KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE – 638 052
(Autonomous)

M.E. DEGREE IN MECHATRONICS ENGINEERING (FULL TIME)

CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – I

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	THEORY							
14MMT11 / 14MMT12	Bridge Course Electronics (or) Bridge Course Mechanical	3	1	0	4	40	60	100
14AMT14	Advanced Mathematics For Mechatronics	3	1	0	4	40	60	100
14MMT13	Computer Numerically Controlled Machines	3	0	0	3	40	60	100
14MMT14	Fluid Power System Design	3	1	0	4	40	60	100
14MMT15	Sensors and Instrumentation	3	0	0	3	40	60	100
14MMT16	Microcontroller and Applications	3	1	0	4	40	60	100
	PRACTICAL							
14MML11	CNC and Sensor & Instrumentation Laboratory	0	0	3	1	100	0	100
				Total	**23**			

CA - Continuous Assessment, ESE – End Semester Examination

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M.E. DEGREE IN MECHATRONICS ENGINEERING (FULL TIME)

CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – II

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	THEORY							
14MMT21	Robotics and Control	3	0	0	3	40	60	100
14MMT22	Integrated Automation Controller	3	1	0	4	40	60	100
14MMT23	Control System Engineering	3	1	0	4	40	60	100
14MMT24	Factory Automation and CIM	3	0	0	3	40	60	100
	Elective-I (Professional)	3	0	0	3	40	60	100
	Elective-II (Professional)	3	0	0	3	40	60	100
	PRACTICAL							
14MML21	Integrated Automation Controller Laboratory	0	0	3	1	100	0	100
				Total	**21**			

CA - Continuous Assessment, ESE – End Semester Examination

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M.E. DEGREE IN MECHATRONICS ENGINEERING (FULL TIME)

CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – III

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	THEORY							
	Elective-III (Professional)	3	0	0	3	40	60	100
	Elective-IV (Professional)	3	0	0	3	40	60	100
	Elective-V (Open)	3	0	0	3	40	60	100
	PRACTICAL							
14MML31	Fluid Power and Robotics Laboratory	0	0	3	1	100	0	100
14MMP31	Project Work – Phase I	0	0	12	6	50	50	100
				Total	**16**			

CA - Continuous Assessment, ESE – End Semester Examination

SEMESTER – IV

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	PRACTICAL							
14MMP41	Project Work – Phase II	0	0	24	12	100	100	200
				Total	**12**			

CA - Continuous Assessment, ESE – End Semester Examination

Total Credits: 72

KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE – 638 052
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M.E. DEGREE IN MECHATRONICS ENGINEERING (PART TIME)
CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – I

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	THEORY							
14MMT11	Bridge Course Electronics (or) Bridge Course Mechanical	3	1	0	4	40	60	100
14MMT12								
14AMT14	Advanced Mathematics for Mechatronics	3	1	0	4	40	60	100
14MMT13	Computer Numerically Controlled Machines	3	0	0	3	40	60	100
	PRACTICAL							
14MML11	CNC and Sensor & Instrumentation Laboratory	0	0	3	1	100	0	100
				Total	**12**			

CA - Continuous Assessment, ESE – End Semester Examination

SEMESTER – II

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	THEORY							
14MMT21	Robotics and Control	3	0	0	3	40	60	100
14MMT22	Integrated Automation Controller	3	1	0	4	40	60	100
14MMT23	Control System Engineering	3	1	0	4	40	60	100
	PRACTICAL							
14MML21	Integrated Automation Controller Laboratory	0	0	3	1	100	0	100
				Total	**12**			

CA - Continuous Assessment, ESE – End Semester Examination

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(Autonomous)

M.E. DEGREE IN MECHATRONICS ENGINEERING (PART TIME)

CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – III

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	THEORY							
14MMT14	Fluid Power System Design	3	1	0	4	40	60	100
14MMT15	Sensors and Instrumentation	3	0	0	3	40	60	100
14MMT16	Microcontroller and Applications	3	1	0	4	40	60	100
				Total	**11**			

CA - Continuous Assessment, ESE – End Semester Examination

SEMESTER – IV

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	THEORY							
14MMT24	Factory Automation and CIM	3	0	0	3	40	60	100
	Elective-I (Professional)	3	0	0	3	40	60	100
	Elective-II (Professional)	3	0	0	3	40	60	100
				Total	**9**			

CA - Continuous Assessment, ESE – End Semester Examination

KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE – 638 052
(Autonomous)

M.E. DEGREE IN MECHATRONICS ENGINEERING (PART TIME)

CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – V

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	THEORY							
	Elective-III (Professional)	3	0	0	3	40	60	100
	Elective-IV (Professional)	3	0	0	3	40	60	100
	Elective-V (Open)	3	0	0	3	40	60	100
	PRACTICAL							
14MML31	Fluid Power and Robotics Laboratory	0	0	3	1	100	0	100
14MMP31	Project Work – Phase I	0	0	12	6	50	50	100
				Total	**16**			

CA - Continuous Assessment, ESE – End Semester Examination

SEMESTER – VI

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	PRACTICAL							
14MMP41	Project Work – Phase II	0	0	24	12	100	100	200
				Total	**12**			

CA - Continuous Assessment, ESE – End Semester Examination

Total Credits: 72

LIST OF ELECTIVES					
Course Code	**Course Title**	**Hours/Week**			**Credit**
		L	**T**	**P**	
14MME01	Mechatronic System Design	3	0	0	3
14MME02	Automotive Electronics and Control *	3	0	0	3
14MME03	MEMS Design	3	0	0	3
14MME04	Machine Vision System	3	0	0	3
14MME05	Process Control Engineering	3	0	0	3
14MME06	Virtual Instrumentation	3	0	0	3
14MME07	Metrology and Computer Aided Inspection	3	0	0	3
14MME08	Applied Sensor Technology	3	0	0	3
14MME09	Rapid Prototyping and Tooling	3	0	0	3
14MME10	Machine Tool Control and Condition Monitoring *	3	0	0	3
14MME11	Applied Finite Element Method	3	0	0	3
14MME12	Diagnostic Techniques	3	0	0	3
14MME13	Nanoscience and Nanotechnology	3	0	0	3
14MME14	Smart Materials and Structures	3	0	0	3
14MME15	Industrial Safety Engineering	3	0	0	3
14AEE02	Industrial Electronics	3	0	0	3
14AET15	Computational Intelligence Techniques	3	1	0	4
14CCT13	Computer Applications in Design	3	0	0	3
14CCE02	Modeling and Analysis of Manufacturing Systems	3	0	0	3
14COE05	Digital Image Processing and Multi Resolution Analysis	3	0	0	3

*- Open Elective

14MMT11 BRIDGE COURSE – ELECTRONICS FOR MECHANICAL GROUP

3 1 0 4

UNIT – I **9**

Basic Electronics: Intrinsic and Extrinsic Semiconductors – Junction diode Characteristics and its applications – Special purpose diodes: Zener diode – Tunnel diode – Schottky diode – Varactor diode - LED, Photodiode of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulators.

UNIT – II **9**

Bipolar Junction Transistor: CE, CB, CC Configurations and Characteristics –Transistor as an amplifier – JFET – MOSFET – UJT – Need for biasing and biasing methods - Single stage transistor amplifier - Cascading amplifiers – Oscillators.

UNIT – III **9**

Operational Amplifiers and its Applications: Operational amplifier (op-amp) – DC and AC performance Characteristics - Arithmetic operations using op-amp - Applications: Instrumentation amplifier, Sample and Hold circuits, Clippers, Clampers, Peak detectors - Op-amp as comparator - Schmitt trigger - Applications of comparator - Waveform generator: square, sine, triangular waves - Multivibrators - Voltage regulators.

UNIT – IV **9**

Power Electronics: Operating mechanism, characteristics and applications of power diodes, SCR, Diac, Triac, SCS, GTO, LASCR – two transistor model of SCR Controlled Rectifiers:single phase – three phase Rectifying circuits and filters - Regulated power supply – SMPS – UPS.

UNIT – V **9**

Electrical Drives and Special Machines: Basic Elements – Types of Electric Drives – Factors influence the choice of electrical drives – Loading conditions and classes of duty – Speed control of Electrical motors. Constructional details and operation of single phase induction motors – Shaded pole induction motor – Linear reluctance motor – Hysteresis Motor – Servo Motors.

Lecture: 45 Tutorial: 15 TOTAL: 60

REFERENCE BOOKS:

1. R.S. Sedha, "Applied Electronics", S. Chand & Co., 3rd revised edition, 2008.
2. Sergio Franco, "Design with operational amplifiers and analog integrated circuits", 3rd Edition, Tata McGraw-Hill, 2007.
3. Muhamed H.Rashid, "Power Electronics Circuits, Devices and Applications", 4thEdition, PHI, 2013.
4. Dubey, G. K., "Fundamentals of Electrical Drives",Narosa Publishing House, New Delhi, 2002.

Course Outcomes:

On completion of the course the students will be able to

- comprehend various electronics devices and concepts underpinning relevant technologies
- develop and analyze electronics circuits related to their specialization applications
- apply knowledge of machines to meet new purposes

14MMT12 BRIDGE COURSE – MECHANICAL FOR ELECTRICAL GROUP

3 1 0 4

UNIT – I **9**

Mechanisms: Kinematics – Links, pairs and mechanisms - 4 Bar mechanism – Crank rocker - Slider crank mechanisms – Inversions – Determination of Velocity and acceleration of simple mechanisms.

UNIT – II **9**

Friction: Types of friction – simple contact friction- belt and rope drives - Ratio of tensions-friction in screw and nuts – Bearings- pivot, collar, journal bearings and rolling element - hydrostatic and aerostatic bearings, plate and disc clutches –basics of brakes.

UNIT – III **9**

Design Engineering: Design of shafts – Springs – Design of gear drives – Spur gear – Helical- 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.

UNIT – IV **9**

Vibration: Single degree freedom systems – Forced, damped vibrations – System response time constant –Vibration isolation – Torsional vibrations – Two rotor systems.

UNIT – V **9**

Machine Tools: Machine tool construction features and operations: 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.

Lecture: 45 Tutorial: 15 TOTAL: 60

REFERENCE BOOKS:

1. Shigley, J.E. and Uicker, J.J., "Theory of Machines and Mechanisms", McGraw-Hill Inc., 2003.
2. Shigley, J.E. and Mischke R.C., "Mechanical Engineering Design" Mcgraw Hill International Edition, 2010.
3. "Design data book", PSG College of Technology 2011.
4. Hall, "Schaums Outline of Machine Design", McGraw Hill, 2001.
5. Sundararajamurthy and Shanmugham, "Machine Design", Anuradha Publishers, 2003.
6. Kalpakjian,S. and Schmid,S., "Manufacturing Processes for Engineering Materials", 5th Edition, Pearson, Prentice Hall, 2007.

Course Outcomes:

On completion of the course the students will be able to

- compute velocity and acceleration in various links of different types of mechanisms
- calculate the friction behavior in various mechanical elements like bearings, belt drives
- design and analyze the shafts, springs, and gear drives with realistic constraints
- analyse the effect of vibration and its control
- elucidate the various machine tools for material removal process

14AMT14 ADVANCED MATHEMATICS FOR MECHATRONICS

3 1 0 4

UNIT I **9**

Linear Algebra: Vector spaces – Subspaces – Span – Linear independence – Basis and Dimension – Linear Transformation, Matrix of Linear Transformation – Dimension theorem (Statement only).

UNIT II **9**

Laplace Transform Methods: Solution of initial and boundary value problems – Characteristics – Canonical forms – D'Alembert's Solution – Laplace transform methods – Displacement in a long string – Solution of Diffusion equation.

UNIT III **9**

Calculus of Variation: Concept of variation – Euler equation – Variational problems with fixed boundaries – Variational problems involving several unknown functions – Functional involving first and second order derivates – Functional involving several independent variables – Isoperimetric problems – Direct methods – Rayleigh-Ritz method – Kantorowich method.

UNIT IV **9**

Graph Theory: Introduction of graphs – Isomorphism – Subgraphs – Walks, paths and circuits – Connected graphs – Eulerian Graphs – Hamiltonian Paths and circuits – Digraph –Some types of digraphs – Connectedness – Adjacency matrix and incidence matrix of graphs – Shortest path algorithms – Dijkstra's algorithm – Warshall's algorithm – Trees – Properties of trees – Spanning trees – Minimal spanning trees – Prim's Algorithm – Kruskal's algorithm.

UNIT V **9**

Finite Element Methods: Partial differential equations – Finite element method – Orthogonal collocation method – Orthogonal collocation with finite element method – Galerkin finite element method.

Lecture:45 Tutorial:15 TOTAL: 60

REFERENCE BOOKS:

1. Stephen Andrilli and David Hecker, "Elementary Linear Algebra", Academic Press, USA, Fourth Edition, 2010.
2. Friedberg, A.H., Insel, A.J. and Spence, L., "Linear Algebra", Prentice Hall of India, New Delhi, 2004.
3. Sankara Rao, K. "Introduction to Partial Differential Equation", Prentice Hall of India, New Delhi, 2011
4. Gupta, A.S., "Calculus of Variations with Applications", Prentice Hall of India Pvt. Ltd., New Delhi, 1997.
5. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall, 2005.
6. Gupta S.K. "Numerical methods for Engineers", New age publishers 2003.

Course Outcomes:

On completion of the course the students will be able to

- apply linear algebra concepts in engineering
- solve wave and diffusion equations by Laplace transforms and variational problems
- handle graph theory oriented problems in Mechatronics engineering
- solve partial differential equations by finite element methods

14MMT13 COMPUTER NUMERICALLY CONTROLLED MACHINES

3 0 0 3

UNIT – I **9**

Construction Features of CNC Machines: Introduction- CNC Machine Building, Drives and Controls: Drive Mechanism, Spindle Drives, Axes drives, Feed drives, Linear Motors and Actuators, Magnetic Levitation. Power transmission elements - Spindle bearing – Arrangement and installation - Guide ways – Configuration and design, friction and anti-friction LM guide ways, Retrofitting.

UNIT – II **9**

Control Systems for CNC Machines & CAD/CAM Integration: Interfacing – Monitoring – Diagnostics – Machine data – Sources of errors - Compensations for Machine accuracy – DNC – Adaptive control CNC systems. Concepts of High speed Machining and micro machining. Networking- networking techniques, LAN, components- Graphics standards – Data exchange format, evolution- features of various interfaces GKS, IGES, DXF, PDES, STEP etc., Process planning, Computer Aided process planning(CAPP) - Variant, generative Approaches.

UNIT – III **9**

CNC Programming: Structure of CNC program, Part Program Terminology - Coordinate system, G & M codes, cutter radius compensation, tool nose radius compensation, tool wear compensation, canned cycles, sub routines, do loop, mirroring features, Manual part programming for CNC turning and machining centre – APT programming for various machines in FANUC - Computer aided part programming - Post processing.

UNIT – IV **9**

Tooling System and Management: Tooling system - Interchangeable tooling system – Preset, Qualified and semi-qualified tools – Coolant fed tooling system – Modular fixturing – Quick change tooling system – Automatic head changers – Tooling requirements for Turning and Machining centers – Tool holders – Tool assemblies – Tool Magazines – ATC Mechanisms – Tool management.

UNIT – V **9**

Economics of CNC Operations and special purpose CNC Machines: Factors influencing selection of CNC machines-Cost of operation of CNC machines-Practical aspects of introducing CNC machines - Maintenance features of CNC machines - Preventive and other maintenance requirements. CNC grinding machines, CNC bending machines- pipe bending, CNC turret Press, CNC EDM-Wire cut EDM, CNC ECM-Electrochemical grinding machines.

TOTAL : 45

REFERENCE BOOKS:

1. Madison, J., “CNC machining Handbook; Basic theory, Production data and Machining process”, Industrial Press Inc., 2005.
2. Alan Overby “CNC Machining handbook; Building, Programming and Implementation”, Tab Electronics, 2010.
3. Michael Fitzpatrick, NE Arlington WA, “Machining and CNC Technology”, 3rd Edition, Mc Graw Hill Education, 2014.
4. Yoram Koren, “Computer Control of Manufacturing Systems”, International Student Edition, Mc Graw Hill International Book Company, 1985.

5. Thyer, G.E., "Computer Numerical Control of Machine Tools", B.H Newberg, 1996.
6. Adithan, M. and Pabla, B.S., "CNC Machines", New Age International (P) Limited, 3rd edition, 2010.
7. Krar and Steve, "CNC technology & programming", TATA McGraw Hil., New Delhi, 1990.
8. Sehrawat, M.S. and Narang, J.S., "CNC Machines (Computer Numerical Control)", Dhanpat Rai and Co (Pvt) Ltd., New Delhi, 2014.
9. http://www.cnc-technology.com

Course Outcomes:

On completion of the course the students will be able to

- comprehend the basic components and mechanisms involved in a CNC system
- develop Part Programming for various machining processes
- select various tooling systems and fixtures
- appreciate about the economic concepts and special purpose CNC machines
- computes the operation and maintenance cost of CNC machines

14MMT14 FLUID POWER SYSTEM DESIGN

3 1 0 4

UNIT – I **9**

Fundamentals and Power Source of Hydraulic System: Basics of fluid power system – Pascal's Law and its application –Fluid properties – Losses in pipes, valves and fittings – Advantages of Fluid power systems. Hydraulic Power pack- Construction, Heat generation and dissipation- Fluid power symbols – Hydraulic pumps: Gear, Vane and Piston pumps, Pump Performance, Characteristics and Selection - Sizing of pumps.

UNIT – II **9**

Control Components of Hydraulic System: Direction control valves: Three way valve, Four way valve, Check valve and shuttle valve – Actuation mechanism – Pressure control valves: Pressure relief, Pressure Reducing, Counter balance, Sequencing and Unloading Valves – Flow control valves and its types – Proportional Valves – Servo valves- Fluid power actuators: Linear and Rotary actuators – types – Cushioning mechanism in cylinders – Sizing of Actuators.

UNIT – III **9**

Fundamentals of Pneumatic System: Properties of Air - Perfect Gas laws – Compressors: piston, screw and vane compressor – Fluid conditioning Elements: Filter, Regulator and Lubricator unit, Pneumatic silencers, After coolers, Air dryers – Air control valves – Pneumatic actuators – Hydrostatic transmission system: Principle, application and sizing.

UNIT – IV **9**

Fluid Power Circuit Design: Circuit design methods: Cascade method, Step counter method and KV Map method (two / three cylinder circuits) – Basic pneumatic circuits – Electrical components and electrical controls for Fluid power circuits – Introduction to Fluid logic devices and applications – Accumulator – Types and application circuits – Pressure intensifier circuits – PLC applications in Fluid power circuit – Introduction to fluid power simulation software.

UNIT – V **9**

Industrial Circuits and Maintenance: Industrial circuits: Speed control circuits – Regenerative cylinder circuits – Pump unloading circuit – Double pump circuit – Counter balance valve circuit – Hydraulic cylinder sequencing circuit – Automatic cylinder reciprocating circuit – Cylinder synchronizing circuits – Fail safe circuits - Sealing devices: Types and materials – Installation, Maintenance and trouble shooting of Fluid Power systems.

LECTURE: 45 TUTORIAL: 15 TOTAL : 60

REFERENCE BOOKS:

1. Esposito Anthony, "Fluid Power with Applications", Seventh Edition, Pearson Higher Education, New York, 2011.
2. Majumdar, S.R., "Pneumatic Systems – Principles and Maintenance", Second Edition, Tata McGraw-Hill, New Delhi, 2006.
3. Majumdar, S.R., "Oil Hydraulic Systems – Principles and Maintenance", Second Edition, Tata McGraw-Hill, New Delhi, 2006.
4. Sullivan James A., "Fluid Power - Theory and Applications", Fourth Edition, Prentice Hall International, New Jersey, 1998.

5. Pippenger, John and Hicks, Tyler, “Industrial Hydraulics”, Third Edition, Tata McGraw-Hill, New Delhi, 1987.

Course Outcomes:

On completion of the course the students will be able to

- identify fluid power components and their symbols as used in industry and also describe the function and operation of hydraulic power pack and control components
- express the functions and operations of Pneumatic components and to design and demonstrate fluid power circuits using PLC, Electrical components and fluid power software
- understand various industrial circuits and to install, maintain and trouble shoot fluid power circuits for engineering applications in a safe manner

14MMT15 SENSORS AND INSTRUMENTATION

3 0 0 3

UNIT – I **9**

Introduction to Measurement: Units and Standards - Instrument classification - Calibration techniques - Characteristics of Instruments - Static and dynamic - Classification of errors - Error analysis - Statistical methods - Uncertainty.

UNIT – II **9**

Non-electrical transducers: Classification of transducers - Temperature Measurement: Filled system thermometer - Bimetallic thermometer - Pressure Transducers: Elastic transducers - Bourdon gauge - Bellows - Diaphragm. Vacuum: McLeod gauge, thermal conductivity gauge - Ionization gauge.

UNIT – III **9**

Flow and Temperature measurement: Turbine flow meter, Electromagnetic flow meter - Hot wire anemometer - Ultrasonic Meter - Resistive transducers - Potentiometer - RTD - Thermistor - Thermocouple - Radiation Pyrometer.

UNIT – IV **9**

Force, Displacement, Magnetic and Digital Sensors : Strain gauges - Force measurement - Inductive transducer - LVDT - RVDT - Capacitive transducer - Piezo electric transducer – Magnetic Sensor- Types –Magneto resistive – Hall effect – Current sensor - Digital displacement transducers.

UNIT – V **9**

Signal Conditioning and Data Acquisition: Need for Signal Conditioning - Amplification - Filtering - Sample and Holding - Data logging and Acquisition - Distributed Data Acquisition and control systems - Interface system and standards.

TOTAL : 45

REFERENCE BOOKS:

1. Doebelin, E. O., "Measurement Systems – Applications and Design", Fifth –Edition, Tata McGraw Hill, New Delhi, 2004.
2. Sawhney, A. K., "A course in Electrical and Electronic Measurement and Instrumentation", Dhanpat Rai and Co (P) Ltd, New Delhi, 2012.
3. Beckwith, Marangoni and Lienhard, "Mechanical Measurements", Sixth Edition, Addison – Wesley, New York, 2006.
4. Roy Choudry, D and Sheil Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd. New Delhi, 2014.
5. Patranabis, D., Sensor and Actuators, Prentice Hall of India, 2005.
6. Manabendra Bhuyan, "Intelligent Instrumentation: Principles and Applications", CRC Press, Newyork, 2011.
7. Barney, "Intelligent Instrumentation", Prentice Hall of India, New Delhi, 1988.

Course Outcomes:

On completion of the course the students will be able to

- describe the basic concepts of measurement system
- attain knowledge of various non-electrical and electrical transducers for measurement
- appreciate the importance of sensors in various applications and realize the signal processing concepts

14MMT16 MICROCONTROLLER AND APPLICATIONS

(Common to Mechatronics & CAD/CAM)

3 1 0 4

UNIT – I **9**

8051 Microcontroller: Microcontroller and embedded processors - Overview of the 8051 family - 8051 microcontroller architecture - Memory organization of 8051 - PSW register - Register banks and stack, Input/ Output ports, pins.

UNIT – II **9**

8051 Programming: Timer/Counter - Serial Communications Interrupts - Instruction set - Addressing modes - I/O port Programming - Timer / counter programming - Serial communications Programming - Interrupt Programming.

UNIT – III **9**

PIC Microcontrollers Architecture: PIC microcontroller overview and features - Harvard architecture - Pipelining – Architecture of PIC18-PinDescription-Memory organization: Program memory-Data Memory -Register Organization.

UNIT – IV **9**

PIC 18Features: I/O Ports Timers Counters-Capture/ Compare - PWM- External Hardware Interrupts- USART-ADC-Interfacing to External memory.

UNIT – V **9**

PIC 18 programming: Addressing Modes - Instruction set-Simple Programs. I/O port programming-Timer/Counter programming- Serial communications Programming - Interrupt Programming.

Lecture:45 Tutorial:15 TOTAL: 60

REFERENCE BOOKS:

1. Mazidi Muhammad Ali and Mazidi Janice Gillispie, "The 8051 Microcontroller and Embedded Systems", Twelfth Impression second edition, Pearson Education, 2013.
2. Mazidi,MuhammadAli,Mckinlay,RolinD.,andCauseyDanny,"PICMicrocontroller and Embedded SystemsusingAssemblyandCforPIC18", Pearson Education Asia, 2008.
3. Ayala Kenncth J., "The 8051 Microcontroller Architecture, Programming and Applications", Second edition, Penarm international publishing (India), Mumbai, 2004.
4. Peatman John B., "Design with PIC Microcontroller", Twelfth Indian reprint, Pearson education, New Delhi, 2005.
5. www.microcontroller.com
6. www.atmel.com
7. www.mirochip.com

Course Outcomes:

On completion of the course the students will be able to

- understand the organization of 8051 microcontroller and its programming concepts
- interpret the basic architecture and features of PIC18 microcontroller
- apply the programming skills for interfacing and various applications using PIC18 microcontroller

14MML11 CNC AND SENSOR & INSTRUMENTATION LABORATORY

0 0 3 1

LIST OF EXPERIMENTS

CNC LABORATORY:

1. Study of G codes and M codes for machining centre and turning centre.
2. Programming and machining of given component using HMT VMC 200T.
3. Programming and machining of given component using HMT VMC T70.
4. Programming and machining of given component using CNC Turning Centre.
5. Programming and simulation of given component using MASTER CAM (Lathe).
6. CNC code generation of given component using MASTER CAM (Lathe) and interfacing it to CNC turning centre.
7. Programming and machining of given component using CNC Machining Centre.
8. Programming and simulation of given component using MASTER CAM (Milling).
9. NC code generation of given component using MASTER CAM (Mill) and interfacing it to CNC Machining Centre.
10. CNC code generation of given component using Pro Manufacturing.

SENSOR & INSTRUMENTATION LABORATORY:

11. Measurement of temperature.
12. Measurement of displacement.
13. Strain Measurement.
14. Torque measurement.
15. Force Measurement.
16. Flow measurement.
17. Pressure Measurement.
18. Level Measurement.
19. Speed Measurement.
20. Measurement of temperature, air-flow using LabVIEW

TOTAL: 45

REFERENCE BOOKS:

1. Radhakrishnan, P., "Computer Numerical Control Machines", New Central Book Agency, 2001.
2. CNC Lab Manuals.
3. Sensors and Signal processing Lab Manual

Course Outcomes:

On completion of the course the students will be able to

- develop, simulate and execute part program using CNC production and trainer machines
- simulate using CAM package and interface the developed program with the machine
- perform the measurements of different physical parameters
- analyse the characteristics of various measurement system

14MMT21 ROBOTICS AND CONTROL

(Common to Mechatronics & Control and Instrumentation Engineering)

3 0 0 3

Prerequisites: Bridge Course Mechanical, Applied Mathematics for Mechatronics

UNIT – I **9**

Introduction: History of robotics, Components and structure of industrial robots – Work space – Robot specifications - Degree of freedom- Joint types - Types of robots – Accuracy, Resolution and Repeatability - End effectors and grippers design – Dexterity -Robot applications.

UNIT – II **9**

Concepts of Finite Transformation: Descriptions: Position, Orientations and translation – Mapping: Changing from frame to frame – Operators: Translations, Rotation and Transformation, Further Properties of Rotations.

Robot Kinematics: Homogeneous Transformation matrices, Representation of links using Denavit - Hartenberg parameters, Forward kinematics and Inverse kinematics – Position, Velocity and acceleration analysis-applications.

UNIT– III **9**

Velocity and Static force: Introduction, Linear and angular velocities of a rigid body, Velocity propagation – Derivation of Jacobian matrix for Serial manipulator, Singularities, Static force of serial manipulator.

UNIT – IV **9**

Robot Dynamics: Acceleration of a rigid body, Inertia of a link, Legrangian formulation, Euler formulation - Recursive Newton Euler formulation – Derivation of equations of motion for manipulators – Inverse dynamics of manipulator.

UNIT – V **9**

Robot Control : Point to point – Continuous path and controlled path motions – Joint trajectory vs Cartesian trajectory – Trajectory planning – Trajectory following - Disturbance rejection – PD and PID control – Computer torque control – Adaptive control – Feedback linearization for under actuated systems.

TOTAL: 45

REFERENCE BOOKS:

1. Craig, John J., "Introduction to Robotics: Mechanics and Control", Third edition, Copyright©2009 Dorling Kindersley (India) Pvt. Ltd., license of Pearson Education in South Asia.
2. Mark W.Spong and M. Vidyasagar "Robotics Dynamics and control", John Wiley Publication, 2008.
3. Groover, M.P., "Industrial Robotics, Technology, Programming and Applications", Second edition Tata Mcgraw-Hill, 2012.
4. Deb, Sathya Ranjan, "Robotics Technology and Flexible Automation", Second edition, Tata Mcgraw-Hill Publication, New Delhi, 2010.
5. S.K Saha "Introduction to Robotics", First Edition, Tata Mcgraw-Hill, 2008.

6. Saeed B. Niku “Introduction to Robotics: Analysis, Control, Applications”, SecondEdition, Wiley India Pvt Ltd, 2012.
7 Robert J. Schilling “Fundamentals Of Robotics: Analysis And Control”, First Edition, Prentice-Hall, 2009.

Course Outcomes:

On completion of the course the students will be able to

- know the basics components and total functionality of an industrial Robot
- ability to solve the kinematics and the linear and angular velocities of a serial manipulator
- solve dynamic equations for different manipulator configurations
- recognize the roll of motion planning and different schemes of control techniques

14MMT22 INTEGRATED AUTOMATION CONTROLLER

3 1 0 4

UNIT – I **9**

Device layer components: Input Devices- Pushbuttons – Proximity Sensors- Read switch –float switch-pressure switch-temperature switch-limit switch-Encoders – MCB - Output Devices – Relays – Contactors – OLR – DOL Starter - Solenoid valves- relay logic program for simple industrial case studies.

UNIT – II **9**

Programmable Logic Controller: Parts of PLC – Principles of operation – PLC sizes – PLC hardware components – I/O modules – Programming devices- different modes of PLC operation-maintenance and troubleshooting procedure.

UNIT – III **9**

PLC Programming : Types of PLC programming – Simple instructions – Latching relays - Converting simple relay ladder diagram into PLC ladder diagram-Timer instructions – On Delay, Off Delay and Retentive Timers – Counter instructions – Up Counter, Down Counter and Up Down Counters- Program control instructions – Data manipulating instructions, math instruction – Closed loop control.

UNIT – IV **9**

Networking of PLC and SCADA: Networking of PLCs – Network communication – OSI Model types – OPC function. Supervisory Control and Data Acquisition – Architecture – development and runtime mode functions, Tools – tag database, recipe database – Data logging, trace – alarm logging – Trend –on line, off line – Security and user access management- Management Information System– report function.

UNIT – V **9**

Distributed Control System and Case Studies: Evolution – Architectures – Comparison – Local control unit – Process interfacing issues – Communication facilities. Operator interfaces – Low level and high level operator interfaces – Operator displays – Engineering interfaces – Low level and high level engineering interfaces – Applications of DCS in – Pulp and paper environment – Petroleum – Refining environment.

Lecture:45 Tutorial:15 TOTAL: 60

REFERENCE BOOKS:

1. Petruzella, Frank D., “Programmable Logic Controllers”, Third Edition, McGraw-Hill, New York, 2010.
2. Stuart Boyer A., “SCADA Supervisory Control and Data Acquisition”, Fourth Edition ISA, USA, 2009.
3. Webb, John, W and Reis, Ronald A., “Programmable Logic Controllers: Principles and Applications”, Fifth Edition, Prentice Hall of India, New Delhi, 2004.
4. Lucas, M.P., “Distributed Control System”, Van Nonstrand reinhold Co. NY, 1986.
5. McMillan, G.K. “Process / Industrial Instruments Handbook”, Fifth edition, Tata McGraw-Hill, New Delhi, 1999.

Course Outcomes:

On completion of the course the students will be able to

- obtain the knowledge about device layer components
- understand PLC architecture and develop PLC Programming
- acquire knowledge about networking of PLC and SCADA
- interpret the elements of DCS and its applications

14MMT23 CONTROL SYSTEM ENGINEERING

3 1 0 4

Pre-requisites: Applied Mathematics for Mechatronics

UNIT – I **9**

System Modelling: System concepts – Mathematical modelling: Electrical systems, Mechanical systems, Electro Mechanical systems – Electrical analogous for mechanical systems – Transfer function: Block diagram reduction techniques, Signal flow graph.

UNIT – II **9**

Time Response Analysis: Test signals – Time response of I and II order systems – Time domain specifications – Steady state error – Generalised error series – Concepts of stability – Routh Hurwitz criterion – Root locus.

UNIT– III **9**

Frequency Response Analysis: Frequency domain specifications – Correlation between time and frequency domain specifications –Bode plot - Polar plot – Nyquist stability criterion– Constant M & N circles – Nichols chart.

UNIT – IV **9**

Compensators Design: Realization of basic compensators – Cascade compensation in time domain and frequency domain –Design of Lag, Lead and Lag – Lead compensator using Bode plot.

UNIT – V **9**

State Space Analysis: Continuous and discrete time state variable theory – State space formulation – State space representation using physical variables, phase variables and canonical variables – Solution of state equations – Controllability - Observability.

Lecture:45 Tutorial:15 TOTAL: 60

REFERENCE BOOKS:

1. Nagrath, I.J. and Gopal M., "Control Systems Engineering", Fifth Edition, New Age International Publishers, New Delhi, 2008.
2. Gopal, M., "Control Systems: Principles and Design", Third Edition, Tata McGraw- Hill, New Delhi, 2008.
3. Nise, Norman S., "Control Systems Engineering", Fifth Edition, Wiley Publishers, 2007.
4. Ogata K., "Modern Control Engineering", Fourth Edition, Pearson Education/ PHI, New Delhi, 2007.
5. Kuo, B.C., "Automatic Control Systems", Eighth Edition, John Wiley & Sons, New York, 2003.

Course Outcomes:

On completion of the course the students will be able to

- develop the mathematical model of an Electrical, Mechanical and Electro mechanical systems
- interpret time response, frequency response, stability of the system and apply the compensation technique to stabilize systems
- analyze the linear and non-linear control systems using continuous and discrete time state variable theory

14MMT24 FACTORY AUTOMATION AND CIM

3 0 0 3

UNIT - I **9**

Automation: Principles and strategies - Elements of an automated system – Levels of automation – Automation in production systems – Automated manufacturing systems – Types – Reasons for automation.

Material handling systems – Types – Design considerations – AGVs – Types and applications – Vehicle guidance technology - Storage systems – Performance –Methods – Automated storage systems.

UNIT - II **9**

Transfer Machines: Transfer Machines: Types, transfer machines for housing type parts, transfer systems, turning devices, pallets, mechanisms for locating and clamping housing - Type parts. Transfer machines for shaft production and gear production. Continuous rotary transfer lines - Layout and output. Automatic Pallet Changer, Modular Fixtures.

UNIT - III **9**

Manufacturing systems: Components of Manufacturing system- Single station manufacturing cells, Manual assembly lines- Automated production lines- automated assembly systems.

UNIT - IV **9**

Cellular Manufacturing: Group technology – Part families – Parts classification and coding – Production flow analysis – Composite part concept – Machine cell design – FMS – Types – Components – Applications and benefits- Automatic data capture - Barcode technology – Radio frequency identification.

UNIT - V **9**

CAQC and Production planning: Benefits of CAQC- Computer Aided Inspection - Contact and Non-contact Inspection Methods - Optical and Non optical types - Computer Aided Testing - Co-ordinate Measuring Machines (CMM).

Material requirement Planning (MRP) - Structure of MRP - Inputs and Outputs of MRP - Manufacturing resource Planning (MRP II) – Enterprise Resource Planning (ERP).

TOTAL: 45

REFERENCE BOOKS:

1. Groover, M.P. “Automation, Production Systems, and Computer-integrated Manufacturing”, Pearson Education, 2010.
2. Groover, M.P. and Simmers, E.W. “Computer Aided Design and Manufacturing”, Pearson Education, 2009.
3. Nand K. Jha. “Handbook of Flexible Manufacturing Systems”, Academic Press, Orlando, 2006.
4. Bedworth, David, “Computer Integrated Design and Manufacturing”, Tata McGraw-Hill, New Delhi, 2007.
5. Koren, Yorem. “Computer Integrated Manufacturing Systems”, McGraw Hill, New York, 2005.

Course Outcomes:

On completion of the course the students will be able to

- understand about automation principles, automated manufacturing systems and material handling systems
- gain knowledge about various transfer machines for production process
- illustrate different manufacturing systems in manufacturing plants
- identify coding systems for different manufacturing parts and design flexible manufacturing systems for a manufacturing industry
- apply computer aided quality control techniques and production planning methods in a manufacturing environment

14MML21 INTEGRATED AUTOMATION CONTROLLER LABORATORY

0 0 3 1

LIST OF EXPERIMENTS

1. Construction of Ladder programming for Boolean operations & Math operations.
2. Interfacing of Electro – Pneumatic system with PLC.
3. Temperature control using PLC.
4. Speed control of AC Motor using PLC and Variable Frequency Drive.
5 Flow control using PLC
6. Pressure control using PLC
7. HMI Interface with PLC.
8. Interfacing PLC real time tag with SCADA
9. Develop a SCADA screen program for process plant operation.
10. Develop a Data base and Recipe tag base in SCADA.
11. Interfacing servo drive with PLC

TOTAL: 45

REFERENCE BOOKS:

- Laboratory manuals

Course Outcomes:

On completion of the course the students will be able to

- design and simulate PLC programs for different logical applications
- interface analog modules with PLC
- design, simulate and interface SCADA with PLC

14MML31 FLUID POWER AND ROBOTICS LABORATORY

0 0 3 1

LIST OF EXPERIMENTS:

A. FLUID POWER LABORATORY :

1. Design and testing of Electro-hydraulic circuit with pressure sequence valve
2. Design of hydraulic circuit for speed control of hydraulic motor and cylinder
3. Circuits with logic controls – AND valve and OR valve
4. Sequential Circuit with pneumatic control (with and without pneumatic timers)
5. Circuits with multiple cylinder sequence – Electrical control
6. Proportional control of Pressure and Flow in hydraulic Circuits
7. Simulation and analysis of fluid power circuits using fluid power simulation software

B. ROBOTICS LABORATORY:

1. Study of 6 DOF Industrial Robot IRB 1410 and system integration
2. Teach TCP and work object for IRB 1410
3. Write a program using online mode to draw a square and circle as per the given dimension
4. Write a program for a given profile using online mode
5. Simulate the robot to follow the target point through off-line mode using robot studio
6. Simulate pick and place operation through off-line mode using robot studio
7. Write an off-line program to develop a user interaction and to read DI/DO interpret

TOTAL: 45

REFERENCE BOOKS:

- Fluid power laboratory manuals
- Robotics laboratory manuals

Course Outcomes :

On completion of the course the students will be able to

- identify the fluid power components and their symbols as used in industry
- design, simulate, construct and test fluid power circuits with pilot, Electrical and Logic control for different applications
- demonstrate the applications of different types of robots
- write the robot program for various applications using simulation software

14MME01 MECHATRONICS SYSTEM DESIGN

3 0 0 3

UNIT – I **9**

Introduction: Mechatronics systems – Key elements – Mechatronics design process – Types of Design - Traditional and Mechatronics design- Integrated product design - Advanced approaches in Mechatronics - Industrial design and ergonomics, safety.

UNIT – II **9**

System Modelling and Identification: Introduction - Model categories - Fields of application - Model development - Model verification - Model validation - Model simulation – Design of mixed system - Electro mechanical system design – Model transformation – Domain independent description forms: Bond graphs – Block diagrams - Simulator coupling.

UNIT – III **9**

System Interfacing: Introduction – Elements of data acquisition and control system – Overview of I/O process - Installation of I/O card and software – TIA/EIA serial interface standards (RS232/422/485) – General Purpose Interface Bus (IEEE 488) - GUI card – Ethernet switch - Man Machine Interfaces.

UNIT – IV **9**

Case Study on Mechatronics Systems: Introduction - Cantilever beam Force measurement system - Strain gauge weighing system - Transducer calibration system - Auto focus Camera - Engine management systems - Controlling temperature of a hot/cold reservoir using PID – pH Control system Control of pick and place robot – Factory Safety system.

UNIT – V **9**

Case Study on Advanced Systems: Sensors in condition monitoring - Mechatronics control in Manufacturing – Artificial neural networks in Mechatronics - Fuzzy logic control in Mechatronics – Micro sensors in Mechatronics.

TOTAL : 45

REFERENCE BOOKS:

1. Shetty, Devdas and Kolk, Richard A., "Mechatronics System Design", Thomson Learning/ Vikas publishing house, New Delhi, 2001.
2. Bolton, W., "Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering", Second Edition, Addison Wesley Longman Ltd., New York, 2009.
3. Pelz, Georg, "Mechatronic Systems: Modeling and Simulation with HDL"s", John Wiley & Sons Ltd, New York, 2003.
4. Bishop, Robert H, "Mechatronics Hand book", CRC Press, London, 2002.
5. Bradley, D. Dawson, N.C.Burd and A.J. Loader, "Mechatronics: Electronics in product and process", Chapman and Hall, London, 1999.

Course Outcomes :

On completion of the course the students will be able to

- identify and analyze the components of Mechatronics system based on designs
- familiarize the interaction between humans and machines
- correlate system design and process with real time applications

14MME02 AUTOMOTIVE ELECTRONICS AND CONTROL

3 0 0 3

UNIT – I **9**

Engine Fundamentals : IC Engines - types - two stroke, four stroke, Petrol and Diesel engines - Ignition system- Fuel system- Cooling system - Exhaust system.

UNIT – II **9**

Sensors and Actuators: Introduction - basic sensor arrangement - types of sensors - oxygen sensor – crank shaft position sensor - temperature sensor - engine oil pressure sensor - fuel metering /vehicle speed sensor and detonation sensor - solenoids - stepper motors- relays.

UNIT – III **9**

Engine Management System: Euro norms - Electronic fuel control - Electronic ignition system - Combined ignition and fuel management - Exhaust emission control - Advanced engine management technology - CAN standard and format.

UNIT – IV **9**

Chassis Control and Safety: Anti-lock brakes - Traction control – Electronic Power Steering- Automatic transmission - Cruise control - Airbags system - Comfort systems.

UNIT – V **9**

Automotive Electricals: Vehicle Electrical systems and circuits – Batteries – Charging systems– Starting systems– Lighting circuits– Dash board instruments – horn – Warning systems – Electric Vehicles.

TOTAL: 45

REFERENCE BOOKS:

1. Ribbens William B., "Understanding Automotive Electronics", Sixth edition, Newnes Publishing, 2003.
2. Denton Tom, "Automobile Electrical and Electronics Systems", Third edition, Edward Arnold Publishers, 2012.
3. Brady Robert N., "Automotive computers and Digital Instrumentation", Prentice Hall International (U.K) Ltd, London, 2000.
4. Jurgon Ronald K., "Automotive Electronics Handbook", McGraw-Hill, New York, 1999.
5. Hollembeak Barry, "Automotive Electricity, Electronics and Computer Controls", Delmar Publishers, New York, 2001.

Course Outcomes:

On completion of the course the students will be able to

- gain the knowledge about the engine fundamentals
- identify the suitable sensors and actuators for automotive system
- recognize the role of electronics in engine management system
- infer the elements of electron chassis control and safety systems
- choose appropriate automotive electrical accessories

14MME03 MEMS DESIGN

(Common to Mechatronis, Applied Electronics, Control and Instrumentation Engineering & VLSI Design)

3 0 0 3

Pre requisites: Sensors and Instrumentation, Bridge course mechanical

UNIT – I **9**

Materials for MEMS and Scaling Laws: Overview - Microsystems and microelectronics - Working principle of Microsystems – Si as a substrate material - Mechanical properties - Silicon compounds - Silicon piezoresistors - Gallium aresenside - Quartz-piezoelectric crystals - Polymer -Scaling laws in Miniaturization.

UNIT – II **9**

Micro Sensors, Micro Actuators: Micro sensors – Types- Micro actuation techniques- Microactuators – Micromotors – Microvalves – Microgrippers – Micro accelerometer – introduction – Types - Actuating Principles, Design rules ,modeling and simulation, Verification and testing –Applications- Fundamentals of micro fluidics- Micro-pump- Types, Actuating Principles, Design rules ,modeling and simulation, Verification and testing –Applications

UNIT – III **9**

Mechanics for Microsystem Design: Static bending of thin plates - Mechanical vibration - Thermo mechanics - Thermal stresses - Fracture mechanics - Stress intensity factors, fracture toughness and interfacial fracture mechanics-Thin film Mechanics-Overview of Finite Element Stress Analysis.

UNIT – IV **9**

Fabrication Process and Micromachining: Photolithography - Ion implantation - Diffusion – Oxidation – CVD - Physical vapor deposition - Deposition by epitaxy - Etching process- Bulk Micro manufacturing - Surface micro machining – LIGA –SLIGA.

UNIT – V **9**

Micro System Design, Packaging and Applications: Design considerations - Process design - Mechanical design – Mechanical Design using Finite Element Method-Micro system packaging – Die level - Device level - System level – Packaging techniques - Die preparation - Surface bonding - Wire bonding – Sealing – CAD tools to design a MEMS device- Applications of micro system in Automotive industry, Bio medical, Aerospace and Telecommunications.

TOTAL : 45

REFERENCE BOOKS:

1. Mohamed Gad-el-Hak, “The MEMS Hand book”, CRC press, 2009.
2. Tai-Ran Hsu, “MEMS and Microsystems Design and Manufacture”, Tata McGraw-Hill, New Delhi, 2008.
3. M.H. Bao, “Micromechanical Transducers: Pressure sensors, accelrometers, and gyroscopes”, Elsevier, New York, 2000.
4. Julian W. Gardner, Vijay K. Varadan, Osama and Awadel Karim, O., “Microsensors MEMS and Smart Devices”, John Wiley & sons Ltd., New York, 2001.
5. Chang Liu, “Foundations of MEMS”, Prentice Hall, 2006.
6. IEEE/ASME: Journal on Microelectromechanical Systems.

Course Outcomes:

On completion of the course the students will be able to

- understand the basic concepts of microsensors, microactuators and micromechanics
- know the microfabrication and micromanufacturing techniques
- apply the knowledge to design a microsystem for various applications

14MME04 MACHINE VISION SYSTEM

3 0 0 3

UNIT – I **9**

Fundamental Concepts: Processing of information in human visual system - Adaptation of different light level - fundamental of Imaging- Introduction to machine vision - Components and specification - Advantages –Disadvantages- Working principles of MVS – Task and benefit – Performance requirement.

UNIT – II **9**

Design of machine vision system: Camera type – Field view – Resolution - Spatial resolution - Measurement of accuracy – Calculation of resolution - Choice of camera - Frame grabber and hardware platform – Pixel rate - Lens design – Focal length – Choice of illumination – Diameter inspection of rivets.

UNIT – III **9**

Lighting system: Demands on machine vision lighting – Light and light perception - Light characteristics – Light sources – Monochromatic light, white light, UV, IR LED and Laser – Polarized lighting – Basic rules and laws of light distribution - Light filter - Directional properties of the light - Types of illuminators – Properties of illuminated field.

UNIT – IV **9**

Camera Computer interface and Image processing: Analog camera buses – Parallel digital camera buses - Standard PC buses – Computer buses – Driver software. Introduction to digital images – Image analysis –Basic, scalar, arithmetic - Image enhancement – Thresholding, Histogram, line profile, intensity measurement – Image processing– Image enhancement – Geometric transformation – Image segmentation - Feature extraction – Morphology – Edge extraction – Fitting - Template matching.

UNIT – V **9**

Software & Applications: Case studies Selection of Machine Vision Software – Various MVS Software's - Case studies: electronic, manufacturing, automobile industries, food and chemical, pharmacy, packaging industries - Research and Aeronautics.

TOTAL: 45

REFERENCE BOOKS:

1. Alexander Hornberg, "Handbook of machine vision", Wiley- VCH, 2006.
2. Davies, E.K., "Machine Vision: Theory, Algorithms, Practicalities", 3rd edition, Elsevier, 2005.
3. Ramesh Jain, Rangachar Kasturi and Brian G. Schunck, "Machine Vision", McGraw-Hill, Mar 1, 1995.
4. Louis J. Galbiati, "Machine vision and digital image processing fundamentals", Prentice Hall PTR, 1990.
5. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision [Hardcover]", 4th edition, Nelson Education, Ltd, 2008.

Course Outcomes :

On completion of the course the students will be able to

- choose the components for designing machine vision system
- interfacing the suitable camera for machine vision applications
- analyse and identify the products with the help of Machine Vision Software

14MME05 PROCESS CONTROL ENGINEERING

3 0 0 3

UNIT – I **9**

Process Dynamics: Need for process control – Mathematical model of first order liquid level, Pressure and Thermal processes – Higher order process – Interacting and non-interacting systems- Continuous and Batch process – Self-regulation – Servo and regulator operation.

UNIT – II **9**

Basic Control Actions: Basic control actions – Characteristics of on-off, proportional, single-speed floating, Integral and Derivative control modes – P+I, P+D and P+I+D control modes – Electronic controllers. Evaluation criteria: IAE, ISE, ITAE and ¼ decay ratio.

UNIT – III **9**

Final Control Element: I/P converter – Pneumatic and electric actuators – Valve positioner – Control valves – Characteristics of control valves: Inherent and Installed characteristics. Valve body – Commercial valve bodies – Control valve sizing – Cavitation and flashing – Selection criteria.

UNIT – IV **9**

Controller with Multiple Loops : Feed forward control – Ratio control – Selective control – Cascade control – Split range control – Inferential control – Predictive control – Adaptive control - Computer process interface for data acquisition and control – Computer control loops.

UNIT – V **9**

Advanced Control Techniques: Introduction to stable and unstable process-Synthesis method – Pole placement method – Internal model control – Delay compensation – Model predictive control.

TOTAL: 45

REFERENCE BOOKS:

1. Stephanopoulos and George, "Chemical Process Control", Prentice Hall India, New Delhi, 1997.
2. Emanuel, S. and Savas, "Computer Control of Industrial Processes", Tata McGraw-Hill, 1991.
3. Harriott and Peter, "Process Control", Tata McGraw-Hill, New Delhi, 2008.
4. Seborg and Dale, E., "Process Dynamics and Control", John Wiley and Sons, New York, 2010.
5. Balchan, J. G. and Mumme, G., "Process Control Structures and Applications", Van Nostrand Renhold Co., New York, 1988.

Course Outcomes :

On completion of the course the students will be able to

- model a process mathematically and develop control strategies
- understand the concept behind the controller tuning and final control elements
- proficient enough to understand advanced control techniques for process control applications

14MME06 VIRTUAL INSTRUMENTATION

(Common to Mechatronics, Applied Electronics & Power Electronics and Drives)

3 0 0 3

Pre-requisites: Sensors and Instrumentation

UNIT – I **9**

Introduction to Virtual Instrumentation: Historical perspective and traditional bench top instruments, advantages of virtual instrument, block diagram of virtual instrument, physical quantities and analog interfaces - User Interfaces and architecture of a virtual instrument and its relation to the operating system.

UNIT – II **9**

LabVIEW Programming Basics –I: Front panel - Block diagram, Tools, Control and Function palette, modular programming - VI and sub VI –structures –FOR – WHILE loops, Case, Sequence Structures, event structures- Formula nodes- local and global variables.

UNIT – III **9**

LabVIEW Programming Basics –II: Arrays, Clusters, string and File – High level and Low level file I/O – Time and Dialog control- Waveform- graph- chart operations- string functions- Report generation and publishing measurement data in web.

UNIT – IV **9**

Data Acquisition System: Instrument control – GPIB – VISA – instrument drivers-serial port communication. Data Acquisition review: Review of Transducer and Signal conditioning, DAQ hardware- AI- AO- DI/O- DAQ assistant and configurations.

UNIT – V **9**

Applications of Virtual Instrumentation: Networking basics for office and industrial applications - Development of process database management system – Simulation of system using VI - Image acquisition and processing – Motion control.

TOTAL : 45

REFERENCE BOOKS:

1. Jeffery Travis and Jim kring, “LabVIEW for Everyone: Graphical Programming Made Easy and Fun”, Third Edition, Pearson Education, India, 2009.
2. Gupta, Joseph, John, “Virtual Instrumentation using LabVIEW”, Second Edition, Tata McGraw Hill, 2010.
3. Wells, Lisa K. Travis and Jeffrey, “LabVIEW for Everyone”, Prentice Hall of India, New Delhi, 2009.
4. Bruce mihure, Austin and Texas, “LabVIEW for data acquisition”, Prentice Hall of India, New Delhi, 2001.
5. LabVIEW Basics I and II Manual, National Instruments, India, 2013.
6. Barry E. Paton, “Sensor, Transducers and LabVIEW”, Prentice Hall of India, New Delhi, 2000.

Course Outcomes:

On completion of the course the students will be able to

- illustrate the fundamentals of Virtual Instrumentation
- develop LabVIEW programming
- interface data acquisition system with real-time applications

14MME07 METROLOGY AND COMPUTER AIDED INSPECTION

3 0 0 3

UNIT – I **9**

Linear and Angular Measurements: Basic concept – Legal metrology- Precision- Accuracy- Types of errors – Standards of measurement- traceability – Interchange ability and selective assembly, gauge blocks, limit gauges - Gauge design. Comparators: mechanical, electronic, optical and pneumatic - Angular measurement: bevel protractor - Angle gauges - Sine bar – Autocollimator - Profile projectors.

UNIT – II **9**

Surface Finish and Form Measurement: Measurement of surface finish: terminology – Roughness – Waviness – Evaluation of surface finish - Stylus probe instrument – Talysurf – Screw thread metrology: errors in thread – Pitch error – Measurement of various elements - Two and three wire method - Best wire size - Thread gauges - Floating carriage micrometer. Measurement of gears - Terminology- Measurement of various elements of gear - Tooth thickness - Constant chord and base tangent method - Parkinson Gear Tester.

UNIT – III **9**

Laser Metrology: Characteristics of LASER sources, LASER micrometer, LASER interferometer – Constructional features - Sources of errors – Measurement of position error, straightness and angle of machine tools, LASER alignment telescope, LASER triangulation techniques. In-process and post process gauging, Automatic gauging, Tool wear measurement, Roundness measurement using LASER, Flexible inspection systems.

UNIT – IV **9**

Co-Ordinate Measuring Machines: Coordinate Metrology, types of CMM, constructional features - Structural elements - Drive systems -Support systems - Displacement transducers - Probing system – Software - Control system, temperature fundamentals and accuracy enhancement.

UNIT – V **9**

Image Processing and Machine vision system: Image processing: Image acquisition & digitization – Windowing – Segmentation - Thresholding - Edge detection techniques, interpretation - Grey scale correlation – Template matching, applications in Inspection, interfacing machine vision and robot, Reverse engineering Applications.

TOTAL : 45

REFERENCE BOOKS:

1. Connie Dotson, Roger Harlow and Richard Thompson, “Fundamentals of Dimensional Metrology”, Thompson Asia, Singapore, 2003.
2. Jain, R. K., “Engineering Metrology”, Khanna Publishers, New Delhi, 20th Edition, 2008.
3. Gupta, I.C., “A Text Book of Engineering Metrology”, Dhanpat Rai and sons, 3rd Edition 2008.
4. Groover, M. P., “Automation, production system and computer integrated manufacturing”, Prentice-Hall, New Delhi, 2008.
5. “ASME Handbook of Industrial Metrology”, Prentice Hall of India, New Delhi, 1992.

6. Farago Francis T. and Curtis Mark A., “Handbook of Dimensional Measurement”, Industrial Press Inc., New York, 2007.
7. Bosch John A., “Coordinate Measuring Machines and Systems”, Marcel Dekker Inc., New York, 1995.

Course Outcomes:

On completion of the course the students will be able to

- understand the types, construction and working principles of measuring instruments
- demonstrate the principles of laser interferometry and laser metrology
- apply the principle of computer aided inspection techniques and image processing techniques

14MME08 APPLIED SENSOR TECHNOLOGY

3 0 0 3

UNIT – I **9**

Introduction to Physical Sensors: Introduction – Historical development of sensors – Sensor Characteristics and Terminology – Physical Effects Employed for Signal Transduction – Classification of sensors – New Sensor Materials and Technologies.

UNIT – II **9**

Semiconductor-Based Sensors: Overview – Thickness-Shear-Mode (TSM) Resonators – Surface Acoustic Wave Sensors – Amperometric Sensors – Conductometric Sensors: Chemiresistors – Capacitive pH Sensors – Ion Channel Sensors – Organic Field-Effect Transistors.

UNIT – III **9**

Magnetic Sensors: Introduction – Hall sensors – AMR sensors – GMR sensors – Induction and fluxgate sensors – Resonance sensors – Magnetic position sensors – Contactless current sensors.

UNIT – IV **9**

Fiber Optic Sensors: Introduction – Corpuscular Properties of Light: Lambert–Beer Law – Luminescence – Light Polarization – Light Scattering – Characteristics of optical sensors – Fiber Optic Sensors Based upon the Fabry–Perot Interferometer – Polarimetric Optical Fiber Sensors – In-Fiber Grating Optic Sensors – Distributed Fiber Optic Sensors.

UNIT – V **9**

Wireless Sensor Networks: Introduction to Wireless Sensor Networks – Individual Wireless Sensor Node Architecture – Wireless Sensor Networks Architecture – Inter layer Communication – Power Consideration in Wireless Sensor Networks – Applications of Wireless Sensor Networks.

TOTAL: 45

REFERENCE BOOKS:

1. John Vetelino, Aravind Reghu, "Introduction to Sensors", CRC Press, 2010.
2. Jacob Fraden, "Handbook of Modern Sensors", Springer, 2010.
3. Jon S. Wilson,"Sensor Technology Handbook", Newnes, 2005.
4. Pavel Ripka, Alois Tipek, "Modern Sensors Handbook", ISTE Ltd, 2007.
5. Roger G. Jackson, "Novel Sensors and Sensing", CRC Press, 2004.
6. Francis To So Yu, Shizhuo Yin, "Fiber Optic Sensors", Marcel Dekker, 2002.
7. Jirı Janata, "Principles of Chemical Sensors", Springer, 2009.

Course Outcomes:

On completion of the course the students will be able to

- critically evaluate their application in different environments
- use technology for production of sensors and is able to apply this to research projects
- understand the theoretical models and to combine sensors to evaluate measurable parameters

14MME09 RAPID PROTOTYPING AND TOOLING

(Common to Mechatronics & CAD/CAM)

3 0 0 3

UNIT – I **9**

Introduction to RP systems: Introduction: Product design and rapid product development - Need for time compression in product development, Conceptual design - Detail design Prototype fundamentals, Fundamentals of RP systems - 3D modelling-3D solid modeling software and their role in RPT - Data format - STL files, History of RP systems, classification of RP systems, benefits of RPT.

UNIT – II **9**

Liquid based RP systems: Stereo Lithography Apparatus (SLA) – Principle - Photo polymers - Post processes - Process parameters - Machine details - Advantages, Solid Ground Curing (SGC) – Principle - Process parameters - Process details - Machine details - Limitations. Solid Object Ultraviolet Laser Printer (SOUP) Principle - Process parameters - Process details - Machine details - Applications.

UNIT – III **9**

Solid based RP systems: Fusion Deposition Modeling (FDM) – Principle - Raw materials – BASS - Water soluble support system - Process parameters - Machine details - Advantages and limitations, Laminated Object Manufacturing – Principle - Process parameters - Process details - Advantages and limitations. Solid Deposition Manufacturing (SDM) - Principle - Process parameters - Process details - Machine details - Applications.

UNIT – IV **9**

Powder based RP systems: Selective Laser Sintering (SLS) – Principle - Process parameters - Process details - Machine details, Advantages and applications, 3-Dimensional Printers (3DP) – Principle - Process parameters - Process details - Machine details – Advantages and limitations, Laser Engineered Net Shaping (LENS) – Principle – Process details - Advantages and applications, Concept Modelers.

UNIT – V **9**

Rapid Tooling and Applications of RP: Indirect Rapid Tooling - Silicone rubber tooling, Aluminum filled epoxy tooling, Spray metal tooling, Direct Rapid Tooling - Direct AIM, Quick cast process, Copper polyamide, Rapid Tool, DMLS, ProMetal, Sand casting tooling, soft tooling vs hard tooling, Applications of RP in product design, automotive industry, medical field – Conversion of CT/MRI scan data - Customised implant - Case studies, reverse engineering - Surface Generation from points on cloud, Growth of RP industry.

TOTAL : 45

REFERENCE BOOKS:

1. Chua, C. K., Leong, K. F. and Lim, C. S., “Rapid Prototyping: Principles and Applications”, World Scientific, New Jersey, 2010.
2. Pham, D. T. and Dimov, S. S., “Rapid manufacturing”, Springer-Verlag, London, 2011.
3. Jacobs, P. F., “Rapid Prototyping and Manufacturing: Fundamentals of Stereolithography”, McGraw-Hill, New York, 1992.
4. Hilton, P. D., “Rapid Tooling”, Marcel Dekker, New York, 2000.
5. home.utah.edu/~asn8200/rapid.html

6. Rapid Prototyping Journal, Emerald Group Publishing Limited
7. http://www.cheshirehenbury.com/rapid/index.html

Course Outcomes :

On completion of the course the students will be able to

- understand and apply the concepts of rapid prototyping in product development
- understand the principle, process, machines and process parameters of different RP processes
- demonstrate the ability to conceptualize manufacturing processes and systems through direct and indirect tooling systems

14MME10 MACHINE TOOL CONTROL AND CONDITION MONITORING

3 0 0 3

UNIT – I **9**

Overview of Automatic Control in Machine Tools: Open loop and closed loop system in machine tools- process model formulation-transfer function control actions-block diagram representation of mechanical pneumatic and electrical systems. Process computer - peripherals-Data logger-Direct digital control-Supervisory computer control.

UNIT – II **9**

Drive Systems and Feed Back Devices in Machine Tools: Hydraulic and Pneumatic drives, Electrical drives – A.C. Motor, D.C. Motor, Servo motor and Stepper motor. Feedback devices - Syncro, resolver, diffraction gratings, potentiometer, Inductosyn and encoders-application in machine tools.

UNIT – III **9**

Adaptive Control and PLC: Adaptive control-types – ACC, ACO, Real time parameter estimation, Applications- adaptive control for turning, milling, grinding and EDM. Programmable logic controller-Functions- Applications in machine tools.

UNIT – IV **9**

Vibration, Acoustic Emission / Sound: Primary & Secondary signals, Online and Off-line monitoring. Fundamentals of Vibration, Sound, Acoustic Emission. Machine Tool Condition Monitoring through Vibration, Sound, Acoustic Emission, Case Studies.

UNIT – V **9**

Condition Monitoring, through other Techniques: Visual & temperature monitoring, Leakage monitoring, Lubricant monitoring, condition monitoring of Lube and Hydraulic systems, Thickness monitoring, Image processing techniques in condition monitoring.

TOTAL : 45

REFERENCE BOOKS:

1. Mikell P.Groover, "Automation Production system and Computer Integrated Manufacturing", Prentice Hall of India Pvt. Ltd., 2010.
2. Sushil Kumar Srivstava, "Industrial Maintenance and Management" S.Chand & Company Ltd., New Delhi, 2011.
3. Manfred Weck, "Hand Book of Machine Tools" –Vol.3, John Wiley & Sons, 1995.

Course Outcomes:

On completion of the course the students will be able to

- understand the automation and coherent technologies in machine tool controls
- familiarize the concepts of drives systems and adaptive control in machine tools
- understand the tool condition monitoring in various technologies

14MME11 APPLIED FINITE ELEMENT METHOD

3 0 0 3

UNIT – I **9**

Introduction: Historical background - Relevance of finite element analysis in design – Matrix approach – Discretisation – Element Types - Matrix algebra – Gaussian elimination – Governing equations for continuum – Classical Techniques in FEM. Weighted residual method – Ritz method. Potential energy approach – Galerkin approach for one and two dimensions.

UNIT – II **9**

One Dimensional Problems: 1-D Finite element modeling – Coordinates and shape functions – Assembly of stiffness matrix and load vector – Finite element equations – Quadratic shape functions – Applications to plane trusses.

UNIT – III **9**

Two Dimensional Problems: Introduction to 2-D Finite element modeling – Scalar valued problem – Poisson equation –Laplace equation – Triangular elements – Element stiffness matrix – Force vector - Stress calculation – Temperature effects.

UNIT – IV **9**

Axisymmetric Elements: Introduction – Shape functions – Strain displacement and stress strain relationship matrices for axi-symmetric element - Torsional cylindrical member – Galerkin approach.

UNIT – V **9**

Isoparametric Elements: Bilinear quadrilateral elements – Quadratic quadrilaterals – Hexahedral elements - Numerical integration – Gauss quadrature –Examples of 2D and 3D applications.

TOTAL : 45

REFERENCE BOOKS:

1. Reddy J.N., "An Introduction to the Finite Element Method", McGraw Hill, International Edition, 2006.
2. Logan D.L, "A First Course in the Finite Element Method", Third Edition, Thomson Learning, 2011.
3. Cook, Robert Davis et al "Concepts and Applications of Finite Element Analysis", Wiley, John & Sons, 2003
4. Segerlind L.J., "Applied Finite Element Analysis", John Wiley, 1984.
5. S.S.Rao, "The Finite Element Method in Engineering", Butterworth-Heinemann, 2010.

Course Outcomes:

On completion of the course the students will be able to

- comprehend the finite element concepts useful for analyzing engineering components
- derive the element matrix equations for solving 1D, 2D structural and thermal problems
- solve and analyze the engineering problems using axisymmetric and isoparametric elements

14MME12 DIAGNOSTIC TECHNIQUES

3 0 0 3

UNIT – I **9**

Maintenance Systems: Maintenance Concept, Maintenance objective, Challenges in maintenance. Planned and unplanned maintenance - Breakdown maintenance - Corrective maintenance - Opportunistic maintenance - Routine maintenance - Preventive maintenance - Predictive Maintenance - Condition based maintenance system - Design out maintenance – Maintenance by objectives – Selection of maintenance system.

UNIT – II **9**

Failure Analysis: Defect generation - Types of failures - Defect reporting and recording - Defect analysis - Failure analysis - Equipment down time analysis - Breakdown analysis - FTA - FMEA - FMECA.

UNIT – III **9**

Systematic Maintenance System: Codification and Cataloguing - Instruction manual and operating manual - Maintenance manual and departmental manual - Maintenance time standard - Maintenance work order and work permit - Job monitoring – Feedback and control – Maintenance records and documentation. Introduction to Total Productive Maintenance (TPM).

UNIT – IV **9**

Computer Managed Maintenance System: Selection and scope of computerization – Equipment classification – Codification of breakdown, material and facilities - Job sequencing - Material management module – Captive engineering module. Decision making in maintenance. Economic aspects of maintenance.

UNIT – V **9**

Condition Monitoring: Condition monitoring techniques – Visual monitoring – Temperature monitoring – Vibration monitoring – Lubricant monitoring – Cracks monitoring – Thickness monitoring - Noise and sound monitoring – Condition monitoring of hydraulic system. Machine diagnostics – Objectives - Monitoring strategies – Examples of monitoring and diagnostics - Control structures for machine diagnosis.

TOTAL: 45

REFERENCE BOOKS:

1. Sushil Kumar Srivastava, “Industrial Maintenance and Management”, S.Chand & Company Ltd, New Delhi, 2011.
2. Manfred W., “Handbook of Machine Tools-Metrological analysis and performance test”, Volume. IV, John Wiley & Sons, New York, 2011.
3. Mishra, R.C. and Pathak, K., “Maintenance Engineering and Management”, Prentice Hall of India Private Ltd., New Delhi, 2012.
4. http://www.maintenanceworld.com
5. http://www.maintenanceresources.com/referencelibrary/maintenancemanagement/index.htm

Course Outcomes :

On completion of the course the students will be able to

- understand the concepts of maintenance and also design and select suitable maintenance alternative
- comprehend the nature of defect analysis and reporting
- elucidate the systematic and computer managed maintenance system
- understand the types, construction and working principles of condition monitoring instruments

14MME13 NANOSCIENCE AND NANOTECHNOLOGY

3 0 0 3

UNIT – I **9**

Nano science and Technology: Introduction to nanoscale materials - atomic & molecular size - nanotechnology application - Scope of nano science and technology - surfaces and dimensional space – Introduction to top-down and bottom-up.

UNIT – II **9**

Nanostructures: Classification of nanostructures-zero, one, two and three dimensional nanostructures. Size dependency in Nanostructures- Nano composite synthesis and processing - quantum size effects in nanostructures. Chemistry of nano shapes.

UNIT – III **9**

Nanomaterial Synthesis: Synthesis of nanomaterials - Method of nanomaterials preparation – wet chemical synthesis - mechanical grinding-gas phase synthesis - Quantum dots - Nano wires - Nano tubes 2D and 3D films.

UNIT – IV **9**

Nanomaterial Properties: Surface to volume ratio - Surface properties of nanoparticles. Mechanical, optical, electronic, magnetic, thermal and chemical properties of nanomaterials. Size dependent properties - size dependent absorption spectra.

UNIT – V **9**

Nanomaterial Physical Properties: Carbon nano tubes - physical properties and applications. Magnetic behavior of nanomaterials. Electronic transport in quantum wires. Surface chemistry of tailored monolayer - Self assembling techniques.

TOTAL : 45

REFERENCE BOOKS:

1. Mark A. Ratner, Daniel Ratner, "Nanotechnology: A gentle introduction to the next Big Idea", Prentice Hall: 1st Edition, 2003.
2. Meyyappan M. "Carbon nanotubes-science and applications" CRC Press, 2009.
3. Waser Rainer, "Nano Electronics and Information Technology", Wiley VCH, 2003.
4. Charles P. Poole, Frank J. Owens, "Introduction to Nanotechnology", Wiley Interscience, 2003.
5. T. Pradeep, "Nano the Essential Nano science and Nanotechnology", Tata McGraw hill, 2007.

Course Outcomes :

On completion of the course the students will be able to

- know the fundamentals of synthesis of nano materials
- gain knowledge about the about physical properties of nano structured materials
- attain knowledge of the applications of nano structured materials

14MME14 SMART MATERIALS AND STRUCTURES

3 0 0 3

UNIT – I **9**

Smart Materials: Introduction to Smart Materials. Types: Piezoelectric materials – Electrostrictive Materials- Magneto strictive materials- Magneto electric materials – Magneto rheological fluids – Electro rheological fluids - Shape memory alloy materials.

UNIT – II **9**

Smart Sensors: Introduction to **S**mart Sensors – Accelerometers - Force Sensors - Load Cells - Torque Sensors - Pressure Sensors – Microphones - Impact Hammers - MEMS Sensors - Fiber Optic Sensors - Sensor Arrays.

UNIT – III **9**

Smart Actuators and Transducers: Introduction to Smart Actuators: Displacement Actuators - Force Actuators - Power Actuators – Vibration – Dampers – Shakers - Fluidic Pumps – Motors. Smart Transducers: Ultrasonic Transducers - Sonic Transducers - Air Transducers.

UNIT – IV **9**

Smart Structures: Concept of Smart structures - Instrumented structures - Sensing technologies - Signal processing and control of smart structures - Vibration Control using Smart structures.

UNIT – V **9**

Case studies on Smart Structures: Case studies on incorporating design, analysis, manufacturing and application issues involved in integrating smart materials and devices with signal processing and control capabilities to engineering smart structures and products.

TOTAL : 45

REFERENCE BOOKS:

1. Gautschi, G., "Piezoelectric Sensorics: Force, Strain, Pressure, Acceleration and Acoustic Emission Sensors, Materials and Amplifiers", Springer, Berlin, New York, 2002.
2. Engdahl, G., "Handbook of Giant Magnetostrictive Materials", Academic Press, San Diego, Calif., London, 2000.
3. Andre Preumont, "Vibration Control of Active Structures: An Introduction", Second Edition, Kluwer Academic Publishers, Boston, 2002
4. Brian Culshaw, "Smart Structures and Materials", Artech House, London, 1996.

Course Outcomes:

On completion of the course the students will be able to

- understand the physical principles underlying the behavior of smart materials
- attain knowledge about smart sensor, actuator and transducer
- gain information about smart structures

14MME15 INDUSTRIAL SAFETY ENGINEERING

3 0 0 3

Pre-requisites: Bridge course mechanical

UNIT – I **9**

Safety in metal working machinery: General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planning machine and grinding machines, CNC machines. **Principles of machine guarding:** Guarding during maintenance, Zero Mechanical State (ZMS), Definition, Policy for ZMS – Guarding of hazards - Point of operation protective devices, machine guarding, types, fixed guard, interlock guard, automatic guard, trip guard, electron eye, positional control guard, fixed guard fencing- guard construction- guard opening.

UNIT – II **9**

Selection and suitability of machine guarding: Lathe – Drilling – Boring – Milling – Grinding – Shaping – Sawing - Shearing presses - Forge hammer – Flywheels – Shafts – Couplings – Gears - Sprockets wheels and chains - Pulleys and belts - Authorized entry to hazardous installations.

Safety in gas furnace operation: Cupola, crucibles, ovens, foundry health hazards, work environment, material handling in foundries, foundry production cleaning and finishing foundry processes.

UNIT – III **9**

Safety in cold working and hot working: Cold working, power presses, point of operation safe guarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot-operated presses, power press electric controls, power press set up and die removal, inspection and maintenance - Metal sheers - Press brakes. Hot working: safety in forging, hot rolling mill operation, safe guards in hot rolling mills – Hot bending of pipes, hazards and control measures.

UNIT – IV **9**

Safety in welding and gas cutting: Gas welding and oxygen cutting, resistances welding, Arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing – Explosive welding, selection, care and maintenance of the associated equipment and instruments – Safety in generation, distribution and handling of industrial gases-colour coding – Flashback arrestor – Leak detection - Pipe line safety - Storage and handling of gas cylinders.

UNIT – V **9**

Safety in finishing, inspection and testing: Heat treatment operations, electro plating, paint shops, sand and shot blasting, safety in inspection and testing, dynamic balancing, hydro testing, valves, boiler drums and headers, pressure vessels, air leak test, steam testing, safety in radiography, personal monitoring devices, radiation hazards, engineering and administrative controls, Indian Boilers Regulation.

TOTAL : 45

REFERENCE BOOKS:

1. McElroy, Frank E "Accident Prevention Manual" for industrial operations, NSC, Chicago, 1988.
2. "Occupational safety Manual", BHEL, Trichy, 1988.

3. John V. Grimaldi and Rollin H. Simonds, “Safety Management”, All India Travelers Book Seller, New Delhi, 1989.
4. Krishnan N.V., “Safety management in industry”, Jaico Publishers House, Bombay, 1997.
5. “The Indian boilers act 1923 with amendments”, Law publishers (India), Pvt. Ltd., Allahabad.

Course Outcomes:

On completion of the course the students will be able to

- understand the basic safety rules and norms in engineering industry
- demonstrate the knowledge in safety of various manufacturing processes
- understand the application of safety in welding operation and boiler operation inspection and testing

14AEE02 INDUSTRIAL ELECTRONICS

(Common to Applied Electronics & Mechatronics)

3 0 0 3

Pre-requisite : Electron Devices, Electrical Machines, Power Electronics

UNIT – I **9**

Power Semiconductor Devices: Principle of operation – Characteristics of power diodes, SCR, TRIAC, GTO, Power BJT, Power MOSFET and IGBT – Thyristor protection circuits.

UNIT – II **9**

Phase Controlled Rectifiers: Single phase half and full converters – Three phase half and full converters – Triggering circuits. Inverters: Single phase and three phase inverters – Types of PWM techniques: Sinusoidal PWM, modified sinusoidal PWM and multiple PWM.

UNIT – III **9**

DC-DC Converters: Chopper: Principle of operation – Step up and step down chopper – Control Strategies –Voltage, Current and Load commutated chopper.

UNIT – IV **9**

AC-AC Converters: Principle of single phase AC voltage controller – Phase control – ON-OFF control. Cycloconverters: Step up and step down operation - Three phase to single phase and three phase to three phase cycloconverters - Introduction to Matrix Converters

UNIT-V **9**

Solid State DC and AC Drives: DC Drives: Conventional speed control methods for DC motors – DC motor control using rectifiers and choppers – AC drives: Conventional speed control methods for AC motors – Control of induction motor by Voltage, frequency, V/f and slip power recovery scheme. Speed control methods of single phase induction motors and synchronous motors- Sensorless control of Induction motor drives

TOTAL : 45

REFERENCE BOOKS:

1. Muhammad.H.Rashid, "Power Electronics: Circuits Devices and Applications", 3rd Edition, Pearson education, 2003.
2. Ned Mohan, Tore M. Undeland, William P. Robbins, "Power Electronics:- Converters, Applications and Design" 3rd Edition, Wiley India, 2012.
3. K.B.Khanchandani, M.D.Singh, "Power Electronics", 2nd Edition, Tata Mc Graw Hill Publishers, New Delhi, 2006.
4. Gopal K.Dubey, "Fundamentals of Electrical Drives", 2nd Edition, Narosa Book Distributors Pvt. Ltd, 2012.
5. Dubey, G. K, "Power Semiconductor Controlled Drives", Prentice Hall International, New York, 2001.

Course Outcomes:

On completion of the course the students will be able to

- understand the characteristics of power semiconductor devices like SCR, MOSFET, IGBT and their switching waveforms
- analyze the various types of power converters and PWM techniques
- understand the conventional and modern control of AC and DC drives

14AET15 COMPUTATIONAL INTELLIGENCE TECHNIQUES

(Common to Applied Electronics, Power Electronics and Drives & Mechatronics)

3 1 0 4

Pre-requisites: Numerical methods

UNIT – I **9**

Artificial Neural Networks: Introduction to Soft computing – Neural Networks – Model – activation functions – architecture – Supervised learning – Perceptrons – Adaline and Madaline – Back propagation algorithm – Radial Basis Function Networks – Unsupervised Learning and Other Neural Networks – Competitive Learning Networks – Kohonen Self Organizing Networks – Learning Vector Quantization – Hebbian Learning.

UNIT – II **9**

Fuzzy logic: Fuzzy Sets – Basic Definition and Terminology – Set theoretic operations – Membership function formulation and parameterization - Extension principle and Fuzzy Relations- Fuzzy if-then Rules – Fuzzy Reasoning – Fuzzy Inference Systems – Mamdani Fuzzy Models –Sugeno Fuzzy Models –Tsukamoto Fuzzy Models – Input Space Partitioning - Fuzzy Modeling.

UNIT – III **9**

Optimization techniques: Derivative based Optimization: Descent Methods –The Method of steepest Descent – Classical Newton's Method – Step Size Determination – Derivative free Optimization: Genetic Algorithms – Simulated Annealing – Particle swarm Optimization - Ant colony optimization.

Unit – IV **9**

Neuro Fuzzy modeling: Adaptive Neuro Fuzzy Inference Systems – Architecture – Hybrid learning Algorithm –learning methods that Cross-fertilize ANFIS and RBFN – Coactive Neuro fuzzy Modeling – Framework – Neuron Functions for Adaptive Networks – Neuro Fuzzy spectrum.

UNIT – V **9**

Applications: Printed Character Recognition – Inverse kinematics Problem – Applications of soft computing techniques for power electronics: MPPT, speed control for electrical machines, harmonic elimination techniques in power converters.

Lecture:45, Tutorial:15, TOTAL: 60

REFERENCE BOOKS:

1. J.S.R Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI, Pearson Education, 2004.
2. Laurene V. Fausett, "Fundamentals of Neural Networks: Architectures, Algorithms and Applications", Pearson Education, III Edition, 2008
3. Timothy J. Ross, "Fuzzy Logic with Engineering Applications" Wiley India.
4. David E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, New York, 1989.
5. Bimal K Bose, "Neural Network Applications in Power Electronics and Motor Drives-An Introduction and Perspective" , IEEE Transactions on Industrial Electronics, Vol.54, Issue: 1, pp.14-33,February 2007.
6. Whei-Min Lin , Chih-Ming Hong and Chiung-Hsing Chen, "Neural Network Based MPPT Control of a Stand Alone Hybrid Power Generation System" IEEE Transactions on Power Electronics, Vol.26, Issue: 12, pp.3571 – 3581,December 2011.

Course Outcomes:

On completion of the course the students will be able to

- describe the characteristics and algorithms of intelligent systems
- design intelligent controllers and its hybrid topology for various applications
- gain fundamental knowledge on optimization techniques and its implementation procedures

14CCT13 COMPUTER APPLICATIONS IN DESIGN

(Common to CAD/CAM & Mechatronics)

3 0 0 3

Pre-requisites: Applied Mathematics, Engineering Drawing

UNIT – I **9**

Introduction to Computer Graphics: Design Process and CAD – Constraints – Computer graphics principles – Line and Circle drawing algorithms- Parametric equations (lines, circle) -2-D & 3-D transformation -Translation, scaling, rotation -Windowing, view ports - Clipping transformation.

UNIT – II **9**

Visual Realism and Curves: Data Exchange formats – IGES, STEP- Hidden Line, Surface, Solid removal Algorithms - Shading – Coloring – RGB, HSV, HLS - Synthetic curves- Cubic Spline, Bezier.

UNIT – III **9**

Solid Modeling: Solid Modeling Techniques – Constructive Solid Geometry & Boundary Representation - Solid modeling systems – Surface modeling- Rapid prototyping - Parametric modeling- Creation of prismatic and revolved parts using solid modeling packages.

UNIT – IV **9**

Tolerance analysis and Mass property calculations: Assembly Modeling – Tolerance modeling and analysis - Mass property calculations – Curve length, Area, Volume, Mass, Moment of inertia.

UNIT – V **9**

Computers in Design Productivity: Reverse engineering of components – Design optimization. Developing design programs using C / LISP for applications like design of shafts, gears etc.

TOTAL : 45

REFERENCE BOOKS:

1. Zeid, Ibrahim, "Mastering CAD/CAM", Tata McGraw Hill, New Delhi, 2006.
2. Hearn Donald and Baker M Pauline, "Computer Graphics" Prentice Hall Inc, 2000.
3. Neumann William M. and Sproul Robert., "Principles of Computer Graphics" McGraw-Hill Book Co. Singapore 2000.
4. Rao P N., "CAD/CAM: Principles and Applications", Second Edition, Tata McGraw Hill,. 2004.

Course Outcomes:

On completion of the course the students will be able to

- know the importance of mathematical concepts behind computer graphics
- understand the basic techniques used to draw 3D objects in the 2D monitor
- get exposure about the synthetic curves and solid modeling techniques
- know the application of Computers in Design Productivity
- know the tolerance analysis and Mass property calculations

14CCE02 MODELING AND ANALYSIS OF MANUFACTURING SYSTEMS

(Common to CAD/CAM, Engineering Design & Mechatronics)

3 0 0 3

Pre-requisites: Industrial Engineering

UNIT – I **9**

Manufacturing Systems and Models : Types and principles of manufacturing systems, types and uses of manufacturing models, physical models, mathematical models, model uses, model building.

UNIT – II **9**

Material Flow Systems: Assembly lines-Reliable serial systems, approaches to line balancing, sequencing mixed models. Transfer lines and general serial systems-paced lines without buffers, unpaced lines. Shop scheduling with many products. Flexible manufacturing systems-system components, planning and control. Group technology-assigning machines to groups, assigning parts to machines. Facility layout-Quadratic assignments problem approach, graphic theoretic approach.

UNIT – III **9**

Supporting Components: Machine setup and operation sequencing-integrated assignment and sequencing. Material handling systems-conveyor analysis, AGV systems. Warehousing-storage and retrieval systems, order picking.

UNIT – IV **9**

Generic Modeling Approaches: Analytical queuing models, a single workstation, open networks, closed networks. Empirical simulation models-event models, process models, simulation system, example manufacturing system.

UNIT – V **9**

Synchronization Manufacturing and Petri Nets: Synchronization Vs Optimization, defining the structure, identifying the constraint, exploitation, buffer management. Basic definitions-dynamics of Petri nets, transformation methods, event graphs, modeling of manufacturing systems.

TOTAL : 45

REFERENCE BOOKS:

1. Askin Ronald G, “Modeling and Analysis of Manufacturing Systems”, John Wiley & Sons, New York, 1993.
2. Mengchu Zhou, “Modeling, Simulation, and Control of Flexible Manufacturing Systems: A Petri Net Approach”, 2000.
3. Jean Marie Proth and XiaolanXie, “Petri Nets: A Tool for Design and Management of Manufacturing Systems”, John Wiley & Sons, New York, 1996.
4. BrandimarteP, and Villa A, “Modeling Manufacturing Systems”, Springer Verlag, Berlin, 1999.

Course Outcomes:

On completion of the course the students will be able to

- select the appropriate types of manufacturing systems and models
- know about the assembly line transfer line and FMS
- use various materials handling systems
- know about generic modeling systems
- use theory of constraints for modeling the component

14COE05 DIGITAL IMAGE PROCESSING AND MULTI RESOLUTION ANALYSIS

(Common to Communication Systems, VLSI Design, Embedded Systems, Computer and Communication Engineering & Mechatronics)

3 0 0 3

Pre-requisites: Digital Signal Processing

UNIT – I **9**

Image Transforms: Orthogonal transforms – FT,DST,DCT, Hartley, Walsh hadamard, Haar, Radon, Slant Wavelet, KL, SVD and their properties

UNIT – II **9**

Image Enhancement and Restoration: Image enhancement - Point operations - contrast stretching - clipping and thresholding - digital negative intensity level slicing - bit extraction. Histogram processing - histogram equalisation -modification. Spatial operations – smoothing spatial filters, sharpening spatial filters. Transform operations. Color image enhancement. Image Restoration – degradation model, Noise models, Unconstrained and Constrained restoration, Inverse filtering – removal of blur caused by uniform linear motion, Wiener filtering, Restoration by SVD and Homomorphic filtering

UNIT – III **9**

Image Compression: Image Compression – Need for data compression – Run length encoding – Huffman coding – Arithmetic coding – predictive coding- transform based compression, - vector quantization – block truncation coding.

Image Segmentation: Point, Edge and line detection -thresholding-Region based approach

Image Representation: boundary based – region based and intensity based description

UNIT – IV **9**

Registration and Multi valued image Processing: Registration – geometric transformation – registration by mutual information

Mutivalued image processing – colour image processing – colour image enhancement- satellite image processing- radiometric correction – other errors- multi spectral image enhancement- medical image processing – image fusion

UNIT – V **9**

Wavelets And Multiresolution Processing : Image Pyramids – Subband coding – The Haar Transform – Multiresolution Expansion – Series Expansion – Scaling Function – Wavelet Function – Wavelet Transform in One Dimension- The Wavelet Series Expansion – The Discrete Wavelet Transform – The Continuous Wavelet Transform – The Fast Wavelet Transform – Wavelet transform in two dimensions– Applications in image denoising and compression

Total : 45

REFERENCE BOOKS:

1. Chanda B, Dutta Majumder D., "Digital Image Processing and analysis", 2nd Edition, PHI learning, 2011
2. Gonzalez, Rafel C. and Woods, Richard E., "Digital Image Processing", 2nd Edition, Prentice Hall, New York, 2006.

3. Jain, Anil K., "Fundamentals of Digital Image Processing", Prentice Hall of India, New Delhi, 2003.
4. Rosenfield, Azriel and Kak, Avinash C., “Digital Picture Processing”, Academic Press Inc, New York, 1982.
5. Jayaraman. S, Esakkirajan. S, and Veerakumar. T, “Digital Image Processing” Tata McGraw-Hill, New Delhi, 2009

Course Outcomes:

On completion of the course the students will be able to

- analyze and process digital images and color images in various domains
- apply concepts of wavelets in image processing for various applications