SCHOOL OF ENGINEERING AND TECHNOLOGY

M. TECH IN ROBOTICS & AUTOMATION ENGINEERING

Credit Definition

Type	Duration (in Hour)	Credit
Lecture (L)	1	1
Tutorial (T)	1	1
Practical (P)	2	1

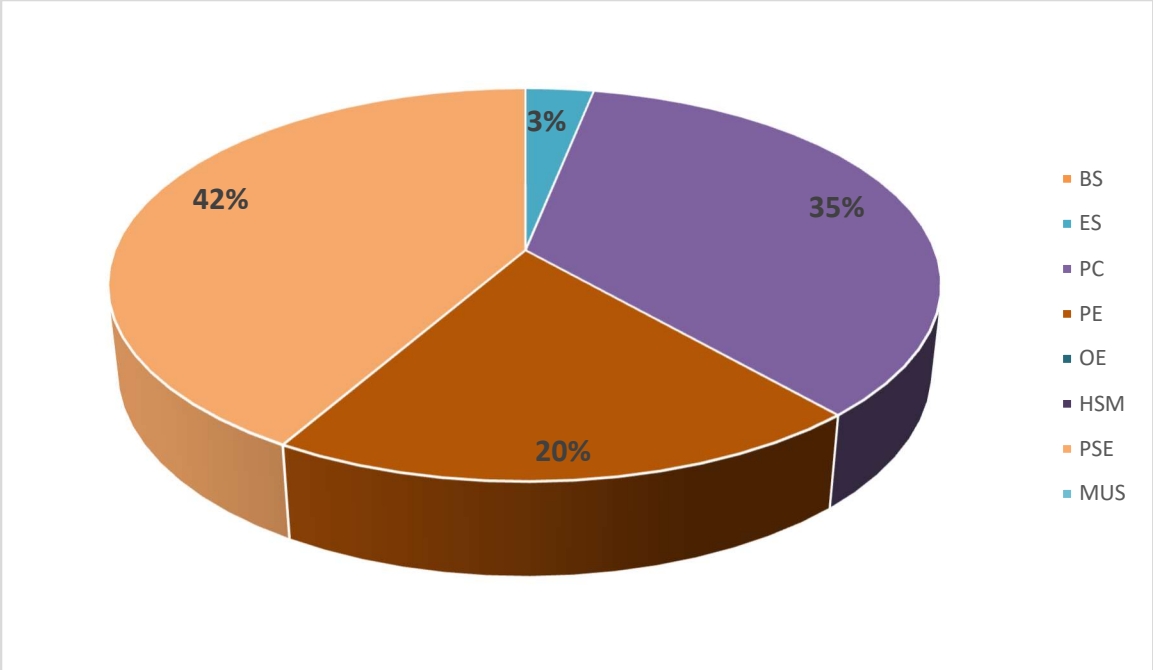
Total Credit

Year	Semester	Hrs/week	Credit
1st	1	33	24
	2	33	24
2nd	3	36	24
	4	40	24
Total			**96**

Category Codification with Credit Break up

Definition of Category	Code	No	Credit
Basic Science	BS	1	0
Engineering Science	ES	2	3
Professional Core	PC	3	34
Professional Elective (Discipline Specific)	PE	4	19
Open Elective (General Elective)	OE	5	0
Humanities & Social Science including Management	HSM	6	0
Project Work / Seminar / Internship / Entrepreneurship	PSE	7	40
Mandatory / University Specified (Environmental Sc. / Induction Training / Indian Constitution / Foreign Language)	MUS	8	0
			96

Category wise Credit Distribution



SCHOOL OF ENGINEERING AND TECHNOLOGY

M. TECH IN ROBOTICS & AUTOMATION ENGINEERING

SEMESTER: I

Sl No.	Course Title	Code	Credit	Type		
				L	T	P
1	Kinematics and Dynamics of Robots	1320020101	3	3	0	0
2	Introduction to Manufacturing Systems (For CSE/IT/ECE/ICE background students) or Introduction to Electrical and Electronics Systems (For MAE/Mechanical/Production/Industrial Engg background students)	1320020102	3	3	0	0
3	Statistics and Numerical Methods	1320020103	3	3	0	0
4	Control system	1320020104	3	3	0	0
5	Elective-I	132002015*	3	3	0	0
6	Kinematics and Dynamics Lab	1320020206	2	0	0	2
7	Manufacturing Systems Lab or Electrical and Electronics Systems Lab	1320020207	2	0	0	2
8	Statistics and Numerical Methods Lab	1320020208	1	0	0	1
9	Elective-I Lab	132002029*	2	0	0	2
10	Control system Lab	1320020210	2	0	0	2
Total Credit			24	33 hrs/ week		

Elective-I/ Elective-I Lab

1	Image Processing	132002015A
2	Computer-Aided Modeling and Design	132002015B
3	Image Processing Lab	132002029A
4	Computer-Aided Modeling and Design Lab	132002029B

SCHOOL OF ENGINEERING AND TECHNOLOGY

M. TECH IN ROBOTICS & AUTOMATION ENGINEERING

SEMESTER: II

Sl No.	Course Title	Code	Credit	Type		
				L	T	P
1	Artificial Intelligence and its Application in Robotics	1320021101	3	3	0	0
2	Robot Sensors and Computer Vision	1320021102	3	3	0	0
3	Machine Learning	1320021103	3	3	0	0
4	Elective-II	132002114*	3	3	0	0
5	Elective-III	132002115*	3	3	0	0
6	Artificial Intelligence Lab	1320021206	1	0	0	1
7	Sensors and Computer Vision Lab	1320021207	1	0	0	1
8	Elective-II Lab	132002128*	1	0	0	1
9	Elective-III Lab	132002129*	1	0	0	1
10	Machine Learning Lab	1320021210	1	0	0	1
11	Sessional: Industry Certified Training Program on Robotics	1320021611	4	0	0	4
Total Credit			24	33 hrs/ week		

Electives-II / Electives-III / Electives-II Lab/ Electives-III Lab

1	Digital System Design	132002114A
2	Robot Programming	132002114B
3	Mechatronics system and its application	132002115A
4	Advanced control systems	132002115B
5	Digital System Design Lab	132002128A
6	Robot Programming Lab	132002128B
7	Mechatronics system and its application Lab	132002129A
8	Advanced control systems Lab	132002129B

SCHOOL OF ENGINEERING AND TECHNOLOGY

M. TECH IN ROBOTICS & AUTOMATION ENGINEERING

SEMESTER: III

Sl No.	Course Title	Code	Credit	Type		
				L	T	P
1	Industrial Automation	1320022101	3	3	0	0
2	Design of Machines and Mechanisms	1320022102	3	3	0	0
3	Elective-IV	132002213*	3	3	0	0
4	Elective-V	132002214*	3	3	0	0
5	Project/ Thesis: Part1	1320022505	12	0	0	12
Total Credit			24	36 hrs/ week		

Electives-IV/ Electives-V

1	Optimization Techniques	132002213A
2	Mobile Robots	132002213B
3	Microprocessors and Micro-Controllers	132002214A
4	Embedded System Design	132002214B

SEMESTER: IV

Sl No.	Course Title	Code	Credit	Type		
				L	T	P
1	Project/ Thesis: Part 2	1320023501	24	0	0	24
Total Credit			24	40 hrs/ week		

SCHOOL OF ENGINEERING AND TECHNOLOGY
M. TECH IN ROBOTICS & AUTOMATION ENGINEERING

SEMESTER –I

KINEMATICS AND DYNAMICS OF ROBOTS

OBJECTIVES:

- To introduce the functional elements of Robotics
- To impart knowledge on the direct and inverse kinematics
- To introduce the manipulator differential motion and control
- To educate on various path planning techniques
- To introduce the dynamics and control of manipulators

OUTCOMES:

- Ability to understand basic concepts of robotics.
- To analyze Instrumentation systems and their applications to various
- To know about the differential motion, add statics in robotics
- To know about the various path planning techniques.
- To know about the dynamics and control in robotics industries

UNIT I
BASIC CONCEPTS **9**

Brief history-Types of Robots–Technology-Robot classifications and specifications-Design and control issues- Various manipulators – Sensors - work cell - Programming languages.

UNIT II
DIRECT AND INVERSE KINEMATICS **9**

Mathematical representation of Robots - Position and orientation – Homogeneous transformation- Various joints-Representation using the Denavit-Hartenberg parameters -Degrees of freedom-Direct kinematics- inverse kinematics-SCARA robots- Solvability – Solution methods-Closed form solution.

UNIT III
MANIPULATOR DIFFERENTIAL MOTION AND STATICS **9**

Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse -Wrist and arm singularity - Static analysis - Force and moment Balance.

UNIT IV
PATH PLANNING **9**

Definition-Joint space technique-Use of p-degree polynomial-Cubic polynomial-Cartesian space technique - Parametric descriptions - Straight line and circular paths - Position and orientation planning.

UNIT V
DYNAMICS AND CONTROL **9**

Lagrangian mechanics-2DOF Manipulator-Lagrange Euler formulation-Dynamic model – Manipulator control problem-Linear control schemes-PID control scheme-Force control of robotic manipulator.

TOTAL: 45 PERIODS

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TEXTBOOKS:
[1] R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005.
[2] JohnJ.Craig, Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 2009.
[3] M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, Industrial Robotics, McGraw-Hill Singapore, 1996.

REFERENCES:
[1] Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis', Oxford University Press, Sixth impression, 2010.
[2] K. K.Appu Kuttan, Robotics, I K International, 2007.
[3] Edwin Wise, Applied Robotics, Cengage Learning, 2003.
[4] R.D.Klafter,T.A.Chimielewski and M.Negin, Robotic Engineering–An Integrated Approach, Prentice Hall of India, New Delhi, 1994.
[5] B.K.Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998.
[6] S.Ghoshal, Embedded Systems & Robotics – Projects using the 8051 Microcontroller, Cengage Learning, 2009.

INTRODUCTION TO MANUFACTURING SYSTEMS
(for CSE/IT/ECE/ICE/EE background students)

UNIT-I
Definition of manufacturing, Overview of manufacturing processes.
Welding Processes- Definition of welding, Gas Welding, Electric Arc Welding- Principle of arc, arc welding equipment, manual metal arc welding. Resistance welding- Principle, Resistance spot welding, Resistance seam welding. Electron beam welding, Laser beam welding, Brazing, Soldering.

UNIT-II
Metal Removal Processes- Introduction of metal removal processes, Concept of chip formation, Orthogonal and oblique cutting, Classification of machine tools, Generation and forming, methods of generating surfaces, Basic elements of machine tools. Introduction to centre lathe, Operations performed on centre lathe.
Reciprocating Machine Tools- Shaper, Planer, Slotter.

UNIT-III
Milling- Introduction, Types of milling machines.
Hole Making Operations- Introduction to Drilling, Boring, Reaming, Tapping.
Grinding- Introduction, Grinding wheel-abrasive type, grain size; Types of grinding machines – cylindrical grinding, surface grinding, centreless grinding, Honing, Lapping.
Introduction to Gear cutting operations.
Unconventional Machining Processes- Working principles of EDM, ECM, USM, LBM.

UNIT-IV:
Process Planning- Concept of process planning, Product cycle in manufacturing, Product Quality, Accuracy of machining, Accuracy of assembly.
Metrology- Tolerance, Limits and Fits, Hole basis system, Linear measurement, Slip gauges, comparators, Angular measurement.
Numeric Control of Machine Tools- Numeric control, NC machine tools, Introduction to CNC and DNC.

Textbooks:

[1] P.N.Rao, "Manufacturing Technology-Metal Cutting and Machine Tools", TMH.
[2] M.P.Groover, "Fundamentals of Modern Manufacturing", Wiley India Pvt., Ltd.
[3] M.P.Groover, "Automation, Production Systems and Computer Integrated Manufacturing", PHI

Reference Books:

[1] Serope Kalpakjian and Steven R. Schimid, "Manufacturing Processes", Pearson.
[2] Gerling Heinrich, “All about Machine Tools”, New Age Publication, 2003.

INTRODUCTION TO ELECTRICAL AND ELECTRONICS SYSTEMS
(for MAE/ME/Production/Industrial Engg. background students)

UNIT-I

Review of DC and AC circuits.
Introduction of DC Circuit parameters and energy sources (Dependent and Independent), Mesh and Nodal Analysis, Superposition, Thevenin’s, Norton’s, Reciprocity, Maximum Power Transfer and Millman’s Theorems.

UNIT-II

Introduction to DC and Induction motors (both three-phase and single phase), Stepper Motor, and Permanent Magnet Brushless DC Motor. Speed and Torque Equation of D.C. motors, Characteristics of D.C. series, shunt and compound motors and their applications, Starting and speed control of D.C. motors, Braking of D.C. motors, Efficiency and testing of D.C. Machines, Introduction of D.C. servo motor and permanent magnet / brushless D.C. motors.

UNIT-III

Review of p-n junction diode.
Introduction to BJT and MOSFETS, hybrid model for transistor at low frequencies.
Digital and analog signals, number systems, Boolean algebra, Switching Theory: - Boolean Algebra Postulates and Theorems, De’ Morgan’s Theorem, Switching Functions- Canonical Forms- logic gates with simple applications, logic gates, Simplification of Switching Functions- Karnaugh Map and Quine Mc-Clusky Methods.

UNIT-IV

Number Systems and Codes: Decimal, Binary, Octal and Hexadecimal Number systems, Codes- BCD, Gray Code, Excess-3 Code, ASCII, EBCDIC, Conversion between various Codes.
Combinational Logic Circuits: Review of basic gates- Universal gates, Adder, Subtractor, Serial Adder, Parallel Adder- Carry Propagate Adder, Carry Look-ahead Adder, Carry Save Adder, Comparators, Parity Generators, Decoder and Encoder, Multiplexer and De-multiplexer, ALU, PLA and PAL.

Textbooks:

[1] S.N Singh, “Basic Electrical Engineering” PHI India Ed 2012.
[2] Chakrabarti, Chanda,Nath “Basic Electrical Engineering” TMH India”, Ed 2012.
[3] R.P. Jain, “Modern Digital Electronics”, TMH, 2nd Ed.
[4] Morris Mano, Digital Logic and Computer Design”, Pearson.

Reference Books:
[1] ZyiKohavi, "Switching & Finite Automata Theory", TMH, 2nd Edition.
[2] S.Salivahanan, A. Vallavaraj, C. Gnanapriya, "Digital Signal Processing", Tata McGraw Hill International/TMH, 2007.

STATISTICS AND NUMERICAL METHODS

OBJECTIVES:

- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and gives procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real-life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

OUTCOMES:

Upon successful completion of the course, students will be able to:

- Apply the concept of testing hypotheses for small and large samples in real-life problems.
- Apply the basic concepts of classifications of design of experiments in the field of agriculture.
- Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.
- Understand the knowledge of various techniques and methods for solving first and second-order ordinary differential equations.
- Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

UNIT I
TESTING OF HYPOTHESIS **12**

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square, and F distributions for mean, variance, and proportion - Contingency table (test for independent) - Goodness of fit.

UNIT II
DESIGN OF EXPERIMENTS **12**

One way and two-way classifications - Completely randomized design – Randomized block design –Latin square design - 2^2 factorial design.

UNIT III
SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS **12**

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method - Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss-Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT IV

INTERPOLATION, NUMERICAL DIFFERENTIATION, AND NUMERICAL INTEGRATION 12

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 12

Single-step methods: Taylor's series method - Euler's method - Modified Euler's method – Fourth order Runge-Kutta method for solving first-order equations - Multistep methods: Milne's and Adams - Bash forth predictor-corrector methods for solving first-order equations.

TOTAL: 60 PERIODS

TEXTBOOKS:

[1] Grewal. B.S. and Grewal. J.S., "Numerical Methods in Engineering and Science ", 10th Edition, Khanna Publishers, New Delhi, 2015.
[2] Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

REFERENCES:

[1] Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
[2] Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
[3] Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 2006.
[4] Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 2004.
[5] Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", 8th Edition, Pearson Education, Asia, 2007.

CONTROL SYSTEM

OBJECTIVES:

- To study the basics of control systems and its response. Stability of mechanical and electrical systems. Use of MATLAB to design a stable control system.
- To introduce the elements of control system and their modeling using various Techniques.
- To introduce methods for analyzing the time response.
- To impart knowledge about the frequency response and the stability of systems
- To introduce the state variable analysis method

OUTCOMES:

- To understand the basic of the control system
- Ability to know about the time and frequency domain analysis
- To know about the different stability of the systems
- To expose students to the state-space representation and its analysis.
- To introduce non-linear systems and their control and to impart knowledge on advanced control techniques

UNIT I
INTRODUCTION **9**
Open-loop and closed-loop systems - Examples - Elements of closed-loop systems - Transfer function - Modeling of physical systems – Mechanical, Thermal, Hydraulic systems, and Electric Networks - Transfer function of DC generator, DC servomotor, AC servomotor, Potentiometer, Synchros, Tachogenerator, Stepper motor - Block diagram - reduction techniques, Signal flow graph – Mason‟ gain formula. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

UNIT II
TIME-DOMAIN ANALYSIS **9**
Standard Test signals – Time response of second-order system - Time domain specifications – Types of systems – Steady-state error constants - Introduction to P, PI and PID modes of feed back control. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

UNIT III
FREQUENCY DOMAIN ANALYSIS **9**
Frequency domain specifications - Time and frequency response correlation – Polar plot – Bode plot – All pass minimum phase and non-minimum phase systems. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

UNIT IV
SYSTEM STABILITY **9**
Characteristic equation - Routh Hurwitz criterion of stability - Absolute and Relative stability – Nyquist stability - Nyquist stability criterion - Assessment of relative stability – Gain and Phase Margin. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

UNIT V
ROOT LOCUS METHOD **9**
Root locus concepts - Construction of root loci – Root contours. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions) STATE SPACE ANALYSIS: Limitations of conventional control theory - Concepts of state, state variables and state model – state model for linear time-invariant systems - Introduction to state-space representation using physical - Phase and canonical variables. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

TOTAL: 45 PERIODS

TEXTBOOKS:
[1] Nagrath I J, and Gopal, M, 'Control Systems Engineering" Prentice Hall of India, New Delhi, 2008.
[2] Richard C Dorf and Robert H Bishop, "Modern Control Systems.", Addison-Wesley -2007

REFERENCES:
[1] Ogata K, "Modern Control Engineering", Pearson Education, New Delhi, 2006.
[2] Kuo B C, "Automatic Control Systems", Prentice-Hall of India Pvt. Ltd, New Delhi, 2004.
[3] Norman C. Nise S, “Control system Engineering‟, John Wiley & Sons, Singapore, 2004.

IMAGE PROCESSING

OBJECTIVES:

- Image Processing course is designed to give knowledge of fundamental and advanced image processing.

OUTCOMES:

At the end of the course, the student will

- Understand the basics of Image processing
- Gain the ability to work with different image processing tools
- Know the application of image processing

UNIT I

Introduction & Digital Image Fundamentals

Fundamentals Steps in Digital Image Processing, Components of Digital Image Processing Systems, Applications of Digital Image Processing, Image Sampling and Quantization, Some basic relationships like Neighborhood, Connectivity, Distance Measures between pixels, Linear and Non-Linear Operations, stereo imaging, and camera calibration.

UNIT II

Image Enhancement in the Spatial Domain

Some basic Gray Level Transformations, Histogram Equalization, Enhancement Using Arithmetic and Logic operations, Basics of Spatial Filters, Smoothening and Sharpening Spatial Filters, Combining Spatial Enhancement Method, Image Negation.

Image Enhancement in the Frequency Domain

Introduction to Fourier Transform and its properties, Fast Fourier Transform, Smoothing and Sharpening Frequency Domain Filters, Homomorphic Filtering.

UNIT III

Image Restoration

Model of the Image Degradation / Restoration Process, Noise Models, Restoration in the presence of Noise Only Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear Position-Invariant Degradations, Estimation of Degradation Function, Inverse filtering, Wiener filtering, Constrained Least Square Filtering, Geometric Mean Filter, Geometric Transformations.

Image Compression

Coding, Inter-pixel, and Psycho-visual Redundancy, Image Compression models, Elements of Information Theory, Error-free compression, Lossy compression, Image compression standards, Introduction to Video Coding.

UNIT IV

Image Segmentation

Detection of Discontinuities - point, lines, and edge segmentation, Edge linking and boundary detection, Thresholding, Region Oriented Segmentation.

Representation and Description
Representation, Boundary Descriptors, Regional Descriptors, Use of Principal Components for Description, Morphological Image Processing: Erosion and dilation, Some basic Morphological Algorithms.

Textbooks:
[1] Rafael C. Gonzalez & Richard E. Woods, "Digital Image Processing", 3rd Edition, Pearson Education, 2009.

Reference Books:
[1] A.K. Jain, "Fundamentals of Digital Image Processing", PHI, 2003.
[2] William K. Pratt, "Digital Image Processing", Wiley, 2007.
[3] Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision" 3rd Edition, Cengage Learning, 2008.

COMPUTER-AIDED MODELING AND DESIGN

OBJECTIVE:
- To provide an overview of how computers are being used in mechanical component design with the use of various CAD standards
- To introduce the concepts of Mathematical Modelling of Engineering Problems using FEM with 2D scalar and vector variables problems respectively.

OUTCOMES:
- To know the basic concepts of modelling and assembly for different mechanical components
- To know the different types of CAD standards used in modeling of mechanical components
- To know about basic concepts of FEA and analysis software for analyzing mechanical components
- To know about different mathematical techniques used in finite element analysis to solve structural and thermal problems

UNIT I
MODELLING AND ASSEMBLY **9**
Assembly modelling – interferences of positions and orientation – tolerance analysis-mass property calculations – mechanism simulation and interference checking

UNIT II
CAD STANDARDS **9**
Standards for computer graphics- Graphical Kernel System (GKS) - standards for exchange images- Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS, etc. - communication standards

UNIT III
INTRODUCTION TO ANALYSIS **9**
Basic concepts of the Finite Element Method - Discretization -Meshing – Mesh refinement- Mesh Enrichment- Natural co-ordinate systems -Types of elements- Special Elements- Crack tip Element- Introduction to Analysis Software.

UNIT IV

TWO-DIMENSIONAL SCALAR VARIABLE PROBLEMS **9**

Second-Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems.

UNIT V

TWO-DIMENSIONAL VECTOR VARIABLE PROBLEMS **9**

Equations of elasticity – Plane stress, plane strain, and axisymmetric problems – Body forces and temperature effects – Stress calculations - Plate and shell elements.

TOTAL:45 PERIODS

TEXTBOOKS:

[1] Ibrahim Zeid "Mastering CAD CAM" Tata McGraw-Hill Publishing Co.2007
[2] Rao, S.S., "The Finite Element Method in Engineering", 5th Edition, Butterworth Heinemann, 2010

REFERENCES

[1] Donald Hearn and M. Pauline Baker "Computer Graphics"'. Prentice Hall, Inc, 1996.
[2] Foley, Wan Dam, Feiner and Hughes - "Computer graphics principles & practice" Pearson, 2nd edition, 1995.
[3] Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and Applications of Finite Element Analysis", 4th Edition, Wiley Student Edition, 2002.

SEMESTER –II

ARTIFICIAL INTELLIGENCE AND ITS APPLICATION IN ROBOTICS

OBJECTIVES:

The student should be made to:

- Study the concepts of Artificial Intelligence.
- Learn the methods of solving problems using Artificial Intelligence.
- Introduce the concepts of Expert Systems and machine learning.
- Learn about planning and reasoning artificial intelligence.
- Solve the risk in artificial intelligence.

OUTCOMES:

At the end of the course, the student should be able to:

- Identify problems that are amenable to solutions by AI methods.
- Identify appropriate AI methods to solve a given problem.
- Formalize a given problem in the language/framework of different AI methods.
- Implement basic AI algorithms.
- Design and carry out an empirical evaluation of different algorithms on a problem formalisation and state the conclusions that the evaluation supports.

UNIT I
INTRODUCTION **13**

History, state of the art, Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents. PROBLEM SOLVING: Solving problems by searching –Informed search and exploration–Constraint satisfaction problems–Adversarial search, knowledge and reasoning– knowledge representation – first order logic.

UNIT II
PLANNING **8**

Planning with forward and backward State-space search – Partial order planning – Planning graphs–Planning with propositional logic – Planning and acting in real world.

UNIT III
REASONING **8**

Uncertainity – Probabilistic reasoning–Filtering and prediction–Hidden Markov models–Kalman filters–Dynamic Bayesian Networks, Speech recognition, making decisions.

UNIT IV
LEARNING **8**

Forms of learning – Knowledge in learning – Statistical learning methods –reinforcement learning, communication, perceiving and acting, Probabilistic language processing, perception.

UNIT V
AI IN ROBOTICS **8**

Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics.

TOTAL : 45 PERIODS

TEXTBOOKS:

[1] Stuart Russell, Peter Norvig, “Artificial Intelligence: A modern approach”, Pearson Education, India2003.
[2] Negnevitsky, M, “Artificial Intelligence: A Guide to Intelligent Systems”, Harlow: Addison-Wesley, 2002.

REFERENCE:

[1] David Jefferis, “Artificial Intelligence: Robotics and Machine Evolution”, Crabtree Publishing Company, 1992.

SCHOOL OF ENGINEERING AND TECHNOLOGY
M. TECH IN ROBOTICS & AUTOMATION ENGINEERING

ROBOT SENSORS AND COMPUTER VISION

OBJECTIVES:

- To understand the concepts of measurement technology.
- To learn the various sensors used to measure various physical parameters.
- To learn the fundamentals of signal conditioning, data acquisition, and communication systems used in mechatronics system development.
- To know about the principles and applications of the vision system in the modern manufacturing environment
- To learn about the algorithms in vision
- To know about the recognition of object
- To be familiar with the applications regarding vision
- To know about the components used for vision

OUTCOMES:

Upon Completion of the course the students will be able to

- Familiar with various calibration techniques and signal types for sensors.
- Apply the various sensors in the Automotive and Mechatronics applications
- Describe the working principle and characteristics of force, magnetic and heading sensors.
- Understand the basic principles of various pressure and temperature, smart sensors.
- Ability to implement the DAQ systems with different sensors for real time applications.
- Knowledge or gadgets of vision systems
- Ability to understand the image capturing and processing techniques
- Ability to apply the vision system in other machines
- Knowledge for recognizing the objects.
- Knowledge in application of vision and image processing in robot operations.

UNIT I

INTRODUCTION **4**

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

UNIT II **11**

MOTION, PROXIMITY, AND RANGING SENSORS

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

FORCE, MAGNETIC AND HEADING SENSORS

Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement, and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.

OPTICAL, PRESSURE AND TEMPERATURE SENSORS

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors – Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

UNIT III

SIGNAL CONDITIONING AND DAQ SYSTEMS **8**

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi-channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

UNIT IV

VISION SYSTEM **8**

Basic Components – Elements of visual perception, Lenses: Pinhole cameras, Gaussian Optics – Cameras – Camera-Computer interfaces

VISION ALGORITHMS

Fundamental Data Structures: Images, Regions, Sub-pixel Precise Contours – Image Enhancement: Gray value transformations, image smoothing, Fourier Transform – Geometric Transformation – Image segmentation – Segmentation of contours, lines, circles and ellipses – Camera calibration – Stereo Reconstruction.

UNIT V

OBJECT RECOGNITION **8**

Object recognition, Approaches to Object Recognition, Recognition by combination of views – objects with sharp edges, using two views only, using a single view, use of dept values.

APPLICATIONS

Transforming sensor reading, Mapping Sonar Data, Aligning laser scan measurements - Vision and Tracking: Following the road, Iconic image processing, Multiscale image processing, Video Tracking - Learning landmarks: Landmark spatiograms, K-means Clustering, EM Clustering.

UNIT VI

ROBOT VISION **6**

Basic introduction to Robotic operating System (ROS) - Real and Simulated Robots - Introduction to OpenCV, Open NI and PCL, installing and testing ROS camera Drivers, ROS to OpenCV – The cv_bridge Package.

TOTAL: 45 PERIODS

TEXT BOOKS:

[1] Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2009

[2] Sawney A K and Puneet Sawney, “A Course in Mechanical Measurements and Instrumentation and Control”, 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

[3] Carsten Steger, Markus Ulrich, Christian Wiedemann, “Machine Vision Algorithms and Applications”, WILEY-VCH, Weinheim, 2008.

[4] Damian m Lyons, “Cluster Computing for Robotics and Computer Vision”, World Scientific, Singapore, 2011.

REFERENCES
[1] C. Sujatha, Dyer, S.A., Survey of Instrumentation and Measurement, John Wiley & Sons, Canada, 2001
[2] Hans Kurt Tonshoff (Editor), Ichiro, "Sensors in Manufacturing" Volume 1, Wiley-VCH April 2001.
[3] John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999.
[4] Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2011.
[5] Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press, 2015
[6] Rafael C. Gonzalez and Richard E.woods, "Digital Image Processing", Addition – Wesley Publishing Company, New Delhi, 2007.
[7] Shimon Ullman, "High-Level Vision: Object recognition and Visual Cognition", A Bradford Book, USA, 2000.
[8] R.Patrick Goebel, " ROS by Example: A Do-It-Yourself Guide to Robot Operating System – Volume I", A Pi Robot Production, 2012.

MACHINE LEARNING

UNIT-I
Introduction: well-posed learning problem, designing a learning system: training experience, target function, final design. Issues in machine learning
Concept, Learning, and General to specific ordering: concept learning task, concept learning as search, version spaces and candidate elimination, inductive bias.

UNIT-II
Decision Tree Learning (DTL): introduction, decision tree representation, problems for DTL, DTL algorithm, hypothesis space search, inductive bias in DTL, issues in DTL.
Bayesian Learning: Introduction, Bayes Theorem, concept learning, least-square hypothesis, predicting probabilities, Bayes optimal classifiers, EM algorithm.

UNIT-III
Instance-Based Learning: introduction, K-nearest neighbor learning, locally weighted regression, case-based reasoning.
Learning a set of rules: introduction, sequential covering algorithm, learning rule sets, first-order rules.

UNIT-IV
Analytical learning: introduction, perfect domain theory, explanation-based learning. Inductive analytical approaches to learning.

Textbooks:
[1] Tom M. Mitchell , "Machine learning", McGraw Hill 1997.
[2] Ethem Alpaydin, "Introduction to machine learning", PHI learning, 2008.
[3] Rajjan Shinghal, "Pattern Recognition", Oxford Press, 2006.

Reference Books:
[1] Duda, Hart and Stork, "Pattern Classification", 2000.
[2] Hastie, Tibshirani, Friedman, "The Elements of Statistical Learning", Springer 2001.

DIGITAL SYSTEM DESIGN

UNIT – I
Gajski's 'Y' Chart, Behavioral Modeling, Data flow modeling, Structural modeling, Hardware Description Language, Specification of combinational systems using VHDL, Introduction to VHDL, Basic language, element of VHDL, Design of Adder, Subtractor, Decoder, Encoder, and Multiplexor circuit, Generic, Component and Package description with example.

UNIT – II
Description and design of sequential circuits using VHDL, Description of Process, Functions, Packages and loop statement using example, Design of shift Register, Design of Counter and Memory using VHDL.

UNIT – III
Register- transfer level systems, Systems, Analysis of RTL Systems, Design of RTL Systems. Data Subsystems, Storage Modules, Functional Modules, Datapaths, Control Subsystems. Basics of State Machine, Design of a Serial Adder with Accumulator, State Graph for Control Network, design of a Binary Multiplier.

UNIT – IV
Programmable Devices: Architecture of Programmable Array Logic and PLA, Architecture description of Field Programmable Gate Array and Complex Programmable Logic Devices, Case studies of robotic application using FPGA/CPLD.

Textbooks:
[1] V.Padroni, "Digital System Design". Pearson.
[2] M. Ercegovac, T. Lang and L.J. Moreno, "Introduction to Digital Systems", Wiley,2000

Reference Books:
[1] C. H. Roth, "Digital System Design using VHDL", Jaico Publishing, 2001
[2] J. Bhaskar, " A VHDL Primer", Addison Wesley, 1999.
[3] Douglas L. Perry , "VHDL Programming by Examples", TMH, 2000
[4] Sumit Ghose, "Hardware Description Languages" PHI, 2000
[5] P.J. Ashendern , "The Designer Guide to VHDL", Kaufmann Pub. 2000
[6] Mark Zwolinski , "Digital System Design with VHDL" Prentice Hall Pub. 1999
[7] Zeidman , "Designing with FPGA & CPLDs", CMP Pub. 1999
[8] Douglas J. Smith , "HDL Chip Design", Doone Pub. 2001

ROBOT PROGRAMMING

UNIT I-Introduction to Robot Programming

Robot programming-Introduction-Types- Flex Pendant- Lead through programming, Coordinate systems of Robot, Robot controller- major components, functions-Wrist Mechanism-Interpolation-Interlock commands Operating mode of robot, Jogging-Types, Robot specifications- Motion commands, end effectors and sensors command.

UNIT II-VAL Language

Robot Languages-Classifications, Structures- VAL language commands motion control, hand control, program control, pick and place applications, palletizing applications using VAL, Robot welding application using VAL program-WAIT, SIGNAL and DELAY command for communications using simple applications.
VAL-II programming-basic commands, applications- Simple problem using conditional statements-Simple pick and place applications-Production rate calculations using robot.

UNIT III- RAPID Language and AML

RAPID language basic commands- Motion Instructions-Pick and place operation using Industrial robot- manual mode, automatic mode, subroutine command-based programming. Move master command language-Introduction, syntax, and simple problems.
AML Language-General description, elements and functions, Statements, constants and variables-Program control statements-Operating systems, Motion, Sensor Commands-Data processing.

UNIT IV- Practical Study of Virtual Robot

Robot cycle time analysis-Multiple robot and machine Interference-Process chart-Simple problems-Virtual robotics, Robot studio online software- Introduction, Jogging, components, work planning, program modules, input, and output signals-Singularities-Collision detection-Repeatability measurement of robot-Robot economics.
AML Language-General description, elements and functions, Statements, constants, and variables-Program control statements-Operating systems, Motion, Sensor commands-Data processing.

Textbooks:

[1] S. R.Deb, “Robotics technology and flexible automation”, Tata McGraw Hill publishing company limited, 1994.
[2] Mikell. P. Groover, “Industrial Robotics Technology”, Programming and Applications, McGraw Hill Co, 1995.
[3] Robotcs Lab manual, 2007.

Reference Books:

[1] Klafter. R.D, Chmielewski.T.A. and Noggin’s., “Robot Engineering : An Integrated Approach”, Prentice Hall of India Pvt. Ltd.,1994.
[2] Fu. K. S., Gonzalez. R. C. & Lee C.S.G., “Robotics control, sensing, vision and intelligence”, McGraw Hill Book co, 1987.
[3] Craig. J. J. “Introduction to Robotics, Mechanics, and control”, Addison-Wesley, 1999.

MECHATRONICS SYSTEMS AND APPLICATIONS

UNIT-I

Introduction: Introduction to Mechatronics System, mechatronics in manufacturing, product and design, Measurement Systems, Control System, comparison between traditional and mechatronics approach.

Sensors and Transducers: Introduction, Performance terminology, Displacement, Position and Proximity, Velocity and motion, Fluid pressure, Temperature sensors, Light sensors, Selection of sensors.

UNIT-II

Mechanical Actuation System: Cams, Gear trains, Ratchet and Pawl, Belt and chain drives, Bearings. Hydraulic and Pneumatic Actuation System: Introduction to Hydraulic and Pneumatic Systems, Directional Control valves, Flow control valves.

Electrical Actuation System: Electrical systems, Solid State Switches, Solenoids, D.C. motors, A.C. motors, Stepper motors.

UNIT-III Processors/Controllers

Microprocessors: Microprocessor systems, Microcontrollers, applications.

Programmable Logic Controllers: Basic PLC structure, Input/output processing, ladder programming, Latching, and internal relays, Sequencing, Timers and Counters, Shift registers, Master and jump controls, Code conversion, Data handling, selection of PLC.

UNIT-IV

System Models: Mathematical models, Mechanical, Electrical, hydraulic and Thermal Systems, Modeling of dynamic systems.

Design of Mechatronics systems: Stages in designing mechatronics system, Traditional and Mechatronic design.

Case studies of Mechatronics system: Pick and place robots, automated guided vehicle, Automatic car park barrier, Engine management system.

Textbooks:

[1] W.Bolton, “Mechatronics” , Pearson education, second edition, fifth Indian Reprint, 2003.
[2] A. Smaili and F. Mrad, "Mechatronics- integrated technologies for intelligent machines", Oxford university press, 2008.

Reference Books:

[1] R.K Rajput, A textbook of mechatronics, S. Chand & Co, 2007.
[2] Michael B. Histand and David G. Alciatore, “Introduction to Mechatronics and Measurement Systems”, McGraw-Hill International Editions, 2000.
[3] D. A. Bradley, Dawson D., Buru N.C. and. Loader A.J, “Mechatronics”, Chapman and Hall, 1993.
[4] Dan Necsulesu, “Mechatronics”, Pearson Education Asia, 2002 (Indian Reprint).
[5] Lawrence J. Kamm, “Understanding Electro – Mechanical Engineering”, An Introduction to Mechatronics, Prentice – Hall of India Pvt., Ltd., 2000.
[6] Nitaigour Premchand Mahadik, “Mechatronics”, Tata McGraw-Hill publishing Company Ltd, 2003.

ADVANCED CONTROL SYSTEMS

OBJECTIVES

- To provide knowledge on design in state variable form
- To provide knowledge in phase plane analysis.
- To give basic knowledge in describing function analysis.
- To study the design of optimal controller.
- To study the design of optimal estimator including Kalman Filter
-

OUTCOMES

- At the end of the course, the student should be able to:
- Design in state variable form
- Knowledge in phase plane analysis.
- To describe function analysis.
- Know the design of optimal controller.
- Know about the design of optimal estimator including kalman filter

UNIT I

STATE VARIABLE DESIGN **9**

Introduction to state Model- effect of state Feedback- Necessary and Sufficient Condition for Arbitrary Pole-placement- pole placement Design- design of state Observers- separation principle- servo design: -State Feedback with integral control

UNIT II

PHASE PLANE ANALYSIS **9**

Features of linear and non-linear systems - Common physical non-linearities – Methods of linearization Concept of phase portraits – Singular points – Limit cycles – Construction of phase portraits – Phase plane analysis of linear and non-linear systems – Isocline method.

UNIT III

DESCRIBING FUNCTION ANALYSIS **9**

Basic concepts, derivation of describing functions for common non-linearities – Describing function analysis of non-linear systems – limit cycles – Stability of oscillations.

UNIT IV

OPTIMAL CONTROL **9**

Introduction – Time-varying optimal control – LQR steady state optimal control – Solution of Ricatti's equation – Application examples.

UNIT V

OPTIMAL ESTIMATION **9**

Optimal estimation – Kalman Bucy Filter-Solution by duality principle-Discrete systems- Kalman

FilterApplication examples.

TEXTBOOKS

[1]Mohandas K. P., "Modern Control Engineering", Sanguine Technical Publishers, 2006
[2] Thaler G.J., "Automatic Control Systems", Jaico Publishing House, 1993
[3] Gopal ,M. Modern control system theory, New Age International Publishers, 2002.

REFERENCES

[1] William S Levine, "Control System Fundamentals," The Control Handbook, CRC Press, Tayler and Francies Group 2011.
[2] Ashish Tewari, „Modern control Design with Matlab and Simulink, John Wiley, New Delhi, 2002.
[3] Ogata K., "Modern Control Engineering", 4th edition, PHI, New Delhi, 2002.
[4] Glad T. and Ljung L. "Control theory –Multivariable and Non-linear methods", Taylor & Francis, 2002
[5] Naidu D.S., "Optimal Control Systems" First Indian Reprint, CRC Press, 2009.

SEMESTER –III

INDUSTRIAL AUTOMATION

OBJECTIVES:

- To know about the basic concepts in industrial automation
- To design automated systems.
- To know about transfer lines and automated assembly
- Be exposed to pneumatic, electric, hydraulic and electronic systems in automation of mechanical operations.
- To know about the advancement in hydraulics and pneumatics

OUTCOMES:

- Knowledge of industrial automation by transfer lines and automated assembly lines.
- Ability to design an automated system
- Understanding of automated controls using pneumatic and hydraulic systems
- Ability to understand the electronic control systems in metal machining and other manufacturing processes.
- To understand advancement in hydraulics and pneumatics systems.

UNIT I

FUNDAMENTAL CONCEPTS OF INDUSTRIAL AUTOMATION 9

Fundamental concepts in manufacturing and automation, definition of automation, reasons for automating. Types of production and types of automation, automation strategies, levels of automation.

UNIT II

TRANSFER LINES AND AUTOMATED ASSEMBLY 10

General terminology and analysis, analysis of transfer lines without storage, partial automation. Automated flow lines with storage buffers. Automated assembly design for automated assembly, types of automated assembly systems, part

feeding devices, analysis of multi-station assembly machines. AS/RS, RFID system, AGVs, modular fixturing. Flow line balancing.

UNIT III
DESIGN OF MECHATRONIC SYSTEMS **8**
Stages in design, traditional and mechatronic design, possible design solutions. Case studies-pick and place robot, engine management system.

UNIT IV
PROGRAMMABLE AUTOMATION **9**
Special design features of CNC systems and features for lathes and machining centers. Drive system for CNC machine tools. Introduction to CIM; condition monitoring of manufacturing systems.

UNIT V
DESIGN FOR HIGH-SPEED AUTOMATIC ASSEMBLY **9**
Introduction, Design of parts for high-speed feeding and orienting, high-speed automatic insertion. Analysis of an assembly. General rules for product design for automation.

TOTAL: 45 PERIODS

TEXTBOOKS:
[1] Mikell P Groover, "Automation Production Systems and Computer- Integrated Manufacturing" Pearson Education, New Delhi, 2001.
[2] Bolton W, "Mechatronics", Pearson Education, 1999.

REFERENCES:
[1] Mikell P Groover, "Industrial Robots – Technology Programmes and Applications", McGraw Hill, New York, USA. 2000.
[2] Steve F Krar, "Computer Numerical Control Simplified ", Industrial Press, 2001.
[3] Joffrey Boothroyd, Peter Dewhurst and Winston A. Knight, "Product Design for manufacture and Assembly", CRC Press, 2011

OPTIMIZATION TECHNIQUES

UNIT-I
Statement of the Optimization Problem, Basic Definitions, Optimality Criteria for Unconstrained Optimization, Optimality Criteria for Constrained Optimization, Engineering Application of Optimization, Overview of optimization technique, Interdisciplinary nature.

UNIT- II
Formulation, Simplex method, Primal to Dual, Dual Simplex method, Sensitivity Analysis.
Gomory's cutting plane method, Branch & Bound Technique.

UNIT-III
Lagrangian method & Kuhn tucker method.
Interpolation method (Quadratic, Cubic & Direct root method). Direct search method – Random search, Pattern search and Rosen Brock's hill-climbing method.

UNIT-IV:
Gradient descent, Newton's method, Marquardt's method, Quasi Newton method.
Response Surface, the Least-Squares Methods, Two-Level Factorial Design, Central Composite Design (CCD), Sequential Nature of RSM.

Textbooks:
[1] S.S. Rao, "Engineering Optimization - Theory and Practice", John Wiley and Sons Inc.
[2] Pierre D.A., "Optimization, Theory with Application", John Wiley & sons.

Reference Books:
[1] Pablo Pedregal, "Introduction to Optimization", Springer.
[2] L.C. Jhamb, "Quantitative Techniques Vol. 1 and 2", Everest Pub. House.
[3] Ranjan Ganguli, "Engineering Optimization-A modern approach", University Press.

MOBILE ROBOTS

UNIT-I
Introduction of Mobile Robotics, Mechanics and Locomotion:
A brief history of mobile robotics, applications and market. Recent advances in the mobile robotics for RISE (Risky Intervention and Surveillance Environment) applications, Locomotion, Key issues in locomotion, legged, wheeled, and aerial mobile robots.
Mobile Robot Kinematics:
Introduction, kinematic models and constraints, mobile robot workspace, beyond basic kinematics, motion control (kinematic control).

UNIT-II
Perception, robotics Architectures, and Robot Learning:
Sensors Classification, sensor characterization, wheel/motor encoders, heading/orientation sensors ground-based beacons, active ranging, motion/speed sensors, vision-based sensors. Low-level control, Control architectures, software frameworks, Robot Learning, case studies of learning robots.

UNIT-III
Mobile Robot Localization:
Introduction, the challenge of localization: Noise and aliasing, to localize or not to
Localize, localization-based navigation versus programmed solutions, map representation, probabilistic map, map-based localization, autonomous map building.
Planning and navigation:
Planning and reaction, obstacle avoidance, D* algorithm, Navigation architecture, case studies.

UNIT-IV
Introduction to image processing:
Introduction to computer vision, Image processing: Point operators, Linear Filters, More neighborhood operators, Fourier transforms, Pyramids and wavelets, Geometric transformations.

Camera Systems in Machine:
Camera Technology, History in Brief, Machine Vision versus closed Circuit Television (CCTV), Sensor Technologies, spatial Differentiation: 1D and 2D, CCD Technology, Full Frame Principle, Frame Transfer Principle, Interline Transfer, Interlaced Scan Interline Transfer, Frame Readout.

Textbooks:
[1] Roland Siegwart & Illah R. Nourbakhsh, "Introduction to autonomous mobile robots", Prentice Hall of India, 2004.
[2] George A. Bekey "Autonomous Robots" MIT Press.
[3] Howie Choset, Kevin M. Lynch, Seth Hutchinson, George A. Kantor, Wolfram Burgard, Lydia E. Kavrakiand Sebastian Thrun, "Principles of Robot motion: Theory, Algorithm and Implementations", MIT Press.

Reference Books:
[1] Richard Szeliski: "Computer Vision: Algorithms and Applications", 2010 Springer.
[2] Alexander Hornberg: "Handbook of Machine Vision", Wiley-VCH.

ADVANCED MICROPROCESSOR AND MICROCONTROLLERS

OBJECTIVES:

The student should be made to:
- Study the Architecture of 8085 microprocessor.
- Study the Architecture of 8086 microprocessor.
- Learn the design aspects of I/O and Memory Interfacing circuits.
- Study about communication and bus interfacing.
- Study the Architecture of 8051 microcontroller.

OUTCOMES:
At the end of the course, the student should be able to:
- Design and implement programs on 8085 microprocessor.
- Design and implement programs on 8086 microprocessor.
- Design I/O circuits.
- Design Memory Interfacing circuits.
- Design and implement 8051 microcontroller-based systems.

UNIT I
8086 MICROPROCESSOR **8**
Architecture – Pin description – Operating modes – Registers – Interrupts – Bus cycle – Addressing modes – Typical configuration of 8086 system – Overview of Instruction set.

UNIT II
80286 MICROPROCESSOR **8**
Functional block diagram - Modes of operation – Real and protected mode – Memory management and protection features.

UNIT III

80386, 80486 PROCESSORS **8**

80386: Functional block diagram - Programming model - Addressing modes and instruction set overview – Address translation - Modes of operation - 80486 processor - Functional block diagram - Comparison of 80386 and 80486 processors.

UNIT IV

PENTIUM MICROPROCESSOR **6**

Introduction – Architecture – Special Pentium registers – Memory management.

UNIT V

PIC MICROCONTROLLER **15**

Architecture – Memory structure – Register File – Addressing modes – Interrupts – Timers: Modes of operation PIC PERIPHERAL FUNCTIONS AND SPECIAL FEATURES: PWM output – Analog to Digital converter – UART – Watchdog timer – RESET Alternatives – Power Down mode – I2C Bus operation

TOTAL: 45 PERIODS

TEXTBOOKS:

[1] Barry B Brey, "The Intel Microprocessor 8086/8088, 80186/80188, 80286, 80386, 80486 Pentium and Pentium processor, Pentium II, III, 4, Prentice Hall of India, New Delhi, 2005.
[2] Douglas V Hall, "Microprocessors and Interfacing: Programming and Hardware", McGraw Hill, New Delhi, 2005.
[3] John B Peatman, “Design with PIC Microcontroller, McGraw Hill, Singapore, 1st Reprint, 2001

REFERENCES:

[1] Mohammed Rafiquzzaman, "Microprocessors and microcomputer-based system design", CRC Press, 2005.
[2] Walter A Triebel, Avtar Singh. “The 8088 and 8086 microprocessors Programming Interfacing Software, Hardware and Applications”, Pearson Education,2009
[3] Myke Pred ko, “Programming and Customising the PIC Microcontroller, “McGraw Hill, USA, 1998

EMBEDDED SYSTEM DESIGN

UNIT -I

Introduction to Embedded System Design, Categories of ES, Overview of Embedded System Architecture, Recent Trends in Embedded Systems, Hardware Architecture of Embedded System, Real-time Embedded Systems and Robots, Robots and Robotics, Microprocessors and Microcontrollers, Microcontroller or Embedded Controller

UNIT - II

Robotics: Classification of Robots, Degree of freedom, Kinematics; Multidisciplinary approach: Motors-DC motors, Stepper Motors, Servo Motors; Power Transmission-Type of Gears, Gear Assembly, CAM follower, Sensors, Open-loop and Closed-loop Controls, Artificial Intelligence, Architecture of 8051 Microcontroller-Assembly language programming (data types, directives, flag bits, PSW, register banks and Stacks).

UNIT- III

Jump, Loop, and Call instruction, Time delay for various 9051 chip, I/O programming and I/O bit manipulation, Interface of LED module, Key Scanning

Case studies to design sensor (LDR), Motor Driver (H-bridge) module

UNIT-IV

Case studies of Closed-loop control and a learning robot- Hardware requirement, Locomotion and obstruction sensing, Learning process, Picking another set of points

Addressing Modes of 8051,Power Management of 8051, Timer Interrupts, Multiplexed displays

Case studies to Design an Intelligent Clock. [T1, R1]

TEXTBOOKS:

[1] Subrata Ghoshal, "Embedded Systems & Robots", Cengage Learning

REFERENCE BOOKS:

[1] M.A. Mazidi, J.G. Mazidi, R.D. Mckinlay, "8051 Microcontroller and Embedded Systems", Pearson.
[2] Dr. K.V.K. Prasad, "Embedded/Real-Time Systems: Concepts Design & Programming", Dreamtech