SRI VENKATESWARA COLLEGE OF ENGINEERING
(An Autonomous Institution, Affiliated to Anna University, Chennai)
SRIPERUMBUDUR TK - 602 117
Regulations – 2018

M.E. Mechatronics Engineering

Choice Based Credit System (CBCS)

Curriculum and Syllabi

SEMESTER I

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C	Prerequisites	Fixed /Movable
THEORY										
1.	MS 18101	Concepts in Electronics Engineering *	FC	4	2	0	2	3	NIL	F
	MS 18102	Concepts in Mechanisms and Machines**	FC	4	3	1	0		NIL	F
2.	MA 18182	Advanced Numerical Methods	FC	4	3	1	0	4	NIL	F
3.	MS 18103	Sensors and Actuators	PC	5	3	0	2	4	NIL	F
4.	MS 18104	Control Systems Design	PC	5	3	0	2	4	NIL	F
5.	MS 18105	Drives and Actuators for Automation	PC	5	3	0	2	4	NIL	F
6.		Elective –I	PE	3	3	0	0	3	NIL	F
PRACTICAL										
7.	MS 18111	Modeling Simulation and Analysis Laboratory	PC	3	0	0	3	2	NIL	F
8.	MS 18112	Technical seminar	EEC	1	1	0	0	1	NIL	F
TOTAL				**34**	**21**	**2**	**11**	**25**	-	-

*** For Mechanical stream students and **For Circuit stream students**

SEMESTER II

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C	Prerequisites	Fixed/ Movable
THEORY										
1.	MS 18201	Machine Design and Product Development	FC	5	3	2	0	4	NIL	M
2.	MS 18202	Mechatronics System design	FC	5	3	0	2	4	NIL	F
3.	MS 18203	Machine Vision	PC	3	3	0	0	3	NIL	F
4.	MS 18204	Micro Controller and PLC	PC	3	3	0	0	3	NIL	F
5.	MS 18205	Industrial Robotics	PE	3	3	0	0	3	NIL	M
6.		Elective - II	PE	3	3	0	0	3	NIL	M
7.	MC 18081	Mandatory Course	MC	2	2	0	0	2	NIL	F
PRACTICAL										
8.	MS 18211	Micro Controller Laboratory	PC	3	0	0	3	2	NIL	F
9.	MS 18212	Machine vision Laboratory	PC	3	0	0	3	2	NIL	F
TOTAL				**30**	**20**	**2**	**8**	**26**	-	-

SEMESTER III

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C	Prerequisites	Fixed/ Movable
THEORY										
1.		Elective - III	PC	3	3	0	0	3	NIL	F
2.		Elective - IV	PE	3	3	0	0	3	NIL	F
3.		Elective - V	PE	3	3	0	0	3	NIL	F
PRACTICAL										
4		Project work (Phase- I)	EEC	12	0	0	12	6	NIL	F
TOTAL				**21**	**9**	**0**	**12**	**15**	**-**	-

SEMESTER IV

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C	Prerequisites	Fixed/Movable
PRACTICAL										
1		Project work(Phase-II)	EEC	24	0	0	24	12	MS 18311	F
TOTAL				**24**	**0**	**0**	**24**	**12**	**-**	-

PROFESSIONAL ELECTIVES
(PE) ELECTIVE - I

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C	Prerequisites	Fixed/Movable
1	MS 18001	Non Linear System Dynamics	PE	3	3	0	0	3	NIL	F
2	MS 18002	Computer Aided Inspection	PE	3	3	0	0	3	NIL	F
3	MS 18003	Digital Manufacturing	PE	3	3	0	0	3	NIL	F
4	MS 18004	Modeling and Finite element Analysis of Electromechanical Systems	PE	3	3	0	0	3	NIL	F
5	MS 18005	Computer Aided Production of Automated parts	PE	3	3	0	0	3	NIL	F

ELECTIVE- II

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C	Prerequisites	Fixed/ Movable
1	CD 18014	Product Life Cycle Management	PE	3	3	0	0	3	NIL	M
2	MS 18006	Micro And Nano Systems	PE	3	3	0	0	3	NIL	M
3	MS 18007	Embedded Systems with Advanced Microcontrollers	PE	3	3	0	0	3	NIL	M
4	MS 18008	Human Machine Interface	PE	3	3	0	0	3	NIL	M
5	MS 18009	Machine Learning	PE	3	3	0	0	3	MS18203	M
6	MS 18010	Communication Protocols	PE	3	3	0	0	3	MS18203	M

ELECTIVE – III, IV & V

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C	Prerequisites	Fixed/Movable
1	MS 18011	Industrial Safety	PE	3	3	0	0	3	NIL	F
2	MS 18012	Industrial Automation for Mechatronics	PE	3	3	0	0	3	NIL	F
3	MS 18013	Advanced Control Systems	PE	3	3	0	0	3	MS18105	F
4	MS 18014	Internet of Things	PE	3	3	0	0	3	MS18011	F
5	MS 18015	Bio Mechatronics	PE	3	3	0	0	3	NIL	F
6	MS 18016	Advanced Computer Vision	PE	3	3	0	0	3	MS18203	F
7	MS 18017	Onboard Computers Programming	PE	3	3	0	0	3	NIL	F
8	MS 18018	Automotive Electronics	PE	3	3	0	0	3	NIL	F
9	MS 18019	Marine Electronics	PE	3	3	0	0	3	NIL	F
10	MS 18020	Avionics for Mechatronics Engineers	PE	3	3	0	0	3	NIL	F
11	MS 18021	Medical Mechatronics	PE	3	3	0	0	3	NIL	F
12	MS 18022	Green Manufacturing	PE	3	3	0	0	3	NIL	F
13	MS 18023	Solid State Drives	PE	3	3	0	0	3	NIL	F
14	MS 18024	Intelligent Product Design and Manufacturing	PE	3	3	0	0	3	NIL	F
15	MS 18025	Analytical Robotics	PE	3	3	0	0	3	MS18205	F

MS 18101	CONCEPTS IN ELECTRONICS ENGINEERING	L	T	P	C
		2	0	2	3

OBJECTIVES :

To understand the basics and working principles of electronic components and their applications.

UNIT I ELECTRONIC COMPONENTS AND DEVICES 7

Resistors, capacitors, inductors, transformers – types and properties - junction diodes, zener diodes, transistors and thyristors - types-operating mechanism-characteristics and applications. LED – characteristics and applications

UNIT II OPERATIONAL AMPLIFIERS AND APPLICATIONS 7

Operational amplifiers – principles, specifications, characteristics and applications- arithmetic operations, integrator, differentiator, comparator, schmitt trigger, instrumentation amplifiers, active filters, linear rectifiers, waveform generators, A/D converters, feedback and power amplifiers, sine wave oscillators

UNIT III DIGITAL ELECTRONICS 6

Number systems – Logic gates – Boolean algebra – Simplification of Boolean functions– Study of Combinational Logic Circuits-Full Adder, Code Converters, Multiplexers, Encoder and Decoders, Study of Sequential Logic Circuits-Flip-flops, Counters, Shift registers – D/A Converters.

UNIT IV MEASURING INSTRUMENTS 5

Rectifiers and Filters - Regulated Power Supply – Switching Power Supplies, Thermal Considerations. Measurement of voltage, current, frequency and power using Multi meters, oscilloscopes, recorders, data loggers, signal sources, counters, analyzers and printers.

UNIT V POWER MANAGEMENT 5

Pulse width modulation and pulse position modulation – batteries–SMPS - sensors, actuators and controllers energy consumption -power optimization of integrated system.

TOTAL : 30 PERIODS

OUTCOMES :

- This course is intended for learning the fundamentals and applications of Electronic Components and Devices.

- The students will learn analog circuits and digital circuits,
- The students will learn about the various testing and measuring instruments.
- Further, students will learn to develop customized electronics components for mechatronics applications.

REFERENCES :

1 Helfrick A.D and Cooper .W. D. " Modern Electronic Instrumentation and Measurements Techniques", Prentice Hall, 2016.
2 Jocob Mill Man, Microelectronics Digital and Analog Circuits & Systems – McGraw-Hill, Edition 2, 2011.
3 Malvino & Leach, Digital Principles &Application, TMH, Seventh edition 2010.
4 Mill Man and Halkias, "Electron Devices and Circuits", McGraw-Hill 2015.
5 Ray & Chaudary, Linear Integrated Circuits, New Age, 2018.

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MS 18101	**Lab Component**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**0**

OBJECTIVES :

To understand the basics and working principles of electronic components and their applications.

LIST OF EXPERIMENTS

1. Study of digital storage oscilloscope.
2. Experimentation with CRO.
3. Design of DC power supplies
4. Design of inverting amplifier and non-inverting amplifiers
5. Design of Instrumentation amplifier.
6. Design of analog filters.
7. Design of combinational circuits and sequential circuits.
8. Design of A/D converters and D/A converters.
9. DC Servo motor driver circuit.
10. Design of stepper motor driver circuit.

TOTAL : 30 PERIODS

OUTCOMES :

Upon Completion of the course:

- The students are able to work with CRO and able to design inverting and non inverting amplifiers
- The students are able to design combinational and sequential circuits
- The students are able to design stepper motor circuit

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. CRO-1
2. DSO-1
3. DC Power supply 5V – 5 No's 12V, 10A - 1 No 24V, 10A or higher - 1 No
4. Function generator-1
5. OP-Amp trainer kit (inverting and non-inverting amplifier module)
6. Analog filters trainer kit
7. Sequential circuit trainer kit
8. Combination circuit trainer kit
9. A/D Converter trainer kit -1 No
10. D/AConverter Trainer kit-1 No
11. Driver Circuit Module for servomotor-1 No
12. Driver Circuit module for stepper motor-1 No
13. Multi-Meter, bread board, and solder machine.
14. Electronic components for power supply (transformer, regulator, diode, capacitors) -5 No's

MS 18102 CONCEPTS IN MECHANISMS AND MACHINES **L T P C**

2 2 0 3

OBJECTIVES :

- To impart knowledge of basic mechanical engineering to the students.

UNIT I MECHANISMS 12

Definition – Machine and Structure – Kinematic link, pair and chain – classification of Kinematic pairs – Constraint& motion - Degrees of freedom – Slider crank – Single and double – Crank rocker mechanisms – Inversions – applications. Kinematic analysis and synthesis of simple mechanisms – Determination of velocity and acceleration of simple mechanisms.

UNIT II FRICTION 12

Types of friction – friction in screw and nuts – pivot and collar – thrust bearings – collar bearing – plate and disc clutches – belt (flat &vee) and rope drives – creep in belts – Jockey pulley – open and crossed belt drives – Ratio of tensions – Effect of centrifugal and initial tension – condition for maximum power transmission.

UNIT III GEARING AND CAMS 12

Gear profile and geometry-nomenclature of spur and helical gears – law of gearing – interference requirement of minimum number of teeth in gears-gear trains-simple and compound gear trains determination of speed and torque in epicyclic gear trains-Cam profile-different types of followers.

UNIT IV VIBRATION 12

Free, forced and damped vibrations of single degree of freedom systems – force transmitted to supports – vibration Isolation – vibration absorption – torsional vibration of shafts – single and multirotor systems – geared shafts – critical speed of shafts.

UNIT V MACHINE TOOLS 12

Machine tool construction-features – operations of lathe, milling machine, drilling machine – Drive system for machine tools – mechanical, hydraulic and electric stepped and variable speeds – spindle speeds and feed drives-linear and reciprocation motion generation.

TOTAL : 60 PERIODS

OUTCOMES :

Upon completion of the course:

- The students will understand the concepts, design, construction and properties of mechanical elements and machines.
- The students will know the concepts of friction, gears and cams
- The students will know the constructional features of machine tools
- The students will know the various drives and motion generation

REFERENCES :

1 Bansal R.K, "Theory of Machines" Laxmi Publications (P) ltd. Fifth Edition, New Delhi. 2015.
2 G.C.Sen and A. Bhattacharya, "Principles of Machine Tools", New Central book Agency, 2010
3 Joseph Edward Shigley, Charles R.Mischke, "Mechanical Engineering Design", Mcgraw Hill International Edition, 2016.
4 Malhotra .D.R. and Gupta .H.C. "The Theory of Machines" SatyaPrakasam, Tech. India Publications, 2000.
5. R.S.Khurmi and Gupta, "Theory of Machines" Eurasia Publishing House Pvt. Ltd. 2012.

MA 18182	ADVANCED NUMERICAL METHODS	L	T	P	C
	(Common to Mechatronics, CAD and Internal Combustion Engineering)	3	1	0	4

OBJECTIVES :

- To impart knowledge on numerical methods that will come in handy to solve numerically the problems that arise in engineering and technology. This will also serve as a precursor for future research.

UNIT I ALGEBRAIC EQUATIONS 12

Systems of linear equations: Gauss Elimination method, pivoting techniques, Thomas algorithm for tridiagonal system –Gauss Seidel, SOR iteration methods - Systems of nonlinear equations: Fixed point iterations, Newton Raphson Method, Graffe's Root squaring method, Eigen value problems-Faddeev – Leverrier Method.

UNIT II ORDINARY DIFFERENTIAL EQUATIONS 12

Runge Kutta Methods for system of IVPs, numerical stability, Adams-Bashforth multistep method shooting method, BVP: Finite difference method, orthogonal collocation method, orthogona collocation with finite element method, Galerkin finite element method.

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UNIT III FINITE DIFFERENCE METHOD FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATION 12

Parabolic equations: explicit and implicit finite difference methods, weighted average approximation - Dirichlet and Neumann conditions – Two dimensional parabolic equations – ADI method; First order hyperbolic equations – method of characteristics, different explicit and implicit methods; numerical stability analysis, method of lines – Wave equation: Explicit scheme- Stability of above schemes.

UNIT IV FINITE DIFFERENCE METHODS FOR ELLIPTIC EQUATIONS 12

Laplace and Poisson's equations in a rectangular region: Five point finite difference schemes, Leibmann's iterative methods, and Dirichlet and Neumann conditions – Laplace equation in polar coordinates: finite difference schemes – approximation of derivatives near a curved boundary while using a square mesh.

UNIT V FINITE ELEMENT METHOD 12

Partial differential equations – Finite element method - orthogonal collocation method, orthogonal collocation with finite element method, Galerkin finite element method-one parameter.

TOTAL : 60 PERIODS

OUTCOMES :

- It helps the students to get familiarized with the linear algebra and graph theory which are necessary to solve numerically the problems that arise in engineering.
- Develops the skill to solve linear system of equations using direct and iterative methods and also acquire the knowledge of solving Eigen Value problems.
- Acquire the skill to solve ordinary differential equations using single step, multistep methods and finite element method.
- Acquire the skill to solve graph using different algorithm.

REFERENCES :

1. Saumyen Guha and Rajesh Srivastava, "Numerical methods for Engineering and Science", Oxford Higher Education, New Delhi, 2010
2. Gupta S.K., "Numerical Methods for Engineers", 3rd Edition Reprint, New Age Publishers, 2018
3. Burden, R.L., and Faires, J.D., "Numerical Analysis – Theory and Applications", 9th Edition – Revised, Cengage Learning, India Edition, New Delhi, 2010
4. Jain M. K, Iyengar S. R, Kanchi M. B., Jain R. K, "Computational Methods for Partial Differential Equations",2nd Edition, New Age Publishers, 2012
   Morton K.W. and Mayers D.F., "Numerical solution of partial differential equations", Cambridge University press, Cambridge, 2014.

MS 18103 SENSORS AND ACTUATORS **L T P C**

3 0 2 4

OBJECTIVES :

To learn the various types of sensors, transducers and signal conditioning circuits for Mechatronics system development

UNIT I INTRODUCTION 7

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 MOTION, PROXIMITY AND RANGING SENSORS 10

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

UNIT III FORCE, MAGNETIC AND HEADING SENSORS 8

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

UNIT IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS 8

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric, Temperature – IC, Thermistor, RTD, Thermocouple.

UNIT V SIGNAL CONDITIONING 12

Need for Signal Conditioning – DC and AC Signal conditioning – Filter and Isolation Circuits – Operational Amplifier Specifications, Characteristics and Circuits – Voltage, Current and Power Amplifiers – Transmitting Circuits – Fundamentals of Data Acquisition System.

TOTAL : L=45+P(30)=75 PERIODS

OUTCOMES :

Upon completion of the course:

- The students will know the principles of motion, proximity and ranging, sensors and able to study the characteristics of it.
- The students will know the principles of force, magnetic and heading sensors and able to study the characteristics of it.
- The students will know the principles of optical, pressure and temperature sensors and able to study the characteristics of it.
- The students will know the principles of signal conditioning and transducers.

REFERENCES :

1. Bolton W., "Mechatronics", Thomson Press, 4th Edition 2010.
2. Bradley D.A., and Dawson, Burd and Loader, "Mechatronics", Thomson Press India Ltd., 2004
3. Ernest O. Doeblin, "Measurement system, Application and Design", Tata McGraw Hill Publishing Company Ltd., Fiftieth Edition, 2004
4. Patranabis D., "Sensor and Actuators", Prentice Hall of India (Pvt) Ltd., 2010.
5. Renganathan S., "Transducer Engineering", Allied Publishers (P) Ltd., 2003

MS 18104	**Lab Component**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**0**

OBJECTIVES :

To learn and gather the practical experience on sensors and its measurements for mechatronics system development.

LIST OF EXPERIMENTS

1. Study on various kinds of sensors and its characteristics.
2. Study on signal conditioning units.
3. Experimentation on voltage, current, power, and frequency measurement.
4. Strain gage, load cell and torque transducer characterization & applications – data acquisition & instrument control.
5. Experimentation with tactile sensor for force and touch detection.
6. LVDT, acoustics ranging, Hall Effect sensor and ultrasonic distance measurement applications.
7. Temperature & Optical transducers Characterization – Data Acquisition & Instrument Control.
8. Study on eddy current sensor for thickness measurement.
9. Study on ultrasonic sensors for material fault diagnosis.
10. Experimentation on laser sensor for non-contact dimension measurement.
11. Study on Experimentation with Gyroscope, Accelerometer and magnetometer.
12. Experimentation with speed and position measurement using encoders.

TOTAL : 30 PERIODS

OUTCOMES :

Upon Completion of the course,

- The students will be able to do sensor selection for the motion,proximity and ranging system development based on the laboratory experience.
- The students will be able to do suitable sensor selection for the force, magnetic and heading system based on the laboratory experience.
- The students will be able to,do suitable sensor selection for the optical, pressure and temperature system based on the laboratory experience.
- The students will be able to, do suitable sensor selection for non contact measurements

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Temperature Sensors (RTD, Thermocouple, Thermistor, & IC Temperature sensor)- 1 in Each
2. Optical sensors (Photovoltaic, Photo Conductive, Photo Transistor, & Photo Diode) - 1 in Each
3. Strain Gauge Trainer – 1 No's
4. Load cell Trainer – 1 No's
5. Torque Transducer Trainer – 1 No's
6. LVDT, Acoustics Ranging and Hall Effect Trainer – 1 No's on Each
7. Pressure sensor, ultrasonic senor Trainer – 1 No's on Each
8. Proximity sensor (Eddy current, optical, inductive, capacitive principle) – 1 No's on Each
9. Gyroscope, Accelerometer and Magnetometer Trainer – 1 No's on Each
10. Encoders(Absolute, incremental)– 1 No's on Each
11. Tactile sensor (force and touch) Trainer– 1 No
12. DAQ card – 5 No
13. PC-5.

MS 18104	CONTROL SYSTEMS DESIGN	L	T	P	C
		3	0	2	4

OBJECTIVES :

- To understand dynamics, design and analysis of control systems to meet the desired spécifications

UNIT I SYSTEM REPRESENTATION AND MODELING 9

Introduction and need for Control Systems with examples – Feedback systems – Block Diagram Definition of Process variable, Set-point, Manipulated variable and Final control element with examples -Open loop and Closed loop systems – Transfer Function Model – State Space Model Mathematical Modeling of Mechanical, Electrical, Pneumatic and Hydraulic systems – Block Diagram reduction – Signal flow graph.

UNIT II DESIGN OF FEEDBACK CONTROL SYSTEM 9

Feedback systems – Block Diagram – Definition of process variable, set –point, manipula variable and final control element with examples – characteristics of on –off,P, PI, PD and P controllers – Implementation issues of PID controller – Modified PID controller – Tuning controller.

UNIT III TIME AND FREQUENCY DOMAIN ANALYSIS 9

Time response of First & Second order systems – Time domain specifications - steady state err and error constants – Routh Hurwitz criterion – Root locus – Bode Plot – Polar Plot – Nyq stability criterion – Stability analysis – Experimental determination of Transfer Functions.

UNIT IV CONTROL SYSTEM DESIGN 9

Root locus approach to control system design – lead, lag, lag-lead compensation using time dom analysis. control system design using frequency domain analysis - lead, lag, lag-lead compensat using frequency domain analysis– P, PI, and PID controllers – tuning methods and rule.

UNIT V CONTROL AND ANALYSIS OF SERVO MOTOR 9

Servo motor – Mathematical Modelling of Servo Motor – Analysis of Servo motor system using Routh Hurwitz criterion, Root locus, Bode Plot, Polar Plot and stability analysis – Implementation of P, PI , PD and PID controllers for servo motor and analysis -bumpless control transfer between manual and PID Control- anti-windup control using PID Controller.

TOTAL : L=45+P(30)=75 PERIODS

OUTCOMES :

Upon successful completion of the course:

- The students will know the various types of control systems and their modeling.
- The students are able to do time domain analysis
- The students will know the approaches to the control system design
- The students will know the various control techniques and analysis of servo motor

REFERENCES :

1. NagoorKani, "Control Systems", RBA Publications (P) Ltd., 2014.
2. B.C. Kuo, "Automatic Control Systems", Prentice Hall of India Pvt. Ltd., New Delhi, 2014.
3. I.J.Nagrath and Gopal, "Control System Engineering", New Age international (P) Ltd., 2017.
4. K.Ogata, "Modern Controls Engineering", Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
5. M. Nakamura .S.Gata&N.Kyura, "Mechatronic Servo System Control", Springer. 2004

MS 18105	**Lab Component**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**0**

OBJECTIVES :

- To study the classical concepts behind the control system design for various systems in both time and frequency domain.

LIST OF EXPERIMENTS

1. Series, cascaded, feedback system modeling.
2. State space modeling
3. Study on time domain representation and specifications
4. Study on Routh-Hurwitz criterion and Root locus techniques
5. Study on frequency domain representation and specifications
6. Bode plot and polar plot technique
7. Study on tuning and finding of controller gain using combination of PID controllers.
8. Study on velocity vs. torque control.
9. Study on position vs. torque control.
10. Study on various motion control systems

TOTAL : 30 PERIODS

OUTCOMES :

Upon Completion of the course:

- The students will be familiarized with control system design for various systems.
- The students will be familiarized with Bode plot and polar plot technique
- The students will be familiarized with velocity and toque, position and torque controls
- The students will be familiarized with various motion control systems.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. MATLAB/ SCILAB – Control System Tool Box with - 15 No's
2. Motion control PLC with motor, load setup and feedback setup-1

MS 18105 DRIVES AND ACTUATORS FOR AUTOMATION **L T P C**

3 0 2 3

OBJECTIVES :

- To impart knowledge in the area of hydraulic, pneumatic electric actuators and their control.

UNIT I FLUID POWER SYSTEM GENERATION AND ACTUATORS 9

Need for automation, Classification of drives-hydraulic, pneumatic and electric –comparison – ISO symbols for their elements, Selection Criteria. Generating Elements-Hydraulic pumps and motor gears, vane, piston pumps-motors-selection and specification -Drive characteristics – Utilizing Elements- Linear actuator – Types, mounting details, cushioning – power packs – accumulators.

UNIT II CONTROL AND REGULATION ELEMENTS 9

Control and regulation Elements—Direction, flow and pressure control valves--Methods of actuation, types, sizing of ports. Spool valves-operating characteristics-electro hydraulic servo valves-Different types-characteristics and performance

UNIT III CIRCUIT DESIGN FOR HYDRAULIC AND PNEUMATICS 9

Typical Design methods – sequencing circuits design -combinational logic circuit design-cascade method - Karnaugh map method-Electrical control of pneumatic and hydraulic circuits-use of relays, timers, counters, Programmable logic control of Hydraulics Pneumatics circuits, PLC ladder diagram for various circuits, motion controllers, use of field busses in circuits.

UNIT IV ELECTRICAL ACTUATORS 9

D.C Motor-Working principle, classification, characteristics, Merits and Demerits, Applications-AC Motor-Working principle, Types, Speed torque characteristics, Merits and demerits, Applications Stepper motor-principle ,classification, construction. Piezo electric actuators – Linear actuators Hybrid actuators – Applications.

UNIT V ELECTRICAL DRIVE CIRCUITS 9

DC Motors - Speed, direction and position control using H-bridge under PWM mode**.** Control of AC motor drives – Need for V/ F drives – Energy saving AC drives. – Stepper Motor – Drive circuits for speed and position control, BLDC motor – Controller – Switched reluctance motor.

TOTAL : L=45+P(30)=75 PERIODS

OUTCOMES :

Upon completion of the course:

- The students will be familiar with basic concepts of hydraulic, pneumatic drives
- The students will be familiar with basic concepts of electric drives
- The students will be familiar with various controlling elements
- The students are able to design the hydraulic and pneumatic circuits using ladder diagram.

REFERENCES :

1. Antony Esposito, "Fluid Power Systems and Control", Prentice-Hall, 2014.
2. Peter Rohner," Fluid Power Logic Circuit Design", The Macmillan Press Ltd., London, 1979.
3. W.Bolton, "Mechatronics, Electronic Control Systems in Mechanical and Electrical Engineering", Pearson Education, 4th Edition 2010.
4. GopalK.Dubey, "Fundamentals of Electrical Drives",Narosa Publications, 2015.

MS 18106

Lab Component

L	T	P	C
0	0	2	0

OBJECTIVES :

To study the functional aspects of different pneumatic and hydraulic Components and its use in circuits and also to train the student in designing different pneumatic and hydraulic circuits for different applications.

LIST OF EXPERIMENTS

Hydraulic and Pneumatic Drives

1. Simulation of speed control circuits in a hydraulic trainer.
2. Simulation of hydraulic circuits in a hydraulic trainer.
3. Simulation of single and double acting cylinder circuits using different directional control values.
4. One shot and regenerative pneumatic circuits.
5. Simulation of ladder logic program.
6. Sequencing of pneumatic circuits.
7. Simulation of logic and electro-pneumatic circuits.
8. Simulation of electro pneumatic sequencing circuits.
9. Simulation of PLC based electro pneumatic sequencing circuits.
10. To design and connect the circuits for the given problem (case study).

Electrical Drives

1. Speed and torque characterization and control of DC motors.
2. Speed and Torque characterization and control of AC motors.
3. Speed and torque characterization and sequence control of stepper motor
4. Electrical energy planning and management of autonomous system.
5. Closed loop position and velocity control of a DC servo motor.
6. Tuning of P, PI and PID controller using simulation software.

TOTAL : 30 PERIODS

OUTCOMES :

Upon Completion of the course, the students will be able to:

- . Simulate the speed control, single and double acting cylinder and its circuits
- Simulate the ladder logic diagram
- Simulate electro pneumatic circuits based on PLC
- Be familiarized with speed and torque characteristics of AC and DC motors

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Hydraulic Trainer with Pump and Valves
2. Pneumatic Trainer with Compressor and Valves
3. Electro Pneumatic Trainer
4. Electro Hydraulic Trainer
5. Hydraulics and Pneumatics Simulation Software
6. System Controlled DC Motor with Feedback Setup
7. System Controlled AC Motor with Feedback Setup
8. System Controlled Stepper Motor Setup
9. MATLAB/SCILAB/ any other Software for Controller Tuning.
10. PC-7

MS 18111	**MODELING SIMULATION AND ANALYSIS LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**2**

OBJECTIVES :

- To learn the drawing, modeling, simulation and assembly of machines and its components.

LIST OF EXPERIMENTS

1. 2D modeling and 3D modeling of components such as
   - Bearing.
   - Couplings.
   - Ball screw.
   - Gears.
   - Sheet metal components
   - Jigs, fixtures and die.
   - Structures and frames

2. Modeling and simulation of mechanism
   - 4 Bar chain
   - Slider crank,
   - Ball and screw,
   - Rack and pinion.
   - Belt and chain drives.
   - Quick return and elliptical trammel.

3. Assembly and simulation of system
   - Serial manipulators
   - Automotive systems
   - Manufacturing machineries

4. Analysis of mechanical components
   - Introduction to FEA packages.
   - Machine elements (link, gear, joints) under static loads and dynamic loads.

TOTAL : 60 PERIODS

OUTCOMES :

Upon Completion of the course, the students will be able to:

- Model various mechanical components.
- Model and simulate. various mechanisms
- Assemble and simulate varius systems
- To do FEA analysis of varius machine elements

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

- PC with Solidworks & FEA packages -15 No's

MS 18112	**TECHNICAL SEMINAR**	**L**	**T**	**P**	**C**
		1	**0**	**0**	**1**

OBJECTIVES:

- To encourage the Students to self study advanced Mechatronics developments
- To prepare and present technical reports.
- To encourage the Students to use various teaching aids such as over head projectors, Power point presentation and Demonstrative models.
- Handle questions with confidence after presentation

METHOD OF EVALUATION

During the Seminar Session each Student is expected to prepare and present a topic on Mechatronics, for duration of about 15 To 20 minutes. In a session of a period per week, Students are expected to present the seminar. Each student is expected to present at least once during the semester and the student is evaluated based on that. At the end of the semester, He / Shewill submit a report on His / Her topic of seminar and marks are given based on the report. Evaluation is 100% Internal.

TOTAL : 15 PERIODS

OUTCOMES:

The students will gain the

- Ability To Review, Prepare And Present Technological Developments
- Ability to utilize teaching aids
- Ability to prepare technical report
- Ability To Face The Placement Interviews

MR 18201	MACHINE DESIGN AND PRODUCT DEVELOPMENT	L	T	P	C
		3	2	0	4

OBJECTIVES :

- To impart the knowledge in the design of machine elements and product design used in mechatronics systems.

UNIT I INTRODUCTION 12

Introduction to national and international symbols- Engineering materials and their physical properties and applied to design- Selection of materials- selection for new design and material considerations-Factors of safety in design- Dimensioning and detailing-Fitness and tolerance-Surface finish and machining symbols –Product development- Elementary concept of functional, aesthetic and form design- Principles of design optimization- Future trends-CAD.

UNIT II STATIC AND VARIABLE STRESSES 12

Static and variable loading in machine elements- Stress concentration- Goodmen and soderberg method of design- Design of power transmission shafts- Subjected to torsion, bending and axial loads- Design of close coiled helical spring -Design of couplings- Muff, Flange, Bushed and pin types.

UNIT III DESIGN OF TRANSMISSION ELEMENTS 12

Design of gears - Selection and specification- Principle of hydrodynamic lubrication – Design of journal bearings – Selection and specification of anti-friction bearings – Life rating of roller bearings.

UNIT IV PRODUCT DESIGN AND DEVELOPMENT 12

Quality function development (QFD) -product design and specification, design for manufacturability (DFM), design for assembly and disassembly, human factors in design ergonomics, creativity in design, TRIZ- axiomatic design.

UNIT V FINITE ELEMENT ANALYSIS 12

Basic Concept of FEA -finite element analysis of one dimensional and two dimensional problems-variational formulation of B.V.P. – Ritz Method-Examples related to one-dimensional and two-dimensional problems.

TOTAL : 60 PERIODS

OUTCOMES :

Upon completion of the course:

- The students will know the design concepts and process
- The students will be able to design the various machine elements subjected to steady, and variable stresses
- The students will know the product design concepts
- The students will know the concepts of finite element analysis.

REFERENCES :

1. George E.Dieter, Linda C.Schmidt, "Engineering Design", McGraw-Hill International Edition, 4th Edition, 2013.
2. Jain R.K., "Machine design", Khanna Publishers, Delhi,21st Edition, 2017.
3. Khurmi R.S and Gupta J.K, "A Text Book of Machine Design", Eurasia Publishing House (P) Ltd, New Delhi, 2014.
4. PSG Design data Handbook, Kalaikhathir Publications, CBE 2017.
5. Ramamurthi, V., "Finite Element Method in Machine Design", Narosa Publishing House, 2012.
6. Shigley J.E. "Mechanical Engineering Design", McGraw-Hill Book Co.,Delhi,2016.
7. Spotts N.F. "Design of Machine Elements", Prentice-Hall of India, 8th Edition, 2006.

MS 18202 MECHATRONICS SYSTEM DESIGN **L T P C**

3 0 2 4

OBJECTIVES :

To impart through knowledge in system modeling, system identification and simulation of mechatronics system.

UNIT I INTRODUCTION **7**

Mechatronics system overview – recent advancements – application – key elements – mechatronics system design process.

UNIT II MODELING OF SYSTEM **12**

Need for modeling – systems overview – representation of systems (block diagram, signal flow graphs, transfer function and state space) -Modeling technique (analytical and identification techniques) – direct method- analogue approach – bond graph approach – modeling of electrical, mechanical, thermal, fluid and hybrid systems – system identification methods overview – Least square method.

UNIT III SIMULATION **12**

Simulation fundamentals – simulation life cycle – Monte Carlo simulation – solution for model equations and their interpretations zeroth and first and second order system and its response – scaling – validation – hardware in loop simulation (HIL) - Controller prototyping – simulation systems in software environment.

UNIT IV DESIGN OPTIMIZATION **7**

Optimization – problem formulation - constraints – over view of linear and nonlinear programming techniques – other optimization techniques- optimal design of mechatronics system with case studies.

UNIT V CASE STUDIES ON BUILDING A MECHATRONICS SYSTEM **7**

Modeling and simulation of automotive system - power window, engine timing, building clutch look up - antilock braking system ABS and automatic transmission controller -modeling of stewart platform with actuators.

TOTAL : L=45+P(30)=75 PERIODS

OUTCOMES :

Upon completion of the course:

- The students will gain knowledge in the basic system modeling.
- The students will be able to use the modeling technique for the mechatronics system design
- The students will be able to do the simulation of mechatronics system
- The students will be able to do the design optimization for mechatronics systems developments.

REFERENCES :

1. Bolton, "Mechatronics – Electronic Control Systems in Mechanical and Electrical Engineering", Addison Wesley Longman Ltd., 4th Edition, 2010.
2. Bradley, D. Dawson, N.C.Burd and A.J. Loader, "Mechatronics: Electronics in Product and Process", Chapman and Hall, London, 1999.
3. Brian morriss, "Automated Manufacturing Systems – Actuators Controls, Sensors and Robotics", McGraw Hill International Edition, 2000.
4. Devadas Shetty, Richard A.Kolkm, "Mechatronics System Design", PWS Publishing Company, 2009

		L	T	P	C
MS 18202	**Lab Component**				
		0	**0**	**2**	**0**

OBJECTIVES :

- To learn the system design and its integration for modeling the mechatronics systems.

LIST OF EXPERIMENTS

1. Modeling of various types of electrical motors and with gear train.
2. Modeling and simulation of automotive system.
3. Power window.
4. Engine timing.
5. Building clutch look up.
6. Antilock braking system ABS.
7. Automatic transmission controller.
8. Modeling of 6 DOF articulated robot.
9. Modeling of SCARA robot.
10. Modeling and Simulation of mobile robot.
11. Modeling of stewart platform with actuators.
12. Modeling of conveyor and object sorting system using various sensors.
13. Modeling of quadcopter.

TOTAL : 30 PERIODS

OUTCOMES :

Upon Completion of the course,

- The students will acquire the hands on experience in design of mechatronics system
- The students will acquire the hands on experience modeling of robots
- The students will acquire the hands on experience in modeling of mechatronics system
- The students will acquire the hands on experience in simulation of mechatronics system.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Adam's Software and MATLAB software packages are to be used to carry out the listed experiments.

MS 18203	MACHINE VISION	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To impart knowledge on imaging machine vision and its applications.

UNIT I INTRODUCTION 8

Human vision – Machine vision and Computer vision – Benefits of machine vision – Block diagram and function of machine vision system implementation of industrial machine vision system – Physics of Light – Interactions of light – Refraction at a spherical surface – Thin Lens Equation

UNIT II IMAGE ACQUISITION 10

Scene constraints – Lighting parameters – Lighting sources, Selection – Lighting Techniques – Types and Selection – Machine Vision Lenses and Optical Filters, Specifications and Selection– Imaging Sensors – CCD and CMOS, Specifications – Interface Architectures – Analog and Digital Cameras – Digital Camera Interfaces – Camera Computer Interfaces, Specifications and Selection – Geometrical Image formation models – Camera Calibration

UNIT III IMAGE PROCESSING 12

Machine Vision Software – Fundamentals of Digital Image – Image Acquisition Modes – Image Processing in Spatial and Frequency Domain – Point Operation, Thresholding, Grayscale Stretching – Neighborhood Operations, Image Smoothing and Sharpening – Edge Detection – Binary Morphology – Colour image processing.

UNIT IV IMAGE ANALYSIS 6

Feature extraction – Region Features, Shape and Size features – Texture Analysis – Template Matching and Classification – 3D Machine Vision Techniques – Decision Making.

UNIT V MACHINE VISION APPLICATIONS 9

Machine vision applications in manufacturing, electronics, printing, pharmaceutical, textile, applications in non-visible spectrum, metrology and gauging, OCR and OCV, vision guided robotics – Field and Service Applications – Agricultural, and Bio medical field, augmented reality, surveillance, bio-metrics.

TOTAL : 45 PERIODS

OUTCOMES :

Upon completion of the course :

- The students will acquire knowledge in machine vision systems
- The students will acquire knowledge in image acquisition systems
- The students will be able to do the image analysis
- The students will acquire knowledge in machine vision applications

REFERENCES :

1. Alexander Hornberg, "Handbook of Machine Vision", Wiley-VCH, USA, 2017
2. EmanueleTrucco, Alessandro Verri, "Introductory Techniques For 3D Computer Vision", First Edition, 1998
3. Eugene Hecht, A.R. Ganesan "Optics", Fourth Edition Pearson New Intl. Edition, 2014
4. Rafael C.Gonzales, Richard.E.Woods, "Digital Image Processing Publishers", Fourth Edition Pearson, 2008.

MS 18204	MICRO CONTROLLER AND PLC	L	T	P	C
		3	0	0	3

OBJECTIVES :

This course is intended for learning the Introduction and Architecture of Microcontroller, Fundamentals of Assembly language Programming, Programming of Microcontroller and Interfacing of Microcontroller. This course is also gives the ideas of Fundamentals. Architecture and Operations of programmable logic controller, Problem solving using logic ladder diagrams and communication in PLCs.

UNIT I INTRODUCTION TO MICRO CONTROLLER 9

Microprocessors and Microcontrollers – CISC and RISC - Fundamentals of Assembly language Programming – Instruction to Assembler – C Programming for Microcontrollers – Compiler and IDE – Introduction to Embedded systems - Architecture 8051 family -PIC 18FXXX – family – Memory organization

UNIT II PROGRAMMING OF 8051 MICROCONTROLLER 9

Instruction set – Addressing modes – I/O Programming-Timer/Counter - Interrupts – Serial communication of 8051.

UNIT III PROGRAMMING OF PIC18FXXX MICROCONTROLLER 9

Instruction set – Addressing modes – I/O Programming-Timer/Counter - Interrupts – Serial communication, CCP, ECCP PWM programming of PIC18FXXX.

UNIT IV PERIPHERAL INTERFACING 9

Interfacing of Relays, Memory, key board, Displays – Alphanumeric and Graphic, RTC, ADCand DAC, Stepper motors and DC Motors, I^2C, SPI with 8051 and PIC family

UNIT V PLC PROGRAMMING 9

Fundamentals of programmable logic controller – Functions of PLCs – PLC operations – Evaluation of the modern PLC – Memory– Selection of PLC – Features of PLC – Architecture– Basics of PLC programming – Developing Fundamental wiring diagrams – Problem solving using logic ladder diagrams – communication in PLCs – Programming Timers – Programming counters – Data Handling**.**

TOTAL : 45 PERIODS

OUTCOMES :

Upon completion of the course:

- The students are able to apply the microcontroller & PLC concepts in various mechatronics applications.
- Students are able to do 8051 microcontroller programming
- Students will gain knowledge in peripheral interfacing
- Students are able to do PLC programming

REFERENCES :

1. Frank D. Petro Zella, "Programmable logic controller" McGraw – Hill Publications, 2016
2. James W. Stewart, "The 8051 Micro controller hardware, software and interfacing, regents Prentice Hall, 2003.
3. John B. Peatman, "PIC programming", McGraw Hill International, USA, 2005.
4. John B. Peatman, "Design with Micro controllers", McGraw Hill International, USA, 2005.
5. Kenneth J. Aylala, "The 8051 Micro controller, the Architecture and Programming applications",2003.
6. Muhammad Ali Mazidi and Janice GillispicMazdi, "The 8051 Microcontroller and Embedded Systems" Pearson Education, Inc 2006.

MS 18205	INDUSTRIAL ROBOTICS	L	T	P	C
		3	0	0	3

OBJECTIVES :

To teach students the basics of robotics, construction features, sensor applications, robot cell design, robot programming and application of artificial intelligence and expert systems in robotics.

UNIT I INTRODUCTION AND ROBOT KINEMATICS 10

Definition need and scope of Industrial robots – Robot anatomy – Work volume – Precision movement – End effectors – Sensors.Robot Kinematics – Direct and inverse kinematics – Robot trajectories – Control of robot manipulators – Robot dynamics – Methods for orientation and location of objects.

UNIT II ROBOT DRIVES AND CONTROL 9

Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers.

UNIT III ROBOT SENSORS 9

Transducers and Sensors – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Representation - Image Grabbing –Image processing and analysis – Edge Enhancement – Contrast Stretching – Band Rationing - Image segmentation – Pattern recognition – Training of vision system.

UNIT IV ROBOT CELL DESIGN AND APPLICATION 9

Robot work cell design and control – Safety in Robotics – Robot cell layouts – Multiple Robots and machine interference – Robot cycle time analysis. Industrial application of robots.

UNIT V ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS 8

Methods of Robot Programming – Characteristics of task level languages lead through programming methods – Motion interpolation. Artificial intelligence – Basics – Goals of artificial intelligence – AI techniques – problem representation in AI – Problem reduction and solution techniques - Application of AI and KBES in Robots.

TOTAL : 45 PERIODS

OUTCOMES :

Upon completion of the course the student will be able to:

- Design robots and robotic work cells
- Write program for controlling the robots.
- Utlize artificial intelligence for mechatronics systems
- Utlize expert systems in robotics.

REFERENCES :

1. Deb, S.R." Robotics Technology and Flexible Automation", Tata Mc Graw-Hill, 2010.
2. Groover,M.P., Weis,M., Nagel,R.N. and Odrey,N.G., "Industrial Robotics -Technology, Programming and Applications",Tata Mc Graw-Hill,(I)., 2012.
3. Jordanides,T. and Torby,B.J., "Expert Systems and Robotics" , Springer –Verlag, New York, May 1991.
4. K.S.Fu, Gonzalez, R.C. and Lee, C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill, 2008.
5. Klafter,R.D., Chmielewski, T.A. and Negin,M., "Robotics Engineering – An Integrated Approach", Prentice-Hall of India Pvt. Ltd., 1989.
6. Koren,Y., "Robotics for Engineers", McGraw-Hill, 1987.
7. Kozyrey, Yu. "Industrial Robots", MIR Publishers Moscow, 1985

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MC18081	**RESEARCH METHODOLOGY AND IPR**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

OBJECTIVES:

- To impart knowledge on formulation of research problem, research methodology, ethics involved in doing research and importance of IPR protection.

UNIT I RESEARCH METHODOLOGY 6

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, Plagiarism, Research ethics

UNIT II RESULTS AND ANALYSIS 6

Importance and scientific methodology in recording results, importance of negative results, different ways of recording, industrial requirement, artifacts versus true results, types of analysis (analytical, objective, subjective), outcome as new idea, hypothesis, concept, theory, model etc.

UNIT III TECHNICAL WRITING 6

Effective technical writing, how to write a manuscript/ responses to reviewers comments, preparation of research article/ research report, Writing a Research Proposal - presentation and assessment by a review committee

UNIT IV INTELLECTUAL PROPERTY RIGHTS 6

Nature of Intellectual Property: Patents, Designs, Trade Mark and Copyright. Process of Patenting and Development: technological research, innovation, patenting & development. Procedure for grants of patents, Patenting under PCT.

UNIT V PATENT RIGTS AND NEW DEVELOPMENTS IN IPR 6

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System.

TOTAL: (L: + T:): 30 PERIODS

OUTCOMES:

At the end of this course, students will be able to

- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understand research problem formulation & Analyze research related information and Follow research ethics
- Correlate the results of any research article with other published results. Write a review article in the field of engineering.
- Appreciate the importance of IPR and protect their intellectual property. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

TEXT BOOKS:

1. Ranjit Kumar, Research Methodology- A step by step guide for beginners, Pearson

Education, Australia, 2005.
2. Ann M. Korner, Guide to Publishing a Scientific paper, Bioscript Press 2004.
3. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

REFERENCES:

1. Kothari, C. R. Research Methodology - Methods and Techniques, New Age International publishers, New Delhi, 2004.
2. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’, Juta & Company, 1996.
3. Robert P. Merges, Peter S. Menell and Mark A. Lemley, “Intellectual Property in New Technological Age”, Aspen Publishers, 2016.
4 Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
5 Mayall , “Industrial Design”, McGraw Hill, 1992.
6 Niebel , “Product Design”, McGraw Hill, 1974.
7 Asimov , “Introduction to Design”, Prentice Hall, 1962.

MS 18211	**MODELING SIMULATION AND ANALYSIS LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**2**

OBJECTIVES :

To introduce and train the students to use microcontroller for actuation and control of speed

LIST OF EXPERIMENTS

1. Assembly language programming and simulation of 8051 in Keil IDE.
2. Alphanumeric and Graphic LCD interfacing using X8051 & PIC Microcontroller.
3. Sensor interfacing with ADC to X8051 & PIC.
4. DAC & RTC interfacing to X8051 & PIC.
5. Timer, Counter and Interrupt program application for X8051 and PIC.
6. Step motor (unipolar & bipolar motor) and PWM servo motor control to interfacing with X8051.
7. UART serial programming in X8051 and PIC.
8. PC Interfacing of stepper motor -Unipolar & Bipolar.
9. Programming of ARM Processor for sensor interface.
10. Programming of ARM Processor for display interface.
11. Stepper motor and Servo motor control using ARM processor.
12. Serial communication of ARM processor with computation platform.
13. Programming on single board computers for sensor and actuator interface.
14. Programming on communication and control between single board computers for machine to machine communication.

TOTAL : 60 PERIODS

OUTCOMES :

Upon Completion of the course the students will be able:

- To use microcontroller and other processor to control different motors like DC motor, stepper motor, servo motor etc.,
- To do assembly language programming and simulation of 8051.
- To do programming using ARM processor
- To do programming on single board computers for sensor nd actuator interface

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. 8051 Microcontroller Trainer Kit with Software-3 No's
2. PIC Trainer Kit with Software -3 No's
3. ARM 7 Trainer Kit with Software -3 No's
4. Single Board Computer Evaluation Board with Software -3 No's
5. Computers-12 No's
6. ADC interface-3
7. Servomotor – 3 no's
8. Stepper motor -3 no's

MS 18212	**MACHINE VISION LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**2**

OBJECTIVES :

To gather the practical exposure on machine vision elements, lighting technique, processing software and algorithms

LIST OF EXPERIMENTS

1. Study on different kinds of vision sensors.
2. Study on lighting techniques for machine vision
3. Study on Design of Machine Vision System.
4. Experimentation on image acquisition towards the computation platform.
5. Pre-processing techniques in image processing
6. Edge detection and region of interest extraction.
7. Experimentation with image processing algorithm for feature extraction.
8. Experimentation with pattern recognition.
9. Vision based pallet inspection.
10. Vision based Gear parameter measurement.
11. Vision based classification of objects.

TOTAL : 60 PERIODS

OUTCOMES :

Upon Completion of the course:

- The students will acquire the hands on experience in machine vision techniques.
- The students will acquire knowledge in design of machine vision system
- The students will be able to do experimentation with image processing
- The students will acquire knowledge in vision based inspection

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. CMOS Camera (USB/Ethernet)- 1 No
2. CCD Camera (USB/Ethernet)-1 No
3. Standard Boom Stand(Bench top setup) - 2 No's
4. Extension Tube (5mm to 50mm) - 2 No's
5. Lenses (between 3mm to 50mm focal length)-2 No's
6. Tele-centric lens - 1 No
7. Lighting (Coaxial, ring lighting, Diffused, backlighting) - 1 No. Each.
8. Machine vision software - 2 No's
9. PC-2 No's

MS 18001	NON LINEAR SYSTEM DYNAMIICS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To impart through knowledge in basic and advance multi body mechanical system dynamics and its mathematical preliminaries.

UNIT I INTRODUCTION TO DYNAMICS 9

Particle Mechanics-Rigid Body Mechanics-Deformable Bodies-Constrained Motion- Kinematics-Rotation-Translation- Velocity- Acceleration Equations –Mechanics of Deformable Bodies-Floating Frame Reference Formulation –Inertia- Generalized Forces-Equation of Motions- Multi Body Systems- Sub Systems- Friction and Spring Nonlinear Model- Nonlinear Dynamic Equations Formulation

UNIT II COMPUTATIONAL METHODS FOR DYNAMIC ANALYSIS 10

Jacobian Matrix- Newton-Pasphon Method- Nonlinear Kinematic Constrain Equation – System Mass Matrix-External and Elastic Forces- Acceleration Vector – Lagrangian Multiplier -langarge's equation – kinetic energy – Hamilton Equation- Hamilton vector field Euler-Lagrangian equation-generalized reaction forces –state vector and equation formulation

UNIT III NONLINEAR SYSTEMS AND CONCEPTS 10

Linear System Time Invarying and Linearization - Linear Time Varying and Linearization – Input and Output Stability - Lyapunov Stability Analysis – Asymptotically stability -Popov's and circle criterion –- Perturbed System – Chaos – periodic orbits-Index theory and limit cycle – center manifold theory- normal forms-Nonlinear analysis- Poincare maps- bifurcations - maps-vector fields - Methods – Control System Design using Lyapunov's direct method

UNIT IV SYSTEM CHARACTERIZATION 9

Stability, controllability, observability - Phase Plane Analysis- Phase Portrait- Limit Cycle-Describing Function- Assumption – Limit Cycles

UNIT V CONTROL OF NONLINEAR MECHANICAL SYSTEMS 7

Double inverted pendulum – nonlinear machineries – robot- suspension system- aircraft.

TOTAL : 45 PERIODS

OUTCOMES :

On successful completion of this course,

- Students will have ability to understand and analysis the multi-body system dynamics for mechanical systems.
- Students are able to develop an equation and able to understand the behavior of the nonlinear systems.
- Students will have a knowledge in system characterization
- Students are familiarized with control of non linear mechanical systems

REFERENCES :

1. Ahmed A. Shabana, Dynamics of multibody Systems, Fourth Edition, Cambridge University Press, 2013.
2. Brian L. Stevens, Frank L. Lewis, Aircraft Control and Simulation, Wiley India Pvt. Ltd; Third edition, 2015.
3. Hasan Khalil, Nonlinear systems and control, Third edition, Prentice Hall, 2017.
4. MahmutReyhanoglu, "Dynamics and control of a class of under actuated mechanical systems", IEEE Transactions on Automatic Control, 44(9), 1999.
5. Stephen Wiggins, Introduction to applied nonlinear dynamics system and Chaos, Second Edition, Springer-Verlag, 2003.
6. Wei Zhong and Helmut Rock, "Energy and passivity based control of the double inverted pendulum on a cart", IEEE, 2001.

MS 18002	COMPUTER AIDED INSPECTION	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To make the learner to design and fabricate inspection methods and systems incorporating electronic systems for inspection and quality control in engineering.

UNIT I FUNDAMENTALS AND CONCEPTS IN METROLOGY 9

Standards of measurement – Analog and digital measuring instruments-comparators – Limits, Fits and Tolerances – Gauge design – Angular measurements – Surface Roughness – Form errors and measurements.

UNIT II INSPECTION AND GENERAL MEASUREMENTS 12

Inspection of gears and threads – Tool makers' microscope – Universal measuring machine – use of Laser interferometer in machine tool Inspection – use of laser in on-line Inspection – Laser micrometer – Laser Alignment telescope.

UNIT III OPTO ELECTRONICS IN ENGINEERING INSPECTION 6

Use of opto electronics in Tool wear measurement – Micro hole measurement and surface Roughness – Applications in In-Process measurement and on line Inspection.

UNIT IV MACHINE VISION 9

Fundamentals of Image Processing – Steps involved in Image Processing – Machine Vision applications in manufacturing and metrology.

UNIT V COORDINATE METROLOGY AND QUALITY CONTROL 9

Co-ordinate measuring machines – Applications and case-studies of CMM in Inspection – Use of Computers in quality control – Control charts – Reliability.

TOTAL : 45 PERIODS

OUTCOMES :

The students will acquire the knowledge on

- Fundamental concepts in Metrology
- computer aided inspection of various geometries
- use of optoelectronics in inspection
- coordinate measuring metrology

REFERENCES :

1. Anil.K.Jain,"Fundamentals of Digital Image Processing", Prentice Hall of India Pvt. Ltd., 2004.
2. Dale.H. Besterfield,"Total Quality Management", Pearson Education Asia, 2002.
3. Jain R.K., "Engineering Metrology", Khanna Publishers, 2000.
4. Manuals of C.M.M. and Systems.
5. Robert G. Seippel, "Opto Electronics for technology and engineering", Prentice Hall, New Jersey, 1989.

MS 18003	DIGITAL MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To explain in detail about the various Mechatronics elements in CNC machines and also programming of CNC machines.

UNIT I INTRODUCTION OF NC, CNC, DNC AND ADAPTIVE CONTROL 6

Classification of machine tools – types, functions and processes - fundamentals of NC and CNC technologies Adaptive control - types, application and benefits - general configuration of adaptive control and function – reasons for process change -practical problems with adaptive control - example for feedback and adaptive control.

UNIT II MECHATRONIC ELEMENTS IN CNC MACHINE TOOLS 9

CNC systems - configuration of the CNC system – interfacing – monitoring – diagnostics machine data - compensations for machine accuracies - PLC in CNC – PLC programming for CNC, steps in programming and case studies - machine structure -types of loads on CNC machine - guide ways and types - mechanical transmission elements - elements for rotary motion to linear motion - ball screw and types -roller screw and types -rack and pinion - various torque transmission elements -requirements of feed drives and spindle drive.

UNIT III MECHATRONICS ELEMENT IN CNC MEASURING SYSTEM AND TOOLING 9

Measuring systems - feedback devices - velocity feedback -analog and digital - position feedback - rotary and linear. Tooling - requirement and planning -preset, qualified and semi qualified tools. Fixtures – requirement - unified and modular fixtures -tool identification - touch trigger probe-tool coding -EEPROM tools. 19 Tool condition monitoring - various indirect and direct methods. Identification and gauging of work piece. Tool locking system -ball lock mechanism and contact pressure monitoring. Automatic tool changing system - types and benefits -tool magazine – sensors in CNC.

UNIT IV CNC PROGRAMMING 14

Machine axes identification - primary, secondary and tertiary -manual CNC programming - Milling programming fundamentals -compensation and offset in milling -fixed cycles in milling - repetitive programming - loops, sub programs and macros. Turning programming fundamentals - compensation and offset in turning -fixed cycles in turning. Computer assisted programming in APT - basic geometry definition -cutter motion definition -postprocessor statements -generation and execution of APT programs.

UNIT V TESTING AND MAINTENANCE OF CNC MACHINES 5

Verification of technical specification and functional aspects, Verification during idle running & machine tool and the work piece accuracy -Installation of CNC machines -Maintenance of CNC machines - machine elements – hydraulic elements -electrical and electronic elements – maintenance schedules.

TOTAL : 45 PERIODS

OUTCOMES :

Upon completion of the course the students will acquire knowledge in :

- Mechatronics elements in CNC machine
- Control elements in CNC machine
- The programming in CNC machine.
- The testing and maintenance of CNC machine

REFERENCES :

1. Grahamt.Smith, “Advanced Machining: The Handbook of Cutting Technology”, IFS Publications Ltd., 1989
2. Groover, M.P., “Automation, Production System and CIM”, Prentice Hall of India Pvt. Ltd, 2003.
3. HMT Limited, “Mechatronics”, Tata Mcgraw-Hill Publishing Co Ltd, 2008.
4. Jayakumar,V., and Mahendran,B., “Computer Aided Manufacturing”, Lakshmi Publications, 2013.
5. Jonathan Lin,S.C., “Computer Numerical Control (From Programming to Networking)”, Delmar Publishers Inc., 2000.
6. Radhakrishnan,P., “CNC Machine”, New Central Book Agency, 2000.
7. Sehrawatt,M.S., and Narang,J.S., “CNC Machine”, DhanpatRai And Co, 2002.
8. Stenerson and Curran, “Computer Numerical Control-Operation and Programming”, PHI Learning Pvt. Ltd., 2008

MS 18004	MODELING AND FINITE ELEMENT ANALYSIS OF ELECTRO MECHANICAL SYSTEMS	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES :

- To equip students with fundamentals of finite element principles so as to enable them to understand the behavior of various finite elements and to be able to select appropriate elements to solve physical and engineering problems with emphasis on structural and thermal engineering applications.

UNIT I INTRODUCTION 6

Basics of FEM – Initial value and boundary value problems – weighted residual Galerkin and Raleigh Ritz methods – review of Variational calculus – Integration by parts – Basics of variational formulation.

UNIT II ONE DIMENSIONAL ANALYSIS 10

Steps in FEA – Discretization, function – derivation of element characteristics matrix, shape function, assembly and imposition of boundary conditions – solution and post processing – One dimensional analysis in solid mechanics and heat transfer.

UNIT III SHAPE FUNCTIONS AND HIGHER ORDER FORMULATIONS 10

Global and Natural Co-ordinates – Shape functions for one and two dimensional elements – Three noded triangular and four noded quadrilateral element – Nonlinear analysis – Isoparametric elements – Jacobian matrices and transformations – Basics of two dimensional axi symmetric analysis.

UNIT IV ANALYSIS OF PRODUCTION PROCESSES 10

FE Analysis of metal casting – Special considerations, latent heat incorporation, gap element – time stepping procedures – Crank – Nicholson algorithm – Prediction of grain structure – Basic concepts of plasticity – Solid and flow formulation – small incremental deformation formulation – FE Analysis of metal cutting, chip separation criteria, incorporation of strain rate dependency

UNIT V COMPUTER IMPLEMENTATION 9

Pre Processing, Mesh generation, elements connectivity, boundary conditions, input of material and processing characteristics – Solution and post processing – Overview of application packages such as ANSYS and DEFORM – Development of code for one dimensional analysis and validation.

TOTAL : 45 PERIODS

OUTCOMES :

Upon completion of the course:

- The students will be familiar with fundamentals of finite element principles
- The students are able to understand the behavior of various finite elements
- The students will be able to select appropriate elements to solve physical and engineering problems with emphasis on structural and thermal engineering applications.
- The students will be able to do FEA using software packages

REFERENCES :

1. Bathe, K.J., "Finite Element Procedures in Engineering Analysis, 2007.
2. Kobayashi, S, Soo-IK-Oh and Altan, T, "Metal forming and the Finite element Methods", Oxford University Press, 1989.
3. Lewis, R.W., Morgan, K, Thomas, H.R., and Seetharaman, K.N., "The Finite Element Method in Heat Transfer Analysis", John Wiley, 1996.
4. Rao, "Finite Element Method in Engineering", Pergammon Press, 1989.
5. Reddy, J.N, "An Introduction to the Finite element Method", McGraw – Hill, 2005.
6. Srinivas, Paleti , Sambana, Krishna Chaitanya , Datti, Rajesh Kumar, "Finite Element Analysis Using Ansys 11.0", PHI Learning Private Limited, 2010.

MS 18005	COMPUTER AIDED PRODUCTION OF AUTOMATED PARTS	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES :

- To impart the system development knowledge on automation production and manufacturing system integration in different applications.

UNIT I COMPUTER AIDED PRODUCTION PLANNING 8

Application – Process, Demand, Volume, Quality, Manufacturing Task. Automated Factory Requirements- Factory Planning - Layout- Macro, Micro, and Submicro Layouts - Work Cel Design - Manufacturing Task - Equipment, Tools and Resources Identification – Levels o Automation-Device, Machine, Cell, Plant, Enterprises - Computer Aided Process Planning (CAPP - MRP – Capacity Planning- Shop Floor Planning – Inventory Control. Tools for Digital Factor Modeling

UNIT II AUTOMATED MATERIAL TRANSFER AND STORAGE SYSTEM 10

Automated Production Line – System Configurations, Work Part Transfer Mechanisms – Fundamentals of Automated Assembly System – System Configuration, Part Delivery at Workstations – Design For Automated Assembly – Overview of Material Handling Equipment's – Consideration In Material Handling System Design – Conveyor Systems – Types of Conveyors – Operations and Features. Automated Guided Vehicle System – Types of Vehicles And AGVs Applications - Automated Transport System- Cranes - Hoist -Conventional Storage Methods and Equipments – Automated Storage/Retrieval System and Carousel Storage System Deadlocks in Automated Manufacturing Systems – Petrinet Models – Applications in Dead Lock Avoidance.

UNIT III GROUP TECHNOLOGY AND FLEXIBLE MANUFACTURING SYSTEMS 10

FMS - Overview – Levels- Manufacturing Module -Assembly Cell -Manufacturing Group Production Systems-Manufacturing Line - Part Families – Visual – Parts Classification and Coding – Production Flow Analysis – Grouping of Parts And Machines by Rank Order Clustering Method – Benefits of GT – Case Studies. FMS – Components – Workstations – FMS Layout Configurations – Computer Control Systems – FMS Planning and Implementation Issues – Architecture of FMS – Flow Chart Showing Various Operations in FMS

UNIT IV AUTOMATION SYSTEMS AND ADVANCED MANUFACTURING TECHNIQUES **7**

Intelligent Manufacturing – Virtual Manufacturing- Internet Controlled Manufacturing-Intelligent Agents – Advanced Manufacturing Systems - Robots Role in Various Levels of manufacturing-Sensors in Manufacturing Process-Automated Measurement and Inspections- Vision based inspection Manufacturing Process -Network and Computer Interface - Industrial Networks for Production Line Control

UNIT V CASE STUDIES **10**

Case studies of Automated Factory – Manufacturing Task - Car Manufacturing & Assembly – Electronics Manufacturing – Food Processing – Textile Processing.

TOTAL : 45 PERIODS

OUTCOMES :

Upon completion of the course the students will be familiar with

- The automated plant design, material handling and storage
- Flexible manufacturing technique
- Automation systems
- Advanced manufacturing concepts.

REFERENCES :

1. Alavudeen and Venkateshwaran, " Computer Integrated Manufacturing" , PHI Learning Pvt. Ltd., New Delhi, 2010.
2. Mikell P.Groover, Automation, Production system and Computer integrated Manufacturing, Prentice Hall of India Pvt. Ltd., Fourth edition 2016.
3. Kant Vajpayee,S. "Computer Integrated Manufacturing", Prentice Hall of India, New Delhi, 2007.
4. SabrieSoloman, Sensors and control systems in Manufacturing, Second Edition, McGrew Hill Publications, 2010.
5. Viswanathan, N., and Narahari, Y., ―Performance Modeling and Automated Manufacturing Systems, Prentice Hall of India Pvt. Ltd., 2000.

CD18014	**PRODUCT LIFE CYCLE MANAGEMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- This course provides the knowledge and practice regarding Product Life Cycle Management. This course gives practice through Product Life Management Strategies and Product Data Management. Product forecasting gives new Product Design for Manufacturing. Also, to understand the integration of PLM/PDM with other applications.

UNIT I INTRODUCTION TO PRODUCT LIFE CYCLE 9

Product life cycle – Introduction, growth, maturity & decline, Product Lifecycle Management- Definition & Overview, Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM - Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (CPDM), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM).PLM/PDM Infrastructure– Network and Communications, Data Management, Heterogeneous data sources and applications.

UNIT II PLM/PDM FUNCTIONS AND FEATURES 9

User Functions – Data Vault and Document Management, Workflow and Process Management, Product Structure Management, Product Classification and Programme Management. Utility Functions – Communication and Notification, data transport, data translation, image services, system administration and application integration.

UNIT III PLM/PDM FUNCTIONS AND FEATURES 9

Case Studies based on top few commercial PLM/PDM tools. Architecture of PLM & PDM tool- PLM vs ERP integration- Agile PLM integration- PLM SCM integration.

UNIT IV ROLE OF PLM IN INDUSTRIES 9

Case studies on PLM selection and implementation (like auto, aero, electronic) - other possible sectors, PLM visioning, PLM strategy, PLM feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for–business, organisation, users, product or service, process performance.

UNIT V BASICS ON CUSTOMISATION/INTEGRATION OF PDM/PLM SOFTWARE 9

PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLM and ERP

TOTAL: (L: 45): 45 PERIODS

OUTCOMES:

Students will be able to:

- Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
- Illustrate various approaches and techniques for designing and developing products.
- Apply product engineering guidelines / thumb rules in designing products for molding, Machining, Sheet metal working etc.
- Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

REFERENCES:

1. Grieves Michael, Product Lifecycle Management- Driving the Next Generation of Lean Thinking, McGraw-Hill, 2006.
2. Stark, John. Product Lifecycle Management: 21st Century Paradigm for Product Realization, Springer-Verlag, 2016.
3. Antti Saaksvuori, AnselmiImmonen, Product Life Cycle Management - Springer, 3rd

Edition,2010.
4. Clement, Jerry; Coldrick, Andy; & Sari, John. Manufacturing Data Structures, John Wiley & Sons, 1992
5. Kari Ulrich and Steven D. Eppinger, Product Design & Development, McGraw Hill International, 6th edition, 2015.
6. Effective Product Design and Development – by Stephen Rosenthol, Business One Orwin, Homewood, 1992

MS 18006	MICRO AND NANO SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To inspire the students about the trends in development and synthesizing of micro and nano systems.
- To introduce students the characterization tools required in micro and Nano material synthesis and fabrication.

UNIT I INTRODUCTION TO MICRO AND NANO TECHNOLOGY 6

Over view of nanotechnology and MEMS -Nano structuring- Nano defects, Nano particles and Nano layers-science and synthesis of Nano materials-lithography-based micromachining-Photolithography, vacuum systems, etching methods, deposition methods, and process integration -LIGA and laser-assisted processing

UNIT II CHARACTERIZATION OF NANO MATERIALS 11

Nano measuring systems – characterization – analytical imaging techniques – microscopy techniques, confocal LASER scanning microscopy -scanning electron microscopy, - transmission electron microscopy, scanning tunnelling microscopy, atomic force microscopy, diffraction techniques – spectroscopy techniques – Raman spectroscopy, 3D surface analysis – Mechanical, Magnetic and thermal properties – Auger Electron Spectroscopy (AES), X-Ray Photoelectron Spectroscopy (XPS), Extended X-ray absorption fine structure (EXAFS) - Electron probe micro-analyser (EPMA)- Application.

UNIT III MICRO AND NANO SENSORS 10

Si active tactile sensor - Fabric tactile sensor and its application – accelerometer-capacitive silicon –wall in-tube flow sensor and its application-Inertial Sensors – Accelerometer – Gyroscope – Pressure Sensors – Piezoresistive –Capacitive -– micro channel heat sinks – optical MEMS – Visual Display– optical data switching – RF MEMS – MEMS variable capacitors – MEMS switches – Resonators- Pressure Sensor, Nano tweezers.

UNIT IV MICRO AND NANO ACTUATORS 10

Requirement for Micro Actuators - Nano Positioners, Micro Mechanical Testing Apparatus - Classification of Micro Actuator-Electrostatic Distributed Actuator- Force Distance various Actuators– Inch Worm, Zipper and Scratch Drive. Thermal Actuation-Bimorph-Buckle Beam - Frequency and Force Characteristics and Advantages -Electro thermal Actuator - Electro Thermal Relay with Mechanical Latch – Force vs Displacement Curve-Piezoelectric Actuation Advantages - MEMS Switch -Thin Film Bulk Acoustic Resonator (FBAR) -Magnetic Actuation-External Magnetic Field Actuators & Issues-Variable Reluctance Actuators -Shape Memory Actuators- Micro Pump and Micro fluidics.

UNIT V MICRO AND NANO SYSTEM 8

Micro engine driven by electro statically actuated comb drive – Micro robots and Nano robots – Micro insects, Night Vision System, Bio MEMS

TOTAL : 45 PERIODS

OUTCOMES :

Upon completion of the course:

- The students will be exposed to the evolution of micro- Nano systems elements
- The students will be able to understand the characteristics of micro and nano systems
- The students will be familiarized with the fabrication technique, micro nano systems
- The Students will be aware of characterization tools for synthesizing materials for micro and nano sensors, devices and actuators and its fabrication technique.

REFERENCES :

1. Chang Liu, “Foundations of MEMS”, Pearson Education International, New Jersey, USA, 2012.
2. Charles P Poole, Frank J Owens, “Introduction to Nano technology”, John Wiley and Sons, 2009
3. Fahrner W.R., “Nanotechnology and Nanoelectronics”, Springer Private Ltd., 2011.
4. Mark Madou , “Fundamentals of Micro fabrication”, CRC Press, New York, 1997.
5. Mohamed Gad-el-Hak, “MEMS Handbook”, CRC press, 2006.
6. Norio Taniguchi, “Nano Technology”, Oxford University Press, New York, 2010
7. Tai – Ran Hsu, “MEMS and Microsystems Design and Manufacture”, Tata-McGraw Hill, New Delhi, 2012.
8. Waqar Ahmed and Mark J. Jackson, “Emerging Nanotechnologies for Manufacturing”, Elsevier Inc.,2014.

MS 18007 ADVANCED	EMBEDDED SYSTEMS WITH MICROCONTROLLERS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To impart knowledge in the area of real time embedded system.
- To understand the ARM & FPGA Processor, high level language descriptions of software for embedded system.

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS AND ARM 9 CORE 10

Definitions – Brief overview of micro-controllers - DSPs,-Typical classifications –Memory Devices and application scenarios of embedded systems. Introduction about ARM 9 Processor-DSP Processor-Sharc Processor - Internal Architecture – Modes of Operations – instruction set – Pipelining – AMBA – Applications and futures.

UNIT II PROGRAMMING OF ARM PROCESSOR 8

Programming of C – ARM Compiler - introduction to linker – librarian –image conversion utility and supporting libraries.

UNIT III INTRODUCTION TO FPGA 10

FPGA & CPLD Architectures - FPGA Programming Technologies- FPGA Logic Cell Structures-FPGA Programmable Interconnect and I/O Ports - FPGA Implementation of Combinational Circuits - FPGA Sequential Circuits -Timing Issues in FPGA Synchronous Circuits

UNIT IV PROGRAMMING OF FPGA 9

Introduction to Verilog HDL and FPGA Design flow with using Verilog HDL - FPGA Arithmetic Circuits - FPGAs in DSP Applications -Design of SDRAM & Halftone Pixel Converter - Programming FPGAs. Introduction to DSP processor -TMS320C54x and TMS320C6x architecture

UNIT V APPLICATIONS OF ARM 9 AND FPGA CONTROLLERS 9

Specific examples of time-critical and safety-critical embedded systems -applications in automation- automotive – aerospace -medical and manufacturing.

TOTAL : 45 PERIODS

OUTCOMES :

Upon completion of the course:

- The students will learn to develop the controller for the real time application.
- The students will gather the knowledge for the effective use of advanced controllers
- The students will be able to do programming in real time product development
- The students will have knowledge in applications of ARM 9 and FPGA controllers

REFERENCES :

1. Ball S.R., "Embedded microprocessor Systems – Real World Design", Prentice Hall, 2006.
2. C.M. Krishna, Kang G. Shin, "Real Time systems", McGraw Hill, 2009.
3. Frank Vahid and Tony Givagis, "Embedded System Design".Wiley, 2006.
4. P. Chu, "FPGA Prototyping by Verilog Examples," Wiley, 2008
5. Steve Kilts, "Advanced FPGA Design," Wiley Inter-Science, Wiley-IEEE Press, 2007.
6. Tim Wilmshurst, "An Introduction to the Design of Small – Scale Embedded Systems", Palgrave Macmillan, 2014.
7. Wayne Wolf, "Computers as Components – Principles of Embedded Computing System Design", Morgan Kaufmann Publishers 2009.

MS 18008	HUMAN MACHINE INTERFACE	L	T	P	C
		3	0	0	3

OBJECTIVES :

- The students gain insight into the field of human-computer interaction

UNIT I INTRODUCTION TO HMI 9

HMI Basics -Human Computer Interaction as an emerging field - Applications of Human Machine Interface (HMI) - HMI types - Human Information Processing -Interaction styles and general design Interaction -strategies Interface metaphors and conceptual models HCI and the World Wide Web HCI - security Accessibility of User Interfaces Usability engineering and evaluation HCI and social computing.

UNIT II ELEMENTS OF HMI 9

HMI Interfacing Considerations -HMI Hardware Selection -HMI Software Selection Configuring System Communications - Passive and active – Mental models-Creating a Tag Database -PLC Programming Considerations -Creating Basic Graphical Displays/Screens-Security – Event controlled interface.

UNIT III PERCEPTION, MEMORY, COGNITION 9

Perception & Cognition - Visual system – image generation and perception-Touch-Hearing-Model Human Processor- STM, LTM, Chunking -Principles of Operation-Power Law - Fitts Law -Hicks Law – factors affecting -Perception, Memory, Cognition

UNIT IV INTEGRATED MODELING FRAMEWORK 9

Supervisory control – criteria for sharing task between operator and machine - human– machine cooperation -human–machine cooperation -generic integrated modeling framework - Car driver Cognitive architecture of the human cognitive system -control loops - tactical Module – HMI in automation.

UNIT V BRAIN COMPUTER INTERFACE 9

Introduction to BCI – brain regions and responsibilities- Active methods for measuring brain activity – invasive and non-invasive procedures - EEG – P300- VEP- ERD-NIRS – Application in Prosthetic Control- Neurorehabilitation – Neurotraining – Brain controlled wheel chairs

TOTAL : 45 PERIODS

OUTCOMES :

Upon completion of the course:

- The students will gain knowledge in the elements of human machine interface
- The students will learn about perception, memory and cognition of human machine interface.
- The students will learn about integrated modeling framework.
- The students gather the ideas about the human machine and brain computer interface for the advanced mechatronics system development.

REFERENCES :

1. Allen Klinger, "Human machine interactive systems", New York: Plenum Press, 1991.
2. Bernhard Graimann, Bredan Allison, GertPfurtscheller, "Brain – computer interfaces", Springer-Verlag Berlin Heidelberg, 2010.
3. Guy A.Boyed., "The hand book of human machine interaction", Ashgate publishing limited, England 2011.
4. Jonathan Wolpaw, Elizabeth Winter Wolpaw," Brain Computer Interfaces: Principles and practice", Edition 1, Oxford University Press, USA, January 2012.
5. Jean-Yves Fiset, "Human-Machine Interface Design for Process Control Applications", ISA Publisher, 2008

MS 18009	MACHINE LEARNING	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To know fundamental behind the various machine algorithms, and also to familiarize the important methods in ANN, Fuzzy and Genetic algorithm

UNIT I SUPERVISED AND SEMI SUPERVISED LEARNING METHODS 10

Introduction to learning & classifiers- LDA – ANN - Naive Bayes classifier- decision tree-Regression-Ordinary Least Squares – linear and Logistic Regression- Gaussian process - Stepwise Regression - Multivariate Adaptive Regression Splines (MARS) -Locally Estimated Scatterplot Smoothing (LOESS) - overview of nearest neighbour -Support vector machines-Temporal difference learningQ-learning.

UNIT II UNSUPERVISED & REINFORCEMENT LEARNING METHODS 8

xpectation–maximization (EM) -Vector quantization, Clustering Fuzzy K &C means algorithm - Density-based spatial clustering of applications with noise (DBSCAN) -Conceptual clustering-Association rule learning -Apriori algorithm- SVD.

UNIT III NEURAL NETWORK 9

Perceptron – Probabilistic Neural Network (PNN) - Back-Propagation (BPN) - Hopfield Network - Self-Organizing Map (SOM) - Learning Vector Quantization (LVQ)-Adaptive Resonance Theory 1 – Adaptive Resonance Theory 2 - Case studies on GA based algorithm development.

UNIT IV FUZZY CLASSIFICATION 9

Basic concepts in Fuzzy Set theory-Fuzzy logic controllers – Principles – Various industrial Applications of Fuzzy logic control – Adaptive Fuzzy systems – Fuzzy Decision making – Fuzzy classification – Fuzzy pattern Recognition – Image Processing applications – Fuzzy optimization - Case studies on fuzzy based algorithm development.

UNIT V GENETIC ALGORITHMS 9

Introduction to genetic algorithm –initialization, selection, mutation and termination-Swarm intelligence – PSO-ACO -Tabu search - Reactive search optimization (RSO)cross-entropy (CE) methods. Case studies on GA based algorithm development.

TOTAL : 45 PERIODS

OUTCOMES :

Upon completion of the course:

- The students will gain the knowledge on artificial learning
- The students will know the classification algorithms for the implementation of intelligent machine.
- The students will gain knowledge in neural networks
- The students will gain knowledge in fuzzy and genetic algorithms

REFERENCES :

1. EthemAlpaydin, "Introduction to Machine Learning" The MIT Press, Cambridge, London. 2nd edition, 2010
2. Klir, G.J. Yuan Bo, "Fuzzy sets and Fuzzy Logic: Theory and Applications", Prentice Hall of India Pvt. Ltd., 2005.
3. LaureneFausett, "Fundamentals of Neural Networks, Architectures, Algorithms and Applications", Prentice Hall, Englewood cliffs, 2004.
4. Randy L. Haupt, Sue Ellen Haupt Practical Genetic Algorithms, Wiley interscience 2nd edition, 2004
5. S. Rajasekaran, GA VijayalakshmiPai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", Prentice Hall of India Private Limited, 2013.
6. Simon Haykin, "Neural Networks – A comprehensive foundation", Prentice Hall, 3rd Edition, 2004.

MS 18010	COMMUNICATION PROTOCOLS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To provide practical knowledge in the basic concepts of wired and wireless communication protocol for automation system development and networking.
- To create the knowledge on standard communication protocols for industrial automation.

UNIT I WIRED BUSES AND PROTOCOLS 9

Wireless-Wired Networks -Serial Communication Protocols-RS232-UART-SPI –- I2C – UNI/O Bus -1 Wire -Camara Link -Parallel Communication -PPI -Wishbone Bus – AMBA - JTAG-Fireware IEEE 1394 Bus- Ethernet Overview - RS485

UNIT II WIRELESS PROTOCOLS 9

Antenna Technology-Network Topologies - Wireless Local Area Networks (WLAN) Wireless Personal Area Networks (WPAN) - Wimedia –Wimax - RF – Bluetooth-Wi-Fi – Zigbee – Wireless Industrial Automation

UNIT III INDUSTRIAL AND AUTONOMOUS SYSTEMS WIRED NETWORK 9

Overview of Industrial Wired Networks –Terminal Bus- Modbus - HART Network -Mechatrolink– Ether CAT- Sercos II/III – CAN- Canopen -Modbus IDA-PROFINET-PROFIBUS-Ethernet/IP-Ethernet Powerlink- AG Automation And Drives (AS-I)-Device Net

UNIT IV INDUSTRIAL WIRELESS NETWORKS 9

Overview of Industrial wireless networks- IWLAN - ISA100 Standards – Remote networks-Controller-based networks -Wireless HART Technology -3G/4G for Automation –RFID Data Tags.

UNIT V APPLICATION OF COMMUNICATION PROTOCOLS 9

Wired machine networking - wireless machine networking – Networking of industry Communication network layout design- case studies -various automation applications.

TOTAL : 45 PERIODS

OUTCOMES :

Upon completion of the course:

- Students will gain knowledge on system communication process.
- Students will be familiarized with wireless protocols
- Students will gain knowledge in industrial and autonomous system wired network
- Students will gain knowledge in the system and industrial networks for automating the simple machine to entire industries.

REFERENCES :

1. Dick Caro, Wireless Networks for Industrial Automation, Third Edition, 2004
2. G&L Motion Control, MMC-SD SERCOS Drive, 2005.
3. Olaf Pfeiffer, Andrew Ayre and Christian Keydel, Embedded Networking with CAN and CANopen, Copperhill Technologies Corporation, 2008.
4. Richard Zurawski, Industrial Communication Technology, CRC Press, 1st edition, 2005.
5. Siemens IK, Industrial Ethernet: IEEE 802.3, 2015.
6. The Wireless Book evolution and Communication, CRC Press Wolfram Behardt and JorgWollert, Stetute, Germany 2016

MS 18011	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To develop and strengthen the safety ideas and motivate the students to impart basic safety skills and understandings to run an industry efficiently and effectively

UNIT I OPERATIONAL SAFETY 9

Hot metal operation, boiler, pressure vessels – heat treatment shop – gas furnace operation – electroplating – hot bending pipes – safety in welding and cutting, Cold – metal operation – safety in machine shop – cold bending and chamfering of pipesmetal cutting – shot blasting, grinding, painting – power press and other machines. Management of toxic gases and chemicals – industrial fires and prevention – road safety – highway and urban safety – safety of sewage disposal and cleaning – control of environmental pollution – managing emergencies in industries – planning security and risk assessments, on – site and off site. Control of major industrial hazards.

UNIT II SAFETY APPRAISAL AND ANALYSIS 9

Human side of safety – personal protective equipment – causes and cost of accidents. Accidents prevention program – specific hazard control strategies – HAZOP training and development of employees – first aid – fire fight devices – accident reporting, investigation. Measurement of safety performance, accident reporting and investigation plant safety inspection, job safety analysis – safety permit procedures. Product safety plant safety rules and procedures – safety sampling – safety inventory systems. Determining the cost effectiveness of safety measurement.

UNIT III OCCUPATIONAL HEALTH 9

Concept and spectrum of health functional units and activities of operational health service – occupational and related disease – levels of prevention of diseases – notifiable occupational diseases Toxicology Lead – Nickel, chromium and manganese toxicity – gas poisoning (such as CO, Ammonia Chlorise, So2, H2s.) their effects and prevention – effects of ultra violet radiation and infrared radiation on human system.

UNIT IV SAFETY AND HEALTH REGULATIONS 9

Safety and health standards – industrial hygiene – occupational diseases prevention welfare facilities. The object of factories act 1948 with special reference to safety provisions, model rules 123a, history of legislations related to safety – pressure vessel act – Indian boiler act – the environmental protection act – electricity act – explosive act.

UNIT V SAFETY MANAGEMENT 9

Evaluation of modern safety concepts – safety management functions – safety organization, safety department- safety committee, safety audit – performance measurements and motivation – employee participation in safety - safety and productivity.

TOTAL : 45 PERIODS

OUTCOMES :

At the end of this course the students are expected to gain knowledge and skills:

Needed to run an industry with utmost safety precautions.

To do safety appraisal and its analysis

In safety and health regulations

In safety management

REFERENCES :

1. John V Grimaldi, Safety Management. AITB publishers, 2003.
2. John.V .Grimaldi and Rollin. H Simonds, "Safety Managenent", All India traveler book seller, New Delhi – 1989.
3. Krishnan N.V, "Safety in Industry", Jaico Publisher House, 1996.
4. Singh, U.K and Dewan, J.M., "Safety, Security and Risk Management", APH publishing company, New Delhi, 1996.

MS 18012	INDUSTRIAL AUTOMATION FOR MECHATRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To impart the knowledge on PLC, Supervisory control and factory automation

UNIT I INDUSTRIAL INSTRUMENTATION AND CONTROL 9

Introduction and need for automation-Instrumentation system for measurement of process `parameters – overview on flow, level, pressure, temperature, speed, current and voltage measurements – proximity and vision based inspection systems – process control systems – continuous and batch process – feedback control system overview.

UNIT II PROGRAMMABLE LOGIC CONTROLLER 9

Fundamentals of programmable logic controller - functions of PLCs - features of PLC selection of PLC - architecture – Basics of PLC programming - logic ladder diagrams – communication in PLCs – Programming Timers and counters – Data Handling -PLC modules - Advanced PLCs.

UNIT III DATA COMMUNICATION AND SUPERVISORY CONTROL SYSTEMS 9

Industrial data communications - fiber optics – Modbus – HART – DeviceNet – Profibus – Fieldbus – Introduction to supervisory control systems – SCADA -Distributed control system (DCS) – Safety systems – man-machine interfaces.

UNIT IV FACTORY AUTOMATION **9**

layout - Tools and software based factory modeling -case study on automated manufacturing units, assembly unit, inspection systems and PLC based automated systems- Introduction to factory automation monitoring software

UNIT V BUILDING AUTOMATION 9

Building layout and its 3D model-Power Distribution System in Buildings-HVAC systems-Systems Design & Operation- PLC in Building Services- Building Automation Systems – control panel- Introduction to building automation software

TOTAL : 45 PERIODS

OUTCOMES :

Upon completion of the course:

- The students will gain knowledge in PLC and its programming
- The students will be familiarized with data communication and supervisory control systems
- The students will be able to develop the automation models by the use of PLC, Supervisory control for a factory
- The students will be able to develop the automation models by the use of PLC, Supervisory control for a building.

REFERENCES :

1. Bequette, B.W., "Process Control Modeling, Design and Simulation", Prentice Hall of India, 2005
2. Berge, J., "Field Buses for Process Control: Engineering, Operation, and Maintenance", ISA Press, 2004.
3. Clarke, G., Reynders, D. and Wright, E., "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes, 1st Edition, 2004.
4. D.Patranabis, "Principles of Industrial Instrumentation", Tata McGraw-Hill Publishing Ltd., New Delhi, 2008.
5. Frank D. Petro Zella, "Programmable Logic Controller" McGraw – Hill Publications, 2015
6. Frank Lamb, "Hands on Industrial Automation", McGraw-Hill Profession, 2013.
7. Hughes, T., "Programmable Logic Controllers", ISA Press, 2000.
8. Lucas, M.P., "Distributed Control System", Van Nastrand Reinhold Company, New York, 1986.
9. Mackay, S., Wrijut, E., Reynders, D. and Park, J., "Practical Industrial Data Networks Design, Installation and Troubleshooting", Newnes Publication, Elsevier, 1st Edition, 2004
10. Mc-Millan, G.K., "Process/Industrial Instrument and Controls Handbook", McGraw-Hill, NewYork, 2004

MS 18013	ADVANCED CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To learn and model the nonlinear and complex control strategies for advanced mechatronics system developments.

UNIT I CONVENTIONAL CONTROL SYSTEM DESIGN 9

Review of feedback systems and design of PID Controllers - Electronic PID controller – Digital PID algorithm – Auto/manual transfer - Reset windup – Practical forms of PID Controller - Evaluation criteria – IAE, ISE, ITAE and ¼ decay ratio – Tuning using Process reaction curve method, Continuous cycling method and Damped oscillation method – pole placement – Lamda tuning.

UNIT II ENHANCEMENT TO SINGLE LOOP CONTROL 9

Feed-forward control – Ratio control – Cascade control – Inferential control – Split-range – override control–- selective control –Auto tuning

UNIT III STATE SPACE ANALYSIS 9

Concepts of state variable and state model – State space to Transfer function and Transfer function to State space modes – Solving time invariant state equation – Controllability – Observability – State Observers – Design of control systems with observers.

UNIT IV NONLINEAR SYSTEMS AND CONTROL 9

Non-linear Systems – Common physical nonlinearities – Linearization of Nonlinear systems – Phase portrait analysis – Isocline method – Liapnov's stability concept – Popov criterian – Kalman algorithm.

UNIT V OTHER CONTROL METHODS 9

LQR-Adaptive Control – Optimal Control – Robust Control – Model Predictive Control – Multivariable Control systems.

TOTAL : 45 PERIODS

OUTCOMES :

Upon completion of the course:

- The students will gain knowledge in conventional control system design
- Students will familiarized with single loop control system
- The students will acquire the knowledge in nonlinear control systems
- Students will be familiarized with the methods used to design the stable system.

REFERENCES :

B.C. Kuo, “Automatic Control Systems”, Prentice Hall of India Pvt. Ltd., New Delhi, 2014

Bequette, B.W., “Process Control Modeling, Design and Simulation”, Prentice Hall of India, 2004

I.J.Nagrath and Gopal, “Control System Engineering”, New Age International (P) Ltd., 6th edition, 2017

K.Ogata, “Modern Controls Engineering“, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.

M. Gopal, “Control Systems Principles and Design”, Tata McGraw Hill Publishing Ltd, 2012.

Zbigniew Ogonowski , “Advanced Control with MATLAB and Simulink”, Ellis Horwood, Ltd

MS 18014	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To understand the fundamentals of Internet of Things
- To learn about the basics of IOT protocols
- To build a small low cost embedded system using Raspberry Pi.
- To apply the concept of Internet of Things in the real world scenario.

UNIT I INTRODUCTION TO IoT 9

Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates -Domain Specific IoTs -IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology

UNIT II IoT ARCHITECTURE 9

M2M high-level ETSI architecture -IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture

UNIT III IoT PROTOCOLS 9

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP -Security

UNIT IV BUILDING IOT WITH RASPBERRY PI & ARDUINO 9

Building IOT with RASPERRY PI-IoT Systems -Logical Design using Python – IoT Physical Devices & Endpoints -IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.

UNIT V CASE STUDIES AND REAL-WORLD APPLICATIONS 9

Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing -Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT.

TOTAL : 45 PERIODS

OUTCOMES :

Upon completion of the course, the student should be able to:

- Analyze various protocols for IoT
- Develop web services to access/control IoT devices.
- Design a portable IoT using Rasperry Pi
- Deploy an IoT application and connect to the cloud.
- Analyze applications of IoT in real time scenario

REFERENCES :

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.
3. Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press,2012.
4. Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things Introduction to a New Age of Intelligence", Elsevier, 2014.
5. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012.

MS 18015	BIO MECHATRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To get the clear understanding of application of mechanics in medicine.
- To study the properties and kinematics of bone and muscles.

UNIT I INTRODUCTION 9

Introduction to bio-mechanics, relation between mechanics and Medicine, Newton"s laws, stress, strain, shear rate, viscosity, visco elasticity, non-Newtonian viscosity, soft tissue mechanics, mechanical properties of soft biological tissues-Bio fluid mechanics-Introduction to Biomechatronic Systems

UNIT II MECHANICS IN SKELETAL AND MUSCULAR SYSTEM 10

Bones, types and functions -Axial and Appendicular Skeleton. Joints: Definition, Types and functions, Mechanical properties of bones. Kinetics and Kinematics relationship of skeletal and muscular system.

UNIT III CONTROL MECHANISM OF BIOLOGICAL SYSTEMS 10

Skeletal muscles servo mechanism, Cardio vascular control mechanism, respiratory control mechanism – interfacing techniques with natural servo mechanism

UNIT IV PROSTHETIC AND ORTHOTIC DEVICES 9

Analysis of force in orthopaedic implants, Hand and arm replacement, different types of models for externally powered limb prosthetics, Lower limb, Upper limb orthotics, and aterial for prosthetic and orthotic devices, Functional Electrical Stimulation, Sensory Assist Devices.

UNIT V SIMULATION AND MODELLING OF BIOMECHANTRONICS 7

Physics-based modeling and simulation of biological structures- variables of interest – geometry-Introduction to model the skeletal system using open source software– human leg prosthesis and normal gait vs prosthesis leg analysis -Upper Extremity Kinematic Model

TOTAL : 45 PERIODS

OUTCOMES :

Upon completion of the course:

- The students will be able to understand the mechanics in skeletal and muscular system
- The students will be able to understand the skeletal mechanics for rehabilitation and prosthetic developments.
- The students will learn to develop the rehabilitation devices and its interface.
- The students will be able to simulate and model bio mechatronics

REFERENCES :

1. C.R Ethier and C.A.Simmons, "Biomechanics from Cells to Organisms", Cambridge University Press, 2007.
2. D.Dawson and Right, "Introduction to Bio-mechanics of Joints and Joint Replacement", Mechanical Engineering Publications Ltd., 1989.
3. Gillian Pocock & Christopher D.Richards, "The Human Body", Oxford University Press, 2009
4. Jacob Kline, "Hand book of Bio Medical Engineering", Academic Press, 1988.
5. Ranganathan T S, "Text Book of Human Anatomy" S. Chand and company New Delhi, 1994
6. Scott L. Delp et L., "OpenSim: Open-Source Software to Create and Analyze Dynamic Simulations of Movement", IEEE Transaction on biomedical engineering vol.54 no.11, 2007.
7. Y.C.Fung, "Biomechanics: Mechanical properties in living tissues", Springer Verlag, New York 1981. 5. Susan J.Hall, Basics Bio Mechanics 4th Edition, McGraw-Hill Publishing Co, 2002

MS 18016	ADVANCED COMPUTER VISION	L	T	P	C
		3	0	0	3

OBJECTIVES :

To impart knowledge on imaging machine vision and its applications

UNIT I IMAGE FORMATION AND CAMERA CALIBRATION 6

Projective Geometry -Imaging through lenses and pin-hole – Basic Photometry – Basic model of imaging geometry – Ideal Camera – Camera with intrinsic parameters – Approximate camera models – Camera Calibration – Methods and Procedure

UNIT II BASICS FOR COMPUTER VISION 6

Sampling Theorem – Numerical Differentiation – Differential Geometry – Singular Value Decomposition – Robust Estimators and Model Fitting

UNIT III SHAPE FROM X 9

Depth Perception in Humans, Cues – Shape from Texture, Shading, Focus, Defocus, Structured Light Reconstruction – Time of Flight Methods

UNIT IV COMPUTATIONAL STEREO AND MOTION 12

Computational Stereopsis – Geometry, parameters – Correspondence problem, correlation based methods, feature-based methods – Epipolar Geometry, essential matrix and fundamental matrix, eight point algorithm – Reconstruction by triangulation, scale factor and up to a projective transformation – Visual Motion – Motion field of rigid objects – Optical Flow – Estimation of motion field – 3D structure and motion from sparse and dense motion fields – Motion based segmentation.

UNIT V ROBOT VISION 12

Visual Tracking – Kalman Filtering and Sequential Monte Carlo – Visual SLAM, solutions, EKFSLAM, Fast SLAM – 3D SLAM – Advanced Visual Servoing, hybrid visual servo, partitioned visual servo.

TOTAL : 45 PERIODS

OUTCOMES :

Upon successful completion of the course

- The students will acquire knowledge in image formation and camera calibration
- The students will acquire knowledge in shape from X.
- The students will acquire knowledge in computational stereo and motion
- The students will acquire knowledge in robot vision

REFERENCES :

1. Boguslaw Cyganek, J. Paul Siebert, An Introduction To 3D Computer Vision Techniques And Algorithms, First Edition, 2009.
2. Emanuele Trucco, Alessandro Verri, "Introductory Techniques For 3D Computer Vision", First Edition, 1998
3. Eugene Hecht, A.R. Ganesan "Optics", Fourth Edition Published by Pearson Education, 2008
4. Yi Ma, Jana Kosecka, Stefano Soatto, Shankar Sastry, "An Invitation to 3-D Vision From Images to Models", First Edition, 2004

MS 18017	ONBOARD COMPUTERS AND PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES :

- Students will understand the on board system architectures and its peripheral features.
- Students will learn the grammar of python programming language.
- Students will understand and be able to use the basic programming principles such as data types, variable, conditionals, loops, recursion and function calls.
- Students will learn how to use on-board computers for real time applications.

UNIT I INTRODUCTION TO SINGLE BOARD COMPUTERS 9

On-Board System Architecture- Processor- Architecture – Features - SPI-I2C- UART USB - Ethernet- CAN Protocol - Wi-Fi – Bluetooth- HDMI- GPIO- Memory-Input Devices – Camera Interfacing.

UNIT II REAL TIME OPERATING SYSTEM 7

Operating System Architecture – File Systems- Resource Management – Process Scheduling – Applications.

UNIT III PYTHON PROGRAMMING 11

Python Language – Using The Interpreter – Python Data types And Functions – Working With Data – List, Dictionary And Set – Processing Primitives – List Comprehensions – File Handling – Object Model Including Variables, Reference Counting, Copying, and Type Checking – Error Handling Iterative Statement-Conditional Statement –Operators – Arrays Libraries- Library - GUI Development.

UNIT IV EMBEDDED PYTHON PROGRAMMING 9

GPIO Programming – Numerical Library- Communication Library- Image Processing – Machine Learning.

UNIT V APPLICATIONS 10

Automotive- Robotics - IOT- Factory Automation - Home Automation.

TOTAL : 45 PERIODS

OUTCOMES :

Upon successful completion of the course

- The learners will be able know about the architecture, programming strategies and application overview of single board computers.
- The students will gain knowledge in real operating system
- The students will be familiarized with python and embedded python programming
- The students will be able to know about the applications of onboard computers programming

REFERENCES :

1. Gabriele Manduchi and Ivan CibrarioBertolotti, Real-Time Embedded Systems: Open-Source Operating Systems, CRC press, 2012.
2. Guttag, John. Introduction to Computation and Programming Using Python. MIT Press, 2013.
3. Mark Lutz,"Learning Python, Powerful OOPs,O'reilly,2011
4. NInadSathaye, Learning python application development, Packt publishing, 2016
5. SaiYamanoor, SrihariYamanoor, Raspberry Pi Mechatronics Projects Packt publishing, 2016.
6. Warren Gay, "Mastering the Raspberry Pi", Apress, 1st ed. edition, 2014

MS 18018	AUTOMOTIVE ELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To create a learning on various automotive electronic components and its integration for automotive development.

UNIT I OVERVIEW OF AUTOMOTIVE SYSTEMS 7

Overview of Automotive Systems - Engine – Engine Types- 4 Stroke Engine Working Fuelling System-Ignition System - Electronic Engine Management System.

UNIT II SENSORS AND ACTUATORS IN AUTOMOTIVE 9

Variables to be Measured - Airflow Rate Sensor -Pressure Measurements - Engine Crankshaft Angular Position Sensor - Magnetic Reluctance Position Sensor - Hall-Effect Position Sensor - Optical Crankshaft Position Sensor -Throttle Angle Sensor Temperature Sensors - Typical Coolant Sensor -Sensors for Feedback Control Exhaust Gas Oxygen Sensor - Oxygen Sensor Improvements -Knock Sensors - Automotive Engine Control Actuators - Fuel Injection - Exhaust Gas Recirculation Actuator - Variable Valve Timing - VVP Mechanism Model -Electric Motor Actuators - Brushless DC Motors - Stepper Motors - Ignition System - Ignition Coil Operations.

UNIT III ENGINE CONTROL & MONITORING SYSTEMS 11

Engine control functions- Digital Power train Control Systems – Digital Engine Control. Control Modes for Fuel Control -Discrete Time Idle Speed Control EGR Control -Variable Valve Timing Control - Electronic Ignition Control -Closed-Loop Ignition Timing -Spark Advance Correction Scheme - Integrated Engine Control System -Secondary Air Management - Evaporative Emissions Canister Purge -Automatic System Adjustment-System Diagnosis-Summary of Control Modes -Engine Crank (Start) -Engine Warm-Up - Open-Loop Control - Closed-Loop Control -Hard Acceleration -Deceleration and Idle -Fuel delivery systems, MPFI, Ignition Systems, Compression Ignition Engines – Emission control Management – Hybrid Power Plants – BAS Electronic stability program (ESP) - Electronic diesel control (EDC).

UNIT IV TRANSMISSION AND SAFETY SYSTEMS & DIAGNOSTICS SYSTEMS 10

Transmission control – Autonomous cruise control – Braking control, ABS – Traction control, ESP, ASR – Suspension control – Steering control – Stability control – Parking Assist Systems – Safety Systems, SRS, Blind Spot Avoidance – Auto transmission electronic control, Telematics.

Automatic Navigation, Future Challenges-Electronic Control System Diagnostics Service Bay Diagnostic Tool - Onboard Diagnostics -Model-Based Sensor Failure Detection - Diagnostic Fault Codes - Onboard Diagnosis (OBD II) -Model-Based Misfire Detection System -Expert Systems in Automotive Diagnosis Occupant Protection Systems.

UNIT V AUTOMOTIVE INSTRUMENTATION AND INFOTAINMENT 8

Modern Automotive Instrumentation -Advantages of Computer-Based Instrumentation Display Devices - LED - LCD - Flat Panel Display -Fuel Quantity Measurement - Coolant Temperature Measurement - Oil Pressure Measurement - Vehicle Speed Measurement -High-Speed Digital Communications (CAN) - CAN Network -Trip Information Computer - Telematics -GPS Navigation -The GPS System Structure -Automotive Diagnostics.

TOTAL : 45 PERIODS

OUTCOMES :

Upon successful completion of the course

- The learners will be known to various automotive sensor components and its working.
- The students will gain knowledge in various engine control and monitoring mechatronics systems
- The will gain knowledge in automotive transmission safety systems and diagnostics
- The students will gain the knowledge on integration of various components in the automotive systems.

REFERENCES :

1. Crouse W.H. “Automobile Electrical Equipment” McGraw Hill Book Co., Inc., New York 3rd edition,1986.
2. R.K. Jurgen, AutomotiveElectronics Handbook, McGraw Hill 2nd Edition. 1999
3. Robert N Brady, Automotive Computers and Digital Instrumentation, Areston Book Prentice Hall, Eagle Wood Cliffs, New Jersey, 1988.
4. Tom Weather Jr. and Cland C. Hunter, “Automotive Computers and Control System” Prentice Hall Inc., New Jersey.
5. William B.Riddens-Understanding Automotive Electronics, Kindle edition-Butter worth Heinemann Woburn-2017.
6. Young A.P. and Griffths, L., Automobile Electrical Equipment “English Language Book Society and New Press

MS 18019	MARINE MECHATRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To study the mechanical, electrical, and communication subsystem in marine vehicles.

UNIT I INTRODUCTION TO MARINE SYSTEMS 9

Marine Hydrodynamics - Anatomy of Sea Level Variability -Marine Vehicles– Classification-Elements in Marine System – Modeling of Marine Vessels – Waves Wind – Water Current Model -Types of Marine Systems -Ship, Submersible, Remotely Operated Vehicle and Autonomous Underwater Vehicles.

UNIT II MARINE MECHANICAL SUBSYSTEMS 9

Ships And Machinery -Diesel Engines -Steam Turbines and Gearing-Marine Boiler Pumps And Pumping Systems - Automatic Combustion Control, Air – Fuel Ratio Control, Feed Water Control Single, Two And Three-Element Type, Steam Pressure Control, Fuel Oil Temperature Control, Control In Main Machinery Units for Temperature of Lubricating Oil, Jacket Cooling Water, Fuel Valve Cooling Water, Piston Cooling Water and Scavenge Air, Fuel Oil Viscosity Control-Refrigeration, Air Conditioning and Ventilation - Deck Machinery and Hull Equipment - Shafting and Propellers -Steering Gear - Fire Fighting and Safety

UNIT III MARINE ELECTRICAL SUBSYSTEMS 9

Ships' Electrical System-Ships' Lighting -Incandescent Lamps - Discharge Lamps Voltage Effects on Lighting - Navigation and Signal Lights - Emergency Lighting -Main Electrical Survey Items - Generators And Governors - Circuit Breakers -Switchboards and Fittings - Cables - Insulation Resistance - Motors and Starters -Emergency Power and Associated Equipment - Steering Gear - Navigation Light Indicators - UMS Operation – Tanker -Introduction-Electric Propulsion Scheme-Power Supply Network.

UNIT IV MARINE MEASUREMENTS, MANOEUVRING AND CONTROL SYSTEMS 9

Manoeuvring, Kinematics & Vessel Dynamics – Marine Positioning Systems - Dynamic Positioning Control Hybrid Control -Weather Optimal Positioning -Propellers and Thrusts-Propulsion Control -Thrust Control Normal- Extreme Conditions - Methods for Thrust Control Marine Automation Systems - Auto Pilot.

UNIT V COMMUNICATION AND NAVIGATION 9

SONAR- Doppler-Underwater acoustics –RADAR– S band RADAR- X-band RADAR – foremast RADAR - AIS – Ship tracking– DGPS

TOTAL : 45 PERIODS

OUTCOMES :

Upon successful completion of the course:

- Students will familiar about various systems in marine vehicles.
- Students will gain knowledge in various marine mechanical subsystems
- Students will be familiarized with marine measurement systems
- Students will be familiarized with marine communication and navigation

REFERENCES :

1. D.A Taylor, Introduction to Marine Engineering, Elsevier, Butterworth Heinemann publication, Second Edition, 2003.
2. Dennis T. Hall, Practical Marine Electrical Knowledge, Wither Publisher, 1999.
3. Asgeir.J Sorensen, Report: Marine control system, 2013.
4. D.A. Taylor, Marine Control Practice, 2nd Edition, Butter worth & Co (Publishers) Ltd., London, 2013.
5. Ferial El-Hawary, The Ocean Engineering Handbook, CRC Press LLC. 2001.
6. Leslie Jackson, Instrumentation and Control Systems, 3rd Edition, Thomas Reed Publication Ltd., London, 1992.
7. Smith, Application of Automatic Machinery and Alarm Equipment in Ships, Marine Engineering Practice, Vol.1, Part 06, Imarest, London

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MS 18020	AVIONICS FOR MECHATRONICS ENGINEERS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To learn about the aircraft system and its automation requirements.
- To study the sensors, measurement, actuators, navigation systems and its control of aircraft systems.

UNIT I OVERVIEW OF AIRCRAFT ENGINEERING 9

Aircraft Systems Engineering Overview - Concept Map - The Seven Steps Systems Engineering - Conceptual System Design -Fundamentals - Components of an Airplane Functions - Motions of a Plane - Components of a Helicopters - Functions Helicopters. Types of Aerial Vehicles – functions – Unmanned aerial vehicles - Quadcoptor – Drone – Micro Aerial Vehicles.

UNIT II SENSORS AND MEASUREMENTS 9

Sensors – Gyroscope -Rate Gyros - Rate Integration and Free Gyro, Vertical and Directional Gyros, Laser Gyroscopes, Accelerometers. Direct Reading Compass, Classification of Aircraft Instruments -Engine Power and Control Instruments Measurement of RPM, Manifold Pressure, Torque, Exhaust Gas Temperature, EPR, Fuel Flow, Engine Vibration, Monitoring Air Data Instruments -Airspeed, Altitude, Vertical Speed Indicators. Static Air Temperature, Angle of Attack Measurement Instrument Displays Panels and Cockpit Layout.

UNIT III MECHANISMS AND ACTUATORS 9

Types of Actuation Systems-Linear and Non-Linear Actuation System, Valves, Modeling of Actuation Systems, Flight Control - Landing Gear - Brake Actuation - Servo-Loop Analysis Actuator Design -Testing Methodologies, Performance Testing Equipment's for Sensors and Actuation Systems.

UNIT IV STABILITY AND CONTROL 9

Automatic Flight Control Systems – Auto Pilot – Longitudinal – Lateral - Fly-By-Wire Flight and Digital Fly-By-Wire Flight Control Systems - Elements, Architecture, System Design. Longitudinal and Lateral Control Law Design - Back Stepping Algorithm – Active Control Technology

UNIT V NAVIGATION 9

Introduction to Navigation – Types – Inertial Navigation Systems - Radio Navigation Approach and Landing Aids -Ground Controlled Approach System -Surveillance Systems-Radio Altimeter – GPS - Integration of GPS and INS.

TOTAL : 45 PERIODS

OUTCOMES :

Upon successful completion of the course:

- The learners will be able to know about the aircraft systems
- The students will gain knowledge in sensors and measurements in aircraft
- The students will be familiarized with aircraft control systems
- The students will gain knowledge in aircraft navigation.

REFERENCES :

1. AGARD-AG-234, "Active controls aircraft Design", 1978.
2. Collinson R.P.G, _Introduction to Avionics', Chapman and Hall, India, 1996.
3. Ian Moir and Allan Seabridge, Aircraft Systems Mechanical, electrical, and avionics subsystems integration, John Wiley & Sons Ltd, 2009.
4. Jane's Unmanned Aerial Vehicles and Targets, Jane's Information Group; ASIN: 0710612575, 1999.
5. Nelson R.C _Flight stability & Automatic Control', McGraw Hill, 1989.
6. Pallet, E.H.J. Aircraft Instruments & Integrated systems‖, Longman Scientific and Technical, McGraw-Hill, 1992.
7. Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.
8. Stevens B.L & Lewis F.L, Aircraft control & simulation', John Wiley Sons, New York, 1992.

MS 18021	MEDICAL MECHATRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To know the principle, design and application of various human measurement and assisted device for the human functional system.

UNIT I INTRODUCTION TO MEDICAL MECHATRONICS 9

Role of Mechatronics in Medical – Overview of human functional system – cell and origin bioelectric potential-Measurement of blood pressure-invasive and noninvasive methods-transducers role in measurement–Heart rate – pressure-temperature-Heart sound – Pulmonary function measurements

UNIT II ASSISTING AND THERAPEUTIC EQUIPMENTS 9

Ventilators – Nerve and muscle stimulators – Diathermy – Heart Lung machine — Dialyzers – centrifuge- coagulators- aspirator – oximeter – spirometer-Nebulizer – Anesthesia machine-Operating Table – examination couches- infusion systems.

UNIT III CARDIAC AND REGULATORY ASSIST SYSTEM 9

Defibrillator - Pacemakers –Muscle and nerve stimulator, Location for Stimulation Synchronous Counter pulsation, Assisted through Respiration Right Ventricular Bypass Pump, Left Ventricular Bypass Pump, Open Chest and closed Chest type, Intra-Aortic Balloon Pumping Veno Arterial Pumping, Prosthetic Cardio Valves, Principle and problem, Biomaterials for implantable purposes, its characteristics and testing. Lithotripsy-Indication and Principle of Haemodialysis, Membrane, Dialysate, Different types of haemodialysis, Monitoring Systems, Wearable Artificial Kidney, Implanting Type.

UNIT IV MEDICAL IMAGING 9

Radio graphic and fluoroscopic techniques –XRay machine- Computer tomography – MRI – FMRI- Ultrasonography – Endoscopy – Colonoscopy -Thermography – Different types of biotelemetry systems and patient monitoring – PET-Introduction to Biometric systems.

UNIT V SENSORY ASSIST DEVICES AND AUTOMATED ANALYSER 9

Types of deafness, hearing aids, application of DSP in hearing aids- Ear irrigator- Voice synthesizer, speech trainer. Ultra sonic and laser canes, Intra ocular lens, Braille Reader, Tactile devices for visually challenged, ophthalmoscopy Text voice converter, screen readers and automated analyser and medical equipment's.

TOTAL : 45 PERIODS

OUTCOMES :

Upon successful completion of the course:

- The students will be able to gain knowledge in therapeutic equipments
- The students able to know the role and importance of artificial assisting devices
- The students will gain knowledge in medical imaging.
- The students are also able to gather functionality and development related issues of assisting devices used in the medical field.

REFERENCES :

1. Albert M Cook and Webster J G – Therapeutic medical devices Prentice Hall Nee York 1982
2. Alfred Horowitz, "MRI Physics for Radiologists – A Visual Approach', Second edition Springer Verlag Network, 1992
3. Andreas.F.Vonracum, Hand book of bio material evaluation, Mc-Millan publishers, 1986.
4. Geddes LA and Baker L.E Principals of Applied Biomedical Instrumentation, John Wiley and sons New York 1989.
5. Jerry L.Prince and JnathanM.Links," Medical Imaging Signals and Systems"- Pearson Education Inc. 2006
6. John L.Semmlow, "Biosignal and Biomedical Image Processing Matlab Based applications" Marcel Dekker Inc.,New York,2004
7. Kolff W.J., Artificial Organs, John Wiley and Sons, New York, 2009
8. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, "Bio-Medical Instrumentation and Measurements", II edition, Pearson Education, 2002 / PHI
9. M.Arumugam, "Bio-Medical Instrumentation", Anuradha Agencies, 2003
   R.S.Khandpur, "Hand Book of Bio-Medical instrumentation", Tata McGraw Hill Publishing Co Ltd., 2003

MS 18022	GREEN MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To introduce the concept of Green Manufacturing Design to the students

UNIT I INTRODUCTION 9

Environmental effects of design – Environmental damage – In efficient energy use – Design for recycling.

UNIT II ENVIRONMENTAL LIFE CYCLE ASSESSMENT 9

Material flow and cycles – Material recycling – Emissionless manufacturing.

UNIT III GREEN DESIGN METHODS 9

Mass balance analysis – Green indicate – Design for disassembly design for recycle – Rist analysis – Material selection.

UNIT IV DESIGN FOR ENVIRONMENT 9

Eco design – Industrial Ecology – Pollution prevention – Reduction of toxic emission.

UNIT V SUSTAINABLE ECONOMIC ENVIRONMENT 9

Solar energy devices – wind energy resources – Full cost accounting methodology – Selection of natural friendly materials.

TOTAL : 45 PERIODS

OUTCOMES :

Upon successful completion of the course:

- Students will understand the concepts of Green Manufacturing Design
- Students will be able to do environmental life cycle assessment
- Students will be able to do green design methods and design for environment
- The learners will develop devices for sustainable economic environment

REFERENCES :

1. Cairn and Francis – Costing the earth – Harvard Business School Press -2009
2. Gradel.T.E. and B.R. Allenby – Industrial Ecology – Prentice Hall – 2010
3. World commission on Environment and Development (WCED), Our Common Future, Oxford University Press, 2005.

MS 18023	SOLID STATE DRIVES	L	T	P	C
		3	0	0	3

OBJECTIVES :

To give the exposure to various switching circuits for electrically operated actuators for the speed, position, direction and breaking task of the automation systems.

UNIT I ELECTRICAL ACTUATORS AND DRIVE CHARACTERISTICS 9

AC - DC Power Sources -Types – Electrical Actuator Input Types - DC Motors, AC Motors, Special Electrical Motors, and Solenoids - Electric Drives – Equations Governing Motor Load Dynamics – Steady State Stability – Multi Quadrant Dynamics Acceleration, Deceleration, Starting & Stopping – Typical Load Torque Characteristics –Selection of Motor.

UNIT II SOLID STATE SWITCHING DEVICES 9

Solid State Relay - Switching Characteristics - Bipolar Junction Transistor (BJT), Metal Oxide Semiconductor - Field Effect Transistor Silicon Controlled Rectifier (SCR) - DIAC- TRIAC- Gate Turn-Off Thyristor (GTO) – Insulated Gate Bipolar Transistor (IGBT) Classification Of PWM Techniques

UNIT III D.C. MOTOR DRIVES 9

Thyristor D.C. Drives – Single and Three Phase Converter - Control Arrangements For D.C. Drives -Chopper-Fed D.C. Motor Drives -D.C. Servo Drives – Speed - Position Control - Digitally Controlled Drives – H Bridge Circuits.

UNIT IV A.C. MOTOR DRIVES 9

Induction Motor Drives –Inverter Fed Drives – Open And Closed Loop Speed Control - Energy Efficient Drive–V/F Control– Voltage / Current Fed Inverter – Closed Loop Control - Synchronous Motors - V/F Control And Self-Control of Synchronous Motor: Power Factor Control – Permanent Magnet Synchronous Motor Drives.

UNIT V SPECIAL ELECTRICAL MOTOR DRIVES 9

Stepper Motor Driver Circuits –Constant Voltage Drive – Current Forced Drive- Chopper Drive – Single Phase and Three Phase BLDC Driver Circuits – Sensorless Motor Drives.

TOTAL : 45 PERIODS

OUTCOMES :

Upon successful completion of the course:

- Students are able to understand the various electrical actuators and their drive characteristics
- Students will be familiarized with solid state switches
- Students will be able to know the various DC and AC drives
- Students will be familiarized with special electrical motor drives

REFERENCES :

1. Austin Hughes, Electric Motor and Drives: fundamentals, types and applications, 4thEdition, Newnes publications, ISBN: 0750647183, 2013

2. Gopal K.Dubey, Fundamentals of Electrical Drives, CRC Press, 2010.

3. Muhammad H. Rashid -Power Electronics Handbook, Third Edition, and Butterworth-Heinemann Publications: ISBN: 0123820367. 1995.

4. Bimal K.Bose. Modern Power Electronics and AC Drives, Academic Press, 2010,

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MS 18024 AND	INTELLIGENT PRODUCT DESIGN AND MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES :

To teach the student the principles and practices of intelligent product design and manufacturing

UNIT I INTRODUCTION TO INTELLIGENT DESIGN AND MANUFACTURING 9

Need - Internet technology and Manufacturing Industry - Digital enterprises - Manufacturing portals – Benefits.

UNIT II TECHNIQUES OF KNOWLEDGE REPRESENTATION 9

Artificial Neural Networks, Fuzzy Logic, Genetic Algorithms, Expert Systems with case studies.

UNIT III INTELLIGENT PRODUCT MODELING TECHNIQUES 9

Intelligent CAD systems, integrating product and process design, manufacturing analysis and CAD/CAM integration, design methodology for automated manufacture, the impacts of intelligent process control on product design, and fuzzy knowledge-based controller design.

UNIT IV APPLICATION OF NEURAL NETWORKS 9

Neural Networks for Intelligent Process Monitoring and Control : Applications to CNC machining, Metal Forming - Intelligent Manufacturing Planning, Scheduling and Control - Intelligent Assembly and Layout Planning.

UNIT V INTERNET BASED COLLABORATIVE CAD/CAM 9

Applications to web based CAD, CAPP, CNC, Assembly planning, and Rapid Prototyping - Challenging issues of Collaborative CAD/CAM.

TOTAL : 45 PERIODS

OUTCOMES :

At the end of this course the student will be able to apply

- Internet technology in manufacturing Industry and use techniques of Knowledge Representation.
- Intelligent product modeling techniques in manufacturing
- Neural networks in manufacturing
- Internet based collaborative CAD/CAM

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REFERENCES :

1. Dagli, C.H., "Intelligent systems in design and manufacturing", ASME, 1994.
2. Huang, G.Q. and Mak, K.L., "Internet Applications in Product design and Manufacturing" , Springer, 2003.
3. Kusiak, A., "Intelligent Design and Manufacturing", Wiley-Interscience, 1992.
4. Parsaei, H.R. and Jamshidi, M., "Design and implementation of intelligent manufacturing systems", Prentics Hall, 1995

MS 18025	ANALYTICAL ROBOTICS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To impart knowledge in the advanced area of Robotics.

UNIT I INTRODUCTION 8

Definition, Types and Classifications of robots – control loops, controls and intelligence, specify degrees of freedoms, actuators and end effectors – grippers, force analysis, serial and parallel manipulators.

UNIT II ROBOT KINEMATICS 10

Introduction – Representation of a rigid body – Mappings and Operators – Homogeneous Transformation, position analysis - Forward Kinematics – Geometric Approach, Algebraic approach, Denvit–Hartenbers representations – Inverse Kinematics. Velocities -Differential motion and velocity of frames – Jacobian

UNIT III ROBOT DYNAMICS AND TRAJECTORY PLANNING 10

Lagrangeon mechanics, dynamic equations for single, double and multiple DOF robots – static force analysis of robots, Trajectory planning – Joint space, Cartesian space description and trajectory planning – third order, fifth order - Polynomial trajectory planning

UNIT IV ROBOT PROGRAMMING & AI 9

Types of Programming – Teach Pendant programming – Requirement of Robot Programing Language, Structure of Robot Programming Language – Offline Programming Systems – Basic concepts in AI techniques – Concept of knowledge representations and Inference – Robot Learning.

UNIT V MODELLING AND SIMULATION 8

Modeling and simulation of robotic joints,- position , velocity and acceleration analyses of simple mechanisms and robots, -synthesis of robots,- simulation of robot configuration.

TOTAL : 45 PERIODS

OUTCOMES :

Upon successful completion of the course:

- The students are able to know about the kinematic arrangement of robots and its applications in the area of manufacturing sectors.
- The students will gain knowledge in robot dynamics and trajectory planning
- The students will be able to do robot programming.
- The students will be able to do modeling and simulation of robots

REFERENCES :

1. Fu.K.S, Gonzalac R.C, Lee C.S.G, "Robotics Control, sensing ,vision and intelligence", Mc-Graw Hill book co 2011.
2. John J. Craig, "Introduction to Robotics: Mechanics and Control", Pearson, Third Edition.2008.
3. Yoram Koren , Robotics, McGraw Hill 2006
4. Groover.M.P., "Industrial Robotics", McGraw – Hill International edition, Second edition, 2012.
   Saeed.B.Niku, "Introduction to Robotics, Analysis, system, Applications", Pearson educations, 2002.