process and its Forms. | [6] |
| **Unit 5: Automated Material Movement and Storage System-I**<br>Introduction, Types of AGV and Their principle of working, Advantages, Limitation and General AGV Guide path, Robots, Benefits of using Industrial Robots, Basic components and benefits of Automated Storage and Retrieval Systems, Conveyors and Pallet Flotation System, Queuing Carrousels and Automatic Work Changers, Coolant and Chip Disposal and Recovery system. | [6] |
| **Unit 6: Automatic Material Handling and Storage systems-II**<br>Design Considerations in Material Handling, Material Transport Equipment-Industrial Trucks, Automated Guided Vehicles, Monorails and Other Rail-Guided Vehicles, Conveyors, Cranes and Hoists, Analysis of Vehicle Based Systems, Conveyor Analysis. Automated Storage/Retrieval Systems, Carousel Storage Systems, Engineering Analysis of AS/RS and Carousel Systems | [7] |

**Text Books:**

1. S. R. Deb; Sankha Deb. Robotics Technology and Flexible Automation, Second Edition McGraw-Hill Education: New York, 2010.
2. M. P. Grover, Zimmer, "CAD/CAM/CIM", Prentice Hall India.

**Reference Books:**

1. H. K. Shivanand, M. M. Benal, Flexible Manufacturing System, V. Koti, New Age Pub. ISBN:9386070227
2. Automation, Production Systems and Computer Integrated Manufacturing, Groover M.P, Prentice Hall of India, ISBN: 9789332572492
3. CAD/CAM, Groover M.P, Zimmers E.W, Prentice Hall of India, ISBN: 9780132440813
4. Approach to Computer Integrated Design and Manufacturing, Nanua Singh, John Wiley and Sons,ISBN:9780471585176
5. Principles of CIM, Vajpayee, PHI, ISBN: 9788120314764
6. Flexible Manufacturing Cells and Systems



HEAD

**B. Computer Integrated Manufacturing**

| | | | | |
|---|---|---|---|---|
| AR504B | PEC | Computer Integrated Manufacturing | 3-0-0 | 3 Credits |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lecture: 3 hrs/week | Continuous Assessment –I :10 Marks<br>Continuous Assessment –II :10 Marks<br>Mid Semester Exam: 30 Marks<br>End Semester Exam: 50 Marks |

**Pre-Requisites**: CAD/CAM-Automation

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

| | |
|---|---|
| CO1 | Explain the basic concepts of CAD, CAM and computer integrated manufacturing system |
| CO2 | Summarize the production planning and control and computerized process planning |
| CO3 | Differentiate the different coding systems used in group technology |
| CO4 | Explain the concepts of flexible manufacturing system (FMS) and automated guided vehicle (AGV) system |
| CO5 | Illustrate automated material handling and storage systems for a typical production system |
| CO6 | Apply the industrial robotics |

**Course Contents:**

| | |
|---|---|
| **Unit 1 Introduction**<br>Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control-Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerized elements of CIM system – Types of production -Manufacturing Control –Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In-Time Production. | [7] |
| **Unit 2 Production Planning And Control And Computerized Process Planning**<br>Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control-Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP). | [7] |



HEAD

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|---|---|
| **Unit 3 Cellular Manufacturing**<br>Group Technology(GT), Part Families – Parts Classification and coding –Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method - Arranging Machines in a GT cell. | [7] |
| **Unit 4 Flexible Manufacturing System (FMS) and Automated Guided Vehicle System (AGVS)**<br>Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control – Quantitative analysis in FMS –Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety. | [7] |
| **Unit 5 Automatic Material Handling and Storage system**<br>Design Considerations in Material Handling, Material Transport Equipment-Industrial Trucks, Automated Guided Vehicles, Monorails and Other Rail-Guided Vehicles, Conveyors, Cranes and Hoists, Analysis of Vehicle Based Systems, Conveyor Analysis. Automated Storage/Retrieval Systems, Carousel Storage Systems. | [6] |
| **Unit 6 Smart Manufacturing**<br>Introduction to additive manufacturing, IoT, Smart Sensing, Smart Machines, Data Visualization and Analysis, Augmented Reality, Cyber-security for manufacturing. | [6] |

**Text Books:**

1"Automation, Production Systems and Computer Integrated Manufacturing", Groover, M.P. Pearson Education, ISBN: 81-7808-511-9 2nd Edition (2004).

2. Industrial Instrumentation and Control By. S.K. Singh The McGraw Hill Companies

**Reference Books:**

1. Mikell P Groover, Automation, production Systems and Computer Integrated Manufacturing, 3 rdEdition, Prentice Hall Inc., New Delhi, 2012.

2. Nanua Singh, System Approach to Computer Integrated Manufacturing, Wiley & Sons Inc., 1996.

3. Andrew Kusiak, Intelligent Manufacturing System, Prentice Hall Inc., New Jersey, 1992PHI

4. Automation, Production Systems and Computer Integrated Manufacturing: M.P. Groover, Pearson Education.

5. Computer Based Industrial Control- Krishna Kant, EEE-PHI,2nd edition,2010 3. An Introduction to Automated Process Planning Systems- Tiess Chiu Chang &Richard A.Wysk

64. Performance Modeling of Automated Manufacturing Systems,- Viswanandham



HEAD

## C. Applied Robotics

| | | | | |
|---|---|---|---|---|
| AR504C | PEC | Applied Robotics | 3-0-0 | 3 Credits |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lecture: 3 hrs/week | Continuous Assessment –I :10 Marks |
| Tutorial: 1hr/week | Continuous Assessment –II :10 Marks |
| | Mid Semester Exam: 30 Marks |
| | End Semester Exam: 50 Marks |

**Pre-Requisites**:

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

| | |
|---|---|
| CO1 | Apply various types of Industrial, field and service Robots and their characteristics and |
| CO2 | Identify with the knowledge of Mathematical modeling of specialized Robots. |
| CO3 | Organize the operation of Robots and processes involved |
| CO4 | Select the right Robot with required configurations and specifications for applications. |
| CO5 | Explain with the applications of various field and service Robots. |
| CO6 | Summarize with the applications of Future of robotics . |

**Course Contents:**

| | |
|---|---|
| **Unit 1: Applications of Robots in Industries**<br>Introduction to robotics - overview, A short history of industrial Robots - Applications of Robots in Welding, car body assembly, painting- Applications of Robot in Machining, material transfer- Kinematics and mechanisms review, tasks descriptions, teaching and programming- End-effectors and system integration | [8] |



HEAD
Dept. Of Automation & Robotics

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|---|---|
| **Unit 2: Cooperative and Swarm Robots**<br>Cooperative manipulation, Challenges in cooperative manipulation- Case studies for Cooperative manipulation for Industrial and Service applications- Introduction to swarm Robots, comparison with other multi-agent systems, challenges and benefits of swarm systems- Algorithms for swarm Robots, application, case study of swarm Robots. | [7] |
| **Unit 3: Field Robotics**<br>Forestry, Robot locomotion, forestry automation, SLAM in forestry- autonomous Robots for silviculture and treatment- Broad acre Applications: Automatic guidance, sowing, weeding, spraying and broad-acre harvesting, Horticulture: picking of fruits- Robot milking, sheep shearing, slaughtering, livestock inspection- Robots in construction, unsolved problems in construction, | [8] |
| **Unit 4: Robots In Surgery And Rehabilitation**<br>Medical robotics, Core concepts, Technology- Medical robotic systems, Research areas and applications- Rehabilitation and Health care robotics: Overview, physical therapy and training Robots- Aids for people with disabilities- Smart prostheses and orthoses, diagnosis and monitoring. | [7] |
| **Unit 5: Entertainment and Personal Robotics**<br>Cleaning Robots, lawn moving Robots- Smart appliances and smart homes- The role of Robots in education, Educational robotic platforms-. Robots and informal learning venues | [6] |
| **Unit 6: Future Robotics**<br>Future directions- Robots for hazardous applications, enabling technologies Search and Rescue robotics: Disaster characteristics-Impact on Robots, Robots actually used at disaster, promising robots, open issues – case studies. | [6] |

**Text Books:**

1.Bruno Siciliano, OussamaKhatib, —Springer Handbook of Roboticsl, Springer-Verlag Berlin Heidelberg 2008.

2. Yangsheng Xu Huihuan Qian Xinyu Wu, "Household and Service Robots", Elsevier Ltd, 2015.



HEAD

**Reference Books:**

1 1. AleksandarLazinica, —Mobile Robots Towards New Applications‖, Advanced Robotic Systems International, 2006.

2. Gregory Dudek,Michael Jenkin, —Computational Principles of Mobile Robotics‖, 2nd edition, Oxford University Press, 2010.

3. L Marques,A de Almeida,Mo Tokhi,GSVirk, —Advances in Mobile Robotics‖, World Scientific Publishing Co. Pte. Ltd. 2008..



HEAD

**D. Electrical Machine and Drives**

| | | | | |
|---|---|---|---|---|
| AR504D | PEC | Electric Machines and Drives | 3-0-0 | 3 Credits |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lecture: 3 hrs/week | Continuous Assessment –I :10 Marks<br>Continuous Assessment –II :10 Marks<br>Mid Semester Exam: 30 Marks<br>End Semester Exam: 50 Marks |

**Pre-Requisites**: Basic Electrical Engineering

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

| | |
|---|---|
| CO1 | Demonstrate construction and working principle of various electric machine |
| CO2 | Illustrate laws of electromagnetic and electro-mechanics, constructional features of Transformer and DC Machines, Characteristics and their operations |
| CO3 | Design and model DC machines |
| CO4 | Explain the implications of those parameters are on performance of system operating those machines. |
| CO5 | Explain the Synchronous Machines and Special Machines: Stepper Motor and Servo Motor |
| CO6 | Explain basic of selection of drive for a given application |

**Course Contents:**

| | |
|---|---|
| **Unit 1 :Introduction to Electric Machine**<br>Basic Principle, Types and constructional Features of Electric machines, Recent Trends in Research and Development in Electrical Machines, Magnetic circuit, Magnetic Materials and their properties ,Magnetically Induced EMF and Force, AC operation of Magnetic circuit, Hysteresis and Eddy-Current Losses Permanent Magnet ,Application of Permanent Magnet Materials | [7] |
| **Unit 2: Transformers**<br>Introduction,TransformerConstructionandPracticalConsiderations,Transformerload,Ideal Transformer,RealTransformerandEquivalentCircuit ,Transformer Losses, Transformer Testing, Efficiency and Voltage Regulation, Excitation Phenomenon in Transformers, Autotransformers, Variable Frequency Transformer | [6] |



HEAD
Dept. Of Automation And

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|---|---|
| **Unit 3 : Principle of Rotating Machines** Introduction, Energy in Magnetic System, Field Energy and Mechanical Force, Multiply-Excited Magnetic Field Systems, Forces/Torques in Systems with Permanent Magnets, Energy Conversion via Electric Field, Dynamical Equations of Electromechanical Systems<br>**DC Machines**<br>Basic principles of electromagnetic energy conversion, Construction ,operation, characteristics, performance of dc generators and motors, testing of dc machines, applications | [7] |
| **Unit 4 :Induction machines**<br>Construction, working principle, equivalent circuit, torque-slip curves, performance calculation, starting, speed control of three-phase inductionmotors.CoggingandCrawling.Hightorque-cagemotors.Inductiongenerator | [7] |
| **Unit 5: Synchronous Machines**<br>Construction, basic principles and theory of cylindrical and salient pole synchronous machines. Equivalent circuit, Working principle, starting, Operation and applications of synchronous motors<br>**Special Machines: Stepper Motor and Servo Motor**<br>Stepper motor general construction, working principle, electric circuit and applications<br>Servo motor general construction, working principle, electric circuit and applications | [7] |
| **Unit 6:Electrical Drives**<br>Type of Electrical Drives – Selection & factors influencing the selection – heating and cooling curves – loading condition and classes of duty – determination of power rating – simple problems<br>Solid State Drives -Advantages of solid state drives – D.C. motor control using rectifiers and choppers – control of induction motor by V, V/f and slip power recovery scheme using inverters and A.C. power regulators. | [6] |

**Text Books:**

1. Stephen J. Chapman, ElectricMachineryFundamentals'4thedition,McGrawHillEducationPvt.Ltd, 2010.
2. P.C.Sen Principles of Electric Machines and power ElectronicsJohnWiley&Sons;3rdEdition 2013
3. Nagrath,I.J.andKothari.D.P.,ElectricMachines',McGraw-HillEducation,2004

**Reference Books:**

1. Theodore Wildi, -Electrical Machines, Drives, and Power Systems ,Pearson Education.,(5th Edition), 2002.
2. B.R. Gupta , 'Fundamental of Electric Machines' New age InternationalPublishers,3rd Edition ,Reprint 2015.
3. Surinder Pal Bali ,Electrical Technology Machines& easurements,Vol.II,Pearson,2013
4. Fitzgerald.A.E.,CharlesKingselyJr,StephenD.Umans,_ElectricMachinery',Sixth edition McGraw Hill Books Company, 2003.



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**Fluid and Thermal Engineering**

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|---|---|---|---|---|
| AR 505 | PCC | Fluid and Thermal Engineering | 3-0-0 | 3 Credits |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lecture: 3 hrs/week | Continuous Assessment –I :10 Marks<br>Continuous Assessment –II :10 Marks<br>Mid Semester Exam: 30 Marks<br>End Semester Exam: 50 Marks |

**Pre-Requisites**:

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

| | |
|---|---|
| CO1 | Compare various fluid properties in engineering applications |
| CO2 | Apply Bernoulli's equation to fluid flow problems |
| CO3 | Interpret issues related to fluid flow losses in hydraulic circuits |
| CO4 | Explain working air compressors and USE of compressed air in pneumatic circuits |
| CO5 | Analyze importance of dimensional analysis for model and prototype testing |
| CO6 | Make use of sources of heat and remedies of heat removal in electronic circuits |

**Course Contents:**

| | |
|---|---|
| **Unit 1 Properties of Fluids**<br>Characteristics of fluids, Mass density, Specific density, specific gravity, Dynamic viscosity, Kinematic viscosity, Surface tension, capillarity, compressibility, Vapour pressure. Fluid Statics: Pascal's law, Pressure at a point, Total pressure, Centre of pressure, Pressure on a plane, Inclined and curved surfaces, Buoyancy, Metacenter and Meta-centric height, stability of submerged and floating bodies | [8] |
| **Unit 2 Introduction of Fluid Kinematics**<br>Types of flows, continuity equation (Cartesian coordinate), velocity and acceleration, visualization of flow field (stream, path and streak Line); Stream function and velocity | [7] |



HEAD
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| potential function. (Simple numerical). Fluid Dynamics Euler's equation of motion along a stream line, Derivation of Bernoulli's equation, Applications of Bernoulli's equation, Venturimeter, Orifice meter, Notches, pitot tube (No derivation and numerical for notches and pitot tube). | |
| **Unit 3 Flow through Pipes and Internal flow**<br>Flow through Pipes: Darcy-Weisbach equation, major and minor losses, Pipes in series Pipes in parallel and concept of Equivalent Pipe, Siphons, Transmission of Power (no derivations for minor losses).<br>Internal flow: Laminar and Turbulent flow physics, Velocity and shear stress distribution for laminar flow in a pipe, fixed parallel plates (simple numerical on velocity, pressure gradient and shear stress). | [8] |
| **Unit 4 Dimensional Analysis and Lift & Drag**<br>Dimensional Analysis and modeling: Significance, Buckingham's Pi Theorem, Similitude, types of similitude. Model and prototype testing<br>Lift and Drag: Friction and pressure drag. Drag and lift coefficients of common geometries. | [7] |
| **Unit 5 Air Compressor**<br>Uses of compressed air, classification of compressors, Reciprocating compressor constructional details of single and multistage compressor, computation of work done, isothermal work done, isothermal efficiency, effect of clearance, volumetric efficiency, need of multi-staging, intercooling and after-cooling. Rotary Air Compressor: Basic principles, classification, construction, working of roots, vane, scroll, Centrifugal and axial compressors. (Descriptive treatment only). | [6] |
| **Unit 6 Heat Transfer**<br>Introduction and Basic Concepts: Application areas of heat transfer, Modes and Laws of heat transfer, Three dimensional heat conduction equation in Cartesian coordinates and its simplified equations, thermal conductivity,Thermal diffusivity, Thermal contact Resistance Thermal Insulation: Types and selection, Economic and cost considerations, Payback period Introduction to heat pipe, Introduction to electronic cooling - Discussion on active and passive methods. | [6] |

**Text Books:**

1. Sukumar Pati, "Fluid Mechanics and Hydraulics Machines", TATA McGraw Hill.
2. Munson, Young and Okiishi, "Fundamentals of Fluid Mechanics", Wiley India
3. Modi P. N. and Seth S. M, "Hydraulics and Fluid Mechanics", Standard Book House.
4. P.K. Nag, Heat & Mass Transfer, McGraw Hill Education Private Limited.
5. M.M. Rathod, Engineering Heat and Mass Transfer, Third Edition, Laxmi Publications.
6. V. M. Domkundwar, Heat Transfer, Dhanpat Rai & Co Ltd.

**Reference Books:**

1. Kundu, Cohen, Dowling, "Fluid Mechanics", Elsevier India
2. Potter Wiggert, "Fluid Mechanics", Cengage Learning
3. Fox, Pichard, "Introduction to Fluid Mechanics", McDonald- Wiley
4. Bela G. Liptak, Instrument Engineers' Handbook – Process Control and Optimization, Volume I & II, Taylor & Francis



HEAD

5. Franck P. Incropera, David P. DeWitt – Fundamentals of Heat and Mass Transfer,
6. Y. A. Cengel and A.J. Ghajar, Heat and Mass Transfer – Fundamentals and Applications, Tata McGraw Hill Education Private Limited.
7. S.P. Sukhatme, A Textbook on Heat Transfer, Universities Press.



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**Industrial Automation Laboratory**

| | | | | |
|---|---|---|---|---|
| AR506 | PCC | Industrial Automation Laboratory | 0-0-2 | 1 Credits |

| Teaching Scheme: | Evaluation Scheme: |
|---|---|
| Practical: 2 hours/week/batch | Continuous Assessment –I :15 Marks<br>Continuous Assessment –II :15 Marks<br>End Semester Exam: 20 Marks |

**Pre-Requisites:**

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

| | |
|---|---|
| CO1 | Develop the circuits for hydraulic and pneumatic systems. |
| CO2 | Develop the circuits for Electro-hydraulic and Electro-pneumatic systems. |
| CO3 | Develop the PLC Circuits for different application |
| CO4 | Demonstrate about SCADA system |

**List of Experiments:**

At least minimum 8 experiments should be performed from the following list

1 Minimum two circuits on Pneumatics to be developed on Pneumatic trainer kit

2. Minimum two circuits on Electro-Pneumatics to be developed on Electro Pneumatic trainer kit

3. Minimum two circuits on Hydraulics to be developed on Hydraulic trainer kit

4. Demonstration of different types of control valves used in hydraulic and pneumatic system.

5. Study of ISO/JIC Symbols for hydraulic and pneumatic systems.

6 PLC Programming on Industrial Applications based on Timers, Counters, Internal Relays (Minimum 4 applications)

7. Demonstration of SCADA system with any one application

8.Industrial visit to study Mechatronics system application and submission of visit report



HEAD

**Text Books:**

1. Antony Espossito, "Fluid power with Applications ", Pearson, Sixth Edition., 2003.
2. W. Bolton, "Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering" - PrenticeHall - 2013 - 5 th Edition Singh, Shio Kumar.
3. Industrial Instrumentation & Control, Tata McGraw-Hill Education, 2010
4. Mikell P Groover, "Automation Production Systems and Computer- Integrated Manufacturing"Pearson Education, New Delhi, 2001.

**Reference Books:**

1. Mechatronics – W. Bolton, Pearson education
2. Mechatronics – Mahalik, TATA McGraw Hill
3. Mikell P Groover, "Industrial Robots – Technology Programmes and Applications" , McGraw Hill ,New York, USA. 2000.
4. Mechatronics – Appu Kuttam, Oxford publications
5. Introduction to PLC programming, NIIT,
6. Programmable logical controller, Hackworth, Pearson Education
7. Programmable logical controller, Reis Webb, Prentice Hall
8 Mechatronics and Microproceesor by Ramchandran Willey India
9 Mechatronics : Integrated Mechanical Electronic System by Ramchandran Willey India
10. Programmable logical controller,3e Gary Dunning Cengage Learning
11.Mechatronics Source Book by N C Braga Cengage Learning
12. Fluid Power with Applications by Anthony Esposito - Pearson Education 2000.
13. Power Hydraulics by Michael J, Prinches and Ashby J. G, - Prentice Hall, 1989 .



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## Robot Kinematics and Dynamics Laboratory

| | | | | |
|---|---|---|---|---|
| AR507 | PCC | Robot Kinematics and Dynamics Laboratory | 0-0-2 | 1 Credits |

| Teaching Scheme: | Evaluation Scheme: |
|---|---|
| Practical: 2 hours/week/batch | Continuous Assessment –I :25 Marks<br>Continuous Assessment –II :25 Marks |

**Pre-Requisites:**

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

| | |
|---|---|
| CO1 | Demonstrate analysis of robot manipulators. |
| CO2 | Illustrate the functionality and limitations of robot actuators. |
| CO3 | Develop program a robot to perform a specified task in a target environment and solve problems in areas suh as robot control and navigation. |

**Text Books:**

**List of Experiments:**

At least minimum 8 experiments should be performed from the following list

1. Determination of maximum and minimum position of links.
2. Verification of transformation (Position and orientation) with respect to gripper and world coordinate system
3. Estimation of accuracy, repeatability and resolution.
4. Robot programming and simulation for any industrial process (Packaging, Assembly)
5. Demonstration of various robotic configurations using an industrial robot



HEAD
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6. Demonstration components of a real robot and its DH parameters.

7. One Industrial visit for Industrial robotic application

8. Case study for industrial robotics.

9.Virtual Modeling For Kinematic And Dynamic Verification Any One Robotic Structure Using Suitable Software

1. Groover, M.P. Weiss, M. Nagel, R.N. & Odrey, N.G., Ashish Dutta, Industrial Robotics, Technology, Programming & Applications, Tata McGraw Hill Education Pvt. Ltd. New Delhi
2. S. R. Deb, Robotics Technology and Flexible Automation, Tata McGraw Hill.
3. Groover M.P.-Automation, production systems and computer integrated manufacturing-Prentice Hall of India.

**Reference Books:**

1. S B Niku, Introduction to Robotics, Analysis, Control, Applications, 2nd Edition, Wiley Publication, 2015.
2. Mikell P. Groover, Automation, Production Systems & Computer Integrated Manufacturing, PHI Learning Pvt. Ltd. , New Delhi, ISBN:987-81-203-3418-2, 2012
3. John Craig, Introduction to Robotics, Mechanics and Control, 3rd Edition, Pearson Education, 2009
4. R K Mittal & I. J. Nagrath, Robotics and Control, McGraw Hill Publication, 2015.
5. Mike Wilson, Implementation of Robotic Systems, ISBN: 978-0-124-04733-4



HEAD

## IoT Laboratory

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| AR508 | PCC | IoT Laboratory | 0-0-2 | 1 Credits |

| Teaching Scheme: | Evaluation Scheme: |
|---|---|
| Practical: 2 hours/week/batch | Continuous Assessment –I :15 Marks<br>Continuous Assessment –II :15 Marks<br>End Semester Exam: 20 Marks |

**Pre-Requisites:**

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

| | |
|---|---|
| CO1 | Develop the interfacing of IoT with Rasberry Pi. |
| CO2 | Design utilizing state of the art hardware boards and software's as per industry standards. |
| CO3 | Make use of research activities in different application areas of IoT |
| CO4 | Develop communication skills and capability to work in team |

**List of Experiments:**

At least minimum 8 experiments should be performed from the following list.

1. Concepts of IoT ,Arduino and Raspberry Pi
2. Interfacing of Buzzer with Arduino Uno
3. Interfacing of Ultrasonic sensor with Arduino Uno
4. Interfacing of Servo motor with Arduino Uno
5. Interfacing of LED and Tricolor LED with Raspberry Pi
6. Interfacing of Push Button Switch with Raspberry Pi
7. Interfacing of 7 segment display with Raspberry Pi
8. Interfacing of PIR Motion sensor with Raspberry Pi
9. Interfacing of Temperature and humidity (DHT11) sensor using IoT



HEAD
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| 10 | Interfacing of 16 X 2 LCD Display using IoT |

**Text Books:**

1. Foundational Elements of an IOT Solution - The Edge, Cloud and Application Development, Joe Biron& Jonathan Follett, Oreilly, First Edition, March 2016

2. Designing Connected Products, 1st Edition, Elizabeth Goodman, Alfred Lui, Martin Charlier, Ann Light, Claire Rowland

3. The Internet of Things (A Look at Real World Use Cases and Concerns), Kindle Edition, 2016, Lucas Darnell

**Reference Books:**

1.Bahga A, Madisetti V. Internet of Things: A hands-on approach; 2014.

2.Tanenbaum A S. Computer Networks. Fifth Edition, Pearson Education India; 2013.

3. Shriram K Vasudevan, Abhishek SN and Sundaram RMD. Internet of Things, First Edition, Wiley India;2019.

4.Raj P, Raman AC. The Internet of things: Enabling Technologies, Platforms, and Use-cases. Auerbach Publications; 2017.

5,Adrian McEwen. Designing the Internet of Things, Wiley;2013.



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**Fluid and Thermal Engineering Laboratory**

| | | | | |
|---|---|---|---|---|
| AR509 | PCC | Fluid and Thermal Engineering Laboratory | 0-0-2 | 1 Credits |

| Teaching Scheme: | Evaluation Scheme: |
|---|---|
| Practical: 2 hours/week/batch | Continuous Assessment –I :25 Marks<br>Continuous Assessment –II :25 Marks |

**Pre-Requisites:**

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

| | |
|---|---|
| CO1 | Interpret basic physics of fluids. |
| CO2 | Explain different hydraulic devices and working of hydroelectric power plant |
| CO3 | Experiment with different types of pumps. |
| CO4 | Make use of thermal engineering concepts in the design of engineering equipment/ systems |

**List of Experiments:**

At least minimum 8 experiments should be performed from the following list.

1. Determination of pressure using manometers (minimum two)
2. Determination of fluid viscosity and its variation with temperature.
3. Verification of modified Bernoulli's equation.
4. Determination of minor/major losses through metal/non-metal pipes.
5. Trial on Reciprocating compressor
6. Study and Trial on blower
7. Determination of Thermal Conductivity of insulating powder.
8. Determination of Thermal Conductivity of metal rod.
9. Study and trial on heat pipe
10. Determination of overall heat transfer coefficient and effectiveness in a Parallel flow and Counter flow Heat Exchanger
11. Determination of thermal co-efficient of natural convection
12. Industrial visit report



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**Text Books:**

1. Sukumar Pati, "Fluid Mechanics and Hydraulics Machines", TATA McGraw Hill.
2. Munson, Young and Okiishi, "Fundamentals of Fluid Mechanics", Wiley India
3. Modi P. N. and Seth S. M, "Hydraulics and Fluid Mechanics", Standard Book House.
4. P.K. Nag, Heat & Mass Transfer, McGraw Hill Education Private Limited.
5. M.M. Rathod, Engineering Heat and Mass Transfer, Third Edition, Laxmi Publications.
6. V. M. Domkundwar, Heat Transfer, Dhanpat Rai & Co Ltd.

**Reference Books:**

1. Kundu, Cohen, Dowling, "Fluid Mechanics", Elsevier India
2. Potter Wiggert, "Fluid Mechanics", Cengage Learning
3. Fox, Pichard, "Introduction to Fluid Mechanics", McDonald- Wiley
4. Bela G. Liptak, Instrument Engineers' Handbook – Process Control and Optimization, Volume I & II, Taylor & Francis
5. Franck P. Incropera, David P. DeWitt – Fundamentals of Heat and Mass Transfer,
6. Y. A. Cengel and A.J. Ghajar, Heat and Mass Transfer – Fundamentals and Applications, Tata McGraw Hill Education Private Limited.
7. S.P. Sukhatme, A Textbook on Heat Transfer, Universities Press.



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## Java Programming Laboratory

| | | | | |
|---|---|---|---|---|
| AR510 | PCC | Java Programming Laboratory | 0-0-2 | 1 Credits |

| Teaching Scheme: | Evaluation Scheme: |
|---|---|
| Practical: 2 hours/week/batch | Continuous Assessment –I :15 Marks<br>Continuous Assessment –II :15 Marks<br>End Semester Exam: 20 Marks |

**Pre-Requisites:**

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

| | |
|---|---|
| CO1 | Apply the concept of multithreading and implement exception handling. |
| CO2 | Apply and access data from a Database with java program |
| CO3 | Develop java programs using interfaces |
| CO4 | Develop applications using Console I/O and File I/O,GUI applications |

**Text Books:**

1. Herbert Schildt, The Complete Reference Java2.0, Fifth edition, TATA McGraw-Hill

**List of Experiments:**

At least minimum 20 experiments should be performed from the following list.

1. Setup java programming environment by using:
   a)Command Prompt Any IDE(Eclipse, J creator etc.)
2. Test the IDE setup by implementing small program.
3. Develop program to demonstrate use of IF statement and its different forms.
4. Develop programs to demonstrate use of
   a)Switch Case statement
   b)Conditional If(?:)
5. Develop programs to demonstrate use of looping statement 'for'
6. Develop programs to demonstrate use of 'while' , 'do while'
7. Develop program for implementation of implicit type casting in Java Part I
8. Develop program for implementation of implicit type casting in Java Part II
9. Develop program for implementation of explicit type conversion in Java
   a) Develop program for implementation of constructor.
   b) Develop program for implementation of multiple constructors in a class.
10. Develop program for implementation of different functions of String Class Part I
11. Develop program for implementation of different functions of String Class Part II
12. Develop program for an implementation of arrays in java
13. Develop program for an implementation of vectors in java



HEAD
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14. Develop program for an implementation of wrapper class to convert object into primitive.
15. Develop program for an implementation of wrapper class to convert primitive into objects
16. Develop program which implements concept of overriding
17. Develop program which implements single and multilevel inheritance
18. Develop program which implements multiple inheritances.
19. Develop a program to import different classes in package
20. Develop program for implementation of multithreading operations Part I
21. Develop program for implementation of multithreading operations Part II
22. Develop program for implementation of try, catch block Part I
23. Develop program for implementation of try, catch block Part II
24. Develop program for implementation of try, catch, finally block.
25. Develop program for implementation of throw, throws clause Part I
26. Develop program for implementation of throw, throws clause Part II
27. Develop minimum two basic applets. Display output with applet viewers and graphics.
    a)Develop program on basic applet.
    b)Develop a program using control loops in applets
28. Write a program to create animated shape using graphics and applets.
    a)Line and Rectangles
    b)Circles and Ellipse
    c)Arcs
    d)Polygons with fill Polygon methods
29. Develop a program to draw following shapes, graphics and applets
    a)Cone
    b)Cylinders
    c)Cube
    d)Square inside a circle
    e)Circle inside a square
30. Develop a program to implementation of I/O stream classes
31. Develop a program to implementation of File stream classes

Company.

2. Phil Hanna, JSP : Complete Reference, TATA McGraw-Hill Company

3. Debasish Jana, Java and Object-Oriented programming Paradigm, PHI. 4. Jana, Java and Object Oriented Programming Paradigm, PHI (2007).

**Reference Books:**

1. Professional Java Programming by Brett Spell, WROX Publication
2. Advanced Java 2 Platform, How to Program, 2nd Edition, Harvey. M. Dietal, Prentice



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Hall.

3. Advanced Java, Gajendra Gupta , Firewall Media.



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## Linear Integrated Circuits

| | | | | |
|---|---|---|---|---|
| AR 511 | PCC | Linear Integrated Circuits | 1-0-0 | Audit |

| **Teaching Scheme:** | **Examination Scheme:** |
|---|---|
| Lecture: 2 hrs/week | Continues Assessment 1: 25 Marks<br>Continues Assessment 2: 25 Marks |

Pre-Requisites:

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

| | |
|---|---|
| CO1 | Explain the characteristics of IC & op-amp parameters |
| CO2 | Explain applications of op-amp |
| CO3 | Discuss IC 555 for various applications |
| CO4 | Discuss oscillators and Multi-vibrator using op-amp |
| CO5 | Design waveform generation |
| CO6 | Relate and implement different converters using op-amp |

**Course Contents:**

| | |
|---|---|
| **Unit 1 Introduction to op-amp**<br>Block diagram of OP-AMP, Differential Amplifier configurations, level shifter, current mirror circuits, and Op-Amp parameters. OP-AMP configurations, Study of op-amp Data Sheets, study of IC 741. | [2] |
| **Unit 2 Applications of op-amp**<br>Summing, Scaling & Averaging Amplifiers using Op-amps, Differential amplifier using op-amp, Subtractor Circuit, Instrumentation amplifier, Schmitt Trigger. | [3] |
| **Unit 3 Special purpose ICs**<br>IC 555 Timer: Block Diagram, Operating Principle, Multi-vibrator using IC 555. IC 565 PLL: Operating Principles, applications, Introduction to voltage regulator. | [3] |
| **Unit 4 Oscillator and Multi-vibrator**<br>Analysis & Design of RC phase shift oscillator, Wein-bridge oscillator, Colpitts oscillator, Astable, Monostable multivibrator | [3] |



HEAD
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| **Unit 5 Waveform Generators**<br>Analysis & Design of Square wave generator, Triangular wave generator, Sawtooth wave generator. | [3] |
| **Unit 6 System Design Using Op-amp**<br>Analog to digital Converter, Digital to analog Converter, V to I & I to V Converter, voltage to frequency converter. | [3] |

**Text Books:**

1. Ramakant A. Gaikwad, "Op Amps and Linear Integrated Circuits", Pearson Education second and latest edition

**Reference Books:**

1. Robert Coughlin, Fredric Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Sixth edition, PE, 2006.
2. David Bell, "Operational Amplifiers and Linear ICs", Third edition, Oxford University Press \
3. B. Somanathan Nair, "Linear Integrated Circuits- Analysis, Design & Applications", Wiley India.
4. T.R Ganesh Babu, "Linear Integrated Circuits" 3rd Edition, Scitech Publication
5. David. A. John & Ken Martin "Analog Integrated Circuit Design", Student Edition, Wiley
6. Sergio Franco "Design with op-amp & Analog Integrated Circuits" , 3rd Edition, Tata McGraw Hill.
7. Sergio Franco "Design with op-amp & Analog Integrated Circuits", 3rd Edition, Tata McGraw Hill.
8. S. Salivahanan & Bhaaskaran "Linear Integrated Circuits", 1st Edition, Tata McGraw Hill.



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**Industrial Safety**

| | | | | |
|---|---|---|---|---|
| MDC03 | MC | Industrial Safety | 2-0-0 | Audit |

| **Teaching Scheme:** | **Examination Scheme:** |
|---|---|
| Lecture: 2 hrs/week | Continues Assessment 1: 25 Marks<br>Continues Assessment 2: 25 Marks |

Pre-Requisites: NA

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

| | |
|---|---|
| CO1 | Illustrate the history of safety moments. |
| CO2 | Make use of safety techniques at industrial work environment |
| CO3 | Construct ergonomic interventions in repetitive works. |
| CO4 | Estimate rules and regulations for health, safety & environment. |
| CO5 | Illustrate rules and principles of safety in Engineering industries. |
| CO6 | Illustrate importance of safety education & training. |

**Course Contents:**

| | |
|---|---|
| **Unit 1: Introduction to Industrial safety**<br>History of Safety movement –Evolution of modern safety concept- general concepts of management –Safety policy - Safety Organization - line and staff functions for safety, budgeting for safety. | [2] |
| **Unit 2: Safety Techniques**<br>Incident Recall Technique (IRT), Job Safety Analysis (JSA), Components of safety audit, types of audit, audit methodology, non-conformity reporting (NCR), audit checklist and report – review of inspection safety survey, safety inspection, safety sampling, Safety Audit.) | [6] |



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| **Unit 3: Human Factors Engineering**<br>Applications of human factors engineering, man as a sensor, man as information processor, man as controller – Man vs Machine. Ergonomics interventions in Repetitive works, training prevention of manual handling injuries in the work place, postural stability, Personal protective equipment's | [4] |
| **Unit 4: Regulations for Health, Safety and Environment**<br>Safety committee and function, Role and responsibilities of safety officer, Role of safety department, Factories act and rules -. Indian explosive act - - Indian petroleum act and rules. Environmental pollution act Manufacture, Indian Electricity act and rules. | [4] |
| **Unit 5: Safety in Engineering**<br>Industry General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, grinding machines, CNC machines, , types, safety principles, electrical guards, work area, material handling, inspection, hazards | [4] |
| **Unit 6: Safety Education and Training**<br>Importance of training- -training methods –conferences, competitions – method of promoting safe practice - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training | [4] |

**Text Books:**

1. "Industrial safety management", L M Deshmukh, TATA McGraw Hill, 2010.
2. "Safety Management in Industry" Krishnan N.V. Jaico Publishing House, Bombay, 1997.

**Reference Books:**

1. "Industrial Accident Prevention" Heinrich H.W. McGraw-Hill Company, New York, 1980.
2. "Industrial Safety" Roland P. Blake, Prentice Hall, Inc., New Jersey, 1973
3. "Safety Management by John V. Grimaldi and Rollin H. Simonds, All India Travelers Book seller, New Delhi, 1989.
4. The Factories Act 1948, Madras Book Agency, Chennai, 2000.
5. Explosive Act, 1884 and Explosive rules, 1883 (India), (2002), Eastern Book company, Lucknow, 10thEdition 6.Human factors in engineering & design, MARK S.SANDERS



HEAD
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**Aptitude Skills–III**

| | | | | |
|---|---|---|---|---|
| HMS05 | HSMC | Aptitude Skills- III | 1-0-0 | 1 Credits |

| Teaching Scheme: | Examination Scheme: |
|---|---|
| Lecture: 1 hrs/week | Continues Assessment 1: 25 Marks<br>Continues Assessment 2: 25 Marks |

**Pre-Requisites:** Communication Skills, Aptitude Skills- I.

**Verbal Ability (12Hrs) (Compulsory)**

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

| | |
|---|---|
| CO1 | Solve the problems on system of equation |
| CO2 | Solve the problems on seating arrangement |
| CO3 | Solve the logical reasoning problems |
| CO4 | Solve the critical analysis problems |
| CO5 | Solve the problems of Data interpretation |
| CO6 | Solve the problems of permutations and Combinations |

| | |
|---|---|
| **Unit 1: Parts of Speech**<br>Word Family (Using the same word as different Parts of Speech), Punctuation | [2] |
| **Unit 2: Analogy**<br>Letter Writing (Formal), E-Mail Writing, CV Writing | [2] |
| **Unit 3: Reading Comprehension**<br>Reading Comprehension, Paragraph Jumbles | [2] |
| **Unit 4: Spotting Errors (in different parts of sentence)**<br>Spotting Errors (in different parts of sentence), Subject-Verb Agreement, Sentence Correction, Sentence Completion | [2] |
| **Unit 5: One Word Substitution**<br>One Word Substitution, Narrating Events/Reports Summary/Precise Writing | [2] |
| **Unit 6: Dialogue Writing Dialogue**<br>Writing, Group Discussion, Interview Skills (Using formal notations & gestures etc.) | [2] |
| **Text Books:**<br>1. Raymond Murphy, Essential English Grammar with Answers, Murphy | |



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2. Objective General English by R.S. Aggarwal, S Chand Publishing; Revised edition (15 March 2017)

**Reference Books:**

1. Rao N, D, V,Prasada, Wren & Martin High School English Grammar and Composition Book, S Chand Publishing, 2017
2. Murphy, Intermediate English Grammar with Answers, Cambridge University Press;Second edition



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**Language Skills- III**

| | | | | |
|---|---|---|---|---|
| HMS06 | HSMC | Language Skills- III | 0-0-2 | Audit |

| Teaching Scheme: | Examination Scheme: |
|---|---|
| Practical: 2 hrs/week | Continuous Assessment –I :25 Marks<br>Continuous Assessment –II :25 Marks |

**Pre-Requisites:** Communication Skills, Language Skills- I

**Languages (Any One)**

**Python Programming (Technical Language) (24Hrs)**

**Syllabus for Python**

**Course Objectives:** This course provides an opportunity to enhance acquisition of the fundamental elements of the Python language. Emphasis is on the progressive development of basic programming syntaxes and essentials used in Python.

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

| | |
|---|---|
| CO1 | Explain essentials and fundamentals of Python Programming. |
| CO2 | Illustrate data types and variables. |
| CO3 | Illustrate Operators and Expressions. |
| CO4 | Make a use of Decision making and Looping statements. |

| | |
|---|---|
| **Unit 1: Introduction**<br>What is Python, what can python do, why python, how to use Python, Python indentation, python comments, basic syntax of program ,first program of python | [6] |
| **Unit 2: Variable and data types**<br>Creating variable, casting, variable name, global variable, local variable, built in datatypes, string, constructor, function of data type, type conversion | [6] |
| **Unit 3 :Operators in Python**<br>Unary Operator ,Binary operator -:(arithmetic operator, logical operator ,assignment operator, ,membership operator ,identity operator ,bitwise operator ) , ternary operator | [6] |
| **Unit 4: Statements and loops**<br>Input & Output Statements ,Conditional Statements ,Simple if Statement ,If-else statement ,Else-if Ladder, Nested if statement, ,while loop ,for loop ,break ,continue ,pass statements | [6] |



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**Text Books:**

1. William Stalling "Cryptography & Network Security", PHI
2. Atul Kahate "Cryptography & Network Security", Mc Graw Hill

**Reference Books:**

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGrawHill.
2. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.
3. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.
4. Internet working with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.
5. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, Moduleed States of America.



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## Mini Project -IV

| | | | | |
|---|---|---|---|---|
| PRJ04 | PROJ | Mini Project IV | 0-0-2 | Audit |

| Teaching Scheme: | Examination Scheme: |
|---|---|
| Practical: 2 hrs/week | Continuous Assessment –I :25 Marks<br>Continuous Assessment –II :25 Marks |

**Pre-Requisites:** NA

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

| | |
|---|---|
| CO1 | Select the appropriate method for solving the problem |
| CO2 | Make use of various engineering techniques and tools to give a solution |
| CO3 | Justify the method/tools used to develop the solution. |
| CO4 | Demonstrate tangible solutions to the problem |
| CO5 | Describe the solution with the help of a project report and presentation. |

The project is a part of addressing societal and industrial needs. Mini project is one of the platforms that students will use to solve real-world challenges. This course focuses on the selection of methods/engineering tools/analytical techniques for problem-solving. Through this course, students gain a thorough understanding of engineering basics and ideas, gain practical experience, have the opportunity to display their skills and learn about teamwork, financial management, communication skills, and responsibility.

**Guidelines**

1. Every student shall undertake the Mini project activity for semester V.
2. The same group of minimum three and maximum of five students who were working for mini project III should work together in Mini project IV
3. The students have to work on different approaches and finalize the best methodology to solve the problem in consultation with the project guide.
4. The students should use different tools /Techniques for the development of the solution to the problem.
5. While developing solutions, the student can take care of effective use of resources, follow ethical practices, finance management,
6. The solution should be optimal, affordable, user-friendly and environment friendly.
7. Critically analysis and testing of the solution provided.



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8. By using IPR, students should reserve their rights of innovations as well as communicate new findings to society with the help of research papers.

The committee of senior faculty members and a project guide will be appointed to monitor the progress and continuous evaluation of each project. The assessment shall be done jointly by the guide and committee members.



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