



Shri Shamrao Patil (Yadavkar) Educational & Charitable Trust's
Sharad Institute of Technology College of Engineering
(An Autonomous Institute)

Yadav (Ichalkaranji)-416121, Dist. – Kolhapur

Teaching and Evaluation Scheme for T Y B.Tech.

Department of Automation and Robotics

Semester: V



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Dept. Of Automation And
Robotics Engineering
SITCOE, Yadav



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Yadrav (Ichalkaranji)-416121, Dist. – Kolhapur

Department: Automation & Robotics

Rev: Course Structure/00/2022-23

Class: T.Y. B. Tech

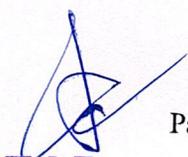
Semester: V

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
PRJ04	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




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Industrial Automation

AR501	PCC	Industrial Automation	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	Continuous Assessment –I :10 Marks Continuous Assessment –II :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

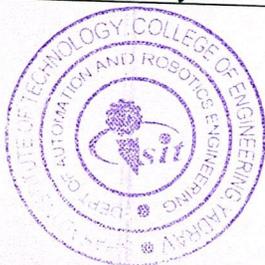
Pre-Requisites: CAD/CAM-Automation

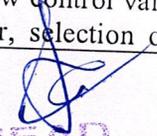
Course Outcomes: At the end of the course, students will be able to:

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 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 Basic elements of hydraulics/pneumatics, Application of Hydraulic system, Various elements with their function, Properties of hydraulic fluid, Various types of pump, 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	[7]




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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 3: Design and Operation of Electro-Pneumatic Logic Control Circuits 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 4: Programmable Logic Controllers (PLC) 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 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-In Touch, Vijeo Citec	[6]
Unit 6: SCADA Network Communication 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: <ol style="list-style-type: none">1. Antony Esposito, "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, 20104. Mikell P Groover, "Automation Production Systems and Computer- Integrated Manufacturing" Pearson Education, New Delhi, 2001.	
Reference Books: <ol style="list-style-type: none">1. Mechatronics – W. Bolton, Pearson education2. Mechatronics – Mahalik, TATA McGraw Hill3. Mikell P Groover, "Industrial Robots – Technology Programmes and Applications", McGraw Hill, New York, USA. 2000.4. Mechatronics – Appu Kuttam, Oxford publications5. Introduction to PLC programming, NIIT,6. Programmable logical controller, Hackworth, Pearson Education7. Programmable logical controller, Reis Webb, Prentice Hall8. 8 Mechatronics and Microprocessor by Ramchandran Willey India	





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- 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, Princes and Ashby J. G, - Prentice Hall, 1989.



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Robot Kinematics and Dynamics

AR502	PCC	Robot Kinematics and Dynamics	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	Continuous Assessment –I :10 Marks Continuous Assessment –II :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

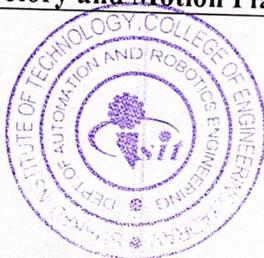
Pre-Requisites: Principles of Robotics, Kinematics and Theory of Machines

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 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 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 Representation of planer motion, Representation of spatial motion, Descriptions: Positions, Orientations, and Frames, Representation: Rotation, translation, transformation, Homogeneous transformation, Rolling, Pitching, and Yawing	[7]
Unit 4: Kinematics Analysis of robotic manipulators Forward and Inverse kinematics of robotic manipulators, Denavit Hartenberg Parameters, Rules for coordinate assignments, Robot coordinate system.	[7]
Unit 5: Trajectory and Motion Planning	[6]



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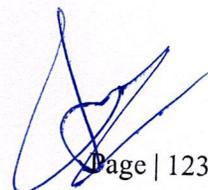


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Trajectory, General Considerations in Path Generation, work envelope of a robot, Cartesian space technique, Joint space technique- Cubic polynomial, Fifth order polynomial, Linear trajectory function, Robot motion planning, Sequence of robotic action, Motion planning approaches, classification of Robot motion planning	
Unit 6: Basics of Robotic Dynamics (Theory) 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, Miodir. 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., —Robotics, Tata McGraw Hill Publications, New Delhi. 6. Yoram Koren, "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, Dhanpat Rai & 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.	




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Internet of Things (IoT)

AR503	PCC	Internet of Things (IoT)	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	Continuous Assessment –I :10 Marks Continuous Assessment –II :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

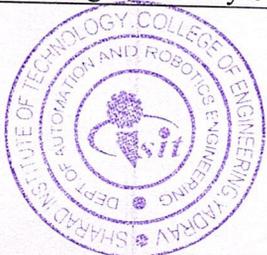
Pre-Requisites: Basic Electronics and Circuits

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 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 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 WPAN Technologies for IoT: IEEE 802.15.4, Zigbee, HART, NFC, Z-Wave, BLE, Bacnet, Modbus.	[7]
Unit 4: IoT Data Protocols 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 Development Challenges, Security Challenges, Other challenges.	[6]



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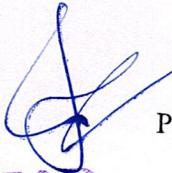


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Unit 6: IoT Applications	[6]
Home Automation, Smart Cities, Energy, Retail Management, Logistics, Agriculture, Health and Lifestyle, Industrial IoT, IoT design Ethics, IoT in Environmental Protection.	
Text Books:	
1. Olivier Hersent, David Boswarthick, 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 Madiseti and ArshdeepBahga, —Internet of Things (A Hands-on-Approach) , 1st Edition, VPT, 2014.	
Reference Books:	
1. Arshdeep Bahga, Vijay Madiseti “ 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	




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Elective-I

A. Factory Automation

AR504A	PEC	Factory Automation	3-0-0	3Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	Continuous Assessment –I :10 Marks Continuous Assessment –II :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

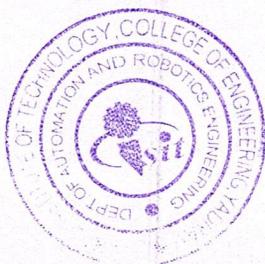
Pre-Requisites: CAD/CAM-Automation, Manufacturing Technology

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 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 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 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]
Unit 4: Control Technologies in Automation: Control Technologies in Automation: Industrial Control Systems, Process Industries versus Discrete Manufacturing Industries, continuous Versus Discrete Control, Computer Process and its Forms.	[6]





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Unit 5: Automated Material Movement and Storage System-I 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 Carrousel and Automatic Work Changers, Coolant and Chip Disposal and Recovery system.	[6]
Unit 6: Automatic Material Handling and Storage systems-II 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	




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Elective-I

B. Computer Integrated Manufacturing

AR504B	PEC	Computer Integrated Manufacturing	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	Continuous Assessment –I :10 Marks Continuous Assessment –II :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

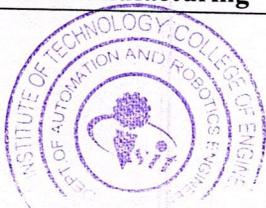
Pre-Requisites: CAD/CAM-Automation

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 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 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]
Unit 3 Cellular Manufacturing	[7]



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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.	
Unit 4 Flexible Manufacturing System (FMS) and Automated Guided Vehicle System (AGVS) 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 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 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, 3rd Edition, 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, 1992 PHI 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 6. Performance Modeling of Automated Manufacturing Systems,- Viswanandham	




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Elective-I
C. Applied Robotics

AR504C	PEC	Applied Robotics	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	Continuous Assessment –I :10 Marks Continuous Assessment –II :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Principle of Robotics

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 capabilities
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 fields and service Robots.
CO6	Summarize with the applications of Future of robotics.

Course Contents:

Unit 1: Applications of Robots in Industries 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]
Unit 2: Cooperative and Swarm Robots 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]




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Unit 3: Field Robotics Forestry, Robot locomotion, forestry automation, SLAM in forestry- autonomous Robots for silvi culture 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 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 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 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, Oussama Khatib, —Springer Handbook of Robotics, Springer-Verlag Berlin Heidelberg 2008. 2. Yangsheng Xu Huihuan Qian Xinyu Wu, "Household and Service Robots", Elsevier Ltd, 2015.	
Reference Books: 1. Aleksandar Lazinica, —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..	




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Elective-I

D. Electrical Drives and System

AR504D	PEC	Electrical Drives and System	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	Continuous Assessment –I :10 Marks Continuous Assessment –II :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

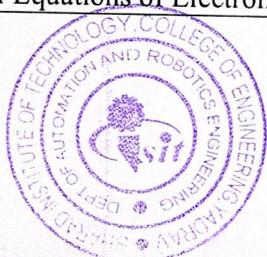
Pre-Requisites: Basic Electrical Engineering

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 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 Introduction,TransformerConstructionandPracticalConsiderations,Transformerload,Ideal Transformer,RealTransformerandEquivalentCircuit ,Transformer Losses, Transformer Testing, Efficiency and Voltage Regulation, Excitation Phenomenon in Transformers, Autotransformers, Variable Frequency Transformer	[6]
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	[7]



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DC Machines Basic principles of electromagnetic energy conversion, Construction ,operation, characteristics, performance of dc generators and motors, testing of dc machines, applications	
Unit 4 :Induction machines 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 Construction, basic principles and theory of cylindrical and salient pole synchronous machines. Equivalent circuit, Working principle, starting, Operation and applications of synchronous motors Special Machines: Stepper Motor and Servo Motor Stepper motor general construction, working principle, electric circuit and applications Servo motor general construction, working principle, electric circuit and applications	[7]
Unit 6:Electrical Drives 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 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,3 rd 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

AR 505	ESC	Fluid and Thermal Engineering	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	Continuous Assessment –I :10 Marks Continuous Assessment –II :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Engineering Mechanics, Mathematics

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 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 Types of flows, continuity equation (Cartesian coordinate), velocity and acceleration, visualization of flow field (stream, path and streak Line); Stream function and velocity 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).	[7]
Unit 3 Flow through Pipes and Internal Flow 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	[8]



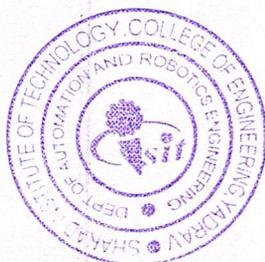
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derivations for minor losses). Internal flow: Laminar and Turbulent flow physics, Velocity and shear stress distribution for laminar flow in a pipe, fixed parallel plates (simple numerical on velocity, pressure gradient and shear stress).	
Unit 4 Dimensional Analysis and Lift & Drag Dimensional Analysis and modeling: Significance, Buckingham's Pi Theorem, Similitude, types of similitude. Model and prototype testing Lift and Drag: Friction and pressure drag. Drag and lift coefficients of common geometries.	[7]
Unit 5 Air Compressor 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 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 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
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Teaching Scheme: Practical: 2 hrs/week	Evaluation Scheme: Continuous Assessment –I :15 Marks Continuous Assessment –II :15 Marks End Semester Exam: 20 Marks
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Pre-Requisites: CAD CAM Automation

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

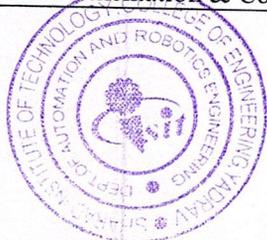
CO1	Develop the circuits for hydraulic and pneumatic systems.
CO2	Develop the circuits for Electro-hydraulic and Electro-pneumatic systems.
CO3	Develop the PLC Circuits for different application
CO4	Demonstrate about SCADA system

List of Experiments:

- 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

Text Books:

1. Antony Esposito, "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





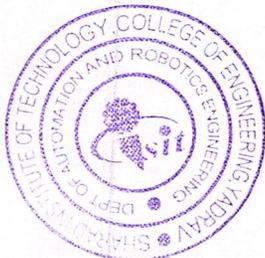
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4. Mikell P Groover, "Automation Production Systems and Computer- Integrated Manufacturing" Pearson Education, New Delhi, 2001.

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
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Teaching Scheme: Practical: 2 hrs/week	Evaluation Scheme: Continuous Assessment –I :25 Marks Continuous Assessment –II :25 Marks
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Pre-Requisites: Kinematics and Theory of Machine

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 such as robot control and navigation.

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
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



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Suitable Software

Text Books:

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



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IoT Laboratory

AR508	PCC	IoT Laboratory	0-0-2	1 Credits
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Teaching Scheme:	Evaluation Scheme:
Practical: 2 hrs/week	Continuous Assessment –I :15 Marks Continuous Assessment –II :15 Marks End Semester Exam: 20 Marks

Pre-Requisites: Basic Electronics

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 10 experiments should be performed from the following list.

1. First experiments should be fundamental of all platforms like Arduinio, Rasperry Pi and Intel
2. Last experiments should be life project on the based on Rasperry Pi or Intel
3. Take 2-3 experiments from Arduino Uno
4. Take 3-5 experiments from Rasperry Pi
5. Take 2-3 experiments from Intel

Arduino Uno:

Experiment List:

1. Interfacing of LED and Tricolor LED with Arduino Uno
2. Interfacing of Push Button Switch with Arduino Uno
3. Interfacing of Buzzer with Arduino Uno
4. Interfacing of 7 segment display with Arduino Uno
5. Interfacing of Light sensor with Arduino Uno
6. Interfacing of PIR Motion sensor with Arduino Uno
7. Interfacing of Ultrasonic sensor with Arduino Uno
8. Interfacing of Temperature and humidity (DHT11) sensor with Arduino Uno
9. Interfacing of 16 X 2 LCD Display with Arduino Uno
10. Interfacing of Servo motor with Arduino Uno



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Raspberry Pi :

Experiment List:

1. Interfacing of LED and Tricolor LED with Raspberry Pi
2. Interfacing of Push Button Switch with Raspberry Pi
3. Interfacing of Buzzer with Raspberry Pi
4. Interfacing of 7 segment display with Raspberry Pi
5. Interfacing of Light sensor with Raspberry Pi
6. Interfacing of PIR Motion sensor with Raspberry Pi
7. Interfacing of Ultrasonic sensor with Raspberry Pi
8. Interfacing of Temperature and humidity (DHT11) sensor with Raspberry Pi
9. Interfacing of 16 X 2 LCD Display with Raspberry Pi
10. Interfacing of Servo motor with Raspberry Pi

Intel Processor based:

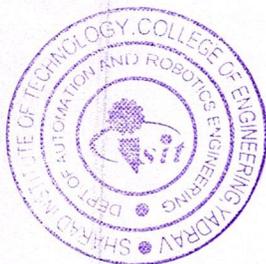
1. Interfacing of Temperature and humidity (DHT11) sensor using IoT
3. Interfacing of 16 X 2 LCD Display using IoT
4. Interfacing of Servo motor using IoT
5. IoT based life project based on Intel processor platform.

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
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Teaching Scheme: Practical: 2 hrs/week	Evaluation Scheme: Continuous Assessment –I :25 Marks Continuous Assessment –II :25 Marks
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Pre-Requisites: Engineering Mechanics, Mathematics

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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Java Programming Laboratory

AR510	PCC	Java Programming Laboratory	0-0-2	1 Credits
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Teaching Scheme: Practical: 2 hrs/week	Evaluation Scheme: Continuous Assessment –I :15 Marks Continuous Assessment –II :15 Marks End Semester Exam: 20 Marks
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Pre-Requisites: Basic Programming Language

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

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





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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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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

Text Books:

1. Herbert Schildt, The Complete Reference Java2.0, Fifth edition, TATA McGraw-Hill 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 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
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Teaching Scheme:	Evaluation Scheme:
Lecture: 1 hrs/week	Continues Assessment 1: 25 Marks Continues Assessment 2: 25 Marks

Pre-Requisites: Basic Electronics

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 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 Summing, Scaling & Averaging Amplifiers using Op-amps, Differential amplifier using op-amp, Subtractor Circuit, Instrumentation amplifier, Schmitt Trigger.	[3]
Unit 3 Special purpose ICs 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 Analysis & Design of RC phase shift oscillator, Wein-bridge oscillator, Colpitts oscillator, Astable, Monostable multivibrator	[3]
Unit 5 Waveform Generators Analysis & Design of Square wave generator, Triangular wave generator, Sawtooth wave generator.	[3]
Unit 6 System Design Using Op-amp Analog to digital Converter, Digital to analog Converter, V to I & I to V Converter,	[3]





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voltage to frequency converter.

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
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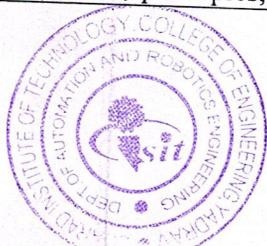
Teaching Scheme:	Evaluation Scheme:
Lecture: 2 hrs/week	Continues Assessment 1: 25 Marks
Pre-Requisites: NA	Continues Assessment 2: 25 Marks

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 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 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]
Unit 3: Human Factors Engineering 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 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 Industry General safety rules, principles, maintenance, Inspections of turning machines,	[4]



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boring machines, milling machine, grinding machines, CNC machines, , types, safety principles, electrical guards, work area, material handling, inspection, hazards	
Unit 6: Safety Education and Training 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	



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Aptitude Skills-III

HMS05	HSMC	Aptitude Skills- III	1-0-0	1 Credits
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Teaching Scheme:	Evaluation Scheme:
Lecture: 1 hrs/week	Continues Assessment 1: 25 Marks Continues Assessment 2: 25 Marks

Pre-Requisites: Communication Skills, Aptitude Skills- I,II

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 Word Family (Using the same word as different Parts of Speech), Punctuation	[2]
Unit 2: Analogy Letter Writing (Formal), E-Mail Writing, CV Writing	[2]
Unit 3: Reading Comprehension Reading Comprehension, Paragraph Jumbles	[2]
Unit 4: Spotting Errors (in different parts of sentence) Spotting Errors (in different parts of sentence), Subject-Verb Agreement, Sentence Correction, Sentence Completion	[2]
Unit 5: One Word Substitution One Word Substitution, Narrating Events/ReportsSummary/Precis Writing	[2]
Unit 6: Dialogue Writing Dialogue Writing, Group Discussion, Interview Skills (Using formal notations & gestures etc.)	[2]
Text Books:	
1. Raymond Murphy, Essential English Grammar with Answers, Murphy	
2. Objective General English by R.S. Aggarwal, S Chand Publishing; Revised edition (15 March 2017)	



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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
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Teaching Scheme:	Evaluation Scheme:
Practical: 2 hrs/week	Continuous Assessment –I :25 Marks Continuous Assessment –II :25 Marks

Pre-Requisites: Communication Skills, Language Skills- I

Languages (Any One)

Python Programming (Technical Language) (24Hrs)

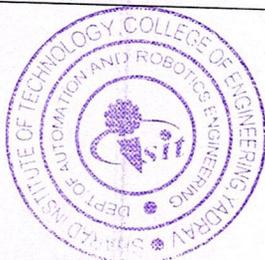
Syllabus for Python

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 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 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 Unary Operator ,Binary operator -(arithmetic operator, logical operator ,assignment operator, ,membership operator ,identity operator ,bitwise operator) , ternary operator	[6]
Unit 4: Statements and loops 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, Moduled States of America.



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Mini Project -IV

PRJ04	PROJ	Mini Project-IV	0-0-2	Audit
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Teaching Scheme: Practical: 2 hrs/week	Evaluation Scheme: Continuous Assessment –I :25 Marks Continuous Assessment –II :25 Marks
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Pre-Requisites: NA

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

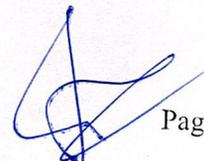
CO1	Select the appropriate method for solving the problem
CO2	Make use of various engineering techniques and tools to give a solution
CO3	Justify the method/tools used to develop the solution.
CO4	Demonstrate tangible solutions to the problem
CO5	Describe the solution with the help of a project report 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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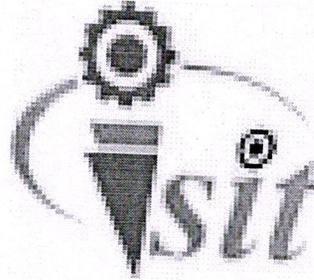
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Teaching and Evaluation Scheme for T Y B. Tech.

Department of Automation and Robotics

Semester: VI



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Department: Automation & Robotics

Rev: Course Structure/00/2022-23

Class: T.Y. B.Tech

Semester: VI

Course Code	Course Type	Course	Teaching Scheme				Evaluation Scheme					Credits
			L	T	P	Total Hrs.	CA1	CA2	MSE	ESE	Total	
AR601	PCC	Design of Machine elements and Transmission system	3	-	-	3	10	10	30	50	100	3
AR602	PCC	Robot Programming	3	-	-	3	10	10	30	50	100	3
AR603	PCC	Control System	3	-	-	3	10	10	30	50	100	3
AR604	PEC	Elective-II	3	-	-	3	10	10	30	50	100	3
OEXXX	OEC	Open Elective-I	3	-	-	3	10	10	30	50	100	3
AR605	PCC	Design of Machine elements and Transmission system Laboratory	-	-	2	2	15	15	-	20	50	1
AR606	PCC	Totally Integrated Automation Laboratory	-	-	2	2	25	25	-	-	50	1
AR607	PCC	Control System Laboratory (MATLAB)	-	-	2	2	25	25	-	-	50	1
AR608	PCC	Electrical machine and drives Laboratory	-	-	2	2	15	15	-	20	50	1
AR609	PCC	CNC and Metrology Laboratory	-	-	2	2	15	15	-	20	50	1
AR610	MC	Values and Ethics	1	-	-	1	25	25	-	-	50	Audit
HMS07	HSMC	Aptitude Skills-IV	1	-	-	1	25	25	-	-	50	Audit
HMS08	HSMC	Language Skills-IV	-	-	2	2	25	25	-	-	50	1
IFT02	PROJ	Industrial Training/ Field Training	-	-	-	-	-	-	-	50	50	Audit
PRJ05	PROJ	Capstone Project Phase –I	-	-	4	4	25	25	-	50	100	2
		Total	17		16	33	245	245	150	410	1050	23

Elective –II

- A. Additive Manufacturing
- B. Industrial Networking
- C. Mobile Robot
- D. Field and Service Robotics



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Design of Machine Elements and Transmission system

AR601	PCC	Design of Machine Elements and Transmission system	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	Continuous Assessment –I :10 Marks Continuous Assessment –II :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

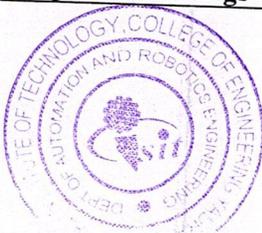
Pre-Requisites: Solid Mechanics, Kinematics and Theory of Machine

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

CO1	Illustrate the basic concept of machine design and evaluate dimensions of simple components
CO2	Relate the concept of Detachable and Permanent Joints and analyze when it is subjected to different loading conditions
CO3	Analyze and design the components for power transmission like shaft and couplings
CO4	Analyze and design different types of gears and belts for engineering applications.
CO5	Analyze and design mechanical springs and bearings.
CO6	Illustrate the concept of designing of Power Screws and analysis of clutches and brakes.

Course Contents:

Unit 1: Introduction Fundamentals of Machine Design-Basic procedure of machine design, Design Standards and Codes - Design against Static and Dynamic Load –Modes of Failure, Factor of Safety, Theories of Failure-Stress Concentration, Stress Concentration Factors, Fatigue Failure, Endurance Limit, Design for Finite and Infinite Life, Soderberg and Goodman Criteria. Modified Soderberg and Goodman diagram.	[6]
Unit2: Detachable and Permanent Joints Design of Bolts under Static Load, Design of Bolt with Tightening/Initial Stress, Design of Bolts subjected to Fatigue – Keys -Types, Selection of Square and Flat Keys-Design of Riveted Joints and Welded Joints.	[6]
Unit 3: Shafts and Coupling Design of Shaft –For Static and Varying Loads, For Strength and Rigidity-Design of Coupling-Types, Flange, Muff and Flexible Rubber Bushed Coupling	[6]
Unit 4: Gears and Belt Drives Classification of gear drives, Terminology of spur, helical, bevel and worm and worm wheel, Design of Spur and Helical Gears, Belt drives-Flat and V Belts, Selection of belts.	[7]
Unit 5: Springs and Bearings	[6]



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Design of Helical Spring-Types, Materials, Static and Variable Loads-Design of Helical Spring- Bearing-Rolling contact bearing and sliding contact bearing-Types, Stribeck's Equation, Dynamic Load Carrying Capacity, Equivalent Bearing Load, Load-Life Relationship, Selection of Bearing Life, ,Load Factor, Selection of Bearing from Manufacturer's Catalogue	
Unit 6: Analysis and applications of Power Screw, Clutches and Brakes Power Screws- Forms of Threads, Terminology of Power Screw, Torque Requirement— Lifting Load, Torque Requirement—Lowering Load, Self-locking Screw, Efficiency of Self-locking Screw, Trapezoidal and Acme Threads, Collar Friction Torque, Overall Efficiency. Clutches - Torque Transmitting Capacity, Energy equation. Brakes – Types , Energy Equations	[6]
Text Books: <ol style="list-style-type: none">1. V. B. Bhandari, "Design of Machine Elements", Tata McGraw Hill Publications, New Delhi, 2008.2. R. L. Norton, "Machine Design: An Integrated Approach", Pearson Education Singapore, 20013. A Machine Design R.S. Khurmi&J.K.Gupta S. Chand publication.4. Machine design S G Kulkarni McGraw Hill Education Publications5. Introduction to Machine design V B Bhandari McGraw Hill Education Publications.6. Design Of Machine Elements Vol I, Vol II J.B.K. Das , P.L. Srinivas Murthy Sapna publication	
Reference Books: <ol style="list-style-type: none">1. R. C. Juvinall, K. M. Marshek, "Fundamental of machine component design", John Wiley & Sons Inc., New York, 3rd edition, 2002.2. J. Hamrock, B. Jacobson and Schmid Sr., "Fundamentals of Machine Elements", International Edition, New York, 2nd edition, 1999.3. S. Hall, A. R. Holowenko, H. G .Langhlin, "Theory and Problems of Machine Design", Schaum's Outline Series, Tata McGraw Hill book Company, New York, 1982.4. J. E. Shigley and C. Mischke, "Mechanical Engineering Design", Tata McGraw Hill Publications, 7th edition, 2004.5. M. F. Spotts, "Design of Machine Elements", Prentice Hall of India, New Delhi. 6. Machine Design by Robert L.Norton, Tata Mc- Graw Hill Publication6. Fundamentals of Machine Component Design by Junvinall Wiley India7. Mechanical System Design by Anurag Dixit SCITECH publication8. Design of Machine Element/Machine Design by Kannaiah SCITECH publication9. Design of Machine Element by Spotts/Shoup/Hornberger/Jayram/Venketesh Pierson Education	




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Robot Programming

A602	PCC	Robot Programming	3-0-0	3Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	Continuous Assessment –I :10 Marks Continuous Assessment –II :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Principles of Robotics

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

CO1	Explain robot programming methods and components of robot programming
CO2	Develop programs using VAL Language to simulate robot movements.
CO3	Create programs using VAL-II Language to simulate robot movements.
CO4	Develop programs using RAPID Language to simulate robot movements.
CO5	Develop robot programmes for specific application using AML Language
CO6	Interpret Practical study of virtual robot software

Course Contents:

Unit 1: Introduction to Robot Programming Robot programming-Introduction-Types- Flex Pendant- Lead through programming, Coordinate systems of Robot, Robot controller- major components, functions-Wrist Mechanism-Interpolation-Interlock commands- Operating mode of robot, Jogging-Types, Robot specifications- Motion commands, end effectors and sensors commands.	[6]
Unit 2: VAL Language Robot Languages-Classifications, Structures- VAL language commands motion control, hand control, program control, pick and place applications, palletizing applications using VAL, WAIT, SIGNAL and DELAY command for communications using simple applications.	[7]
Unit 3: VAL-II VAL-II programming-basic commands, applications- Simple problem using conditional statements-Simple pick and place applications- Robot welding application using VAL program, Production rate calculations using robot.	[6]
Unit 4: RAPID Language RAPID language basic commands- Motion Instructions-Pick and place operation using Industrial robot manual mode, automatic mode, subroutine command based programming. Move master command language-Introduction, syntax, simple problems	[6]
Unit 5: AML Language AML Language - General description, elements and functions, Statements, constants and variables-Program control statements-Operating systems, Motion, Sensor commands-	[7]



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Data processing.

Unit 6: Practical Study of Virtual Robot

Robot cycle time analysis-Multiple robot and machine Interference-Process chart-Simple problems-Virtual robotics, Robot studio online software- Introduction, Jogging, components, work planning ,program modules, input and output signals-Singularities-Collision detection-Repeatability measurement of robot-Robot economics.

[7]

Text Books:

1. K.S Fu, R.C. Gonzalez, C.S.G. Lee, Robotics, McGraw Hill, 1987.
2. Y. Koren, Robotics for Engineers, McGraw Hill, 1985
3. J.J. Craig, Robotics, Addison-Wesley, 1986.
4. Saeed B. Niku, "Introduction to Robotics – Analysis, Systems and Application" : PHI 2006.
5. Richard D, Klafter, Thomason A Chmiel Owski, Michel Nagin "Robotics Engg-an Integrated Approach" PHI 2005.
6. R.K. Mittal & I.J. Nagrath, "Robotics & Control" TMH-2007.
7. Saha, S.K., "Introduction to Robotics, 2nd Edition, McGraw-Hill Higher Education, New Delhi, 2014.

Reference Books:

1. Cameron Hughes Tracey Hughes, Robot Programming: A Guide to Controlling Autonomous Robots, 1/e First Edition, 2016, ISBN: 9789332577442
2. S. R. Deb, Robotics Technology and Flexible Automation, 2010. McGraw Hill ISBN: 9780070077911
3. Mikell. P. Groover, Industrial Robotics: Technology, Programming, and Applications 2nd Edition, McGraw Higher Ed. 2012, ISBN: 9781259006210,
4. Industrial Robotics Technology, Programming and Applications, McGraw Hill Co, 1995.
5. Robotics Lab manual, 2007.



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Control System

AR603	PCC	Control System	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	Continuous Assessment –I :10 Marks Continuous Assessment –II :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

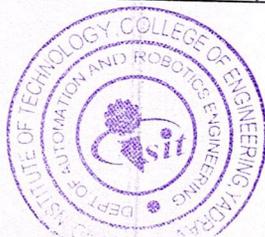
Pre-Requisites: Industrial Automation

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

CO1	Explain the basic concepts of control system.
CO2	Determine Time Domain characteristics of control systems.
CO3	Determine Frequency Domain characteristics of control systems.
CO4	Examine P, PI and PD controller on system.
CO5	Illustrate the concept of Stability Analysis.
CO6	Explain the concept of Proportional and Derivative control.

Course Contents:

Unit 1: Introduction to Control Systems: Open and Closed loop control systems, Transfer function of the system, State Variable Model, Mathematical Modeling-Mechanical- Spring, Damper, Mass; Electrical- Resistor, Capacitor and Inductor; Transfer function of AC Servomotor, Tachometer, Stepper Motor, Block Diagram Reduction- Signal Flow graph, Mason's Gain formula.	[6]
Unit 2: Time Domain Analysis: Time Response, Steady State Analysis, Transient Response Analysis, Feedback characteristics of Control systems.	[6]
Unit 3: Frequency Domain Analysis: Correlation between time domain and frequency domain specification, Polar Plot, Nyquist Plot and Bode Plot.	[7]
Unit 4: P,PI and PID Controller on system: Introduction to P, I & D controller, Individual effect on overall system performance, PI, PID Controller and effect on overall system performance.	[7]
Unit 5: Stability Analysis: Concept of Stability, Routh-Hurwitz Stability criteria, Root Locus Technique, Effect of Pole Zero addition on root locus.	[7]
Unit 6: Non Linear Control Systems: Proportional and Derivative control with gravity compensation, computed torque control, Sliding mode control, adaptive control, observer based control.	[6]
Text Books	
1. M. Gopal: Control System: Principles and Design, Tata Mc Graw-Hill Publication.	
2. I. J Nagrath, M. Gopal-Control System Engineering; New Age International Publishers-	



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5th Edition 2008.

3. K Ogata: Modern Control Engineering, Eastern Economy, 5th Edition 2011.

Reference Books:

1. Katsuhiko Ogata", Modern Control Engineering", Prentice Hall, 2010
2. B C Kuo, Automatic Control System, Wiley Publication 8th Edition.
3. Norman S Nise, Control System Engineering, John Wiley and Sons, 6th Edition, 2014.
4. M. Gopal, Digital Control and State Variable Methods, Tata Mc Graw Hill, 3rd Edition.




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Elective-II

A. Additive Manufacturing

AR604A	PEC	Additive Manufacturing	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	Continuous Assessment –I :10 Marks Continuous Assessment –II :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

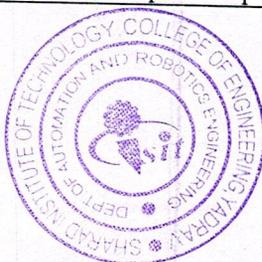
Pre-Requisites: Manufacturing Technology

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

CO1	Explain the fundamentals of rapid prototyping techniques
CO2	Explain the techniques of Liquid Based and Solid Based Rapid Prototyping Systems
CO3	Explain the techniques of Powder Based Rapid Prototyping Systems
CO4	Use appropriate tooling for rapid prototyping process
CO5	Use rapid prototyping techniques for reverse engineering.
CO6	Make use of the RP Applications.

Course Contents:

Unit 1 Introduction History – Development of RP systems – Applications in Product Development, Reverse Engineering, Rapid Tooling, Rapid Manufacturing- Principle – Fundamental – File format Other translators – medical applications of RP – On demand manufacturing – Direct material deposition – Shape Deposition Manufacturing.	[8]
Unit 2 Liquid Based and Solid Based Rapid Prototyping Systems Classification – Liquid based system – Stereo Lithography Apparatus (SLA), details of SL process, products, Advantages, Limitations, Applications and Uses. Solid based system – Fused Deposition Modelling, principle, process, products, advantages, applications and uses – Laminated Object Manufacturing	[7]
Unit 3 Powder Based Rapid Prototyping Systems Selective Laser Sintering – principles of SLS process, principle of sinter bonding process, Laser sintering materials, products, advantages, limitations, applications and uses. Three Dimensional Printing – process, major applications, research and development. Direct shell production casting – key strengths, process, applications and uses, case studies, research and development. Laser Sintering System, e-manufacturing using Laser sintering, customized plastic parts, customized metal parts, e-manufacturing – Laser	[8]



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Engineered Net Shaping (LENS).	
Unit 4 Rapid Tooling Conventional Tooling Vs. Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling methods	[7]
Unit 5 Reverse Engineering Basic concept, Digitization techniques, Model Reconstruction, Data Processing for Rapid Prototyping, Reverse Engineering (RE) Methodologies and Techniques, Selection of RE systems, RE software, RE hardware, RE in product development.	[6]
Unit 6 RP Applications Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP.	[6]
Text Books: 1. Chua Chee Kai, Leong Kah Fai, "Rapid Prototyping: Principles and Applications", World Scientific, 2003. 2. Ian Gibson, David W. Rosen, Brent Stucker, "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2nd edition, 2010.	
Reference Books: 1. Chua C K, Leong K F, Chu S L, Rapid Prototyping: Principles and Applications in Manufacturing, World Scientific. 2. Gibson D W Rosen, Brent Stucker., Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer. 3. Noorani R, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons. 4. Hilton P, Jacobs P F, Rapid Tooling: Technologies and Industrial Applications, CRC press. 5. Liou W L, Liou F W, Rapid Prototyping and Engineering applications: A tool box for prototype development, CRC Press. 6. Ali K. Kamrani, Emand Abouel Nasr, "Rapid Prototyping: Theory and Practice", Springer, 2006	




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**Elective-II
B. Industrial Networking**

AR604B	PEC	Industrial Networking	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	Continuous Assessment –I :10 Marks Continuous Assessment –II :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

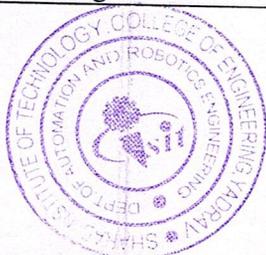
Pre-Requisites: Digital Electronics and Microprocessor

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

CO1	Apply the concepts of data communications and to design computer networks using subletting and routing concepts.
CO2	Compare the various medium access control techniques.
CO3	Compare and contrast the characteristics of physical layer.
CO4	Analyze the different protocols.
CO5	Compare and contrast the different network components.
CO6	Illustrate about wireless sensor networks

Course Contents:

Unit 1: Introduction Modern instrumentation and control systems – OSI model – Protocols – Standards – Common problems and solutions – Grounding/shielding and noise - EIA-232 interface standard – EIA-485 interface standard – Current loop and EIA-485 converters. FIBRE OPTICS: Introduction – Fibre optic cable components and parameters – Basic cable types – Connection fibres – troubleshooting.	[7]
Unit 2 MODBUS Overview – Protocol structure – Function codes – Modbus plus protocol –Data Highway – AS interface (AS-i) –Device Net: Physical layer – Topology – Device taps – Profibus PA/DP/FMS:Protocol stack – System operation.	[7]
Unit 3: IEEE/ISO standards – Medium access control – frames – Reducing collisions – Auto negotiation –LAN system components – Structured cabling – Industrial Ethernet – Troubleshooting Ethernet. CAN BUS: Concepts of bus access and arbitration – CAN: Protocol-Errors: Properties – detection –processing – Introduction to CAN 2.0B	[8]
Unit 4: Wireless Communications Radio spectrum – Frequency allocation – Radio modem – Intermodulation – Implementing a radio link, – RFID: Basic principles of radio frequency identification – Transponders – Interrogators	[7]



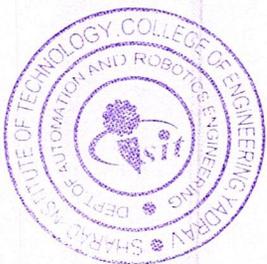
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Unit 5: Applications Automotive communication technologies – Design of automotive X-by-Wire systems, - The LIN standard – The IEC/IEEE Train communication network: Applying train communication network for data communications in electrical substations.	[6]
Unit 6: Overview Of Wireless Sensor Networks Challenges for Wireless Sensor Networks, Enabling Technologies For Wireless Sensor Networks	[6]
Text Books: 1. Steve Mackay, Edwin Wright, Deon Reynders and John Park, "Practical Industrial Data Networks: Design, Installation and Troubleshooting", Newnes (Elsevier), 2004 2. Albert Lozano-Nieto, "RFID Design Fundamentals and Applications", CRC Press, 2011	
Reference Books: 1. Richard Zurawski, "The Industrial Communication Technology Handbook", Taylor and Francis, 2005 2. Dominique Paret, "Multiplexed Networks for Embedded Systems", John Wiley & Sons, 2007	



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**Elective-II
C. Mobile Robot**

AR604C	PEC	Mobile Robot	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	Continuous Assessment –I :10 Marks Continuous Assessment –II :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

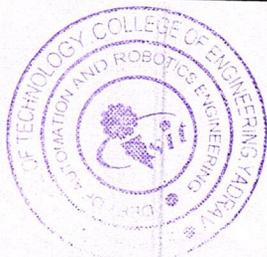
Pre-Requisites: Principles of Robotics, Factory Automation, Computer Integrated Manufacturing

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

CO1	Interpret the role of unmanned aerial vehicles (UAVs) in past, present, and future society
CO2	Explain about the Payload for the UAVs
CO3	Explain about the various components of UAVs.
CO4	Explain about the Underwater Robotics
CO5	Explain about Kinematic control of wheeled mobile Robots.
CO6	Illustrate basics of Autonomous Underwater Systems

Course Contents:

Unit 1: Overview and Background Definitions History of UAVs - classifications of UAVs scale- lift generation method contemporary applications- military- government- civil-societal impact and future outlook operational considerations- liability / legal issues-insurance- ethical implications- human factors- LOS / BLOS.	[7]
Unit 2: Payload For UAV Introduction – Types – Non dispensable Payloads - Electro-optic Payload Systems - Electrooptic Systems Integration - Radar Imaging Payloads - Other Non dispensable Payloads -Dispensable Payloads - Payload Development	[6]
Unit 3: Unmanned Aerial System (UAS) Components Platforms Configurations- characteristics-applications- propulsion- Internal combustion - on-board flight control- payloads- sensing / surveillance- weaponized- delivery communications- command/control- telemetry - launch / recovery systems- Ground control stations.	[7]
Unit 4: Underwater Robotics Robotics in Water - Basics Representation of Underwater Robot - Types and Classification of Underwater Robotics - Differentiating Aerial and Underwater Robotics - Overview about Environmental Factors affecting object in water.	[7]



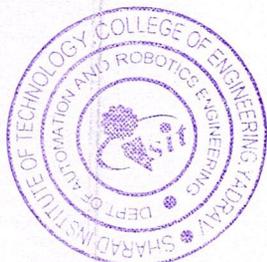
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Unit5: Control System and Manipulator Control System and Types of Control Systems in Underwater Robotics - Sensors Connected with the Underwater Robotics - Introduction to Underwater Manipulators - Introduction to Hydraulics on Underwater Vehicles - Applications of Underwater Vehicles.	[7]
Unit6: Autonomous Underwater Systems Introduction to AUVS - Development of RA E12 MOBILE ROBOTICS 4 0 0 4 AUVs,ROV in Market - Case Study on AUV Control System Basics - Case Study on Subsea Manipulator - Case Study on Technologies Used.	[6]
Text Books: <ol style="list-style-type: none">1. Roland Siegwant & Illah R. Nourbakhsh, Introduction to Autonomous Mobile Robots, MIT Press, 2004.2. Bruno Siciliano, OussamaKhatib, —Springer Handbook of Robotics, Springer-Verlag Berlin Heidelberg 2008.3. Yangsheng Xu Huihuan Qian Xinyu Wu, "Household and Service Robots", Elsevier Ltd, 2015	
Reference Books: <ol style="list-style-type: none">1. ASA Test Prep. Remote Pilot Test Prep — UAS: Study & Prepare. Wellfleet Press, 2016. 978-15771513262. Austin, Unmanned Aircraft Systems: UAVS Design, Development and Deployment. Wiley, 2010. 978-0-470-05819-03. Baichtal, Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs. Que Publishing,2016. 978-07897559884. Beard & McLain, Small Unmanned Aircraft: Theory and Practice. Princeton University Press, 2012. 978-06911492195. Cares & Dickmann, Operations Research for Unmanned Systems. Wiley, 2016. 978-1-118-91894-46. Gianluca Antonelli, —Underwater Robots, Springer, 2014	




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Elective-II

D. Field services and Robotics

AR604D	PEC	Field and Service Robotics	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	Continuous Assessment –I :10 Marks Continuous Assessment –II :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Principles of Robotics, Factory Automation, Computer Integrated Manufacturing

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

CO1	Explain the basic concepts of working of robot.
CO2	Illustrate about Challenges of Localization
CO3	Summarize about planning and Navigation
CO4	Identify about Robots in different applications.
CO5	Make use of the humanoid robots functions & its operations.
CO6	Extend challenges in developing autonomous mobile Robots.

Course Contents:

Unit 1: Introduction History of service robotics – Present status and future trends – Need for service robots - Applications- Examples and Specifications of service and field Robots. Non conventional Industrial robots.	[7]
Unit 2: Localization Introduction-Challenges of Localization- Map Representation- Probabilistic Map based Localization- Monte carlo localization- Landmark based navigation-Globally unique localization- Positioning beacon systems- Route based localization.	[6]
Unit 3: Planning and Navigation Introduction-Path planning overview- Road map path planning- Cell decomposition path planning-Potential field path planning-Obstacle avoidance - Case studies: Tiered robot architectures.	[7]
Unit 4: Field Robots Ariel robots- Collision avoidance-Robots for agriculture, mining, exploration, underwater, Civilian and military applications, Nuclear applications, Space applications.	[7]
Unit5: Humanoids Wheeled and legged, Legged locomotion and balance, Arm movement, Gaze and auditory orientation control, Facial expression, Hands and manipulation, Sound and speech generation, Motion capture/Learning from demonstration, Human activity recognition	[7]



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using vision, touch, sound, Vision, Tactile Sensing, Models of emotion and motivation. Performance, Interaction, Safety and robustness.	
Unit6: Overview and Background Definitions- History of UAVs - classifications of UAVs scale- lift generation method- contemporary applications- military- government- civil-societal impact and future outlook- operational considerations- liability / legal issues-insurance- ethical implications- human factors- LOS / BLOS	[6]
Text Books: 1. Roland Siegwart, Illah Reza Nourbakhsh, Davide Scaramuzza, „Introduction to Autonomous Mobile Robots”, Bradford Company Scituate, USA, 2004 2. Riadh Siaer, „The future of Humanoid Robots- Research and applications”, Intech Publications, 2012.	
Reference Books: 1. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India P Ltd., 2006. 2. Kelly, Alonzo; Iagnemma, Karl; Howard, Andrew, "Field and Service Robotics ", Springer, 2011	



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Design of Machine Elements and Transmission System Laboratory

AR605	PCC	Design of Machine Elements and Transmission System Laboratory	0-0-2	1 Credits
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Teaching Scheme: Practical: 2 hrs/week	Evaluation Scheme: Continuous Assessment –I :15 Marks Continuous Assessment –II :15 Marks End Semester Exam: 20 Marks
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Pre-Requisites:

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

CO1	Demonstrate understanding of various design considerations.
CO2	Apply basic principles of machine design
CO3	Acquire skill in preparing production drawings of various components designed.
CO4	Design concept of welded & threaded joint, and analyze when it is subjected to different loading condition

List of Experiments:

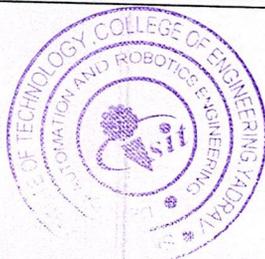
Design exercises in the form of design calculations with sketches and or drawings on following machine system with using 3D software

1. Design of coupling system.
2. Design of screw jack.
3. Design of welded joints
4. Design of threaded joints

A design report giving all necessary calculations for the design of components and assembly should be submitted in a separate file

Minimum 2 exercises from the following list

1. To develop Industrial/Real life application demonstration model of different types of Joints. (Cotter joint and Knuckle joint)
2. To observe the system where transmission of power takes place through shaft, Keys, coupling, like Transmission of power from motor to pump/generator/lathe machine/drilling machine. By selecting suitable materials, design the shaft, key and coupling. To prepare design report and assembly drawing indicating overall dimensions, tolerances, and surface finish. Also to prepare bill of materials
3. To develop a demonstration models of different types of couplings.
4. To develop a demonstration models of different types of key



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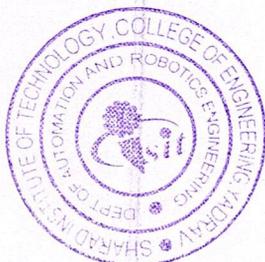
5. Stress analysis of any machine element mentioned in the syllabus using any application software and programming language
6. Design a Mini-Project to develop and apply the knowledge of Machine Design and drafting software for any mechanical system on the basis of: (a) Idea generation, (b) Creativity, Reliability and safety, (c) Design parts of the system (d) Ergonomic Considerations (e) Use of International standards
7. Design a Mini-Project to develop and apply the knowledge of Machine Design for Two stage Gear Box

Text Books:

1. V. B. Bhandari, "Design of Machine Elements", Tata McGraw Hill Publications, New Delhi, 2008.
2. R. L. Norton, "Machine Design: An Integrated Approach", Pearson Education Singapore, 2001
3. A Machine Design R.S. Khurmi & J.K. Gupta S. Chand publication.
4. Machine design S G Kulkarni McGraw Hill Education Publications
5. Introduction to Machine design V B Bhandari McGraw Hill Education Publications.
6. Design Of Machine Elements Vol I, Vol II J.B.K. Das , P.L. Srinivas Murthy Sapna publication
7. Machine Component Design William Orthwein Jaico publication

Reference Books:

1. R. C. Juvinall, K. M. Marshek, "Fundamental of machine component design", John Wiley & Sons Inc., New York, 3rd edition, 2002.
2. J. Hamrock, B. Jacobson and Schmid Sr., "Fundamentals of Machine Elements", International Edition, New York, 2nd edition, 1999.
3. S. Hall, A. R. Holowenko, H. G. Langhlin, "Theory and Problems of Machine Design", Schaum's Outline Series, Tata McGraw Hill book Company, New York, 1982.
4. J. E. Shigley and C. Mischke, "Mechanical Engineering Design", Tata McGraw Hill Publications, 7th edition, 2004.
5. M. F. Spotts, "Design of Machine Elements", Prentice Hall of India, New Delhi. 6. Machine Design by Robert L. Norton, Tata McGraw Hill Publication
6. Fundamentals of Machine Component Design by Juvinall Wiley India
7. Mechanical System Design by Anurag Dixit SCITECH publication
8. Design of Machine Element/Machine Design by Kannaiah SCITECH publication



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Totally Integrated Automation Laboratory

AR606	PCC	Totally Integrated Automation Laboratory	0-0-2	1 Credits
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Teaching Scheme:	Evaluation Scheme:
Practical: 2 hrs/week	Continuous Assessment –I :25 Marks Continuous Assessment –II :25 Marks

Pre-Requisites: Basic knowledge of Semiconductor Physics and Basic Electronics.

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

CO1	Explain PLC hardware and Software
CO2	Develop the ladder diagrams for using PLC ladder instructions
CO3	Utilize the HMI/SCADA system for Various application
CO4	Develop Prototype models using 3D printing concept.

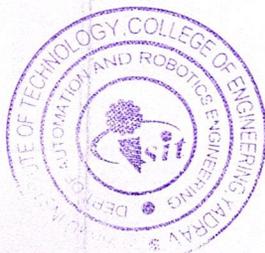
List of Experiments:

At least minimum 10 experiment should be performed from the following List

1. Study of hardware and software used in PLC
2. Implementations of Logic function and De Morgan's theorem using Ladder diagram
3. Implementation of arithmetic instruction using Ladder diagram
4. Implement ladder diagram using timers and counters
5. Develop Logic implementation of Switching of lights
6. Develop Logic implementation of Door Bell operation
7. Develop Logic implementation of traffic light control
8. Develop Logic implementation of bottle filling application
9. Develop application using SCADA system.
10. Develop HMI implementation of any application
11. Industrial visit to Automation Plant
12. Demonstration of 3D Printer and fabrication of simple Prototype model using 3 D printer

Text Books:

1. "Programmable Logic Controller – Principles and Applications", 5/e, J. W. Webb, R.A. Reis; Prentice Hall of India Ltd. ISBN 81-203-2308-4.
2. "Programmable Logic Controller – Principles and Applications, by NIIT; Prentice Hall Publications Pvt. Ltd. India, ISBN 81-203-2525-7.
3. "Programmable Logic Controller – Programming methods and Applications", Hackworth



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4. John R. and Hackworth Frederick D. Jr.; Pearson Education LCE, ISBN 81-297-0340

Reference Books:

1. Introduction to PLC – Gary Dunning – Delmar Pub.
2. Various PLC manufacturers catalogue.
3. Programmable Logic Controller – FESTO Pneumatics, - Bangalore
4. SCADA, Stuart A. Boyer (ISA Publi.) ISBN 1-55617-660-0.
5. Practical SCADA for industry, David Bailey, (Elsevier Publi.) ISBN 0-7506-5805-3.




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Control System Laboratory (MATLAB)

AR607	PCC	Control System Laboratory (MATLAB)	0-0-2	1 Credits
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Teaching Scheme: Practical: 2 hrs/week	Evaluation Scheme: Continuous Assessment –I :25 Marks Continuous Assessment –II :25 Marks
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Pre-Requisites: Industrial Automation

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

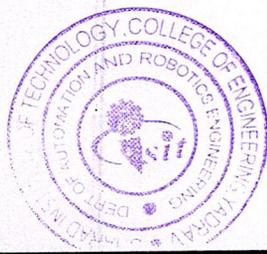
CO1	Determine the system response in both time domain.
CO2	Determine the stability by Applying Routh Hurwitz Criteria and Root Locus Method.
CO3	Determine the stability and response by constructing Polar, Nyquist and Bode Plot.

List of Experiments:

1. Different Tool Boxes in MATLAB, Introduction to Control Systems Tool Box, transpose and inverse values of given matrix.
2. Plot the pole and zero configuration in s-plane for the given transfer function.
3. Plot Module Step Response of given transfer function and find delay time, rise time, peak time and peak overshoot.
4. Determine the time response of the given system subjected to any arbitrary input.
5. Simulation of Step Response and Impulse Response for Type-0, Type-1 and Type-2 system with Unity Feedback using MATLAB.
6. Determination of stability by using Root Locus using MATLAB for 2nd, 3rd and 4th order system of a linear time invariant system.
7. Determination of stability by using Bode Plot using MATLAB for 2nd, 3rd, 4th order system of Linear Time Invariant system.
8. Determination of stability by using Nyquist plot using MATLAB for 2nd, 3rd and 4th order system.

Text Books:

1. Gopal. M., "Control Systems: Principles and Design", Tata McGraw-Hill, 1997.
2. Kuo, B.C., "Automatic Control System", Prentice Hall, sixth edition, 1993.
3. Ogata, K., "Modern Control Engineering", Prentice Hall, second edition, 1991.
4. Nagrath & Gopal, "Modern Control Engineering", New Age International, New Delhi.
5. Ambikapathy A., Control System, Khanna Book Publishing Company, 2018.



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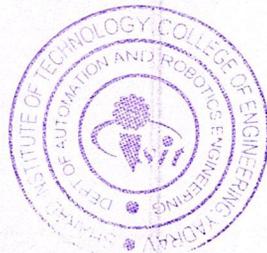
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Reference Books:

1. Benjamin C. Kuo, "Automatic control systems", Prentice Hall of India, 7th Edition, 1995.
2. Schaum's Outline Series, "Feedback and Control Systems" Tata McGraw-Hill, 2007.
3. John J. D'Azzo & Constantine H. Houpis, "Linear Control System Analysis and Design", Tata McGraw-Hill, Inc., 1995.
4. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Addison – Wesley, 1999.




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Electric Machines and Drives Laboratory

AR608	PCC	Electric Machines and Drives Laboratory	0-0-2	1 Credits
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Teaching Scheme:	Evaluation Scheme:
Practical: 2 hrs/week	Continuous Assessment –I :15 Marks Continuous Assessment –II :15 Marks End Semester Exam: 20 Marks

Pre-Requisites: Basic Electrical Engineering

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

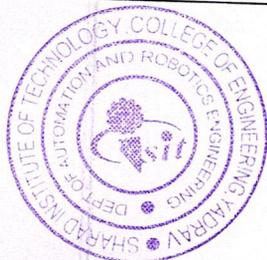
CO1	Examine performance of D.C. Shunt motor.
CO2	Test 3-phase Squirrel Cage Induction Motor and Slip Ring Induction Motor.
CO3	Demonstrate starters used for Induction Motors
CO4	Demonstrate Stepper Motor and Servo Motor

List of Experiments:

1. To Reverse the direction of D.C. Shunt motor.
2. To control speed of dc shunt motor by varying armature voltage and field current method.
3. To perform Load test of D.C. shunt motor.
4. To perform an open circuit test and blocked rotor test on 3 phase Squirrel Cage IM to draw equivalent circuit.
5. To Perform load test on a 3 phase Squirrel Cage Induction Motor
6. To Speed control of 3 phase Slip Ring Induction Motor.
7. To Study starters used for Induction Motors
8. To Study construction & working Stepper Motor.
9. To Study construction & working of Servo Motor

Text Books:

1. Stephen J. Chapman, electric Machinery Fundamentals' 4th edition, McGrawHill Education Pvt.Ltd, 2010.
2. P.C.Sen Principles of Electric Machines and power Electronics John Wiley & Sons ,3rd



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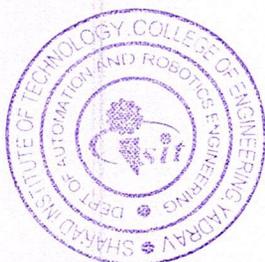
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Edition 2013

3. Nagrath, I.J. and Kothari, D.P., 'Electric Machines', McGraw-Hill Education, 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 International Publishers, 3rd Edition, Reprint 2015.
3. Surinder Pal Bali, 'Electrical Technology Machines & Measurements', Vol. II, Pearson, 2013
4. Fitzgerald, A.E., Charles Kingsley Jr, Stephen D. Umans, 'Electric Machinery', Sixth edition McGraw Hill Books Company, 2003.
5. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
6. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
7. P. S. Bhimbhra, "Electrical Machinery", Khanna Publishers, 2011.
8. I. J. nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
9. A. S. Langsdorf, "Alternating current Machines", McGraw Hill Education, 1984.
10. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.




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CNC and Metrology Laboratory

AR609	PCC	CNC and Metrology Laboratory	0-0-2	1 Credits
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Teaching Scheme:	Evaluation Scheme:
Practical: 2 hrs/week	Continuous Assessment –I :15 Marks Continuous Assessment –II :15 Marks End Semester Exam: 20 Marks

Pre-Requisites: Manufacturing Technology

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

CO1	Explain the significance of measurement system, errors, and calibration of measuring devices.
CO2	Demonstrate use of metrological tools for linear, angular measurements
CO3	Demonstrate the programming and simulation using different Packages
CO4	Analyze Manufacturing process with the help of Control Charts and Process Capability

List of Experiments:

Group A

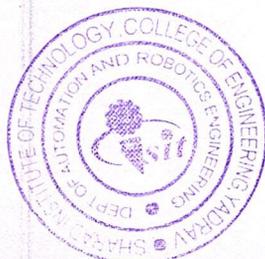
At least minimum 2 experiments should be performed from the following list

1. Programming and simulation of a lathe using any CAM package
2. Programming and simulation of a machining centre using any CAM package
3. Programming and operation of a CNC Lathe
4. Programming and operation of a CNC machining centre

Group B

At least minimum 6 experiments should be performed from the following list

- 1 Study & Use of various linear measuring instruments (Vernier and micrometers)
2. Calibration of Dial Indicator using slip gauge.
3. Study and use of mechanical & pneumatic comparator
4. Study & use of Bevel protractor and Sine Bar for measurement of Angle.



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5. Measurements of Screw thread parameters using Profile Projector
6. Measurement of gear tooth thickness using gear tooth Vernier caliper.
7. Demonstrate use of Gear Measuring Instruments
8. Study & use of Variable (X-Bar) chart
9. Study & use of Attribute (P) chart

Text Books:

1. R.K. Jain, "Engineering Metrology", Khanna Publisher,
2. I.C. Gupta, "Engineering Metrology", Dhanpat Rai Publications.
3. N Sidheshwar, P Kannaiah, "Machine Drawing", TATA Magraw hill, 2009.
4. Anand Bewoor, Vinay Kulkarni, " Metrology & Measurement" The McGraw-Hill Comp.
5. B.C. Nakara & K. K. Choudhari, "Instrumentation Measurement & Analysis", TATAMagraw hill, 2012.
6. Quality Control by Anand Beoor & Vinay Kulkarni Wiley India PVT.Ltd

Reference Books:

1. "Engineering Metrology", I.C. GUPTA, Dhanpat Rai and Sons, 1988, 2nd Edition.
2. "Practical Engineering Metrology", Sharp K.W.B. Pitman, London, 1973, 1st Edition.
3. Beckwith T.G, and N. Lewis Buck, Mechanical Measurements, Addison Wesley, 1991, 5th editio
4. N.V Raghavendra and L. Krishnamurthy, Engineering Metrology and Measurements, Oxford University Press, 2014.
5. Serope Kalpakjian and Steven R. Schmid, Manufacturing, Engineering & Technology, Pearson, Sixth Edition



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Values and Ethics

AR610	MC	Values and Ethics	1-0-0	Audit
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Teaching Scheme:	Evaluation Scheme:
Lecture: 1 hrs/week	Continues Assessment 1: 25 Marks Continues Assessment 2: 25 Marks

Pre-Requisites: NA

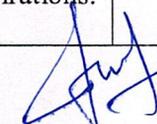
Course Outcomes: At the end of the course, students will be able to:

CO1	Relate the Ethics & Human interface
CO2	Improve Attitude, Morals, Aptitude, Integrity towards Society
CO3	Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
CO4	Explain the significance of value inputs in a classroom and start applying them in their life and profession
CO5	Develop Publication ethics
CO6	Develop Business ethics in professional careers

Course Contents:

Unit 1: Ethics and Human Interface Ethics and Human Interface, Essence, determinants and consequences of Ethics in human actions; Dimensions of ethics; ethics in private and public relationships Human Values – lessons from the lives and teachings of great leaders, reformers and administrators, Role of family, society in inculcating values, role of educational institutions in inculcating values	[2]
Unit 2: Attitude, Morals, Aptitude, Integrity towards Society Attitude: content, structure, function, Attitude and its influence and relation with thought and behavior, Aptitude and foundational values towards society, integrity, impartiality and non-partisanship, empathy, tolerance and compassion intelligence-concepts.	[2]
Unit 3: Understanding Harmony in the Human Being - Harmony in Myself Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body', Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Programs to ensure Sanyam and Swasthya	[2]
Unit 4 Value Education Need, Guidelines, content and process for value Education, self Exploration-Natural Acceptance and Experiential Validation, continuous Happiness and Prosperity, Relationship and Physical Facilities, Method to fulfill the above human aspirations: Understanding and living in harmony at various levels.	[2]




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Unit 5 Publication Ethics Publication Ethics: Introduction, Scope & importance, Best practices/standards initiatives & Guidelines: COPE, WAME, etc. Conflict of Interest, Publication Misconduct: definition, concept, problems that lead to unethical behavior & Vice versa, complaints & appeals	[2]
Unit 6 Business Ethics Ethics - Meaning, Importance, & Types of Ethics, Nature and Relevance to Business ethics, Values and Attitudes of Professional Engineers, Seven Principles of Public Life, Ethics in Business: Features, Principles, Need & Importance, Issues in Business ethics, Improving ethical behavior in Business.	[2]
Text Books: <ol style="list-style-type: none">1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.2. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.3. Neeraj Kumar, "Lexicon for Ethics, Integrity & Aptitude", Chronicle Publication, 2016.4. Santosh Ajmera, Nand Kishor Reddi, "Ethics - Integrity and Aptitude", Tata Mc Graw Hill Publication, 2014.5. M. Karthikeyan "Ethics, Integrity and Aptitude", Tata Mc Graw Hill Publication, 2015.	
Reference Book <ol style="list-style-type: none">1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA.2. A N Tripathy. 2003. Human Values. New Age International Publishers.3. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers . Oxford University Press.4. B P Banerjee. 2005. Foundations of Ethics and Management. Excel Books.5. B L Baijpai. 2004. Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.	




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Aptitude Skills-IV

HMS07	HSMC	Aptitude Skills-IV	1-0-0	Audit
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Teaching Scheme:	Evaluation Scheme:
Lecture: 1 hrs/week	Continuous Assessment –I :25 Marks Continuous Assessment –II :25 Marks

Pre-Requisites: Aptitude Skills-III

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 Permutation and combination

Course Contents:

Unit 1: System of equations quadratic equations, Surds and indices, solution of equations, Ages	[2]
Unit 2: Seating Arrangements Linear seating Arrangement, Circular seating arrangement, Complex seating arrangement	[2]
Unit 3: Logical Reasoning Numerical based on sense of direction, Blood relations, Odd man Out	[2]
Unit 4: Critical analysis Clocks and Calendar based problems, Cryptarithmic, heights and distances	[2]
Unit 5: Data Interpretation Table form, Bar form, Line for Pi chart form	[2]
Unit 6: Permutation and combination Permutation and combinations	[2]
Text Books: 1. RS Aggarwal "A Modern Approach to Verbal & Non-Verbal Reasoning ", S. Chand Publisher; 2016 edition 2. RS Aggarwal, " Quantitative Aptitude for Competitive Evaluations ", S. Chand Publisher; 2016 edition 3. Raymond Murphy "Essential English Grammar with Answers", Murphy	
Reference Books: 1. Rao N,D,V,Prasada, Wren & Martin High School English Grammar and Composition Book, S Chand Publishing, 2017	



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2. Murphy, Intermediate English Grammar with Answers, Cambridge University Press; Second edition
3. RS Aggarwal, Objective General English, S. Chand Publisher; 2016 edition



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Language Skills- IV

HMS08	HSMC	Language Skills- IV	0-0-2	1 Credit
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Teaching Scheme:	Evaluation Scheme:
Practical: 2 hrs/week	Continuous Assessment –I :25 Marks Continuous Assessment –II :25 Marks

Pre-Requisites: Language Skills- III

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

CO1	Make use of Function in Python Programming.
CO2	Make use of Python collections.
CO3	Make use of classes and its objects in python.
CO4	Make use of file and it's handling functions.

Unit 1: Python Collections Why we Need Function, Categories of Functions-Predefined, User-define, Parts of Functions Arguments, Return Value, Definition of Function, Function Calling, Lambda (Introduction)	[6]
Unit 2: Python Collections List, tuple, set, dictionary— constructor, check, change, remove item, list comprehension, Sort, loop through, joining	[6]
Unit 3:Class and Object OOP Characteristics, creating class, init_() method, creating Object, accessing methods and variables of class, constructor and destructor, inheritance, super(); function overloading	[6]
Unit 4:File handling Path & Directory Settings-Absolute, Relative, File Modes (r,w,a,etc), Open & Close file Reading File using Python--Read Line by Line readline () function, Read Word, Read character (offset), Writing Text File using Python--Write Mode, Append Mode, Exception handling	[6]
Text Books 1. Exploring Python, Timothy Budd, Mc Graw Hill Publication, ISBN:9780073523378, August 2010 2. Beginning Python, Peter C. Norton, Alex Samuel, Dave Aitel, Eric Foster-Johnson, Leonard Richardson, Jason Diamond, Aleatha Parker, Michael Roberts, ISBN: 978- 0-7645-9654-4, August 2005.	



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Reference Books

1. Python: Create - Modify - Reuse, James O. Knowlton, Wrox Publication, ISBN: 978-0-470-25932-0, July 2008.
2. Professional Python Frameworks: Web 2.0 Programming, Dana Moore, Raymond Budd, William Wright, Wrox Publication, ISBN: 978-0-470-13809-0, October 2007.



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Industrial Training /Field Training

IFT02	PROJ	Industrial Training /Field Training	0-0-0	Audit
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Teaching Scheme:	Evaluation Scheme:
	End Semester Exam: 50 Marks

Pre-Requisites: Basic knowledge of all courses

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

Course Description: -Internship / Training is educational and career development opportunity, providing practical experience in a field or discipline. At the end of the Fourth and Fifth semesters , every student should undergo practical training in an industry / professional organization / Research laboratory with the prior approval of the HoD/TPO/Principal of the college and submit the report along with the completion certification from the Industry/ Organization. The report will be evaluated during the Sixth semester by the department.
Course Learning Outcomes: -
After successful completion of the course, students will be able to
1. Verify the Technical knowledge in real industrial situations.
2. Develop interpersonal communication skills.
3. Discuss activities and functions of the industry in which the Internship/training has done.
4. Write the technical report.
Prerequisite: - Basics of Mechanical Engineering, Good written and Oral Communication.
Guideline for Students: -
1. Arrive at work as per schedule, ready to work and stay for the agreed-upon time.
2. Present yourself in a professional manner at all times, including being appropriately dressed at the workplace.
3. Communicate any concerns with your supervisor and the internship/Training coordinator in a timely manner and respectfully.



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4. Demonstrate enthusiasm and interest in what you are doing, ask questions and take the initiative as appropriate.

5. Complete and submit assigned tasks by designated timelines. Meet all deadlines.

Student's Diary/ Daily Log

The main purpose of writing a daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the student's thought process and reasoning abilities. The students should record in the daily training diary the day-to-day account of the observations, impressions, and information gathered and suggestions given if any. It should contain sketches & drawings related to the observations made by the students.

The daily training diary should be signed after every day by the supervisor/ in charge of the section where the student has been working. The diary should also be shown to the Faculty Mentor.

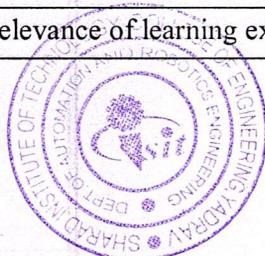
Student's Diary and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the SITCOE immediately after the completion of the training. It will be evaluated on the basis of the following criteria:

- Regularity in the maintenance of the diary.
- Adequacy & quality of information recorded.
- Drawings, sketches, and data recorded.
- Thought process and recording techniques used.
- Organization of the information.

Internship Report

After completing the internship, the student should prepare a comprehensive report to indicate what he/she has observed and learned in the training period. The daily diary will also help to a great extent in writing the industrial report since much of the information has already been incorporated by the student into the daily diary. The competent authority should sign the training report. The Internship report should be evaluated on the basis of the following criteria:

- I. Originality.
- II. Adequacy and purposeful write-up.
- III. Organization, format, drawings, sketches, style, language, etc.
- IV. Variety and relevance of learning experience.



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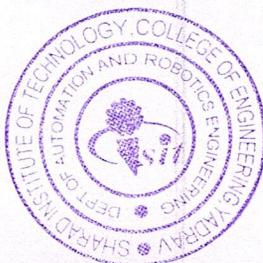
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V. Practical applications and relationships with basic theory and concepts taught in the course.

Evaluation of Internship/Training

The student should be evaluated based on his training report and presentation before an expert committee constituted by the concerned department as per norms. The evaluation will be based on the following criteria:

- Quality of content presented.
- Proper planning for presentation.
- Effectiveness of presentation.
- Depth of knowledge and skills.
- Attendance records, daily diary, and departmental reports shall also be analyzed along with the Internship Report.



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Capstone Project Phase-I

PRJ05	PROJ	Capstone Project Phase-I	0-0-4	2 Credits
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Teaching Scheme:	Evaluation Scheme:
Practical: 4 hrs/week	Continuous Assessment 1: 25 Marks Continuous Assessment 2: 25 Marks End Semester Evaluation: 50 Marks

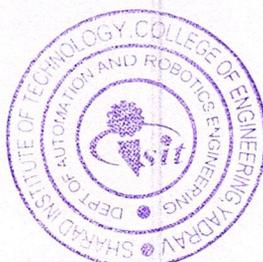
Pre-Requisites: All courses

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

CO1	State the exact title of the project and problem definition.
CO2	Explain the motivation, objectives, and scope of the project.
CO3	Review the literature related to the selected topic of the project.
CO4	Design the mechanism, and components of the system and prepare detailed drawings.
CO5	Evaluate the cost considering different materials/manufacturing processes.

The students in a group of not more than FOUR will work under the guidance of the faculty member on the project work undertaken by them. The completion of work and the submission of the report and assessment should be done at the end of VII Sem. The project work should consist of any of the following or an appropriate combination:

1. A comprehensive and up-to-date survey of literature related to the study of a phenomenon or product.
2. Design of any equipment and/or its fabrication and testing.
3. Critical Analysis of any design or process for optimizing the same.
4. Experimental verification of principles used in applications related to various specializations related to Mechatronics Engineering.
5. Software development for particular applications.
6. A combination of the above.




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It is expected that the students should complete at least 50% of the total project work in the VI Semester. The objective is to prepare the students to examine any design or process or phenomenon from all angles, to encourage the process of independent thinking and working, and to expose them to industry. The students may preferably select the project works from their opted elective subjects. The students should submit the report in a prescribed format, before the end of the VIIth semester. The report shall be comprehensive and presented typed on A₄ size sheets and bound. The number of copies to be submitted is the number of students plus two. The assessment would be carried out by the panel of examiners for both, term work and oral Evaluations.



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