



K.E. Society's
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, Affiliated to Shivaji University, Kolhapur)
Final Year B. Tech Syllabus
To be implemented for the 2023-27 NEP Batch
Department of Mechatronics Engineering

Class: - Final Year B. Tech	Semester-VII
Course Code: MC4011	Course Name: Design of Mechatronics System

L	T	P	Credits
2	-	--	2

Course Description:

Most mechanical engineering systems today involve significant amounts of electrical and electronic control systems. Effectively, most modern mechanical engineering systems are mechatronic systems. Thus, it is essential for the mechanical engineer to have a strong understanding of the composition and design of mechatronic systems, which is the goal of this course. Mechatronic systems are around us everywhere. A car contains many mechatronic systems, such as anti-lock braking systems, traction control, the engine control unit and cruise control, to name a few. A satellite dish position control unit is another example of a mechatronic system. Modern industrial automated processes would not be possible without the discipline of mechatronics, covering areas such as vehicle manufacturing, pharmaceutical industries, and food processing plants. Robotic systems are interesting and complex examples of mechatronic systems that contain many sensors and actuators and that require very fast and sophisticated controllers. This course will represent a gateway into the world of electrical, electronic, and control engineering.

Course Learning Outcomes:

After successful completion of the course, students will be able to,

1. Demonstrate key elements of mechatronics system design process.
2. Apply a systematic approach to the design process of mechatronics systems.
3. Create system modelling of basic models.
4. Realize the concept of real time interfacing and data acquisition.

Prerequisite:

Basic knowledge in subjects like mechanics, electromagnetism, measurements, system design & dynamics and control engineering.





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Final Year B. Tech Syllabus
To be implemented for the 2023-27 NEP Batch
Department of Mechatronics Engineering

1. Devdas Shetty & R. A. Kolk, Mechatronics System Design, Cenage Learning.
2. Georg pelz, "Mechatronic Systems: Modeling and simulation".

Reference Books:

1. Bishop, Robert H, "Mechatronics Hand book", CRC Press.
2. Bradley, D.Dawson, N.C. Burd and A.J. Loader, "Mechatronics: Electronics in Products and Processes"..
3. De Silva, "Mechatronics: A Foundation Course", Taylor & Francis, Indian Reprint.





K.E. Society's
Rajarambapu Institute of Technology, Sakharale
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Final Year B. Tech Syllabus

To be implemented for the 2023-27 NEP Batch

Department of Mechatronics Engineering

3.	Unsupervised Learning: Clustering algorithms: K-means, hierarchical clustering, DBSCAN Dimensionality reduction techniques: Principal Component Analysis (PCA), t-distributed Stochastic Neighbor Embedding (t-SNE) Association rule learning: Apriori algorithm Evaluation metrics for unsupervised learning models: silhouette score, Davies-Bouldin index	06
4.	Deep Learning: Introduction to neural networks: perceptron's, activation functions Building blocks of deep learning: layers, neurons, weights, biases Popular deep learning architectures: Convolutional Neural Networks (CNNs) for image classification, Recurrent Neural Networks (RNNs) for sequential data, and their variants	06
5.	Evaluation of Learning Algorithms: Cross-validation, learning curves, and statistical hypothesis testing. Ensemble learning methods: bagging, boosting, stacking Hyper parameter tuning techniques: grid search, random search, Bayesian optimization	06
6.	Machine Learning based Artificial Neural Networks: Fundamentals of Artificial Neural Networks, Perceptron, Model of Neuron in an ANN, Backpropagation.	06

References -

Links:

1. Coursera online course by Andre NG, on Machine Learning.
2. <http://www.stanford.edu/class/cs229/materials.html>

Text Books:

1. T. Hastie, R. Tibshirani, J. Friedman, The Elements of Statistical Learning (2ed.), 2008.

Reference Books:

1. Christopher Bishop, "Pattern Recognition and Machine Learning", 2016
2. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, "Introduction to Statistical Learning", Springer, 2013
3. Richard Duda, Peter Hart, David Stork, "Pattern Classification", John Wiley & Sons, Second edition 2001.
4. NPTEL online course by Prof. Balaraman Ravindran on Introduction to Machine Learning.





K.E. Society's
Rajarambapu Institute of Technology, Sakharale
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Final Year B. Tech Syllabus
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	transmission systems, Actuators and its selection while designing a robot system, Types of Controllers, Wireless control for welding robots.	
4	Robot Kinematics and Dynamics: Forward Kinematics, Inverse Kinematics, Differential Motion: link velocity and Acceleration analysis, Jacobian matrix and Singularity. Introduction, Linear trajectory function, polynomial trajectory function, Link forces and moments; Recursive formulation, Gravity Compensation, Role of Jacobian: Force and Velocity ellipsoid, Robot Dynamics: Euler-Lagrange formulation, Newton-Euler formulation.	06
5	Programming and Languages for Robotics: Methods of robot programming, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages: Generations of Robotic Languages, Introduction to various types such as VAL, RAIL, AML, ROS.	06
6	Application of Robotics in Industry: Application of robot in welding, machine tools, material handling, and assembly operations, parts sorting and parts inspection, AI in robotics, Autonomous Robots, Introduction to Swarm Robots, Introduction to Cobots, Future Application and Challenges and Case Studies.	06

References-

Text Books:

- Richard D Klafter, Thomas Achmielewski and Mickael Negin, Robotic Engineering - An Integrated Approach, Prentice Hall Department of Industrial Design Detail Syllabi 318NIT Rourkela India, New Delhi, 2001.
- Mikell P Groover, Industrial Robotics - Technology, Programming and Applications, McGraw Hill.
- Introduction to Robotics- John J. Craig, Addison Wesley Publishing.

Reference Books:

- James A Rehg, Introduction to Robotics in CIM Systems, Prentice Hall of India.
- Deb S R, Robotics Technology and Flexible Automation, Tata McGraw Hill, New Delhi, 1994.
- Janaki Raman P A, Robotics and Image Processing, Tata McGraw Hill.
- Robotics for Engineers -Yoram Koren, McGraw Hill International.





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Rajarambapu Institute of Technology, Sakharale
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Final Year B. Tech Syllabus

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Department of Mechatronics Engineering

	Recall of Transformers (CT/PT), Voltmeter, Ammeter, Energy meter, Terminal Blocks & Din Rails, Concept of Relays and Contactors (NO/NC) Recall of Power Supplies, Earthing & Grounding practices.	
2.	Basics of HVAC: Refrigeration Cycle, Components of an A/C system, Fixed Air Volume & Variable Air Volume Applications, Psychrometric Able to perform: Capture the requirements of HVAC Systems by site survey Suggest and taking approval from the customer for HVAC Systems Install approved HVAC components as per site requirements, Wire Electrical and Electronics components as per the requirements, Test of HVAC systems, Provide Technical Support for HVAC Systems.	06
3.	Fire Alarm system: Fire Lifecycle, Detection Technologies, Fire Panel Technologies, Input / Output Devices, Detector & Device Wiring Schema, Fireman's Telephony & Talkback system, NFPA, Guidelines, Fire Safety Strategies Able to perform: Capture the requirements of Fire Alarm Systems by site survey, Suggest and taking approval from the customer for Fire Alarm Systems, Install approved Fire Alarm components as per site requirements, Wire Electrical and Electronics components as per the requirements, Test of new systems at customer site, Provide Technical Support for Fire Alarm Systems at the site.	06
4.	Access Control Systems: Access Control Systems, Access Control Technologies, Data Encryption & Security, Access Control Strategy, Access Controllers, Biometrics, Barriers, Reporting & Operations Able to perform: Capture the requirements of Access Controls Systems by site survey Suggest and taking approval from the customer for Access Controls System Install approved Access Controls components as per site requirements Wire Electrical and Electronics components as per specifications Test Access Control Systems at customer premises, Provide Technical Support for Access Controls Systems, Achieve Quality and Productivity as per company norms.	06
5.	CCTV Surveillance: Optics in Cameras, Types of Camera Technologies, Types of Cameras, Video Analytics, Integration Able to perform: Capture the requirements of CCTV Surveillance Systems by site survey, Suggest and taking approval from the customer for CCTV System to be installed, Install approved CCTV components as per site requirements, Wire Electrical and	06





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Final Year B. Tech Syllabus

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Class: - Final Year B.Tech.	Semester-VII
Course Code: MC4091	Course Name: Basics of Cloud Computing

L	T	P	Credits
3	-	--	3

Course Description: Cloud computing is the on-demand availability of computer system resources, especially data storage and computing power, without direct active management by the user. The term is generally used to describe data centers available to many users over the Internet. Clouds may be limited to a single organization (enterprise clouds) or be available to many organizations (public cloud).

Course Learning Outcomes:

After successful completion of the course, students will be able to,

1. Describe fundamental concepts of cloud computing and its Architecture.
2. Differentiate and analyze the components of various cloud platforms.
3. Analyze the Key Components of Amazon Web Services (AWS)
4. Analyze the applications of Cloud Computing in different domains.

Prerequisite:

- ✧ Fundamental knowledge of Operating System.
- ✧ Basics of Client Server Programming and Network Protocols.

Course Content		
Unit No	Description	Hrs
1.	Introduction to Cloud Computing Introduction to Cloud Computing, Roots of Cloud Computing, Desired Features of Cloud Computing, Challenges and Risks, Benefits and Disadvantages of Cloud Computing.	06
2.	Virtualization Introduction to Virtualization Technology, Load Balancing and Virtualization, Understanding Hypervisor, Seven Layers of Virtualization, Types of Virtualization, Server, Desktop, Application Virtualization.	06
3.	Cloud Architecture, Services and Storage: NIST Cloud Computing Reference Architecture, Public, Private and Hybrid Clouds, IaaS, PaaS, SaaS, Architectural Design Challenges, Cloud Storage.	06



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Final Year B. Tech Syllabus
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Class: -Final Year B. Tech	Semester-VII
Course Code: MC4111	Course Name: Machine Tool Design

L	T	P	Credits
3	--	--	3

Course Description:

This course aims to prepare students for developing their careers in design engineering especially in Machine Tool Design. The course will impart students the capability to design machine tools by understanding functional and operational requirements. This course will provide thorough understanding and application of the concepts of design of machine tools, design and/or selection of drives for machine tools; will impart knowledge to design machine tool structures, Design of beds, columns and housings, all types of guide ways, power screws, spindle, spindle supports and other parts of machine tools. It will also impart the knowledge of the dynamics of machine Tools and select the proper control system.

Course Learning Outcomes:

After successful completion of the course, students will be able to,

1. Select & design drive system for machine tool.
2. Decide layout of machine tool.
3. Design machine tool structure, guide ways and power screws.
4. Determine dynamic characteristics of machine tool & carry stability analysis.
5. Demonstrate control systems in machine tools and SPM.

Prerequisite:

Students should have,

1. A good understanding of different types of drives and their selection.
2. Strong understanding of Analysis of mechanical elements, strength of materials and mechanical component design.

Course Content		
Unit No	Description	Hrs.
1.	Design of Machine Tool Drives:	06





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Final Year B. Tech Syllabus
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Department of Mechatronics Engineering

Functions, requirements and classification, Control systems for speeds, feeds and various motions, Manual & automatic control systems, Adoptive Control Systems Numerical Control of machine tools- fundamental concept, classification and structure of NC system, CNC, DNC Machining Centers
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References-

Textbook:

- N. K. Mehta, Machine tool design and numerical control, Tata McGraw Hill Publication.

Reference Books:

- S. K. Basu, Design of Machine Tools, Oxford and IBH publishing, New Delhi
- P. H. Joshi, Machine tools handbook-Design and operation, McGraw Hill, New Delhi
- Sen and Bhattacharya, Principles of machine Tools, New age central book agency
- Koenigs-Berger, Principles of machine Tools, Oxford, New York, Pergamon Press
- T H Wentzell, Machine Design Cengage Learning, New Delhi.
- G. K. Grover, Mechanical Vibration, Nemchand & Brothers, Roorkee.
- Dr. V. P. Singh, Mechanical Vibrations. Chand & Sons New Delhi.
- N/A Central Machine Tool Institute, Machine Tool Design Handbook Hardcover





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Final Year B. Tech Syllabus
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Department of Mechatronics Engineering

	electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.	
3.	Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives	06
4.	Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Hybridization of different energy storage devices.	06
5.	Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power 7 20% electronics, selecting the energy storage technology,	06
6.	Communications, supporting subsystems: In vehicle networks- CAN, Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies	06

References -

Text Books:

- 1) Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press,

Reference Books:

1. James Larminie, John Lowry, Electric Vehicle Technology Explained.
2. Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design.





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Final Year B. Tech Syllabus

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	Work Study: Method Study, Process Charts, Flow Process Charts, String Diagrams, Advanced Tools: Motion Capture Systems, Digital Twin Applications in Process Analysis	
2. Quality and Reliability Engineering	Total Quality Management (TQM) and Six Sigma, Statistical Process Control (SPC), Control Charts, Process Capability Analysis, Failure Modes and Effects Analysis (FMEA), Mean Time Between Failures (MTBF), Reliability Prediction Models, Quality Standards: ISO 9001, Six Sigma Methodology, Case Studies: Quality Management in Automated Manufacturing Systems	04
3. Facilities Design	Facility location factors and evaluation of alternate locations; types of plant layout and design of product and process layout. Assembly line balancing Computerized layout design techniques; assembly line balancing; materials handling systems, Automated Guided Vehicles (AGVs), conveyors, robotics, Tools for layout planning: CRAFT, Systematic Layout Planning (SLP), Sustainable facility design principles	06
4. Production Planning and Control	Functions and objectives of PPC, Forecasting methods for demand planning, Aggregate planning and scheduling, Inventory control: EOQ, ABC, and JIT systems, Integration of mechatronics systems in PPC	06
5. Inventory Management	Demand Forecasting, Inventory models-basic model, production model, price discount model, Inventory systems ROL system and Periodic review systems. Application problems. Materials requirement planning (MRP), MRP I, MRP II.	06
6. Project Management	Project Life Cycle: Initiation, Planning, Execution, Monitoring, and Closure Tools and Techniques: Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), Gantt Charts, Agile and Lean Project Management Risk Management and Mitigation Strategies	06

References -

Text Books:

1. K C Jain and L N Agarwal, Production Planning and Control, 6th edition, Khanna Publishers, 2008.
2. M Mahajan, Production Planning and Control, Dhanpat Rai & Co., 2010.





K.E. Society's
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Final Year B. Tech Syllabus
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Class: - Final Year. B. Tech	Semester-VII	L	T	P	Credits
Course Code: MC4191	Course Name: Emerging Smart Materials for Mechatronics Applications	3	-	--	3

Course Description:

The syllabus for "Emerging Smart Materials for Mechatronics Applications" typically covers a range of topics related to smart materials and their applications in mechatronics systems. Here's a brief overview of what you might expect:

Course Learning Outcomes:

After successful completion of the course, students will be able to,

1. Develop familiarity with various smart materials and their applications.
2. Design sensors and actuators using smart materials like piezoelectric materials and shape memory alloys (SMAs).
3. Analyze vibration control and damping structures using smart materials.
4. Interpret emerging technical literature related to smart materials and structures.

Prerequisite: Nil

Course Content

Unit No	Description	Hrs
1.	Introduction to Smart Materials: Overview of smart materials and their applications in sensing and actuation.	06
2.	Piezoelectric Materials: Piezoelectricity, constitutive equations, types of piezoelectric materials, control of piezoelectric actuators, and applications.	06
3.	Shape Memory Alloys (SMAs): Properties of SMAs, shape memory effects, pseudo-elasticity, design of SMA actuators, and applications in precision equipment.	06
4.	Magneto strictive Materials: Basics of magnetic properties, magnetostriction, types of magneto strictive materials, design and control of magneto strictive actuators, and applications for active vibration control.	06
5.	Optical fibers	06





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Final Year B. Tech Syllabus

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Department of Mechatronics Engineering

Program Elective-IV

Class: - Final Year B. Tech	Semester- VII
Course Code: MC4231	Course Name: Computer Network and Cyber Security

L	T	P	Credits
3	--	--	3

Course Description: Computer networking is the engineering discipline concerned with the communication between computer systems and devices. While cyber security aims to equip students with the knowledge and skills required to defend computer operating systems, networks and data from cyber-attacks. This course is an introduction to the basic networking principles, protocols and concepts that make today's internet work. Also, it encompasses how to safeguard against threats to computer hardware, software and data including theft, hacking, virus and more.

Course Learning Outcomes:

After successful completion of the course, students will be able to,

1. Describe the various networking components and topologies.
2. Illustrate the concepts, services and protocols used in Computer networks.
3. Solve problems related to Ipv4 addressing.
4. Describe fundamental terms in cybercrime and compare various cyber-attacks & offences.
5. Demonstrate cyber forensics using modern tools & techniques.
6. Construct a strategy for creating awareness about cyber security for e-banking and legal issues among the social community.

Prerequisite: Basic of computer fundamentals.

Course Content

Unit No	Description	Hrs
1.	Networking Fundamentals: Data communication, Transmission, Media, Guided Media, Unguided media, Network topologies, Introduction to LAN, WAN, MAN, Networking Devices,	06





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Final Year B. Tech Syllabus
To be implemented for the 2023-27 NEP Batch
Department of Mechatronics Engineering

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| <ol style="list-style-type: none">3. Andrew S. Tanenbaw11, "Computer Networks", Pearson Education, Fourth Edition.4. James Graham, Ryan Olson, Cyber Security Essentials, |
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Final Year B. Tech Syllabus

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Department of Mechatronics Engineering

	Design Development and Sizing, Systematic Design Methodology and Construction of Micro Aerial Quadrotor Vehicles.	
3. UAV Fundamentals	Kinematics and Dynamics of Fixed-Wing UAVs, Dynamic Model for a Miniature Aerobatic Helicopter, Quadrotor Kinematics and Dynamics, Dynamics and Control of Flapping Wing MAVs, Principles of Guidance, Navigation, and Control of UAVs.	06
4. UAV Propulsion	UAV Propulsion: Introduction, Power Management of a Hybrid Electric Propulsion System Powered by Solar Cells, Fuel Cells, and Batteries for UAVs.	06
5. UAV Control	Linear Flight Control Techniques for UAV, Nonlinear Flight Control Techniques for UAV, Adaptive Control of UAV: Theory and Flight Tests, Robust and Adaptive Control Methods for Aerial Vehicles.	06
6. UAV Applications	Survey of UAVs for Traffic Monitoring, Cooperative Unmanned Aerial Systems for Fire Detection, Monitoring, and Extinguishing.	06

References-

Text Books:

1. Kimon P. Valavanis, George J. Vachtsevanos, Handbook of Unmanned Aerial Vehicles, Springer

Reference Books:

1. Neeraj Kumar Singh, Porselvan Muthukrishnan, Industrial System Engineering for Drones, Apress

2. Sachi Nandan Mohanty, J.V.R. Ravindra, Drone Technology: Future Trends and Practical Applications, Wiley





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Final Year B. Tech Syllabus

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Department of Mechatronics Engineering

3.	CMOS Process Technology: Fabrication process flow- basic steps, the CMOS n-Well process, layout design rules, stick diagram, full-custom mask layout design MOS Inverter (Static Characteristics): Resistive-load inverter, inverter with n-type 16 MOSFET load, CMOS inverter MOS Inverters (Switching Characteristics and Interconnects effects): Delay-time definitions, calculation of delay times, logical efforts, inverter design with delay constraints, estimation of interconnect parasites, calculation of interconnect delay, Bus vs. Network-on-Chip (NoC), switching power dissipation of CMOS inverters.	06
4.	Combination CMOS Logic Circuits: MOS logic circuits with depletion CMOS loads, CMOS logic circuits, complex logic circuits, CMOS transmission gates (pass gates), ratioed, dynamic and pass transistor logic circuits.	06
5.	Sequential MOS logic circuits: Behavior of bi-stable elements, SR latch circuits, clocked latch and flip-flop circuits, CMOS D-latch and edge-triggered flip-flop. Timing path, Setup time and hold time static, example of setup and hold time static, setup and hold slack, clock skew and jitter, Clock, reset and power distributions.	06
6.	Semiconductor Memories: Memory Design, SRAM, DRAM structure and implementations Recent Trends in VLSI Design & its research issues in industry: System case studies. Design automation of VLSI Systems: basic concepts. Deep Sub-micron Technologies: Some Design Issues	06

References -

Text Books:

- VLSI Design Black Book Paperback. by Kattula Shyamala Dr. ...
- Cmos Vlsi Design: A Circuits and Systems Perspective, 3/E by Weste Neil H.E., David Harris.
- Principles CMOS VLSI Design by Weste H.E.

Reference Books:

- N. H. E. Weste and C. Harris, "Principles of CMOS VLSI Design: A System Perspective, 3rd Edition, Pearson Education 2007.
- J. Rabaey, A. Chandrakasan and B. Nikolic, Digital Integrated Circuits: A Design Perspective, 2nd Edition, Prentice Hall 2004.





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Final Year B. Tech Syllabus

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Department of Mechatronics Engineering

5.	Program for Pick and place and palletizing application on 6-axis and 7-axis articulated robot.	02
6.	Program for welding application on 7-axis articulated robot.	02
7.	Design and execute a given robotic automation task using a 6-axis or 7-axis robot.	02
8.	Using simulation software for offline programming and task validation, simulating industrial operations and optimizing robot paths.	02
9.	Industrial Visit	02

References –

Textbooks:

1. Manual by Fanuc Robotics India Pvt. Ltd.
2. Robotics, control vision and intelligence-Fu, Lee and Gonzalez. McGraw Hill international
3. Introduction to Robotics- John J. Craig, Addison Wesley Publishing.

Reference Books:

1. Robotics for Engineers -YoramKoren, McGraw Hill International
2. Industrial Robotics-Groover, Weiss, Nagel, McGraw Hill International.





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Final Year B. Tech Syllabus
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7.	Synthesize and transfer an electronic circuit using circuit simulation software to the PCB layout design software for transistor as a switch (Dip Trace).	02
8.	Design PCB layout for Op-Amp based application	02
9.	Design and Fabrication of PCB Layout for Linear Power Supply using simulation tool and dip trace	02
10.	Synthesize complete PCB for a given electronic circuit (mini project)	02

References -

1. Robert L. Boylestad, Louis Nashel Sky "Electronic Devices and Circuit Theory", Person Publication
2. Anand Kumar, "Fundamental of Digital Circuits", PHI Publication

Text Books:

1. Printed Circuit Boards: Design and Technology Bossart TMH, New Delhi 2008 or latest edition
2. Ultiboard user manual National Instruments www.ni.com
3. Orcade online manual Cadence www.cadence.com





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2.	Networking Topologies and its simulation using CISCO packet tracer	02
3.	Demonstration of Network Connectivity Testing Tools/Utilities	02
4.	Network Service configuration and testing: DHCP, DNS, FTP, SMTP etc.	02
5.	Demonstration of Network Packet Capturing and Analysis Tool (Wireshark)	02
6.	Installation and configuration of Kali Linux Operating System.	02
7.	Demonstration of Cyber Attacks: Social Engineering, Phishing, DOS/DDOS, SQL Injection using Kali Linux	02
8.	Demonstration of Browser Forensics & Security	02
9.	Demonstration of Operating System (OS) Forensics & Security	02
10.	Demonstration of Cryptographic techniques	02

References -

Text Books:

1. Behrouz A. Forouzen, "Data Communications and Networking with TCP/IP Protocol Suite", 6th Edition, Tata Mag. Hill, Indian Edition.
2. The Basic of Digital Forensics by John Sammons, Syngress Edition: 02
3. Kali Linux Penetration Testing Bible by Gus Khawaja Wiley

Reference Books:

5. Behrouz A. Forouzen, "TCP/IP Protocol Suite", 4th edition, Tata Mag. Hill, 2010.
6. Behrouz A. Forouzen, "Data communications and networking" 5th edition, Tata Mag. Hill.
7. Andrew S. Tanenbaum, "Computer Networks", Pearson Education, Fourth Edition.
8. The Ultimate Kali Linux Book by Author: Glen D. Singh Packt Publishing 2nd Edition.





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Final Year B. Tech Syllabus

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Department of Mechatronics Engineering

9.	Design, model and verify ring oscillator circuit	02
10.	Design and verify the magnitude comparator	02

References -

Text Books:

1. Sung MO Kang, CMOS Digital Integrated Circuit Design, TATA McGraw HILL.

Reference Books:

1. N. H. E. Weste and C. Harris, "Principles of CMOS VLSI Design: A System Perspective, 3rd Edition, Pearson Education 2007.
2. J. Rabaey, A. Chandrakasan and B. Nikolic, Digital Integrated Circuits: A Design Perspective, 2nd Edition, Prentice Hall 2004.





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9.	Integrate and test Object detection and tracking using onboard camera and OpenCV (ultrasonic or LiDAR sensors).	02
10.	Battery health monitoring, UAV Data Analysis (altitude, velocity, GPS track) and Power Management during flight.	02

References -

Text Books:

- Austin, R. 'Unmanned Aircraft Systems: UAVS Design, Development and Deployment,' Wiley.
- Valavanis, K. P., & Vachtsevanos, G. J., 'Handbook of Unmanned Aerial Vehicles,' Springer.

Reference Books:

- Pounds, P. E., & Mahony, R. E., 'Modeling and Control of Mini-Flying Machines.'
- Quan, Q., 'Introduction to Multicopter Design and Control,' Springer.
- Drone Build and Fly Manuals – PX4/Ardupilot Documentation.





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(An Empowered Autonomous Institute, Affiliated to Shivaji University, Kolhapur)

Final Year B. Tech Syllabus
To be implemented for the 2023-27 NEP Batch
Department of Mechatronics Engineering

2. Two weeks of in-plant training must be completed.
3. Capstone project phase-I must be completed.

Course Content

The project work may consist of,

1. To search and select an appropriate topic for capstone project work in view of innovations, new products, and solutions to long-standing problems.
2. A comprehensive and up-to-date survey of literature related to the study of a phenomenon or product.
3. Prepare and refine the project proposal to the point where the student should demonstrate that it is worthy of the undertaking and should be completed in time.
4. Prepare a well-defined project plan with a budget linked to project activities and outcomes.
5. Apply appropriate methodology to solve critical engineering problems.
6. Design and development of equipment, components, and test setup.
7. Conduct experiments, test products, and processes for various parameters, and interpret the results.
8. Write the technical report.

Students should complete the following work during semester-VIII

Design of Product or Process, Analysis, Experimentation/Fabrication, Testing, Modification, and Final Report Preparation.

Course Assessment-

Projects will be evaluated using Rubrics that assess

- the design, development, and final solution assets
- the final written report
- the final oral presentation

Each student's performance should be assessed individually with the team's overall performance by the supervisor, Group chairman, and committee using the rubrics provided in the Appendices. The project committee should consist of at least four academic staff with a project supervisor. The average scores of all supervisors for each rubric are combined using the following percentages to get a weighted average grade point.

Design, development & solution assets - 60%
Project report and presentation - 40%





K.E. Society's
Rajarambapu Institute of Technology, Sakharale
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Final Year B. Tech Syllabus
To be implemented for the 2023-27 NEP Batch
Department of Mechatronics Engineering

	Key terms of Accounting and Finance, Accounting Principles underlying Preparation of Financial Statements	
2.	Analyzing Health of a Firm Techniques of Analyzing Health of a Firm, Classification of Ratios – Liquidity, Leverage, Activity, Profitability, Analysis of Cash Flows	4
3.	The Management of Working Capital Need of Working Capital, Operating Cycle of Working Capital, Determinants of Working Capital, Preparation of Working capital statement	4
4.	Investment Decision Rules Investment Decision Rules, Evaluation Criteria for Investment Decision: Payback, ARR, NPV, PI & IRR, Decision Tree Analysis	4
5.	Long Term Financing Long Term Financing: Shares, Debentures, Loan capital, foreign capital, FDI, Euro issues & external borrowings, Venture capital financing.	4
6.	Financing Decisions and Cost of Capital Risk & Return, Cost of Capital, Cost of Equity, Cost of Debt, Weighted Average Cost of Capital	4

References:

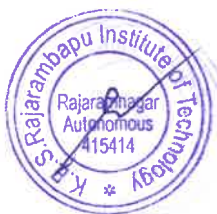
Reference Books:

1. Paul Kimmel, J. Weygandt, D. Kieso, Financial Accounting
2. S.N. Maheshwari & S.K. Maheshwari, Problems & Solutions in Advanced Accountancy, Vikas Publishing House Pvt. Ltd., New Delhi
3. M.C. Shukla, T.C. Grewal & S. C. Gupta, Advanced Accounts, S. Chand
4. M. Y. Khan & P. K. Jain, Financial Management, Tata McGraw-Hill Publishing Company Limited, New Delhi
5. Prasanna Chandra, Financial Management, Tata McGraw-Hill Publishing Company Limited.

Note: Being online course, lecture videos of each unit will be made available through college platform to the students. For each unit there will be separate assignment. Students need to submit all assignments within specified time.

Weightage: 25% weightage for unit wise assignments + 75% weightage for final exam.

Final exam will be held at college campus.





K.E. Society's
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, Affiliated to Shivaji University, Kolhapur)

Final Year B. Tech Syllabus

To be implemented for the 2023-27 NEP Batch

Department of Mechatronics Engineering

	Levels of management, Organizations-elements, types and characteristics of organization, Management by Objectives (MBO)	
3	Planning Tools Methods of scientific management- Critical Path Method (CPM), Programme Evaluation & Review Techniques (PERT), Network Crashing, Bar Chart, Mile-Stone chart, Gant Chart	04
4	Methods of Economic Analysis Economic equivalence, Methods of comparison of alternatives- Present Worth Method, Rate of Return method, Benefit-Cost ratio method	04
5	Make or Buy Decision Approaches of make or buy decision-Simple cost analysis, Economic analysis, break-even analysis, Payback analysis	04
6	Depreciation Methods of Depreciation- Straight line method, Declining balance depreciation, Sum of years digits method, sinking fund method, service output method	04

References:

Text Books:

1. Gilbert Daniel R, Freeman R. Edward and Stoner James A. F, "Management" Pearson Education.
2. Harold Kerzner, "Project Management- A system approach to planning, scheduling and controlling", John Wiley & Sons Inc.
3. Punmia B. C. and Khandelwal K. K, "Project Planning, Scheduling and controlling with PERT and CPM", Laxmi Publications Pvt. Ltd.
4. Paneerselvam R, "Engineering Economics", Prentice Hall India Learning Private Limited.

Reference Books:

6. Cannice Mark V, Koontz Harold and Weihrich Heinz, "Management", McGraw Hill Education (I) Pvt. Ltd.
7. Blank Leland and Tarquin Anthony, "Basics of Engineering Economy", Tata McGraw-Hill.
8. Mithani D. M, "Managerial Economics- Theory & Applications", Himalaya Publishing House-New Delhi.





K.E. Society's
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, Affiliated to Shivaji University, Kolhapur)

Final Year B. Tech Syllabus
To be implemented for the 2023-27 NEP Batch
Department of Mechatronics Engineering

Class: Final Year B. Tech	Semester-VIII
Course Code: IP4024	Course Name: Industry Internship & Project

L	T	P	Credits
-	-	--	12

Course Description:

Internship is designed to expand the depth and breadth of academic learning of students in their particular areas of study. It is an opportunity for students to receive experience in applying theories learned from the classroom to specific experiences with the community and work world. An internship can also heighten awareness of community issues, motivate students to create opportunities, embrace new ideas, and give direction to positive change. A successful internship can give valuable information in making decisions about the direction of future studies or employment. An internship is an opportunity not only to use and develop industry-related knowledge and skills, but also to enhance some of the skills that are transferable to any professional work setting. Students from Final year B.Tech are eligible to do this internship. Selected candidates by college will be permitted for internship of minimum 20 weeks in 8th semester. During this Internship, it is expected that students should identify the problems arising in the industry related to Engineering, and they have to give the solution to the company.

Course Learning Outcomes:

1. Internship

After the successful completion of the IIP- II the student should be able to

1. Examine the functioning of the company on the terms of inputs, transformation process and the outputs (products and services)
2. Develop an attitude to adjust with the company culture, work norms, code of conduct.
3. Recognize and follow the safety norms, Code of conduct.
4. Demonstrate the ability to observe, analyse and document the details as per the industry practices.
5. Interpret the processes, systems and procedures and to relate to the theoretical concepts-studies.
6. Develop the leadership abilities, communication.
7. Demonstrate project management and finance sense

2. Project

After the successful completion of the project, the student should be able to;





K.E. Society's
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, Affiliated to Shivaji University, Kolhapur)

Final Year B. Tech Syllabus
To be implemented for the 2023-27 NEP Batch
Department of Mechatronics Engineering

Students should select technical problems occurring within the industry as a project in consult with industry & Institute mentors.

• **Evaluation**

Faculty Mentor will be assigned to each student by the Institute who will monitor the progress of internship and project and help the student to sort-out any issues/ problems arising. Mentor of student from college will visit the industry as per the schedule given below.

Sr.No.	Evaluation	Period
1.	At the beginning of the program for orienting Students to the company and finalize the project	During 2 nd Week
2.	Review-I (ISE-1)	During 10 th week
3.	Review-II (ISE-2)	During 15 th week
4.	Review-III (ESE)	During 20 th week

*Review-III is End Semester Examination (ESE), which will be conducted at institute.

*During ESE, students should submit, Project & internship report, Work diary, Internship & project completion certificate issued by industry etc. to respective departments.





K.E. Society's
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, Affiliated to Shivaji University, Kolhapur)

Final Year B. Tech Syllabus
To be implemented for the 2023-27 NEP Batch
Department of Mechatronics Engineering

	Key terms of Accounting and Finance, Accounting Principles underlying Preparation of Financial Statements	
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3.	The Management of Working Capital Need of Working Capital, Operating Cycle of Working Capital, Determinants of Working Capital, Preparation of Working capital statement	4
4.	Investment Decision Rules Investment Decision Rules, Evaluation Criteria for Investment Decision: Payback, ARR, NPV, PI & IRR, Decision Tree Analysis	4
5.	Long Term Financing Long Term Financing: Shares, Debentures, Loan capital, foreign capital, FDI, Euro issues & external borrowings, Venture capital financing.	4
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4. M. Y. Khan & P. K. Jain, Financial Management, Tata McGraw-Hill Publishing Company Limited, New Delhi
5. Prasanna Chandra, Financial Management, Tata McGraw-Hill Publishing Company Limited.

Note: Being online course, lecture videos of each unit will be made available through college platform to the students. For each unit there will be separate assignment. Students need to submit all assignments within specified time.

Weightage: 25% weightage for unit wise assignments + 75% weightage for final exam.

Final exam will be held at college campus.





K.E. Society's
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, Affiliated to Shivaji University, Kolhapur)

Final Year B. Tech Syllabus
To be implemented for the 2023-27 NEP Batch
Department of Mechatronics Engineering

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3. Punmia B. C. and Khandelwal K. K, "Project Planning, Scheduling and controlling with PERT and CPM", Laxmi Publications Pvt. Ltd.
4. Paneerselvam R, "Engineering Economics", Prentice Hall India Learning Private Limited.

Reference Books:

6. Cannice Mark V, Koontz Harold and Weihrich Heinz, "Management", McGraw Hill Education (I) Pvt. Ltd.
7. Blank Leland and Tarquin Anthony, "Basics of Engineering Economy", Tata McGraw-Hill.
8. Mithani D. M, "Managerial Economics- Theory & Applications", Himalaya Publishing House-New Delhi.





K.E. Society's
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, Affiliated to Shivaji University, Kolhapur)

Final Year B. Tech Syllabus
To be implemented for the 2023-27 NEP Batch
Department of Mechatronics Engineering

Class: Final Year B. Tech	Semester-VIII
Course Code: RE4044	Course Name: Research Internship

L	T	P	Credits
-	-	-	12

Course Description:

Research experience for undergraduates is important not only for conducting research on a topic that has an impact on a current research activity, but also as a tool to enhance undergraduate education. For the engineering technology students, research experiences allow them to carry out in-depth study of engineering concepts, while emphasizing hands-on experiences and practical applications. Participating in research projects strengthens the student's resume, and fulfills the requirements of present day employers, who demand sound engineering skills in their employees.

Course Learning Outcomes:

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

1. Investigate the technical literature.
2. Recognize and evaluate theories, practices, and/or research on a chosen topic by conducting a thorough literature review and submitting a written integrative, critical summary of the current literature.
3. Design a research problem and develop a methodology.
4. Develop and implement an advanced original research or creative project.
5. Develop the ability to explain the conceptual viability of the project and describe the major components involved.
6. Develop advanced discipline-relevant skills and competencies.
7. Write a research report and paper.

Course Content

Students should carefully discuss with their research advisor about time expectations to complete the research project.

Degree to which students meet expectations: The following is a minimum set of expectations for every student enrolled for this course for credit:

- i) perform a background literature search and review,
- ii.) Develop a project plan,
- iii.) Perform experimental work or applied experimental work,
- iv.) Write and present a research report.





K.E. Society's
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Final Year B. Tech Syllabus
To be implemented for the 2023-27 NEP Batch
Department of Mechatronics Engineering

Entrepreneurial Internship (EI)

Class: Final Year B. Tech	Semester-VIII
Course Code: ED4104	Course Name: Project Management (Online Course)

L	T	P	Credits
2	-	--	2

Course Description:

To improve and update knowledge of new entrepreneurs in the areas of project preparation & appraisal techniques; decision-making process in the sector of industrial, infrastructure & sustainable opportunities that would lead to improved viability, returns and effective investment decisions. Writing a business plan which can gain interest of the fund providers like venture capitalists and other sources of funding.

Course Learning Outcomes:

After successful completion of the course, students will be able to,

1. Develop a Comprehensive Business Plan for selected business.
2. Evaluate Project Viability Through Financial Appraisal.
3. Analyze the Environmental and Technical Aspects of a Project.
4. Apply Project Management Techniques.
5. Assess the Commercial Feasibility of a Business Opportunity.

Prerequisite:

General knowledge of economics & clear concept about own business model.

Course Content

Unit No	Description	Hrs
1.	Project appraisal -Project Development Cycle, Preparation of feasibility studies, project formulation, screening for pre-feasibility studies, stages of feasibility report preparation, Project Analysis including Market Analysis, Technical Analysis & Financial Analysis, Various analytical techniques and integrating the data gathered into a full-fledged business plan.	04





K.E. Society's
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, Affiliated to Shivaji University, Kolhapur)

Final Year B. Tech Syllabus

To be implemented for the 2023-27 NEP Batch

Department of Mechatronics Engineering

2. Katz, J.A. and Green, R.P., Entrepreneurial Small Business, McGraw Hill
3. Mullins, J. and Komisar R., Getting to Plan B, Harvard Business Press
4. O'Donnell, M., The Business Plan: Step by Step, UND Center for Innovation.
5. Scarborough, N.M. and Zimmerer, T.W., Effective Small Business Management, Pearson
6. Pickle, H.B. and Abrahamson, R.L., Small Business Management, Wiley
7. Desai, V., Dynamics of Entrepreneurial Development & Management, Himalaya Publishing
8. Kao, J., Creativity & Entrepreneurship, Prentice Hall [SEP]
9. Singh, Narendra, Project Management & Control, Himalaya Publications





K.E. Society's
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, Affiliated to Shivaji University, Kolhapur)

Final Year B. Tech Syllabus

To be implemented for the **2023-27 NEP Batch**

Department of Mechatronics Engineering

	entry system. Accounting Records: Fundamentals of record keeping, the accounting process, Computer-based accounting systems. Accounting cycle.	
2.	Financial Management – Definition, nature, objectives, functions and scope of financial management, Preparation of financial plan – its objectives, essential features, consideration in formulating financial plan	04
3.	Financial Statements: Balance sheet: assets, liabilities. Income statement: concept of income, concept of expenses, concept of gain and losses. Components of the income statement. Cash flow statements: purpose, components, concept, Process.	04
4.	Nature & Scope of Marketing – Evolution, core marketing concepts, selling concept, marketing concept, Holistic marketing concept, portfolio approach-BCG matrix. Marketing Research- Concept & practice, Steps in Marketing Research.	04
5.	Marketing Environment and STP: Demographic, economic, political, legal, socio cultural, technological environment (Indian context); environmental scanning to discover marketing opportunities, Segmentation, Targeting and Positioning, difference between segmentation, targeting and positioning.	04
6.	Marketing Mix: Product, Price, Promotion and Place. Product Decisions: Concept of Product, Levels of Product, Product Mix Decisions, Product Line Decisions, Individual Product Decisions, Branding, Product Life-cycle - Stages. Pricing Decisions: Meaning, Factors influencing Pricing Decisions, Methods of Pricing Place Decisions: Meaning, Channels of Distribution Promotion Decisions: Elements of Promotion Mix, Advertising, Publicity, Sales Promotion, Personal Selling, Direct Marketing and Public Relations,	04

References -

Text Books:

1. Maheshwari, S.N. and Maheshwari, S.K., Financial Accounting, Vikas Publishing House
2. Leach C.J. and Melicher, R.W. Entrepreneurial Finance, Thomson.
3. For B2C = Kotler, P., Keller, K.L., Koshy, A. and Jha, M.: Marketing Management, Pearson





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(An Empowered Autonomous Institute, Affiliated to Shivaji University, Kolhapur)

Final Year B. Tech Syllabus
To be implemented for the 2023-27 NEP Batch
Department of Mechatronics Engineering

Class: Final Year B. Tech	Semester-VIII	L	T	P	Credits
Course Code: ED4064	Course Name: Entrepreneurship Development Program (EDP)	-	-	--	1

Course Description:

Student will attend short term intensive EDP program organized either in house or by any authorized agency approved by CIIED.

Prerequisite: General knowledge of business & clear concept about own business model.

Course Learning Outcomes:

After successful completion of the course, students will be able to,

1. Apply knowledge of engineering, economics, marketing and finance for formulation of business plan, starting & managing new business.

Course Content:

1 Student will undergo training programs organized by CIIED.

Programs on marketing, Finance management, project report preparation by professional agencies. Students are required to apply this knowledge for preparing final project report.

2. Student will complete online certification course- **Entrepreneurial & Employability Skill Development Program** by Singapore polytechnic in association with Jugad Funda & Shivaji University, Kolhapur or any other approved agencies.

Evaluation- ISE **50** marks by mentor for-

1. Completion of online certification course- **Entrepreneurial & Employability Skill Development Program** by Singapore polytechnic in association with Jugad Funda & Shivaji University, Kolhapur or any approved agencies.
2. Active participation in programs by completing various activities/assignments in program.





K.E. Society's
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, Affiliated to Shivaji University, Kolhapur)

Final Year B. Tech Syllabus
To be implemented for the 2023-27 NEP Batch
Department of Mechatronics Engineering

	20%	Market Survey	20
	20%	Completion of Legal Aspects	20
	50%	Final Report	50
ESE	100%	ESE -Final Report	100





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Rajarambapu Institute of Technology, Sakharale
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Final Year B. Tech Syllabus
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Department of Mechatronics Engineering

	innovation and economic development; Overview of global IPR systems (WIPO, WTO, TRIPS Agreement)	
2	Patents: Concept of patents and patentability criteria (novelty, inventive step, industrial applicability); Types of patents: Utility, Design, and Plant Patents; Patent application process: Filing, examination, and grant; Patent infringement and enforcement; Case studies on patent disputes in technology sectors; Introduction to Patent Cooperation Treaty (PCT) and international patent filing	
3	Copyrights and Related Rights: Concept of copyright and its scope; Subject matter of copyright: Literary, artistic, musical, and software works; Rights of copyright holders and limitations (fair use, public domain); Copyright registration and enforcement; Digital rights management and challenges in the digital era; Case studies on copyright infringement in software and media	
4	Trademarks and Industrial Designs: Concept of trademarks and their importance in branding; Types of trademarks: Word marks, logos, service marks, collective marks; Trademark registration process and infringement; Concept of industrial designs and their protection; Design registration and enforcement; Case studies on trademark and design disputes	
5	Trade Secrets and Geographical Indications: Concept of trade secrets and their protection; Legal framework for trade secrets (e.g., NDAs, confidentiality agreements); Geographical Indications (GIs): Concept and significance; Protection of GIs and their role in promoting local products; Case studies on trade secret theft and GI disputes	
6	IPR Management, Ethics, and Global Perspectives: IPR management in technology transfer and commercialization; Licensing and assignment of IP rights; IPR in open innovation and collaborative research; Ethical issues in IPR: Biopiracy, patenting life forms, and access to medicines; Global IPR trends and challenges: Counterfeiting, piracy, and cross-border enforcement; Role of IPR in startups and entrepreneurship; Future of IPR in emerging technologies (AI, blockchain, biotechnology)	





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Rajarambapu Institute of Technology, Sakharale
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Final Year B. Tech Syllabus
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Department of Mechatronics Engineering

Class:-Final Year B. Tech.	Semester- VII	L	T	P	Credits
Course Code : REH403	Course Name : Research Project (Synopsis) Phase 1	-	-	-	2

Course Description:

This course is designed to guide B. Tech. students through the initial phase of their research project, focusing on the development of a comprehensive research synopsis. Students will be introduced to the fundamentals of research methodology, including problem identification, literature review, research design, and ethical considerations. The course emphasizes the formulation of clear research questions, the selection of appropriate methodologies, and the preparation of a well-structured research proposal. Through mentoring sessions, students will learn to conduct systematic literature reviews, design research frameworks, and present their synopsis/proposal effectively. The course aims to equip students with the skills necessary to plan, propose, and defend their research projects, setting a strong foundation for the successful execution of their research in Phase 2.

The evaluation process is designed to assess students' understanding and application of research concepts. It includes in Semester Evaluation (ISE - 50%) and End-Semester Evaluation (ESE - 50%) comprises presentation sessions.

Course Learning Outcomes:

After successful completion of the course, students will be able to,

1. Demonstrate an understanding of research methodology and project planning.
2. Identify a research problem with clear objectives and questions.
3. Conduct a systematic literature review using appropriate sources and tools.
4. Develop a research synopsis with a well-defined methodology and expected outcomes.
5. Present research synopsis/proposal effectively.





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Rajarambapu Institute of Technology, Sakharale
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Final Year B. Tech Syllabus
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Department of Mechatronics Engineering

Class:- Final Year B. Tech.	Semester- VIII	L	T	P	Credits
Course Code : REH402	Course Name : Research Project Phase 2	-	-	-	11

Course Description:

This course is designed to guide B. Tech. students through the execution and reporting phase of their research project, building on the foundation laid in Phase 1. Students will implement the research plan outlined in their synopsis, focusing on data collection, experimentation, analysis, and interpretation. The course emphasizes the application of research methodologies, tools, and techniques to address the research problem effectively. Through regular mentoring sessions, students will refine their research approach, troubleshoot challenges, and ensure adherence to ethical guidelines. The course also focuses on the preparation of a detailed research report and the presentation of findings.

The evaluation process is designed to assess students' ability to execute their research plan and communicate their results effectively. It includes In-Semester Evaluation (ISE - 50%) and End-Semester Evaluation (ESE - 50%), comprising progress reviews, report submissions, and final presentations.

Course Learning Outcomes:

After successful completion of the course, students will be able to,

1. Apply appropriate analytical tools and techniques to process and interpret research.
2. Identify and address challenges encountered during the research process.
3. Prepare a comprehensive research report detailing the objectives, methodology, findings, and conclusions.
4. Communicate research outcomes effectively through written and oral presentations.
5. Demonstrate ethical guidelines and standards throughout the research process.

