AUTONOMOUS

SYLLABUS

VII & VIII Semesters

B.E. in Mechatronics

2023

MITE

Invent Solutions

MANGALORE INSTITUTE OF
TECHNOLOGY & ENGINEERING

Institute Vision

*"To attain perfection in providing **Globally Competitive Quality Education** to all our Students and also benefit the global community by using our strength in **Research and Development**"*

Institute Mission

*"To establish world class educational institutions in their respective domains, which shall be C**enters of Excellence** in their stated and implied sense. To achieve this objective, we dedicate ourselves to meet the challenges of becoming **Visionary and Realistic**, **Sensitive and Demanding**, **Innovative and Practical,** Theoretical **and Pragmatic;** ALL at the same time"*

Department Vision

"To accomplish excellence in imparting Quality Education in Mechatronics and tocontribute to community through Research and Development"

Department Mission

- *To divulge knowledge in the fields of Mechanical, Electricals & Electronics, and Computer Engineering, related areas with an emphasis on evolving the essential proficiencies and virtues anticipated of Mechatronics Engineer.*
- *To establish best in class laboratories to endorse applied knowledge of Mechatronics to meet the needs of the society.*
- *To instill better interpersonal abilities, promote leadership, ethics and entrepreneurship among students through efficient training and development.*
- *To prepare robust and responsible graduate to pursue higher studies and research to meet the global requirements.*

Program Educational Objectives (PEOs)

After successful completion of the program, the graduates will be

PEO-1: Be able to solve engineering problems and develop sustainable products by integrating multi-disciplinary knowledge in Mechanical, Electronics, Computer andControl engineering to meet societal needs.

PEO-2: Be able to work and manage teams in cross cultural, multinational and multilingual environment with competent interpersonal and communication skills alongwith high professional, social and ethical morale.

PEO-3: Have research aptitude and engage in continual learning with inclination towards entrepreneurship.

Program Specific Outcomes (PSOs)

Graduates of the Mechatronics will be able to

PSO1: Exhibit multi-disciplinary knowledge in robotics and automation, mechanical, electronics, and computer engineering to excel in professional career.

PSO2: Manage and lead teams with ethics, have research aptitude, adapt to currenttrends in technologies and contribute to society with a passion towards life-long learning.

LIST OF COURSES

VII / VIII Semester Courses			
Sl. No.	**Course Code**	**Course Title**	**Sem**
PROFESSIONAL CORE COURSES			
1	23MTPC401	Industrial Robotics	VII
2	23MTPC402	Embedded Systems	VII
PROFESSIONAL ELECTIVE COURSES			
3	23MTPE411	Thermal Engineering	VII
4	23MTPE412	Digital Image Processing	VII
5	23MTPE413	Robot Perception	VII
6	23MTPE42X	MOOCs (NPTEL/SWAYAM) 8/12 WEEKS	VIII
OPEN ELECTIVE COURSES			
7	23MTOE411	Automation in Manufacturing	VII
8	23MTOE412	Biomechatronics	VII
9	23MTOE413	Soft Robotics	VII
SKILL ENHANCEMENT COURSE			
10	23MTSE409	Project Phase-II	VII
11	23MTSE431	Internship	VIII
12	23MTSE432	Publication/Patenting	VIII
HUMANITIES & SOCIAL SCIENCE COURSE			
13	23HMCC421	Constitution of India & Professional Ethics	VII

VII Semester (2023 Scheme): Mechatronics

Sl. No.	Course Code	Course Title	Category	Teaching Dept.	Teaching Hours /Week			Examination (Marks)			Duration of Exam (SEE) in Hrs.	Credits
					L	T	P	CIE	SEE	Total		
1.	23MTPC401	Industrial Robotics	Professional Core Course	MT	3	0	2	50	50	100	3	4
2.	23MTPC402	Embedded Systems	Professional Core Course	MT	3	0	2	50	50	100	3	4
3.	23MTPE41X	Professional Elective–III*	Discipline Specific Elective	MT	3	0	0	50	50	100	3	3
4.	23MTOE41X	Open Elective-III**	Open Electives	MT	3	0	0	50	50	100	3	3
5.	23MTSE409	Project Phase-II	Skill Enhancement	MT	-	-	12	100	100	200	-	6
6.	23HMCC421	Constitution of India & Professional Ethics	Humanities & Social Sciences	Humanities/ Any dept.	1	0	0	100	-	100	-	1
											Total Credits	**21**

***Professional Elective Course-III**

Sl. No.	Course Code	Course Title
1.	23MTPE411	Thermal Engineering
2.	23MTPE412	Digital Image Processing
3.	23MTPE413	Robot Perception

****Open Elective Course-III**

Sl. No.	Course Code	Course Title
1.	23MTOE411	Automation in Manufacturing
2.	23MTOE412	Biomechatronics
3.	23MTOE413	Soft Robotics

VIII Semester (2023 Scheme): Mechatronics

Sl. No.	Course Code	Course Title	Category	Teaching Dept.	Teaching Hours/Week			Examination Marks			Duration of Exam (SEE) in Hrs	Credits
					L	T	P	CIE	SEE	Total		
1.	23MTPE42X	MOOCs* (NPTEL/SWAYAM) 8/12 WEEKS	Professional Elective	MT	-	-	-	-	-	100	-	2
2.	23MTSE431	Internship	Skill Enhancement	MT	-			100	100	200	3	12
3.	23MTSE432	Publication/Patenting	Skill Enhancement	MT	-	-	-	100	-	100	-	2
											Total Credits	**16**

*** Massive Open Online Courses (MOOCs) -** Identified by the BoS of the department

Guidelines for MOOCs

To promote self-paced, flexible, and industry-relevant learning, a Two-Credit Online professional elective course is introduced in the VIII semester curriculum for all Bachelor of Engineering (B.E.) programs. Students are required to complete an approved online course as per the following guidelines:

1. **Registration and Course Completion:**

   Students must complete any one of the *Board of Studies (BOS)* approved online courses by registering for an 8-week or 12-week course offered through recognized platforms such as NPTEL or SWAYAM. Registration can be done during semester VI or semester VII.

2. **Credit Conversion:**

   The score obtained in the proctored examination conducted by the respective online platform shall be formally converted into course credits as per institute norms.

3. **Provision for students failing to clear the Online Course**

   If a student fails to successfully complete the selected online course within two consecutive attempts before the commencement of Semester VIII, they must register for an elective course offered by the respective department. This elective will be delivered in online mode by the department.

4. **Assessment Pattern for the alternate elective:**

   a. All assignments for the alternate elective course must be submitted online.
   b. The Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE) shall be conducted in offline mode.
   c. Students must physically appear for these examinations at the institute.

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VII & VIII Semester

Industrial Robotics			
Semester	**VII**	CIE Marks	**50**
Course Code	**23MTPC401**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**3:0:2**	Exam Hrs	**3**
Total Hrs	**64**	Credits	**4**

Course Learning Objectives: This course is designed to

1. Familiarize robot end effectors and sensors
2. Provide the knowledge on basic robot programming and cell design
3. Describe the application of robots in material transport systems

Module 1: Robot End Effector and Sensors	**No. of Hrs: 8 +4**

End Effector, Types of End Effectors, Mechanical Grippers, Types of Grippers Mechanisms, Other types of Grippers, Tools and End effectors, Gripper Selection and Design

Transducers and Sensors in Robotics: Tactile, Proximity and Range Sensors, uses of Sensors in Robotics

Textbook 1: Chapter: 5.1 to 5.6, 6.1 to 6.5

Laboratory Components:

1. Simulate a Robotic Arm to Perform Point to Point Linear Movement on Cubic Solid Model
2. Simulate a Robotic Arm to Perform Point to Point Linear Movement on Cylindrical Solid Model

Module 2: Robot Motion Analysis and Robot Kinematics	**No. of Hrs: 9 +4**

Introduction to Manipulator Kinematics, Position Representation, Forward and Reverse Transformation of a 2-Degree of Freedom Arm, Adding Orientation, Homogeneous Transformations and D-H Convention

Textbook 1: Chapter: 4.1 to 4.5

Laboratory Components:

1. Simulate a Robotic Arm to Perform a Drilling Operation at the Center of the Work Piece
2. Simulate a Robotic Arm to Perform a Milling Operation on the Surface of the Work Piece

Module 3: Robots Dynamics and Material Handling Systems	**No. of Hrs: 8+4**

Manipulator Path Control, Joint Space Schemes, Robot Dynamics, Static Analysis, Compensating for Gravity, Robot Arm Dynamics, Configuration of a Robot Controller, Material Handling Systems, Principles and Design Consideration, Material Transport Systems, Storage Systems, Processing Operation - Spot Welding, Continuous Arc Welding, Spray Coating

Textbook 1: Chapter: 4.3, 4.5, 13: 13.1 to 13.3, 14: 14.1 to 14.3

Laboratory Components:

1. Perform Point to Point Linear Movement Operation in a Robot System
2. Perform Point to Point Circular Movement Operation in a Robot System

Module 4: Robot Cell Design & Control	**No. of Hrs: 9+4**
Robot Cell Layouts, Multiple Robots and Machine Interference, Considerations in Work-Cell Design, Work-Cell Control, Interlocks, Error Detection and Recovery, Work -Cell Controller, Robot Cycle Time Analysis, Graphic Simulation of Robotic Work Cells Textbook 1: Chapter: 11.1 to 11.9 **Laboratory Components:** 1. Perform a Welding Operation on a Work Piece Utilizing a Robotic System 2. Perform Pick and Place Operation Utilizing a Robotic System	
Module 5: Robot Programming languages	**No. of Hrs: 8+6**
Methods of Robot Programming, Lead -Through Programming Methods, a Robot Program as a Path in Space, Motion Interpolation, Wait, Signal and Delay Commands, Branching, Capabilities and Limitations of Lead-Through Methods Textbook 1: Chapter: 8.1 to 8.7 **Laboratory Components:** 1. Simulate a Robotic Arm to Perform Conveyor Tracking Operation 2. Simulate a Robotic Arm to Perform a Continuous Path Operation for Surface Painting 3. Simulate a Robotic Arm to Perform Stacking of Objects on a Pallet in a Predefined Pattern	
Course Outcomes: At the end of the course, the student will be able to: 1. Illustrate the mechanical gripper by considering force and gripping mechanisms 2. Describe the components of a robot work-cell explaining the importance of cycle-time analysis for efficient robotic system operation 3. Apply manipulator kinematics and d-h conventions to compute forward and inverse transformations for robotic arms 4. Apply robot path control, dynamics and material-handling principles to improve robotic system performance 5. Apply robot programming languages and lead-through methods to stimulate robot paths, motions and control logic	
Textbook: 1. Mikell P. Groover, Mitchel Weiss, Roger N. Nagel, Nicholas G. Odrey & Ashish Dutta, "Industrial Robotics: Technology, Programming, and Applications", 2nd Edition, McGraw-Hill, 2012	

Reference Books:

1. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd., 2006
2. Fu K S, Gonzalez R C, Lee C.S.G, "Robotics: Control, Sensing, Vision and Intelligence", McGraw Hill, 1987
3. John J. Craig, "Introduction to Robotics: Mechanics and Control", 3rd Edition, Pearson Education, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd., 2005

Web links:

1. Introduction to obotics**:** https://onlinecourses.nptel.ac.in/noc21_me32/preview, IIT Kanpur. NPTEL Online Courses
2. Robotics**:** https://onlinecourses.nptel.ac.in/noc21_me76/preview, IIT Madras. NPTEL Online Courses
3. Introduction to Industrial Automation and Control**:** https://nptel.ac.in/courses/108105063, IIT Kharagpur. NPTEL

Embedded Systems			
Semester	**VII**	CIE Marks	**50**
Course Code	**23MTPC402**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**3:0:2**	Exam Hrs	**3**
Total Hrs	**64**	Credits	**4**

Course Learning Objectives: This course is designed to

1. Impart knowledge of fundamental embedded system concepts, components, and application areas
2. Provide understanding of embedded software elements including interrupts, device drivers, and firmware
3. Familiarize with RTOS concepts and real-world embedded system applications

Module 1: Introduction to Embedded Systems	**No. of Hrs: 8+4**

Embedded Vs General computing system, Classification of Embedded systems, Communication Interfaces, Embedded System Components, Characteristics and Quality Attributes of Embedded Systems

Textbook 1: Chapter: 1, 2.4.1 to 2.4.8, 2.5,2.6.1 to 2.6.5, 3

Laboratory Components:

1. Embedded Systems with ARM Assembly Programming for Arithmetic Operations
2. Embedded Systems GPIO Interfacing for LED Blinking using ARM

Module 2: Embedded Device Driver and Interrupt Service Mechanism	**No. of Hrs:9+4**

Programmed Input Output, Interrupt Service Routine Concept, Interrupt Sources, Interrupt Service Handling Mechanism, Multiple Interrupts, Context and the Periods for Context Switching, Interrupt Latency and Deadline, Direct Memory Access, Device Driver Programming

Textbook 2: Chapter: 4

Laboratory Components:

1. Implementation of External Interrupt Handling and Interrupt Service Routine (ISR) using ARM Processor.
2. Interfacing Relay switch and Buzzer to ARM processor

Module 3: Embedded System Firmware Design	**No. of Hrs: 8+4**

Embedded Firmware Design Approaches, Embedded Firmware Development Languages, Fundamental Issues in Hardware Software Co Design, Computational Models in Embedded System, Embedded Product Development Cycle (EDLC)-Objectives and Phases, Modeling of EDLC

Textbook1: Chapter: 7.1 to 7.3, 9.1, 9.2, 15.1 to 15.5

Laboratory Components:

1. Development of Embedded Firmware for Temperature Sensor Interfacing using ARM Processor
2. Design and Development of Embedded Firmware for Serial Communication (UART) using ARM Processor

Module 4: RTOS Based Embedded System Design	**No. of Hrs: 9+4**

Introduction to Basic Concepts of RTOS- Task, Process and Threads, Multiprocessing and Multitasking, Preemptive and Non-Preemptive Scheduling, Task Communication, Task Synchronization, Shared Memory, Message Passing, Inter Process Communication Synchronization between Processes Semaphores, Mailbox, Pipes, Priority Inversion, Priority Inheritance

Textbook 1: Chapter: 10.1 to 10.8

Laboratory Components:

1. Implement multitasking using Free RTOS and Demonstrate Task Scheduling in an Embedded System
2. Implement Task Synchronization using Semaphore in an RTOS Environment

Module 5: Embedded System Applications	**No. of Hrs: 8+6**

Applications of Embedded System: Embedded System in Washing Machine, Automotive Electronics, Control System and Industrial Automation, Virtual Instrumentation, Digital thermometer, Hand Held computers, Navigation System IP Phone, Software Defined Radio, Smart Cards and RF Tags

Textbook 1: Chapter: 4.1, 4.2
Textbook 3: Chapter: 10

Laboratory Components:

1. Design and Implement a Digital Thermometer using a Temperature Sensor and ARM Microcontroller
2. Implement an RFID-Based Authentication System using an Embedded ARM Processor

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

1. Describe the concepts of embedded systems, their components, communication interfaces, and key characteristics
2. Illustrate an embedded system application and the importance of real-time requirements.
3. Develop an embedded program that handle I/O, interrupts, and device drivers for practical system tasks
4. Design an embedded firmware by combining, hardware–software co-design, and development methods
5. Implement real-time embedded systems integrating concepts of task scheduling, synchronization, and inter-process communication

Textbooks:

1. Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education Private Limited, 2nd Edition, 2017
2. Raj Kamal, "Embedded Systems Architecture, Programming and Design", McGraw-Hill Education, 2nd Edition, 2008
3. Dr. K. V. K. K. Prasad, "Embedded Real Time Systems: concepts, Design and Programming", 1st Edition, 2010

Reference Books:

1. James K. Peckol, "Embedded systems- A contemporary design tool", John Wiley, 2008, ISBN: 978-0- 471-72180-2
2. Peter Marwedel, "Embedded System Design", Springer , 3rd Edition, 2018

Web links:

1. Introduction to Embedded Systems: https://youtu.be/uFhDGagZzjs
2. Embedded-Systems covering basics, sensors/actuators: https://youtu.be/ih9s386VE4o
3. Real Time Operating System: https://youtu.be/o8SAeVTCE18?si=vEpy_QANlTjMid5-
4. RTOS Task: https://youtu.be/qxy3ZqZgj6U?si=3zC6l4ee4SqkNGz

Thermal Engineering			
Semester	**VII**	CIE Marks	**50**
Course Code	**23MTPE411**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**3:0:0**	Exam Hrs	**03**
Total Hrs	**42**	Credits	**03**

Course Learning Objectives: This course is designed to

1. Impart the knowledge of thermodynamic systems and its equilibrium and zeroth law of thermodynamics
2. Strengthen the essential knowledge of heat & work transfer and various forms of energy
3. Impart the knowledge of conduction, convection and radiation heat transfer and heat exchangers

Module 1: Zeroth Law of Thermodynamics and Work and Heat	**No. of Hrs: 9**

Introduction: Thermodynamic Approaches. Examples of System Boundary and Control Surface, Thermodynamic Properties; Thermodynamic Process, Thermodynamic State and Equilibrium, Applications of Zeroth Law of Thermodynamics
Work and Heat: Mechanical Work and Thermodynamic Work, Work and Heat Transfer of Various Processes through P-V Diagrams

Textbook 1: Chapter: 1.1 to 1.6, 3.1 to 3.5

Module 2: First Law and Second Law of Thermodynamics	**No. of Hrs: 9**

First Law of Thermodynamics Forms of Energy, Energy Transfer by Heat and Work, Work Done for Closed Systems using Air and Water/Steam in Thermodynamic Processes, First Law for Process and Cycle, Open and Closed Systems, Steady Flow and Unsteady Flow, Cyclic and Non Cyclic Processes, Steady Flow Energy Equation (SFEE)
Second Law of Thermodynamics: Second Law Statements and its Equivalence, Applications of Second Law in Heat Engine, Refrigerator and Heat Pump

Textbook 1: Chapter: 5.1 to 5.4, 6.1 to 6.7

Module 3: Conduction Heat Transfer	**No. of Hrs: 8**

Introduction: Modes of Heat Transfer, Basic Laws Governing Conduction, Convection and Radiation, Thermal Conductivity, Convective Heat Transfer Coefficient, Combined Heat Transfer Mechanisms, Boundary Conditions of First, Second and Third Kind
Conduction: Three-Dimensional Conduction Equations in Cartesian Coordinate System, One-Dimensional Steady-State Heat Conduction through Plane and Composite Walls (no derivation), Overall Heat Transfer Coefficient and Thermal Contact Resistance and Basic Numerical

Textbook 2: Chapter: 1.1 to 1.4, 2.1 to 2.5

Module 4: Convection Heat Transfer	**No. of Hrs: 8**

Forced Convection: Introduction, Dimensional Analysis using Buckingham's Theorem, Dimensionless Numbers, Use of Correlations for Flow over a Flat Plate and Flow Inside the Duct

Free Convection: Introduction, Flow over a Flat Plate, Velocity Boundary Layer, Thermal Boundary Layer, Dimensional Analysis using Buckingham's Theorem, Dimensionless Numbers, Use of Correlations for Flow over a Flat Plate and Flow Inside the Duct

Textbook 2: Chapter: 7.1, 7.2, 8.1 to 8.4

Module 5: Radiation Heat Transfer and Heat Exchangers	No. of Hrs: 8

Radiation Heat Transfer: Fundamentals of Thermal Radiation, Definitions of Radiation Properties, Stefan-Boltzmann Law and Kirchhoff's Law, Concepts of Black and Gray Surfaces, Radiation Heat Exchange between Parallel Infinite Surfaces, Effect of Radiation Shields and Basic Numerical

Heat Exchangers: Types of Heat Exchangers: Shell and Tube, Plate, Finned Tube, LMTD and NTU approaches. Applications: Power plants, HVAC Systems, Automobile Radiators, Chemical Industries and Refrigeration Systems

Textbook 2: Chapter: 10.1 to 10.7, 11.1 to 11.9

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

1. Illustrate the concepts of temperature measurement, work and heat transfer, work done in open and closed system and Cyclic and non-cyclic systems, modes of heat transfer and heat exchange
2. Outline the principles and significance of the First and Second Laws of Thermodynamics
3. Apply conduction mode of heat transfer principles to basic engineering problems
4. Apply convection heat transfer principles to basic engineering problems
5. Apply LMTD and NTU methods to design heat exchangers

Textbooks:

1. P. K. Nag, "Basic and applied Thermodynamics", Tata McGraw Hill Publication, 2nd Edition, 2002
2. R K Rajput, "Heat & Mass transfer", S. Chand Publication, 5th Edition, 2018

Reference Books:

1. J. B. Jones and G. A. Hawkins, "Engineering Thermodynamics", John Wiley and Sons, 2nd Edition, 1986.
2. Ozisik, "Heat transfer-A basic approach", Tata McGraw Hill, 1st Edition, 2002.
3. B. T. Nijaguna, "Basic Engineering Thermodynamics Data Handbook, 1st Edition, 2002

Web links:

1. Basic Concepts of Thermodynamics: https://youtu.be/cLSYrrnjauo
2. Application-Based Thermodynamics: https://youtu.be/26MvygJWFC0
3. Thermal management of electronic devices using ANSYS software https://youtu.be/9-sPSq9mbhU

Digital Image Processing			
Semester	**VII**	CIE Marks	**50**
Course Code	**23MTPE412**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**3:0:0**	Exam Hrs	**3**
Total Hrs	**42**	Credits	**3**

Course Learning Objectives: This course is designed to

1. Familiarize students with the fundamental concepts of digital image processing
2. Impart knowledge of spatial and frequency domain techniques such as intensity transformations, filtering, Fourier transforms, image restoration, reconstruction
3. Provide students skills to process and analyze digital images through enhancement, segmentation and shape analysis techniques

Module 1: Digital Image Fundamentals	**No. of Hrs: 8**

Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Image Sensing and Acquisition, Image Acquisition Using a Single Sensor, Image Acquisition Using Sensor Arrays, Basic Concepts in Sampling and Quantization, Representing Digital Images, Neighbors of a Pixel, Some Basic Relationship between Pixels

Textbook 1: Chapter: 1.1, 1.4, 1.5, 2.3.1, 2.3.3, 2.4.1, 2.4.2, 2.5

Module 2: Image Enhancement	**No. of Hrs: 8**

The Basics of Intensity Transformations and Spatial Filtering, Image Negatives, Log Transformations, Power-Law Gamma Transformations, Piecewise-Linear Transformation Functions, Histogram Equalization, Histogram Matching Specification, The Mechanics of Spatial Filtering, Spatial Correlation and Convolution, Smoothing Linear Filters, Order-Statistic (Nonlinear) Filters, Unsharp Masking and High boost Filtering

Textbook 1: Chapter: 3.1.1, 3.2.1 to 3.2.4, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 3.5.1, 3.5.2, 3.6.3
Textbook 2: Chapter: 5.3 to 5.7

Module 3: Filtering in the Frequency Domain	**No. of Hrs: 8**

Obtaining the DFT from the Continuous Transform of a Sampled Function, The 2-D Discrete Fourier Transform and its Inverse, Frequency Domain Filtering Fundamentals, Image Smoothing Using Frequency Domain Filters, Ideal Lowpass Filters, Butterworth Lowpass Filters, Gaussian Lowpass Filters, Ideal High pass Filters, Butterworth High pass Filters, Gaussian High pass Filters

Textbook 1: Chapter: 4.4.1, 4.5.5, 4.7.2, 4.8.1 to 4.8.3, 4.9.1 to 4.9.3
Textbook 2: Chapter: 5.8 to 5.10

Module 4: Image Restoration and Morphological Image Processing	**No. of Hrs: 9**
A Model of the Image Degradation/Restoration Process, Mean Filters, Order-Statistic Filters, Bandreject Filters, Bandpass Filters, Reconstruction Using Parallel-Beam Filtered Back projections, Erosion and Dilation, The Hit-or-Miss Transformation, Boundary Extraction, Hole Filling Textbook 1: Chapter: 5.1, 5.3.1, 5.3.2, 5.4.1, 5.4.2, 5.11.5, 9.2.1, 9.2.2, 9.4, 9.5.1, 9.5.2 Textbook 2: Chapter: 6.4, 6.7	
Module 5: Image Segmentation	**No. of Hrs: 9**
Detection of Isolated Points, Line Detection, Basic Edge Detection, Basic Global Thresholding, Optimum Global Thresholding Using Otsu's Method, Region Growing, Region Splitting and Merging Textbook 1: Chapter: 10.2.2, 10.2.3, 10.2.5, 10.3.2, 10.3.3, 10.4.1, 10.4.2	
Course Outcomes: At the end of the course, the student will be able to: 1. Describe fundamentals of digital image processing, including image acquisition, sampling and quantization, digital representation, and pixel relationships 2. Illustrate image segmentation techniques for detecting regions, boundaries, and shapes in digital images 3. Apply spatial domain enhancement techniques to improve image quality 4. Utilize principles of frequency domain filtering to modify image characteristics such as smoothness and edge detail 5. Apply image restoration, filtering, reconstruction, and morphological techniques to process and enhance digital images	
Textbooks: 1. Rafael C.. Gonzalez and Richard E Woods, "Digital Image Processing", 4th Edition, Pearson Education, 2018 2. S. Sridhar, "Digital Image Processing ", 2nd Edition, Oxford University Press, 2020	
Reference Books: 1. A. K. Jain. "Fundamentals of Digital Image Processing", 1st edition, Pearson, 2004 2. Mikell P. Groover, Mitchel Weiss, Roger N. Nagel,"Industrial Robotics", 2nd Edition, McGraw Hill Education India Private Limited,2019	
Web links: 1. Image Processing: https://www.youtube.com/watch?v=CVV0TvNK6pk 2. Introduction to Digital Image Processing: https://www.youtube.com/watch?v=DSGHkvQBMbs 3. Digital Image Processing: https://nptel.ac.in/courses/117105135	

Robot Perception			
Semester	**VII**	CIE Marks	**50**
Course Code	**23MTPE413**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**3:0:0**	Exam Hrs	**3**
Total Hrs	**42**	Credits	**3**

Course Learning Objectives: This course is designed to

1. Introduce the fundamental principles of robot perception, including image formation, camera calibration, and sensing mechanisms used in robotic systems
2. Enable the application of classical and learning-based vision techniques for feature extraction, recognition, and 3D perception in robotic environments
3. Familiarize students with the integration of perception algorithms for robotic localization, mapping, and vision-based control systems

Module 1: Robot Perception Fundamentals	**No. of Hrs: 8**

Role of Perception in Robotics, Sensors for Robot Perceptions, Robot Vision, Modalities of Robot Perception, Image Formation and Perspective Projection, Radiometry and Photometry, Camera Calibration and Lens Distortion, Limitations of Classical Perception

Textbook 1: Chapter: 1, 2, 6
Textbook 2: Chapter: 10, 13

Module 2: Preprocessing Pipeline for Robot Perception	**No. of Hrs: 8**

Digital Image Representation, Point Operations and Intensity Transformations, Spatial Filtering, Convolution, Gradient Based Methods, Morphological Operations, Preprocessing Pipelines for Robotics, Classical Image Processing vs Learned Feature Extraction

Textbook 1: Chapter: 3
Textbook 2: Chapter: 11
Textbook 3: Chapter: 6

Module 3: Feature Extraction and Recognition	**No. of Hrs: 8**

Points, Lines, and Regions, Feature Descriptors and Matching, CNN for Vision, Learned Feature Hierarchies, CNN Based Object Detection, Semantic and Instance Segmentation, Fiducial Markers for Robotics

Textbook 1: Chapter: 4, 14
Textbook 2: Chapter: 12
Textbook 3: Chapter: 9, 15, 16

Module 4: Geometry-based Perception with Learning	**No. of Hrs: 9**
Multiple View Geometry, Epipolar and Stereo Vision, Depth Estimation, Triangulation, Pose Estimation and Camera Motion, Visual Odometry, Learning-Based Depth Estimation, Learning-Assisted Motion Estimation Textbook 1: Chapter: 7, 11, 12 Textbook 2: Chapter: 6, 13 Textbook 3: Chapter: 9, 14	
Module 5: Visual SLAM	**No. of Hrs: 9**
Visual Landmarks and Map Representation, Pose-Graph SLAM, Semantic Perception, Object-Level SLAM, Scene Understanding for Navigation and Manipulation, Vision-Based Control and Servoing Textbook1: Chapter: 12 Textbook2: Chapter: 6, 15 Textbook3: Chapter: 9, 16, 18	

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

1. Describe the principles of image formation, camera calibration, and sensing required for robotic perception systems
2. Describe classical image processing and feature extraction techniques used in robotic vision
3. Apply classical and learning-based feature extraction and recognition methods to solve robot perception tasks
4. Apply geometric vision and learning-assisted methods for depth estimation, motion estimation, and visual odometry in robotic systems
5. Apply visual perception techniques, including deep learning-based scene understanding, for localization, mapping, and vision-based robot control

Textbooks:

1. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer, 2011.
2. Peter Corke, “Robotics, Vision and Control: Fundamental Algorithms in Python”, 3rd ed., Springer, 2023.
3. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, “Deep Learning”, MIT Press, 2016.

Reference Books:

1. Alexandros Iosifidis and Anastasios Tefas, “Deep Learning for Robot Perception and Cognition”, Academic Press, 1st Edition, 2022.
2. Morgan Quigley, Brian Gerkey, and William D. Smart, “Programming Robots with ROS”, O’Reilly Media, 2015.

Web links:

1. NPTEL – Computer Vision - https://nptel.ac.in/courses/106105216
2. NPTEL – Reinforcement Learning - https://nptel.ac.in/courses/106106143
3. YouTube - Stanford CS231N Deep Learning for Computer Vision - https://www.youtube.com/watch?v=2fq9wYslV0A
4. YouTube – Perception and Learning for Robotics - https://www.youtube.com/watch?v=1NcluUFDwxo

Automation in Manufacturing			
Semester	**VII**	CIE Marks	**50**
Course Code	**23MTOE411**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**3:0:0**	Exam Hrs	**03**
Total Hrs	**42**	Credits	**03**

Course Learning Objectives: This course is designed to

1. Familiarize students with manufacturing operations, automation concepts and CNC systems
2. Provide knowledge of manufacturing systems, quality control methods and modern inspection technologies
3. Impart understanding of production planning and control, lean manufacturing practices and just in time production systems

Module 1: Manufacturing Operations	**No. of Hrs: 8**

Production System: Facilities and Manufacturing Support Systems, Automation in Production Systems, Manual Labor in Production Systems, Automation Principles & Strategies, Manufacturing Operations, Production Facilities, Product/Production relationship and Manufacturing costs

Textbook 1: Chapter: 1, 2, 3

Module 2: Automation and Computer Numerical Control	**No. of Hrs: 8**

Basic Elements of an Automated System, Advanced Automation Functions and Levels of Automation, Industrial Control Systems - Continuous Versus Discrete Control, Computer Process Control, Forms of Computer Process Control, Computer Numerical Control - Fundamentals of NC and CNC Technology, Applications, Analysis of Positioning Systems and Part Programming

Textbook 1: Chapter: 4, 5, 7

Module 3: Manufacturing Systems	**No. of Hrs: 9**

Components of Manufacturing Systems, Types of Manufacturing Systems, Single Station Manned Cells and Single Station Automated Cells. Automated Assembly System - Types of Automated Assembly Systems, Analysis of Single Station and Multi Station Assembly Machine. Group Technology - Part Families and Machine Groups, Parts Classification, Cellular manufacturing and Flexible Manufacturing System (FMS) - Components, Planning and Implementation Issues

Textbook 1: Chapter: 13, 14, 17, 18, 19

Module 4: Quality Control Systems	**No. of Hrs: 9**

Traditional and Modern Quality Control Methods, Statistical Process Control, Six Sigma and Taguchi Methods in Quality Engineering, Inspection Technologies - Automated Inspection, Coordinate Measuring Machines, Other Coordinate Metrology Techniques, Surface Measurement, Machine Vision, Optical Inspection Techniques and Noncontact Non Optical Inspection Technologies

Textbook 1: Chapter: 20, 21, 22

Module 5: Manufacturing Support Systems	**No. of Hrs: 8**
Process Planning, Computer Aided Process Planning, Concurrent Engineering and Design for Manufacturing, Advanced Manufacturing Planning, Production Planning and Control Systems, Lean Production, Waste in Manufacturing and Just in Time Production System Textbook 1: Chapter: 24, 25, 26	
Course Outcomes: At the end of the course, the student will be able to: 1. Illustrate the fundamentals of manufacturing operations and automation 2. Describe automation systems, industrial control methods, and quality control techniques used in manufacturing 3. Apply the concepts of manufacturing systems, group technology, and flexible manufacturing systems 4. Apply quality control methods and modern inspection technologies to manufacturing scenarios 5. Apply manufacturing support systems to improve industrial operations	
Textbooks: 1. Automation, Production Systems and Computer Integrated Manufacturing, M. P. Groover, Pearson education. Third Edition, 2008	
Reference Books: 1. Anatomy of Automation, Amber G.H & P. S. Amber, Prentice Hall, 1962 2. Industrial Automation, W.P. David, John Wiley and Sons, 1989	
Web links: 1. Manufacturing Operations - Industrial Automation: https://youtu.be/i1SQ9h-DpSk 2. Computer Numerical Control: https://youtu.be/HUdvgZ9hZag 3. Group technology, Cellular Manufacturing & flexible manufacturing systems: https://youtu.be/OG-1Xy1OpUM 4. Quality Control Systems: https://youtu.be/e5g2NmIUdck 5. Industry 4.0 & Smart Manufacturing: https://youtu.be/MHQR_Kdl4tU	

Biomechatronics			
Semester	**VII**	CIE Marks	**50**
Course Code	**23MTOE412**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**3:0:0**	Exam Hrs	**3**
Total Hours	**42**	Credits	**3**

Course Learning Objectives: This course is designed to

1. Provide knowledge of biomechatronics as an interdisciplinary field integrating biological systems with mechatronics engineering
2. Introduce the principles and roles of actuators and sensors used in biomechatronics and human–machine interaction systems
3. Familiarize assistive and prosthetic biomechatronic devices and their functional operations

Module 1: Introduction to Biomechatronics	**No. of Hrs: 8**

Biomechatronics System, Physiological Systems: Biochemical, Nervous, Cardiovascular, Respiratory, Musculoskeletal, Role of Biomechatronics

Fusion of Biology and Mechatronics: Manipulation, Locomotion, Sensory Interactions, Processing

Textbook 1: Chapter: 1
Textbook 2: Chapter: 1

Module 2: Biomechatronic Actuators	**No. of Hrs: 8**

Design Goals of Actuators, **Types of Biomechatronic Actuators:** Electromagnetic, Fluidic, Shape Memory Alloys, Electroactive Polymers

Purpose of Biomechatronic Actuators: Biological Function Replacement, Augmentation

Textbook 2: Chapter: 2

Module 3: Sensors for Biomechatronics	**No. of Hrs: 8**

Natural Sensors, **Sensory Receptors:** classification, neuromuscular anatomy, Biomedical signals

Electromyographic (EMG) sensors: Surface EMG, Intramuscular EMG, Nerve Cuff, Electroencephalography (EEG) Sensor, Electrocardiography (ECG) Sensor, Electrooculography (EOG) Sensor, Oxygen Sensors

Textbook 1: Chapter: 5
Textbook 2: Chapter: 3

Module 4: Sensory Assistive Devices	**No. of Hrs: 9**

Hearing aid and Implants: Microphones, Analog amplifiers, Digital amplifiers, Bone Conduction Devices, Middle Ear Implants

Visual Prostheses: Sonar-Based Systems, Visual Neuroprostheses, Retinal Implants, Optic Nerve Simulation, Visual Cortex Implants

Textbook 1: Chapters: 6, 7

Module 5: Prosthetic Limbs	**No. of Hrs: 9**
Evolution of Prosthetics, Kinematic Model of the Arm, Kinematic Model of the Leg, Kinematics of Limb Movement, Walking Dynamics, Passive Prosthetics, Upper Limb Prosthetics, Lower Limb Prosthetics, Active Prosthetics Textbook 1: Chapter: 10	
Course Outcomes: At the end of the course, the student will be able to: 1. Articulate the principles, scope, and applications of biomechatronics 2. Describe physiological sensing mechanisms and biomedical signals used in biomechatronic systems 3. Describe the operating principles of sensory assistive devices for hearing and vision 4. Apply principles of sensors and actuators in biomechatronic systems for human-machine interaction 5. Apply kinematics and dynamics concepts to human limb movement in passive and active prosthetic limbs	
Textbooks: 1. Graham M. Brooker, "Introduction to Bio-Mechatronics", Sci Tech Publishing, 2012. 2. Jacob Segil, "Handbook of Biomechatronics", Academic Press, 2019	
Reference Books: 1. Marko B. Popovic, Biomechatronics, Academic Press, 2019. 2. Graham M. Brooker, "Introduction to Bio-Mechatronics, Volume 2: Systems and applications", IET, 2nd Ed., 2025	
Web links: 1. Biomechatronics Overview, MIT Media Lab, Youtube: https://www.youtube.com/watch?v=69YLdKKpYD8 2. Biomechatronics: Bugs, Body Parts and Bionics, Imperial College London, Youtube: https://www.youtube.com/watch?v=qfL_nrA3pdA 3. Biomechanics, NPTEL: https://onlinecourses.nptel.ac.in/noc23_bt04/preview 4. TU Delft, Opencourseware – Bio mechatronics: https://ocw.tudelft.nl/courses/bio-mechatronics/ 5. Jaipur Foot, Shree Bhagwan Mahaveer Viklang Sahayata Samiti (BMVSS) - https://www.jaipurfoot.org	

Soft Robotics			
Semester	**VII**	CIE Marks	**50**
Course Code	**23MTOE413**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**3:0:0**	Exam Hrs	**3**
Total Hrs	**42**	Credits	**3**

Course Learning Objectives: This course is designed to

1. Provide an understanding of soft robotics, including its principles, materials, actuation, and sensing mechanisms
2. Impart knowledge of modeling, fabrication, and control concepts relevant to compliant and deformable robotic systems
3. Familiarize application areas and design challenges of soft robots in manipulation, medical, and wearable domains

Module 1: Fundamentals of Soft Robotics	**No. of Hrs: 8**
Introduction to Soft Robotics, Limitations of Rigid-Body Robotics, Compliance, Adaptability, Embodiment, Morphological Intelligence, Interaction with Unstructured Environments, Classification of Soft Robots Textbook 1: Chapter: 1	
Module 2: Materials and Design	**No. of Hrs: 8**
Materials for Soft Robotics, Fibrous and Textile-Based Soft Robots, Nanostructured Materials, Fabrication Techniques, Design Considerations for Soft Robots Textbook 2: Chapter: 2 Textbook 3: Chapter: 13, 17	
Module 3: Bio-Inspired Actuation	**No. of Hrs: 8**
Biological Inspiration for Soft Actuation, Artificial Muscles, Pneumatic and Fluidic Soft Actuators, Shape Memory alloy Actuators, Cable-Driven and Tendon-Driven Actuation, Distributed Actuation, Performance Metrics Textbook 1: Chapter 3	
Module 4: Sensing in Soft Robots	**No. of Hrs: 9**
Sensing Requirements in Soft Robotics, Soft and Stretchable Sensors, Tactile Sensors, Proprioception, Flexible Electronics, Information Processing in Embodied Systems, Sensor-Actuator Integration Textbook 2: Chapter: 9	
Module 5: Modelling, Control and Applications	**No. of Hrs: 9**
Modelling Challenges in Soft Robotics, Continuum and Reduced Order Models, Control Strategies for Soft Robots, Compliance and Passive Dynamics, Applications: Manipulation, Medical, Wearable Robots Textbook 1: Chapter: 5, 7	

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

1. Articulate the fundamental concepts, characteristics, and challenges of soft robotic systems
2. Describe soft materials, fabrication methods, and design strategies used in soft robotic systems
3. Apply bio-inspired actuation and sensing principles to soft robotic systems
4. Apply basic modeling and control concepts to study the behavior of compliant and deformable robots
5. Apply soft robotic solutions for manipulation, medical, and wearable applications

Textbooks:

1. Cecilia Laschi, Barbara Brown, Barry Trimmer, Benoît Tondu and Fumiya Iida, "Soft Robotics", Springer, 2016
2. Sangbae Kim, Cecilia Laschi and Barry Trimmer, "The Science of Soft Robots: Design, Materials and Information Processing, Springer, 2019
3. Alexander Verl, Alin Albu-Schäffer, Oliver Brock, and Annika Raatz. "Soft robotics." Berlin, Heidelberg: Springer, 2015

Reference Books:

1. Barbara Mazzolai, Cecilia Laschi and Paolo Dario, "Soft Robotics: Trends, Applications and Challenges", Springer Tracts in Advanced Robotics, Springer, 2015
2. Thrishantha Nanayakkara, "Handbook on Soft Robotics", Springer, 2024

Web links:

1. Harvard Biodesign Lab - https://biodesign.seas.harvard.edu/soft-robotics
2. NASA – Soft Robotics Engineers - https://plus.nasa.gov/video/surprisingly-stem-soft-robotics-engineers/
3. Youtube – Power of Soft Robotics - https://www.youtube.com/watch?v=EWD1GI7GIPg

PROJECT PHASE – II			
Semester	**VII**	CIE Marks	**100**
Course Code	**23MTSE409**	SEE Marks	**100**
Teaching Hrs/Week (L: T: P)	**0:0:12**	Exam Hrs	**3**
		Credits	**6**

Objectives:

1. To enable students to execute, validate, and communicate the engineering solution to the identified problem conceptualized in Project Phase – I
2. To motivate students to extend their project work toward research publications, patent filing, funding proposals, or technology transfer, where applicable

General Guidelines for CIE procedure:

1. The Department project coordinator will take the responsibility of monitoring all the activities related to the project execution
2. The HOD shall constitute project evaluation/review committee(s) & the composition shall be as follows:
    a. HOD or one of the HODs in case of an interdisciplinary project, shall be the Chairman of the committee
    b. Project Coordinator shall be member - Convener
    c. Project guide shall be the member
    d. One/Two senior faculty members nominated by the HOD (may be from different departments in case of an interdisciplinary project jointly nominated by the HODs)
3. Project teams must implement the problem identified using the proposed methodology through systematic experimentation and/or simulation leading to a functional solution or validated outcome in consultation with their project guide
4. Each project team shall maintain a project diary and record their project progress at regular interval of time. This shall carry signature of the students and the project guide
5. Marks may be equally or proportionally distributed among team members based on contribution assessed by the guide and committee
6. A student shall obtain minimum of 40% of the total CIE marks to gain eligibility for SEE

General Guidelines for SEE procedure:

1. The Department project coordinator will take the responsibility of all the requirements for successful conduction of the SEE
2. SEE for project work will be conducted by two examiners (one internal examiner and the other an external examiner) appointed by the Controller of Examinations
3. Project teams must present their projects that have been executed and completed with a functional solution or validated outcome during the SEE
4. Each project team shall bring to the SEE a project report that shall carry signature of the students, project guide, HOD and the Principal. Plagiarism, data fabrication,

or copying of work will result in stringent disciplinary action and /or penalties. (Note: Any disciplinary actions or penalties will be as per institutional policy)

5. Marks may be equally or proportionally distributed among team members based on contribution assessed by the examiners
6. A student shall obtain minimum of 40% of the total SEE marks to pass this course

Deliverables:

1. Comprehensive Project Report comprising of:
   - Abstract
   - Introduction
   - Literature Survey
   - Problem Definition
   - Proposed Methodology
   - Design
   - Implementation
   - Results and discussion
   - References
   - Appendices

   The project report shall be prepared in the prescribed format provided by the institute
2. A plagiarism report shall be obtained from the Department of Library. Acceptable similarity threshold is generally below 20%, and hence, the plagiarized content shall not exceed 20%. Similarity above 20% will require resubmission after proper revisions

Review and Evaluation for CIE:

1. There shall be two reviews and a presentation. Total of 100 CIE marks is distributed as follows:

Review - 1	
Phase wise execution of proposed solution	20 Marks
Use of modern tools for proposed solution	10 Marks
Contribution as an individual and team member	10 Marks
Total	**40 Marks**
Review - 2	
Complete Implementation and Demonstration of Modules	15 Marks
Report Quality & Formatting	15 Marks
Total	**30 Marks**
Presentation	
Presentation	20 Marks
Team work	10 Marks
Total	**30 Marks**
Grand Total	**100 Marks**

2. First review shall be conducted after one month from the start of the semester
3. Every department shall develop rubrics to assess performance of the students based on the above given parameters

Evaluation for SEE:

1. There shall be a presentation for SEE. Total of 100 SEE marks is distributed as follows:

SEE	
Execution of proposed solution	40 Marks
Evaluation of Project Report	30 Marks
Project presentation & Question and Answer	30 Marks
Total	**100 Marks**

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

1. Execute the problem identified using the methodology proposed through systematic design, development, experimentation, and/or simulation, leading to a functional solution or validated outcome
2. Translate theoretical concepts into practical implementation while considering constraints such as feasibility, cost, sustainability, safety, ethics, and societal relevance
3. Exhibit the resourcefulness to act independently as well as collaboratively within a team in overcoming technical challenges encountered during project execution
4. Plan tasks effectively, manage time and resources, meet defined milestones, and adhere to deadlines, reflecting professional engineering practice
5. Prepare a comprehensive project report that clearly documents design decisions, implementation details, experimental results, analysis, and conclusions using standard technical writing practices
6. Confidently present the project work through reviews, demonstrations, seminars, and viva-voce examinations, addressing questions from peers, faculty, and examiners

Constitution of India & Professional Ethics			
Semester	**VII**	CIE Marks	**100**
Course Code	**23HMCC421**	SEE Marks	**-**
Teaching Hrs/Week (L: T:P)	**1:0:0**	Exam Hrs	**-**
Total Hrs	**13**	Credits	**01**

Course Learning Objectives: This course is designed to

1. Introduce the foundational principles and features of the Indian Constitution
2. Familiarize the Fundamental Rights and Directive Principles
3. Provide an understanding of Union and State government policies and Electoral Process
4. Develop awareness on Sustainable development goals, energy conservation and climate change
5. Inculcate Ethical responsibilities and Code of Conduct

Module 1: Introduction to the Indian Constitution	**No. of Hrs: 2**

Definition and Significance of the Constitution, Making of the Constitution, Constituent Assembly, Preamble, Salient features of the India Constitution, Amendments, other Provisions and Citizenship

Module 2: Fundamental Rights and Duties	**No. of Hrs: 4**

Fundamental Rights: Right to Equality, Right to Freedom, Right to Life & Personal Liberty, Right against Arbitrary arrest and Preventive Detention, Right against Exploitation, Right to Religion, Cultural & Educational Rights and Right to Constitutional Remedies, Restrictions and Limitations, Directive Principles of State Policy and its relevance in the society, Fundamental Duties of Citizens

Module 3: Union and State Government Structure	**No. of Hrs: 3**

Union Govt: Union Legislature- Parliament-Lok Sabha and Rajya Sabha, Sessions of Parliament, Parliamentary System, Parliamentary Committees, Important Parliamentary Terminologies

Union Executive– President, Prime Minister, Union Cabinet, Union Council of Ministers

Union Judiciary-Supreme Court of India, Judicial Review and Judicial Activism

State Govt: State Legislature- State Legislative Assembly, State Legislative council

State Executive- Governor, Chief Minister, State Cabinet, State Council of Ministers

State Judiciary- High Court and Subordinate Courts

Elections: Election Commission of India, Process and Laws

Emergency Provisions

Module 4: Ethics and Sustainable Development	**No. of Hrs: 2**

Ethics: Values and types, Honesty, Trust, Integrity and Reliability in Engineering, Sustainable development goals, energy conservation, sustainable developments, Environmental Ethics: climate change and ethical responsibility

Module 5: Professional Ethics for Engineers	**No. of Hrs: 2**

Scope & Aims, Code of Ethics, Professional responsibility, Accountability, Research Ethics, Clash of Ethics (example with respect to technology), Conflicts of Interest, Risks, Safety, Liability and Corporate Social Responsibility

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

1. State the preamble and the basic features of the Indian Constitution
2. Explain the Fundamental Rights, Directive Principles of State Policy and their relevance in contemporary Indian society
3. Compare the functioning of the Union and State legislature, Executive and Judiciary
4. Classify Ethical, Virtues and explain sustainable development goals and climate change
5. Outline the Aims, Code of Ethics, and principles of Corporate Social Responsibility

Textbooks:

1. Raja Ram, M., (2015), Constitution of India & Professional Ethics, (3rd Edition), New Age International Publishers.
2. Dr. Tharanath, Santhosh Prabhu & Suma Suresh Kogilgeri, (2018), Constitution of India & Professional Ethics, Pristine Publishing House.
3. Sharma Brij Kishore, (2011), Introduction to the Constitution of India, (8th Edition), PHI Learning Pvt. Ltd.
4. Charles E Harris, Michael S. Pritchard & Michael J. Rabins (2018), Engineering Ethics: Concepts and Cases), (1st Edition), IEEE / Cengage.
5. Iqbal, Jaquir, (2013), SDG – Sustainable Urban Development: Challenges, Achievements & Opportunities, (1st Edition), Global Vision Publishing House.

Weblinks:

1. Making of the Indian Constitution - https://www.youtube.com/watch?v=Z5nQ4xea9ts
2. Parts, Articles and Schedules of the Indian Constitution - https://www.youtube.com/shorts/TJRdYarLPYI
3. The Indian Constitution - https://www.youtube.com/watch?v=vXvlSXlmkyM
4. Professional Engineering Ethics - https://www.youtube.com/watch?v=SVz6Q7EoBJM
5. Sustainable Development Goals- https://www.youtube.com/watch?v=qAIolKgDPrA

Internship			
Semester	**VIII**	CIE Marks	**100**
Course Code	**23MTSE431**	SEE Marks	**100**
Teaching Hrs/Week (L: T: P)	**-**	Exam Hrs	**03**
Total Hrs	**-**	Credit	**12**

Objectives: This course is designed to

1. Bridge the gap between academic learning and real-world engineering practice
2. Provide hands-on experience in industry, research and incubation environments
3. Develop technical, analytical, and professional skills
4. Expose students to organizational structure, workflow, and workplace ethics
5. Enhance employability, innovation, and lifelong learning capabilities

Preamble:

Internship refers to the position of a student as trainee or a temporary (or unconfirmed) employee, who works in an organization, with or without pay/stipend, in order to gain work experience or satisfy requirements for a qualification. It is a structured, supervised professional experience in an industry, research organization, or incubation centers.

Internships play a vital role in bridging the gap between theoretical education and professional practice. In general, engineering internships serve as a crucial component of professional education by providing experiential learning, industry readiness, and holistic skill development, ultimately producing competent engineers or entrepreneurs. Apart from these, it develops professional ethics, work culture awareness and communication skills.

Types of Internships:

Following are the types of internships:

i. **Industry Internship:** Carried out in the engineering industry, companies, manufacturing units, startups, business, IT industry. The topic involved may be technical, managerial, production-related tasks, live projects, or innovative activities

ii. **Research Internship:** Carried out at universities, research labs, or R&D departments or organizations. The internship involves literature review, data analysis, and experimental work leading to publications, prototypes, technical reports or innovations. The research internship may induce students to plan for higher studies or academic career

iii. **Entrepreneurship Internship:** Undertaken in association with start-ups, or entrepreneurship cells or launching own idea in Preincubation/Incubation centers. The internship offers exposure to business planning, prototype, product development, and promotes innovation, risk-taking, and entrepreneurial mindset

iv. **Post-Placement Internship:** Refers to the internship offered to students after they receive a confirmed job offer (placement) from a company, but before formally joining as full-time employees. This internship (on-site, virtual, or hybrid) ensures that students are groomed to be professionally ready, technically competent, and culturally aligned with the organization even before official induction

General Guidelines:

1. The official engagement period of 15-week for students selected/recruited by the company/ organization only at their premises under the supervision of the company, shall only be considered as an internship
2. The period of training and working of students who have been recruited as employees by organizations at the beginning of the 4th year of the program, shall also be treated as an internship
3. The assigned faculty mentor/coordinator/guide should monitor the student's progress, and document offer letters, training reports, attendance, and evaluations for awarding academic credits
4. All students undergoing an internship, should adhere to all the guidelines, reporting protocols, and evaluation procedures prescribed by the Institution and the company
5. Students must submit the certificate of completion of an internship with the period of internship clearly mentioned, from the respective company/organization

Procedure for CIE:

1. The Department Internship coordinator identified by the HOD will take the responsibility of monitoring all the activities related to the Internship
2. The HOD shall constitute Internal Internship evaluation/review committee & the composition shall be as follows:
    a. HOD shall be the Chairman of the committee
    b. Internship Coordinator shall be member – Convener
    c. Internal Internship Guide shall be member
    d. Two senior faculty members nominated by the HOD shall be the members
3. The External Internship evaluation/review committee shall be composed of industry supervisor/external guide. For evaluation, the industry supervisor/external guide may join the review in online mode
4. The internal evaluation shall be conducted by the departmental review committee based on the student's internship progress, documentation, and presentation which will comprise the student's daily report, focusing on the regularity, completeness, and clarity of the internship logbook/diary; the deliverables and outcomes, considering the quality of work, relevance, and achievement of the stated objectives; and the presentation skills, assessing clarity, communication effectiveness, and the ability to present the work in a structured and professional manner
5. The external evaluation shall be carried out by the industry supervisor/external guide based on the student's performance at the workplace which will comprise the student's technical knowledge, assessment of the understanding and application of domain-specific concepts during the internship; work ethics, considering professionalism, punctuality, discipline, and adherence to organizational practices; deliverables and outcomes, evaluating the quality and completion of assigned tasks; and the ability to learn independently, adapt to new and emerging technologies, and exhibit critical thinking, reflecting the student's capacity for continuous learning, problem-solving, and adaptability in a professional environment

Procedure for SEE:

1. SEE for Internship will be conducted by two examiners (one internal examiner and the other an external examiner) appointed by the Controller of Examinations
2. Students must present their Internship work to the examiners
3. Each student shall bring to the SEE, an Internship report which includes the Internship Completion Certificate from the organization. The report shall also carry signatures of the student, Internship guides (Internal & External), HOD and the Principal

Deliverables:

1. Internship Daily Report
2. Final Internship Report
3. Internship Completion Certificate

Evaluation for CIE:

There shall be two reviews and a presentation. Total of 100 CIE marks is distributed as follows:

Review – 1 & 2 (Internal Internship Evaluation Committee)	
Internship Daily Report	10 Marks
Deliverables and Outcomes	10 Marks
Presentation Skills	05 Marks
Review – 1 Total	**25 Marks**
Review – 2 Total	**25 Marks**
Review – 1 & 2 (External Internship Evaluation Committee)	
Technical Knowledge	10 Marks
Work Ethic	05 Marks
Deliverables and Outcomes	05 Marks
Ability to Learn, Adapt & Critical Thinking	05 Marks
Review – 1 Total	**25 Marks**
Review – 2 Total	**25 Marks**
Grand Total	**100 Marks**

Evaluation for SEE:

Total of 100 SEE marks is distributed as follows:

SEE (Internal & External Examiners)	
Internship Report	70 Marks
Final Presentation	30 Marks
Grand Total	**100 Marks**

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

1. Apply engineering knowledge to real-world industrial or societal problems
2. Demonstrate technical competency in a professional environment
3. Analyze and solve practical engineering problems using modern tools / techniques
4. Communicate effectively through reports and presentations
5. Exhibit professional ethics, teamwork, and adaptability
6. Inculcate industry practices, workflows, and organizational behavior

Publication / Patenting			
Semester	**VIII**	CIE Marks	**100**
Course Code	**23MTSE432**	SEE Marks	**-**
Hrs/Week (L: T: P)	**-**	Exam Hrs	**-**
Total Hrs	**-**	Credit	**02**

Objectives: This course is designed to

1. Enable students to systematically document literature review and research gaps
2. Train students in research paper writing and publication process
3. Provide knowledge of patentability search and drafting patent applications
4. Motivate students to publish research work or file patents
5. Inculcate ethical research practices

Procedure for CIE:

1. The project guide from Project Phase I / II shall continue as the research guide, ensuring continuity in converting the completed project work into a research publication or patent

2. Students shall derive research contributions from their completed project work, focusing on:
   a. Accurately representing experimental results
   b. Providing evidence for validated outcomes / effective performance
   c. Explicit mention of novelty / innovation

3. The evaluation shall be carried out based on the following three major components:

   Component 1: Literature Review & Manuscript / Patent Drafting
   a. Comprehensive literature survey and identification of research gap
   b. Structuring of research paper / patent document
   c. Technical depth, methodology, and clarity of presentation
   d. Patentability analysis (in case of patent track)

   Component 2: Submission / Filing
   a. Submission of manuscript to a reputed Scopus / SCI /WoS indexed journal
   OR
   Filing of a patent application with appropriate authority
   b. Submission proof (acknowledgement / application number) is mandatory

   Component 3: Publication / Patent Outcome
   Publication of article in Scopus / SCI / WoS indexed journal
   OR
   Publication of patent

4. Marks shall be awarded proportionately based on:
   a. Paper publication status (accepted / published)
   b. Patent filing / publication status

5. Students must ensure originality and adherence to ethical practices, including proper citation and avoidance of plagiarism.

6. A plagiarism report shall be submitted, with similarity generally not exceeding 10%, failing which revision and resubmission is required.

7. Progress shall be monitored through periodic reviews by the departmental committee, focusing on:
   a. Conversion of project work into quality manuscript / patent
   b. Quality of manuscript / patent drafting
   c. Readiness for submission / publication

8. The HOD shall constitute publication/patenting evaluation/review committee(s) & the composition shall be as follows:
   a. HOD or one of the HODs in case of an interdisciplinary project, shall be the Chairman of the committee
   b. Coordinator shall be member - Convener
   c. Guide shall be the member
   d. One/Two senior faculty members nominated by the HOD (may be from different departments in case of an interdisciplinary project jointly nominated by the HODs)

Deliverables:

1. Literature Review Report / Patentability Report
   a. Representation of problem identification
   b. Representation of gap analysis
   c. Survey of recent literature / prior art

2. Manuscript / Patent Draft
   Structured manuscript (Abstract, Introduction, Methodology, Results, References)

   OR

   Patent Draft (Title, Abstract, Claims, Description, Drawings)

3. Submission Proof
   Journal submission acknowledgement / Patent filing receipt

4. Paper Publication / Patent Filing / Patent Publication Evidence

Evaluation for CIE:

Total of 100 CIE marks is distributed as follows:

Sl. No.	Description	Marks
1.	Literature Review, Research Paper Writing / Patentability Search, Drafting the Patent Application	50
2.	a. Submission & Acceptance of manuscript (Scopus / SCI / WoS) OR b. Filing a Patent Application	30
3.	a. Publication of Article (Scopus / SCI / WoS) OR b. Publication of Patent	20
	Total	**100**

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

1. Systematically document literature review and gaps in a specific domain
2. Prepare a structured research manuscript or patent document following standard guidelines
3. Perform patentability search and analyze prior art for innovation feasibility
4. Demonstrate the ability to submit research work to journals or file patent applications
5. Apply ethical practices in research, including plagiarism avoidance and proper citation