KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE – 638 052
(Autonomous Institution affiliated to Anna University of Technology, Coimbatore)

M.E. DEGREE IN MECHATRONICS ENGINEERING

CURRICULUM

(For the candidates admitted from academic year 2011 – 12 onwards)

SEMESTER - I

Course Code	Course Title	Hours / Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	THEORY							
11MM101	Bridge Course Electrical (or) Bridge Course Mechanical	3	1	0	4	50	50	100
11MM102								
11MM103	Applied Mathematics for Mechatronics	3	1	0	4	50	50	100
11MM104	Computer Numerically Controlled Machines	3	0	0	3	50	50	100
11MM105	Fluid Power System Design	3	1	0	4	50	50	100
11MM106	Sensors and Instrumentation	3	0	0	3	50	50	100
11MM107	Microcontroller and Interfacing	3	1	0	4	50	50	100
	PRACTICAL							
11MM108	CNC and SSP Laboratory	0	0	3	1	100	0	100
				Total	**23**			

CA – Continuous Assessment, ESE – End Semester Examination

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SEMESTER - II

Course Code	Course Title	Hours / Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	THEORY							
11MM201	Robotics and Control	3	0	0	3	50	50	100
11MM202	Integrated Automation Controller	3	1	0	4	50	50	100
11MM203	Advanced Control Systems	3	1	0	4	50	50	100
11MM204	Factory Automation	3	0	0	3	50	50	100
	Elective I	3	0	0	3	50	50	100
	Elective II	3	0	0	3	50	50	100
	PRACTICAL							
11MM205	Integrated Automation Controller Laboratory	0	0	3	1	100	0	100
				Total	**21**			

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M.E. DEGREE IN MECHATRONICS ENGINEERING

CURRICULUM
(For the candidates admitted from academic year 2011 – 12 onwards)

SEMESTER - III

Course Code	Course Title	Hours / Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	THEORY							
	Elective III	3	0	0	3	50	50	100
	Elective IV	3	0	0	3	50	50	100
	Elective V	3	0	0	3	50	50	100
	PRACTICAL							
11MM301	Fluid Power and Robotics Laboratory	0	0	3	1	100	0	100
11MM302	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							
11MM401	Project Work – Phase II	0	0	24	12	100	100	200
				Total	**12**			

CA – Continuous Assessment, ESE – End Semester Examination

LIST OF ELECTIVES					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
11AE106	Computation Intelligent Techniques	3	0	0	3
11CC101	Computer Applications in Design	3	0	0	3
11CC102	Modelling and Analysis of Manufacturing Systems	3	0	0	3
11MM011	Process Control Engineering	3	0	0	3
11MM012	Computer Integrated Design	3	0	0	3
11MM013	Automotive Electronics and Control	3	0	0	3
11AE017	Industrial Electronics	3	0	0	3
11MM014	Metrology and Computer Aided Inspection	3	0	0	3
11MM015	Diagnostic Techniques	3	0	0	3
11MM016	MEMS Design	3	0	0	3
11MM017	Smart Materials and Structures	3	0	0	3
11MM018	Applied Finite Element Method	3	0	0	3
11MM019	Nanotechnology	3	0	0	3
11MM020	Rapid Prototyping and Tooling	3	0	0	3
11MM021	Virtual Instrumentation	3	0	0	3
11MM022	Advanced Embedded Sensors and System Design	3	0	0	3
11MM023	Machine Vision System	3	0	0	3
11MM024	Industrial Safety Engineering	3	0	0	3
11ED102	Optimization Techniques In Design And Manufacturing	3	1	0	4
11VL025	Digital Image Processing	3	0	0	3

11MM101 BRIDGE COURSE – ELECTRONICS FOR MECHANICAL GROUP

3 1 0 4

Objectives:

- To create basic knowledge in the area of electronics for the mechanical discipline students
- To acquaint the students with the basic characteristics of Electronic devices
- To enhance the knowledge of the students in the area of Integrated circuits and Power Electrons

MODULE - I **15**

Electronic Components and Amplifiers: Passive components - Intrinsic and Extrinsic semiconductors - PN Junction diodes and its applications - Special purpose diodes: Zener diode – Tunnel diode – Schottky diode – Varactor diode - LED, Photodiode - Bipolar Junction Transistor: CE, CB, CC Configurations - Transistor as an amplifier – JFET – MOSFET – UJT – Amplifiers - Biasing methods - Single stage transistor amplifier - Cascading of amplifiers – Oscillators - Tuned amplifiers - Power amplifiers.

MODULE - II **15**

Operational Amplifiers and Its Applications: Operational amplifier (op-amp) – 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.

MODULE - III **15**

Power Electronics: Rectifying circuits and filters - Regulated power supply design - Thyristor families: SCR, DIAC, TRIAC, LASCR - Operating mechanism, characteristics and applications - Introduction to power electronic circuits: Phase controlled Rectifier – Chopper – Inverter - Ac voltage controller - Cyclo converter.

Lecture: 45, Tutorial: 15, TOTAL: 60

REFERENCE BOOKS

1. Salivahanan, S., Suresh Kumar, N., and Vallavaraj, A., "Electronic Devices and Circuits", Tata Mc-Graw Hill, Fourth reprint,2008.
2. Roy Choudhry, D. and Shail B.Jain, "Linear Integrated Circuits", Fourth Edition, New Age International Publisher, 2010.
3. Mehta, V., K., "Principles of Electronics", S.Chand & Company Ltd., New Delhi, 2005.
4. Sedha, R.S., "A Textbook of Applied Electronics", S.Chand & Company Ltd., New Delhi, 2nd new edition, 2010.
5. Bimbra, P.S., "Power Electronics", Eleventh edition, Khanna Publishers, 2003.

11MM102 BRIDGE COURSE - MECHANICAL FOR ELECTRICAL GROUP

3 1 0 4

Objectives: At the completion of the course, the student should be able to:

- Develop their proficiency in mechanical design, materials and manufacturing processes
- Develop the ability to perform mechanism analyses to find the position, velocity, acceleration
- Develop skills for designing and analyzing linkages and other mechanisms and to develop the ability to identify, formulate and solve friction problems

MODULE – I **17**

Mechanisms and Friction: Kinematics – Links pairs and mechanisms - 4 Bar mechanism – Crank rocker – Slider crank mechanisms – Time ratio – Determination – Velocity and acceleration in links – Introduction to vibrations (Basics only). Friction – Nature of surfaces and contact – Friction mechanisms and limiting angle of friction – Friction on screw and nut – Pivot and collar friction – Belt friction – Plate and disc clutches – Brakes.

MODULE - II **15**

Design of Machine Elements and Transmission Systems: Design of shafts – Springs – Introduction to power screws - Application of journal bearings and rolling elements bearings – Re-circulating all/nut assembly – Hydrostatic and aerostatic – bearings. Belt and chain drives – Design of gear drives – Spur gear – Worm and worm wheel.

MODULE - III **13**

Manufacturing Process: Introduction to Casting process - Types – Casting defects – Welding process - Types – Machining process and conventional machine tools - Forming Process.

Lecture: 45, Tutorial: 15, TOTAL: 60

REFERENCE BOOKS

1. Shigley, J.E., “Kinematic Analysis of Mechanisms”, McGraw-Hill, 1988.
2. Shigley, J.E. and Uicker, J.J., “Theory of Machines and Mechanisms”, McGraw-Hill Inc., 2003.
3. Shigley, J.E., “Mechanical Engineering Design”, McGraw-Hill Co., 2010.
4. “Design data book”, PSG College of Technology, 1976.
5. Hall, “Machine Design - Schaum's outline Series”, McGraw Hill, 1983.
6. Sundararajamurthy and Shanmugham, “Machine Design”, Khanna Publishers, New Delhi, 1997.

11MM103 APPLIED MATHEMATICS FOR MECHATRONICS

3 1 0 4

Objective:

On completion of the course the students are expected

- To understand the basic concepts and properties of random processes.
- To understand various types of graphs, trees and basic concepts of algorithm and Least square techniques and decomposition in matrix theory.
- To know about the special types of non-linear ordinary differential equations and the advanced techniques in Numerical Methods.

MODULE – I **15**

Random Processes: Classification – Stationary random processes - Auto correlation – Cross correlation - Power spectral density - Linear system with random input.

Graph Theory: Introduction Simple Graphs, Graphs isomorphism. The incidence and adjacency matrices, Sub-graphs, Vertex degrees, paths and cycles, shortest path problem. Dijgkstra's algorithm – Tress, minimum weight spanning tree, Kurskal's algorithm.

MODULE - II **15**

Matrix Theory: Special vectors and Matrices, Matrix inversion lemma - Least square normal equations - The Cholesky decomposition – Toeplitz matrices and their solutions – Singular value decomposition.

Non-Linear Ordinary Differential Equations: Introduction – Equations with separable variables – Equations reduced to linear form – Bernoulli's equation – Riccati's equation – Special form of Riccati's equation – Non-linear pendulum – Duffing's equations.

MODULE - III **15**

Numerical Techniques: Single step methods to solve differential equation – Taylor's series method – Euler's method – Improved Euler's method – Modified Euler's method – IV order Runge-Kutta method – Multi step methods to solve differential equation – Milne's Predictor - Corrector method– Adam's Predictor-Corrector method Stability analysis – Boundary value problems – Difference methods – Shooting methods.

Lecture: 45, Tutorial: 15, TOTAL: 60

REFERENCE BOOKS

1. Stepheson, G. and Radmore, D.M., "Advanced Mathematical Methods for Engineering and Science Students", Cambridge University Press, 1990.
2. Medhi, J., "Stochastic Processes", New Age International Publishers, New Delhi, 2008.
3. Froberg, C.E., "Numerical Mathematics", The Benkamin Cummings Publishing Co. Inc, 1985.
4. Jain, M. K., Iyengar, S. R. K. and Jain, R. K., "Numerical Methods for Scientific and Engineering Computation", New Age International (P) Ltd. Publishers, 2008.
5. Ale Bjord, " Numerical Methods for least square problems, society for industrial and applied Mathematics,Philadelphia.pa, SIAM 1996
6. Bondy, J. A. and Murthy, U. S. R., "Graph Theory with Applications", Macmillan, 1977.

11MM104 COMPUTER NUMERICALLY CONTROLLED MACHINES

3 0 0 3

Objectives:
At the end of study student should be able to know the constructional, programming & controlling features of CNC Machines and tools.

MODULE - I **17**

Construction Features and Tooling: CNC Machine Building, structural details, 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. Tooling system - Interchangeable tooling system – Preset and 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.

MODULE - II **14**

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, Generation of CNC program using popular CAM software – APT programming for various machines in FANUC - Computer aided part programming - Post processing.

MODULE - III **14**

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.

TOTAL: 45

REFERENCE BOOKS

1. Madision James, "CNC machining Handbook; Basic theory, Production data and Machining process", New york : Industrial press Inc., 1996.
2. Radhakrishnan, P., "Computer Numerical Control Machines", New Central Book agency, 2001.
3. Sehrawat, M.S. and Narang, J.S., "CNC Machines (Computer Numerical Control)", Dhanpat Rai and Co (Pvt) Ltd., Educational & Technical Publishers, New Delhi, 2002.
4. Mechatronics, "HMT Limited", Tata McGraw Hill Publishing Company Ltd., 2001.
5. Yoram Koren, "Computer Control of Manufacturing Systems", International Student Edition, Mc Graw Hill International Book Company, 1985.
6. Thyer, G.E., "Computer Numeric Control of Machine Tools", B.H Newberg, 1996.
7. Adithan, M. and Pabla, B.S., "CNC Machines", New Age International (P) Limited, Second edition.
8. Krar and Steve, "CNC technology& programming", TATA McGraw Hill Publishing company Ltd., New Delhi, 1990.
9. http://www.cnc-technology.com

11MM105 FLUID POWER SYSTEM DESIGN

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

3 1 0 4

Objectives:

To expose the students to the technology that deals with the generation, control and transmission of power using pressurized fluids and to design a setup for low cost Automation.

MODULE - I **17**

Hydraulic system components: Basics of fluid power system - Pascal's Law and its application – Fluid properties – Losses in pipes, valves and fittings – Advantages of Fluid power systems – Fluid power symbols – Hydraulic pumps: Gear, Vane and Piston pumps, Sizing of Pumps, Pump Performance, Characteristics and Selection – 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.

MODULE - II **13**

Pneumatic system components: The perfect Gas laws – Compressors: piston, screw and vane compressor – Fluid conditioning Elements: Filter, Regulator and Lubricator unit, Pneumatic silencers, Aftercoolers, Air dryers – Air control valves – Fluid power actuators: Cylinders and Motors – Types – Cushioning mechanism – Sizing of Actuators – Hydrostatic transmission system – Basic pneumatic circuits – Electrical controls for Fluid power circuits – Introduction to Fluid logic devices and applications – PLC applications in Fluid power circuit.

MODULE - III **15**

Circuit design and Industrial circuits: Circuit design methodologies: Cascade method, Step counter method, KV Map method – Industrial circuits: Speed control circuits – Regenerative cylinder circuits – Pump unloading circuit – Double pump circuit – Counter balance valve circuit – Hydraulic cylinder sequencing circuit (using pressure sequence valve) – Automatic cylinder reciprocating circuit – Cylinder synchronizing circuits – Fail safe circuits – Accumulator – Types and application circuits – Pressure intensifier circuits – Sealing devices – Types and materials – Installation, Maintenance and trouble shooting of Fluid Power systems.

Tutorials: Sizing of pumps and Actuators, Circuit simulation using fluid power simulation software.

Lecture: 45, Tutorial: 15, TOTAL: 60

REFERENCE BOOKS

1. Esposito Anthony, "Fluid Power with Applications", Seventh Edition, Pearson Higher Education, New York, 2009.
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.

11MM106 SENSORS AND INSTRUMENTATION

3 0 0 3

Objectives:
Aim is to learn the concept and principle of operation of various sensors, which finds an extensive application in the field of Automation

MODULE - I **15**
Measurement Characteristics: Units and Standards – Instrument classification - Calibration techniques - Characteristics of Instruments - Static and dynamic - Classification of errors - Errors analysis – Statistical methods – Uncertainty - Classification of transducers – Instruments for measuring temperature, pressure and flow.

MODULE - II **15**
Electrical and Intelligent Instruments: Sensors for Displacement, Force and Torque, Liquid level – Measurement of pH – Light sensors – Smart sensor - Intelligent instruments for measuring pressure and flow – Digital transducers - Digital method of measuring frequency, period, phase difference, pulse width, time interval, time count.

MODULE - III **15**
Signal Conditioning and Data Acquisition: 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", Tata McGraw Hill, New Delhi, 1992.
2. Sawhney, A. K., "A course in Electrical and Electronic Measurement and Instrumentation", Dhanpat Rai and Co (P) Ltd, New Delhi, 2004.
3. Beckwith, Marangoni and Lienhard, "Mechanical Measurements", Fifth Edition, Addison – Wesley, New York, 2000.
4. Roy Choudry, D and Sheil Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd. New Delhi, 2003.
5. Bouwens, A. J., "Digital Instrumentation", Tata McGraw Hill, New Delhi, 1998.
6. Barney, "Intelligent Instrumentation", Prentice Hall of India, New Delhi, 1988.

11MM107 MICROCONTROLLER AND INTERFACING

3 1 0 4

Objectives:

- To teach the students to understand the hardware design of microcontroller-based embedded systems
- To learn the concepts of ALP
- To understand the architecture of the PIC microcontrollers and how to write high-level languages, and embed the code in flash memory for stand-alone system for embedded system designs.

MODULE - I **15**

8051 Microcontroller: Microcontroller and embedded processors – Overview of the 8051 family – 8051 microcontroller architecture – Memory organization of 8051 – PSW register – Register banks and stack – 8051 - Input/Output ports, pins and circuits - Timer/Counter - Serial Communications – Interrupts - Instruction set – Addressing modes.

MODULE - II **15**

8051 Programming and Interfacing: I/O Programming - Timer / counter programming – Serial communications Programming – Interrupt Programming - Interfacing: keyboard interface – Display devices – Analog to digital and digital to analog converters – Sensors – Pulse Measurement - Stepper motor – Interfacing to external memory - Interfacing to 8255.

MODULE -III **15**

PIC Microcontrollers: PIC microcontroller overview and features – Harvard architecture and pipelining – PIC Memory organization - Register file structure and addressing – CPU register – Simple Instruction set – PIC 16F8XX Microcontrollers - Memory organization – Interrupts - I/O ports – Timers – Capture/Compare/PWM Module – Master Synchronous Serial Port Module – USART - Analog to Digital Converter – Applications.

Lecture: 45, Tutorial: 15, TOTAL: 60

REFERENCE BOOKS

1. Mazidi Muhammad Ali and Mazidi Janice Gillispie, "The 8051 Microcontroller and Embedded Systems", Fifth Indian reprint, Pearson education, 2003.
2. Ayala Kenncth J., "The 8051 Microcontroller Architecture, Programming and Applications", Second edition, Penarm international publishing (India), Mumbai.
3. Peatman John B., "Design with PIC Microcontroller", Twelfth Indian reprint, Pearson education, New Delhi, 2005.
4. Deshmukh Ajay V, "Microcontrollers Theory and Applications", Tata McGraw-Hill, New Delhi, 2005.
5. www.microcontroller.com
6. www.atmel.com
7. www.mirochip.com
8. www.keil.com
9. www.8051projects.net
10. www.hobbyprojects.com
11. www.maxim-ic.com
12. Journal of ACM Transactions on Embedded Computing Systems

11MM108 CNC AND SSP LABORATORY

0 0 3 1

Objectives:

- The student will acquire theoretical and practical knowledge related to machining processes. Process planning techniques will be studied and applied for manufacturing mechanical components. Finally automation and integration of manufacturing systems will be taken into account, which will be specially focused on numerical control programming.
- To explore the practical knowledge in various measurement systems such as temperature force, displacement etc. and signal processing system.

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. CNC 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.

SSP LABORATORY:

1. Measurement of temperature.
2. Measurement of displacement.
3. Strain Measurement.
4. Torque measurement.
5. Force Measurement.
6. Flow measurement.
7. Pressure Measurement.
8. Level Measurement.
9. Speed Measurement.
10. Measurement of temperature, flow etc using labVIEW

TOTAL: 45

REFERENCES

1. Doebelin, E. O., “Measurement Systems: Applications and Design”, Tata McGraw Hill, 2004.
2. Sawhney, A. K., “A Course in Electrical and Electronic Measurement and Instrumentation”, Dhanpat Rai & Co, New Delhi, 2004.
3. Sensors and Signal processing Lab Manuals.
4. CNC Lab Manuals.

11MM201 ROBOTICS AND CONTROL

3 0 0 3

Objectives:

The objectives of this course are to introduce the student to the modeling, simulation, and control of spatial multi-degree-of-freedom robotic manipulators. In particular, the student will study the kinematics and dynamics of robotic manipulators. The student will aware about the trajectory planning and control of robots. At the end of this course, the student should be able to understand about the robots, types and their applications. The student will also understand about the kinematics and dynamics concepts. The types of trajectory and trajectory planning will come in practice to the student after the completion of this course.

MODULE- I **15**

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

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

MODULE - II **17**

Robot Kinematics: Homogeneous Transformation matrices, Skew symmetrics matrices, Representation of links using Denavit-Hartenberg parameters, Forward kinematics and Inverse kinematics

Velocity and static force: Introduction, Linear and angular velocities of a rigid body, Velocity propagation – Derivation of the jacobian, Serial manipulator jacobian, Singularities of serial manipulator, Static force of serial and parallel manipulator

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

MODULE - III **13**

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", Second edition, Prentice Hall Inc., London, 2005.
2. Mark W.Spong and M. Vidyasagar "Robotics Dynamics and control"Wiley publication.1984.
3. Groover, M.P., "Industrial Robotics, Technology, Programming and Applications", Tata Mcgraw-Hill, New York, 2008.
4. Deb, Sathya Ranjan, "Robotics Technology and Flexible Automation", Sixth edition, Tata Mcgraw-Hill Publication, New Delhi, 2008.
5. "Robotics fundamental concepts and analysis" A shitava Ghosal,Oxford university press,2006.

11MM202 INTEGRATED AUTOMATION CONTROLLER

3 1 0 4

Objectives:

- To understand the need of automation
- Learn about the various technology development in industrial automation
- Learning of basic PLC concepts & programming techniques
- Understanding SCADA & DCS industrial automation functions
- Case studies in DCS

MODULE – I **15**

Programmable Logic Controllers and Programming: Introduction – Parts of PLC – Principles of operation – PLC sizes – PLC hardware components – I/O modules – Programming devices – Types of programming – Simple instructions – Latching relays PLC ladder diagram, Converting simple relay ladder diagram in to PLC relay ladder diagram.

Timer instructions – On Delay, Off Delay and Retentive Timers – Counter instructions – Up Counter, Down Counter and Up Down Counters, control instructions – Data manipulating instructions, match instruction – Level of industrial control.

MODULE – II **15**

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 – log, trace – alarm logging –Trend –on line, off line – Security and user access management, Management Information System– report function.

MODULE – III **15**

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, Tata McGraw–Hill, 2010.
2. Lucas, M.P., "Distributed Control System", Van Nonstrand reinhold Co. NY, 1986.
3. Webb, John W. "Programmable Logic Controllers: Principles and Application", Fifth edition, Prentice Hall of India, New Delhi, 2004.
4. McMillan, G.K. "Process / Industrial Instruments Handbook", Fifth edition, Tata McGraw-Hill, New Delhi, 1999.
5. www.opcfoundation.com
6. www.progea.com
7. www.rockwellautomation.com
8. Rockwell automation RSVIEW32 Manual -2010

11MM203 ADVANCED CONTROL SYSTEMS

3 1 0 4

Objectives:

- To derive the mathematical models of electrical and mechanical systems
- To understand the concept of time response, frequency response and their significance
- To understand the concept of stability of a dynamic system
- To understand the compensation technique that can be used to stabilize control systems
- To understand the concept of continuous and discrete time state variable theory
- To enable the students to analyze, design, and synthesize the linear and non-linear control systems and will become familiar with analytical methods
- To use MATLAB/LabVIEW facility to aid in the analysis and design of control systems

MODULE – I **13**

System Modelling: System concepts – Mathematical modelling of Electrical systems, Translational and Rotational systems – Electrical analogous for mechanical systems – Transfer function; Block diagram reduction techniques – Signal flow graph.

MODULE – II **16**

Time and Frequency 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 – Frequency domain specifications – Correlation between time and frequency domain specifications – Polar plot – Bode plot – Constant M & N circles – Nyquist stability criterion.

MODULE – III **16**

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

TUTORIALS **15**

MATLAB / LabVIEW applications: Partial Fraction expansion, Transformation of Mathematical models, Transient response analysis, Root locus, Bode diagrams, Nyquist plots, analysis of compensator design problems and State space analysis.

Lecture: 45, Tutorial: 15, TOTAL: 60

REFERENCE BOOKS

1. Ogata, Katsuhiko, “Modern Control Engineering”, Fourth Edition, Pearson Education, New Delhi, 2003.
2. Kuo, B.C. “Automatic Control Systems”, Seventh Edition, Prentice Hall of India, New Delhi, 2002.
3. Nagrath, I. J. and Gopal, M. “Control Systems Engineering”, Third Edition, New Age International, New Delhi, 2003.
4. Goodwin, G.C. and et al, “Control system design”, Pearson Education, 2003.
5. Gopal , M., “Control Systems, Principles & Design”, Tata McGraw-Hill, New Delhi, 2002.
6. Dorf, R.C. and Bishop, R.H. “Modern Control Systems”, Addison Wesley, New York, 1995. (MATLAB reference).
7. Leonard, N.E. and Levine, William. “Using MATLAB to Analyze and Design Control Systems”, Addison Wesley, New York, 1995.

11MM204 FACTORY AUTOMATION

3 0 0 3

Objectives: On completion of the course the student will be able to understand

- Many of the Transfer Machines types
- Many of the automation fundamentals and control techniques.
- Material handling technologies
- Concept of Quality Control Techniques, FMS

MODULE - I **12**

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.

MODULE - II **17**

Automations, Group Technology and MRP: Fundamental concepts: Automation, reasons for automation. Types of automation, automation strategies. Methods of work part transport, transfer mechanism, buffer storage, product design for transfer machine automation, Economics of automation - Decision making between manual/semi automated/fully automated systems, AS/RS – Types, components of AS/RS, Analysis, AS/RS controls, AGV-Types.

Principals of concurrent Engineering - Group technology - Computer Aided Process Planning - Material requirement Planning (MRP) - Structure of MRP - Inputs and Outputs of MRP - Manufacturing resource Planning (MRP II) in a CIM system.

MODULE - III **16**

Computer Aided Quality Control and FMS: Computer Aided Quality Control (CAQC): Computer Aided Inspection - Contact and Non contact Inspection Methods - Optical and Non optical types - Computer Aided Testing - Co-ordinate Measuring Machines (CMM) - Benefits of CAQC - Total Quality Management (TQM).

FMS: Architecture – Types – FMS compared to other types of manufacturing approaches - Benefits of FMS, JIT, 5S, Introduction to Lean Manufacturing.

TOTAL: 45

REFERENCE BOOKS

1. Groover, M.P. “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall of India, New Delhi, 2009.
2. Groover, M.P. and Simmers, E.W. “Computer Aided Design and Manufacturing”, Pearson Education, 2002.
3. Jha, Nand K. “Handbook of Flexible Manufacturing Systems”, Academic Press, Orlando, 2006.
4. Bedworth, David., “Computer Integrated Design and Manufacturing”, Tata McGraw-Hill, New Delhi, 2002.
5. Koren, Yorem., “Computer Integrated Manufacturing Systems”, McGraw Hill, New York, 2005.

11MM205 INTEGRATED AUTOMATION CONTROLLER LABORATORY

0 0 3 1

Objectives: The students will able to understand

- The concepts of programmable logic controllers
- To know the PLC programming techniques
- The interfacing concepts with real time applications
- Automation of process using PLC
- Automation of process using SCADA

LIST OF EXPERIMENTS

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

TOTAL : 45

REFERENCES

- Lab Manuals

11MM301 FLUID POWER AND ROBOTICS LABORATORY

0 0 3 1

Objectives:

- To introduce fluid power components, circuits and systems to the students
- To provide hands-on experience in designing , analyzing and implementing control systems for real and physical systems
- To familiarize the students with the concepts and techniques in robot manipulator control, enough to evaluate, choose and incorporate robot in engineering systems
- To provide hands on experience in designing the controller for robotic manipulators
- To give exposure in the machine vision system

LIST OF EXPERIMENTS

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.

ROBOTICS LABORATORY:

1. Point to Point and Continuous Programming exercise for 6 axis articulated arm robot.
2. Robot programming exercises – using Virtual reality Software.
3. Design and Implementation of PID controller function for single stage linear inverted pendulum (Using MATLAB)
4. Mechanical modelling for ball and beam system using MATLAB
5. Programming for sbRIO – Mobile robot using Lab VIEW
6. Defect identification using Smart Camera Evaluation for Mission Vision application.

TOTAL: 45

REFERENCES

- Lab Manuals

11AE106 COMPUTATIONAL INTELLIGENT TECHNIQUES

(Common to, Applied Electronics, Power Electronics and Control and Instrumentation Engineering and Mechatronics Engineering)

3 1 0 4

Objective:

- To expose the students about the different types of architecture, learning and training methods of neural networks
- To study the concept of rule based system and its modeling
- To expose the students the various optimization techniques
- To learn and analyze the modeling of neuro fuzzy systems
- To study the various real time applications of neuro fuzzy system

MODULE – I **15**

Neural Networks: Introduction to Soft computing – Neural Networks – Supervised learning-Perceptrons – Adaline – Back propagation Multilayer perceptrons – Radial Basis Function Networks – Unsupervised Learning and Other Neural Networks – Competitive Learning Networks – Kohonen Self Organizing Networks – Learning Vector Quantization – Hebbian Learning.

Fuzzy Logic: Fuzzy Sets – Basic Definition and Terminology – Set theoretic operations – Member function formulation and parameterization – Fuzzy Rules and Fuzzy Reasoning

MODULE - II **15**

Fuzzy Logic: 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 and Fuzzy Modeling.

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 – Random Search – Downhill Simplex Search.

MODULE -III **15**

Neuro Fuzzy Modelling: 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.

Applications: Printed Character Recognition – Inverse Kinematics Problem – Automobile fuel efficiency prediction – Soft Computing for Color Recipe Prediction – Single MLP approaches – CANFIS modeling for color recipe prediction

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. R.C.Eberhart, P.K.Simpson and R.Dobbins, "Computational Intelligence PC Tools", AP Professional, Boston 1996.
3. David E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, New York, 1989.
4. S.Rajasekaran and G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", Prentice Hall of India, New Delhi, 2004.

11CC101 COMPUTER APPLICATIONS IN DESIGN

(Common to M.E. Mechatronics Engineering and CAD/CAM branches)

3 0 0 3

Objective:

- To study the mathematical concepts and fundamentals of graphics.
- To study the 2D and 3D transformations, Solid modeling and Visual realism.
- To improve the skill of writing the programs to solve design problem.

MODULE - I **15**

Introduction to Computer Graphics and Visual Realism: 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 – Data Exchange formats – IGES, STEP- Hidden Line, Surface, Solid removal Algorithms - Shading – Coloring – RGB, HSV, HLS.

MODULE - II **15**

Curves and Solid Modeling: Synthetic curves- Cubic Spline, Bezier - 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.

MODULE - III **15**

Computers in Design Productivity: Assembly Modeling – Tolerance modeling and analysis - Mass property calculations –Area, Volume, Mass, Moment of inertia - 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.

11CC102 MODELING AND ANALYSIS OF MANUFACTURING SYSTEMS

(Common to M.E. CAD/CAM and Mechatronics Engineering branches)

Objective: **3 0 0 3**

- To understand the principles of making models for manufacturing systems.
- To analyze the system using theory of constraints and petrinets.

MODULE -I **15**

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

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.

MODULE – II **15**

Group Technology and Layout, Supporting Components: 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, **decomposition of large facilities**, Machine setup and operation sequencing-task assignment, integrated assignment and sequencing. Material handling systems-conveyor analysis, AGV systems. Warehousing-storage and retrieval systems, order picking.

MODULE -III **15**

Generic Modeling Approaches, Synchronization Manufacturing and Petri nets: : Analytical queuing models, a single workstation, open networks, closed networks. Empirical simulation models-even models, process models, simulation system, example manufacturing system models. **Case studies: problem definition, wxyz design approach Planer company design approach**. 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. Ronald G Askin, “Modeling and Analysis of Manufacturing Systems”, John Wiley and Sons, Inc, 1993.
2. Mengchu Zhou, “Modeling, Simulation, and Control of Flexible Manufacturing Systems: A Petri Net Approach”, 2000.
3. Jean Marie Proth and Xiaolan Xie, “Petri Nets: A Tool for Design and Management of Manufacturing Systems” John Wiley and Sons, New York, 1996.
4. P Brandimarte, A Villa, “Modeling Manufacturing Systems” Springer Verlag, Berlin, 1999.

11MM011 PROCESS CONTROL ENGINEERING

3 0 0 3

Objectives:

- To learn the basic concepts of process control and to develop sufficient knowledge in controllers and digital computer in process control
- To understand the behaviour of various physical system and mathematical model
- To learn the basic control action and characteristic of the different controllers

MODULE – I **15**

Process Dynamics and Control Actions: Need of 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 regular operation. Basic control actions - On/off, P, P+I, P+I+D, floating control - Pneumatic and electronic controllers- Evaluation criteria.

MODULE - II **15**

Controller Using Complex Control Techniques: Controller tuning – Z-N and Cohen-Coon method- Feedback control system with large dead time and Inverse response - Feed forward control - Ratio control – Selective control – Cascade control - Split range control – Inferential control – Predictive control - Adaptive control – Final control element – Actuators - I/P and P/I converters - Valve positioner - Control valve characteristics.

MODULE – III **15**

Controller for stable and unstable systems and Digital Computers: Introduction to stable and unstable process-Synthesis method – Pole placement method - Internal model control - Delay compensation - Model predictive control – Computer process interface for data acquisition and control – Computer control loops.

TOTAL: 45

REFERENCE BOOKS

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

11MM012 COMPUTER INTEGRATED DESIGN

(Use of "PSG Design Data" may be permitted)

3 0 0 3

Objectives: At the completion of the course, the student should be able to

- Explain the use and applications of parametric design
- Explain the use and applications of software packages in the product design
- Explain the use and applications of computer aided manufacturing (CAM) systems
- Develop their proficiency in mechanical design, materials and manufacturing processes

MODULE - I **16**

Introduction and Design of Shaft: Phases of design - Standardization and interchangeability of machine elements - Tolerances for process and function - Individual and group tolerances - Selection of fits for different design situations - Design for assembly and modular constructions - Concepts of integration – Concepts of concurrent engineering – Structural. Design of shaft - Analysis and design of shafts for different applications - Detailed design - Preparation of production drawings - Integrated design of shaft, bearing and casing - Design for rigidity.

MODULE - II **14**

Gears and Gear Boxes: Principles of gear tooth action - Gear correction - Gear tooth failure modes - Stresses and loads – Component design of spur, helical, bevel and worm gears - Design for sub assembly - Integrated design of speed reducers and multi - Speed gear boxes - Application of software packages.

MODULE - III **15**

Clutches and Brakes: Integrated design of automobile clutches and over running clutches. Brakes - Dynamic and thermal aspects of vehicle braking - Integrated design of brakes for machine tools, automobiles and mechanical handling equipments.

TOTAL: 45

REFERENCE BOOKS

1. Newcomb, T. P. and Spur, R. T., "Automobile Brakes and Braking Systems", Second Edition, Chapman and Hall, London, 1975.
2. Juvinall, R. L. C., "Fundamentals of Machine Component Design", John Wiley & Sons, New York, 2006.
3. Maitra, G. M., "Hand Book for Gear Design", Tata McGraw-Hill, New Delhi, 2005.
4. Shigley, J. E., "Mechanical Engineering Design", McGraw-Hill, New York, 2008.

11MM013 AUTOMOTIVE ELECTRONICS AND CONTROL

3 0 0 3

Objectives:

The electronics control of mechanical equipments in the field of Automobiles gives more comfort, efficiency and also user friendly to the user. This subject is formed such a way that to create a knowledge to the students to understand and create various electronics control of Automotive elements.

MODULE - I **15**

Sensors and Actuators: Introduction - Temperature – Pressure - Air flow - Position – Oxygen - Speed – Knocks - Principle of operation, arrangement and materials – Solenoids - Relays - Stepper motor.

MODULE- II **20**

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

MODULE -III **10**

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

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, 2004.
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.

11AE017 INDUSTRIAL ELECTRONICS

(Common to Mechatronics, Applied Electronics and Control and Instrumentation Engg)

3 0 0 3

Objectives:

- To familiarize the Mechatronics students with power electronics and its applications in Industries
- To get an overview of different types of power semiconductor devices and phase controlled rectifiers
- To study the basic topologies in DC-DC converters and inverters

MODULE - I **16**

Power Electronic Devices and Converters: Principle of operation – Characteristics of power diodes, SCR, TRIAC, GTO, Power BJT, Power MOSFET and IGBT – Thyristor protection circuits. Phase controlled Rectifiers: Single phase full converters – Three phase half and full converters – Triggering circuits. Inverters – PWM techniques – Sinusoidal PWM, modified sinusoidal PWM and multiple PWM.

MODULE - II **12**

DC-DC and AC-AC Converters: Chopper: Principle of operation – Step up and step down chopper – Control Strategies –Voltage, Current and Load commutated chopper. AC voltage Controller: Principle of single phase AC voltage controller – Phase control – ON-OFF control – Multistage sequence control – Cycloconverters - Step up and step down operation - Three phase to single phase and three phase to three phase cycloconverters.

MODULE - III **15**

Solid State DC and AC Drives: Constructional details, principle of operation and performance characteristics of DC motors – DC motor control using rectifiers and choppers – AC drives - Constructional details, principle of operation and performance characteristics of single phase induction motor, three phase induction motor – Control of induction motor by V, V/f and slip power recovery scheme using inverters and AC power regulators.

TOTAL: 45

REFERENCE BOOKS

1. Rashid, M. H., "Power Electronics: Circuits Devices and Applications", Third Edition, Prentice Hall International, New Delhi, 2004.
2. Mohan, Ned, Undeland and Robbins, "Power Electronics", John Wiley and Sons, New York, 2002.
3. Singh, M. D. and Khanchandani, K. B., "Power Electronics", Second edition, Tata McGraw-Hill, New Delhi, 2007.
4. Dubey, G. K., "Fundamental Electric Drives", Second Edition, Narosa Publications, 2002.
5. Dubey, G. K., "Power Semiconductor Controlled Drives", Prentice Hall International, New York, 2001.

11MM014 METROLOGY AND COMPUTER AIDED INSPECTION

3 0 0 3

Objectives: On completion of the course the students will be able to

- Understand the types, construction and working principles of inspection instruments
- Learn the principle of laser based inspection instruments and systems
- Apply the principle of computer aided inspection techniques

MODULE - I **15**

Introduction to Metrology: Units of length – Legal basis for length measurement – Traceability – Interchangeability, gauge blocks - Auto collimator - Measurement of Straightness and flatness, Profile projectors, pneumatic and electronic comparators, Surface finish measurement - Talysurf, gear metrology - Gear rolling tests.

MODULE - II **15**

Laser Metrology: 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.

MODULE - III **15**

Co-Ordinate Measuring Machines and Image Processing: 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. Applications - Reverse engineering, 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 .

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, 2008.
3. Gupta, I.C., “A Text Book of Engineering Metrology”, Dhanpat Rai and sons, 2008.
4. Groover, M. P., “Automation, production system and computer integrated manufacturing”, Prentice-Hall, New Delhi, 2008.
5. “ASME Handbook of Industries 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.

11MM015 DIAGNOSTIC TECHNIQUES

3 0 0 3

Objectives: At the end of the study the student will be able to

- Plan the maintenance activity for a manufacturing plant
- Know-How to find the fault in an equipment
- Manage the maintenance activities using computers effectively

MODULE - I **17**

Maintenance Systems and Failure Analysis: Maintenance Concept, Maintenance objective, Challenges in maintenance. Defect generation - Types of failures - Defect reporting and recording - Defect analysis - Failure analysis - Equipment down time analysis - Breakdown analysis - FTA - FMEA - FMECA. 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.

MODULE - II **16**

Systematic and Computer Managed 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). 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.

MODULE - III **12**

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 Management”, S.Chand & Company Ltd, New Delhi, 1998.
2. Bibring, Manfred H., “Handbook of Machine Tools”, Volume. III, John Wiley & Sons, New York, 1984.
3. Mishra, R.C. and Pathak, K., “Maintenance Engineering and Management”, Prentice Hall of India Private Ltd., New Delhi, 2002.
4. http://www.maintenanceworld.com/
5. http://www.maintenanceresources.com/referencelibrary/maintenancemanagement/index.htm

11MM016 MEMS DESIGN

3 0 0 3

Objectives: The course is designed so that students will

- Gain a fundamental understanding of standard micro fabrication techniques and the issues surrounding them
- Know the major classes, components, and applications of MEMS devices/systems and to demonstrate an understanding of the fundamental principles behind the operation of these devices/systems
- Understand the unique requirements, environments, and applications of MEMS
- Apply knowledge of micro fabrication techniques and applications to the design and manufacturing of an MEMS device.

MODULE - I **20**

Scaling and Micro Mechanics: Overview - Microsystems and microelectronics - Working principle of Microsystems - Micro actuation techniques - Micro sensors – Types – Microactuators – Types – Micropump – Micromotors – Microvalves – Microgrippers - Scaling laws in Miniaturization - Static bending of thin plates - Mechanical vibration - Resonant vibration - Thermo mechanics - Thermal stresses - Fracture mechanics - Stress intensity factors, fracture toughness and interfacial fracture mechanics.

MODULE - II **13**

Materials and Fabrication Process: Substrates and wafer - Single crystal silicon wafer formation - Ideal substrates - Mechanical properties - Silicon compounds - Sio_2, SiC, Si_3N_4 and polycrystalline silicon - Silicon piezoresistors - Gallium aresenside - Quartz-piezoelectric crystals - Polymers for MEMS - Conductive polymers – Photolithography - Ion implantation - Diffusion – Oxidation – CVD - Physical vapor deposition - Deposition by epitaxy - Etching process.

MODULE - III **12**

Micro System Design and Manufacturing: Clean room technology - Bulk Micro manufacturing - Surface micro machining – LIGA –SLIGA - Micro system packaging – Materials - Die level - Device level - System level – Packaging techniques - Die preparation - Surface bonding - Wire bonding – Sealing - Design considerations - Process design - Mask layout design - Mechanical design - Applications of micro system in Automotive industry, Bio medical, Aero space 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. Fatikow, S. and Rembold, U., “Microsystem Technology and Microrobotics”, Springer-Verlag Berlin Heidelberg, 1997.
4. Francis, E., Tay, H. and Choong, W. O., “Microfludics and BioMEMS Applications”, Springer, 2002.
5. Julian W. Gardner, Vijay K. Varadan, Osama and Awadel Karim, O., “Microsensors MEMS and Smart Devices”, John Wiley & sons Ltd., New York, 2001.
6. IEEE/ASME: Journal on Microelectromechanical Systems.

11MM017 SMART MATERIALS AND STRUCTURES

3 0 0 3

Objectives: The objectives are to provide students with

- The fundamentals of smart materials, devices and electronics, in particular those related to the development of smart structures and products
- The skills, knowledge and motivation in the design, analysis and manufacturing of smart structures and products

MODULE - I **12**

Smart Materials: Smart Materials - Piezoelectric materials - Electrostrictive Materials – Magnetostrictive materials - Magnetoelectric materials - Magnetorheological fluids - Electrorheological fluids - Shape Memory materials.

MODULE - II **15**

Smart Sensor and Actuator: Smart Sensors – Accelerometers - Force Sensors - Load Cells - Torque Sensors - Pressure Sensors – Microphones - Impact Hammers - MEMS Sensors - Fiber Optic Sensors - Sensor Arrays - Smart Actuators - Displacement Actuators - Force Actuators - Power Actuators – Vibration – Dampers – Shakers - Fluidic Pumps – Motors - Smart Transducers - Ultrasonic Transducers - Sonic Transducers - Air Transducers.

MODULE - III **18**

Smart Structures: Concept of Smart structures - Instrumented structures - Sensing technologies - Signal processing and control of smart structures - Vibration Control using 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. Srinivasan, A.V., “Smart Structures: Analysis and Design”, Cambridge University Press, Cambridge, New York, 2001.
2. Moulson, A. J. and Herbert, J. M., “Electroceramics: Materials, Properties, Applications”, Second Edition, John Wiley & Sons, Chichester, West Sussex, New York, 2003.
3. Gautschi, G., “Piezoelectric Sensorics: Force, Strain, Pressure, Acceleration and Acoustic Emission Sensors, Materials and Amplifiers”, Springer, Berlin, New York, 2002.
4. Engdahl, G., “Handbook of Giant Magnetostrictive Materials”, Academic Press, San Diego, Calif., London, 2000.
5. Andre Preumont, “Vibration Control of Active Structures: An Introduction”, Second Edition, Kluwer Academic Publishers, Boston, 2002.
6. Brian Culshaw, “Smart Structures and Materials”, Artech House, London, 1996.

11MM018 APPLIED FINITE ELEMENT METHOD

3 0 0 3

Objectives:

- To familiarize the fundamentals of FEA
- To understand the principles involved in discretization and finite element approach
- Learn to form the stiffness matrices and force vectors for simple elements

MODULE – I **15**

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 dimensional.

MODULE – II **15**

One Dimensional Problems and Two 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.

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.

MODULE – III **15**

Axi-Symmetric and Isoparametric Elements: Introduction – Element matrices for axi-symmetric element - Torsional cylindrical member- Bilinear quadrilateral elements – Quadratic quadrilaterals – Hexahedral elements - Numerical integration – Gauss quadrature –Examples of 2D and 3D applications

Lecture : 45, Tutorial : 15, TOTAL : 60

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, 2007.
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, “Finite Element Analysis”, McGraw Hill, 2005.

11MM019 NANO TECHNOLOGY

3 0 0 3

Objectives:

Impart the basic knowledge on Nanoscience and Technology. Understand the various process techniques available for the processing of Nanostructured materials. Impart knowledge on the exotic properties of nanostructured materials at their nanoscale lengths. Acquire the knowledge about the various nanoparticles, processing methods and their skills. Study the reactive merits of various process techniques.

MODULE – I **16**

Nanomaterial synthesis methods: Introduction to scientific revolutions – Types of nanomachines and nanotechnology - Atomic structure, molecules and phase Energy - Molecular and Atomic size - surfaces and dimensional space – Top-down and bottom-up.

Introduction to Nanoscale materials - Synthesis and processing, Methods of nano structured materials preparation: Mechanical grinding, wet chemical synthesis, Sol-gel processing, gas phase synthesis, gas condensation processing, chemical vapor condensation – Nano composite synthesis and Processing.

MODULE - II **15**

Nanomaterial properties and quantum dots: Opportunity at the nano scale - Length and time scale in structures - Energy landscapes - Inter dynamic aspects of inter molecular forces -Evolution of band structure and Fermi surface.

Quantum dots - Nano wires - Nano tubes 2D and 3D films.

MODULE - III **14**

Physical properties of nanostructured materials: Influence of Nano structuring on Mechanical - Optical, electronic, magnetic and chemical properties – Gramsize effects on strength of materials, optical properties of quantum dots and quantum wires – Electronic transport in quantum wires carbon nano tubes - Magnetic behavior of single domain particles and nanostructures - Self assembling techniques.

TOTAL: 45

REFERENCE BOOKS

1. Mick Wilson, Kamali Kannargare., Geoff Smith, “Nano technology: Basic Science and Emerging technologies”, Overseas Press, 2005.
2. Charles P. Poole, Frank J. Owens, “Introduction to Nanotechnology”, Wiley Interscience, 2003.
3. Mark A. Ratner, Daniel Ratner, “Nanotechnology: A gentle introduction to the next Big Idea”, PrenticeHall P7R:1st Edition, 2002.

11MM020 RAPID PROTOTYPING AND TOOLING

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

3 0 0 3

Objectives:

- To learn the basics of Rapid Prototyping and its processes
- To familiarise the Principles of Rapid Tooling
- Extend students' knowledge and understanding of the current and emerging manufacturing technologies being used for rapid prototyping by today's most successful product developers and manufacturers

MODULE – I **16**

Introduction and Liquid Based RP Processes: Introduction: Need for time compression in product development, Prototype fundamentals, Fundamentals of RP systems - 3D modelling - Data format - STL files, History of RP systems, classification of RP systems, benefits of RPT, 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.

MODULE - II **14**

Solid and Powder Based RP Processes: 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

Powder based RP systems: Selective Laser Sintering (SLS) – Principle - Process parameters - Process details - Machine details, 3-Dimensional Printers – Principle - Process parameters - Process details - Machine details, Concept Modelers.

MODULE – III **15**

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, Laser Engineered Net Shaping – Principle – Process details.

TOTAL: 45

REFERENCE BOOKS

1. Chua, C. K., Leong, K. F. and Lim, C. S., "Rapid Prototyping: Principles and Applications", World Scientific, New Jersey, 2003.
2. Pham, D. T. and Dimov, S. S., "Rapid manufacturing", Springer-Verlag, London, 2001.
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

11MM021 VIRTUAL INSTRUMENTATION

3 0 0 3

Objectives:

To understand basic concepts of virtual instrumentation, programming techniques, data acquisition and interfacing techniques and use of Virtual instrumentation for different application.

MODULE – I **15**

Review of Virtual Instrumentation and Programming: 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.

VI and sub - VI, 'G' Programming techniques - Loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O, instrument drivers, publishing measurement data in web.

MODULE - II **15**

Data Acquisition and Interfaces: Introduction, classification of signals, analog interfacing, connecting the signal to the board, guidelines, practical interfacing, signal sources, waveform data types, Use of DAQmx. RS 232C/RS485, GPIB. Bus interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI system controllers, Ethernet control of PXI.

MODULE – III **15**

Networking and Applications of Virtual Instrumentation: Networking basics for office and industrial applications, VISA and IVI. Applications of virtual instrumentation - 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, 1997.
4. Brucemihure, Austin and Texas, "LabVIEW for data acquisition", Prentice Hall of India, New Delhi, 2001.
5. "LabVIEW Basics I and II Manual", National Instruments, India, 2009.
6. Barry Paton, "Sensor, Transducers and LabVIEW", Prentice Hall of India, New Delhi, 2000.
7. www.ni.com

11MM022 ADVANCED EMBEDDED SENSORS AND SYSTEM DESIGN

3 0 0 3

Objectives:
To allow the student to study the design and development process for dedicated computer systems in relation to environment in which they operate. Understand and to apply a design methodology for dedicated computer-based system

MODULE – I **15**

Introduction and Development Environment: Embedded computing - Characteristics of embedded computing applications - Embedded system design challenges - Constraint - Driven - IP - Based design – Hardware - Software co-design. The execution environment - Memory organization - System space - Code space - Data space - Unpopulated memory space – I/P space - System start-up - Interrupt response cycle - Function calls and Stack Frames – Run. Time environment - Object placement.

MODULE - II **15**

Embedded Computing Platform & System Design: CPU bus - Memory devices – I/O devices - Component interfacing - Designing with microprocessors - Development and debugging - Design example - Design patterns - Dataflow graphs - Assembly and linking - Basic compilation techniques - analysis and optimization. Inter. Process communication - Signals - Signals in UML - Shared memory communication.

MODULE – III **15**

Design Techniques : Accelerated design - Design for video accelerator - Networks for embedded systems - Networks based design - Internet enabled systems design methodologies and tools - Design flows - Designing hardware and software components - Requirement analysis and specification - system analysis and architecture design - System integration - Structural and behavioral description - Case studies.

TOTAL: 45

REFERENCE BOOKS

1. Wayne Wolf, “Computers as Components, Principles of Embedded Computer Systems Design”, Morgan Kaufman Publishers, 1999.
2. Jean J. Labrosse, “Embedded system Building blocks; complete and ready-to-use modules in C”, 1997.
3. Arnold S.Berger, “Embedded Systems Design; an Introduction to Processes, Tools and Techniques”, 1992.
4. Arnold S. Berger , “Embedded System Design”, CMP books, USA 2002.

11MM023 MACHINE VISION SYSTEM

3 0 0 3

Objectives:
To educate and train students in fundamental and advance concepts of machine vision system and also train the students in design and development of machine vision applications for industrial applications.

MODULE – I **15**

Fundamental Concepts of human vision system: Processing of information in human visual system – Design and structure of the eye - Neural adaptation to monochromatic aberrations – Adaptation of different light level – ON\OFF structure and division of the whole luminance amplitude in two segments - Motion sensitivity in the retina - Monophology.

Machine Vision: Introduction to building machine vision inspection- specification - Advantages – Part and working principles of MVS – Task and benefit – Performance requirement.

MODULE - II **15**

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.

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.

MODULE – III **15**

Camera Computer interface: Analog camera buses – Parallel digital camera buses - Standard PC buses – Computer buses – Driver software. Machine vision algorithms: Fundamental data structure – Image enhancement – Geometric transformation – Image segmentation - Feature extraction – Morphology – Edge extraction – Fitting - Template matching- Feature machine vision system.

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.

11MM024 INDUSTRIAL SAFETY ENGINEERING

3 0 0 3

Objectives:

- To study the basic safety rules in engineering industry
- To get adequate knowledge in safety of various manufacturing processes
- To study about the application of safety in finishing and quality control

MODULE – I **14**

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.

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.

MODULE - II **14**

Safety in cold forming: 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.

Safety in hot working: Hot working safety in forging, hot rolling mill operation, safe guards in hot rolling mills – Hot bending of pipes, hazards and control measures.

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

MODULE – III **17**

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.

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. "Accident Prevention Manual", NSC, Chicago, 1982.
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 in Industry”, Jaico Publishery House, 1996.
5. “Indian Boiler acts and Regulations”, Government of India.
6. “Safety in the use of wood working machines”, HMSO, UK 1992.
7. “Health and Safety in welding and Allied processes”, Welding Institute, UK, High Tech. Publishing Ltd., London, 1989.

11ED102 OPTIMIZATION TECHNIQUES IN DESIGN AND MANUFACTURING

(Common to M.E. Engineering Design, Mechatronics and CAD/CAM branches)

3 1 0 4

Objective:

- To understand clearly where optimization fits into the problem;
- To formulate a criterion for optimization;
- To have sufficient understanding of the theory of optimization to select an appropriate optimization strategy for static and dynamic applications.

MODULE - I **15**

Introduction and Unconstrained Optimization: General Characteristics of mechanical elements, adequate and optimum design, principles of optimization, formulation of objective function, design constraints – Classification of optimization problem. Single variable and multivariable optimization, Techniques of unconstrained minimization – Golden section, pattern and gradient search methods – Interpolation methods -Quadratic function method.

MODULE - II **15**

Constrained Optimization: Optimization with equality and inequality constraints - Indirect methods using penalty functions, Lagrange multipliers; Geometric programming- Constrained, mixed inequality and unconstrained minimization; Introduction - GA, SA and NN based on optimization - Fuzzy systems - Taguchi Technique - Parallel processing

MODULE - III **15**

Static and Dynamic Applications: Structural applications – Design of simple truss members-Re analysis techniques Design applications – Design of simple axial, transverse loaded members for minimum cost, maximum weight – Design of shafts and torsionally loaded members – Design of springs. Dynamic Applications – Optimum design of single and two degree of freedom systems, vibration absorbers. Optimum design of simple linkage mechanisms. Case study: optimization of process parameters in production operation.

Lecture: 45, Tutorial: 15, TOTAL: 60

REFERENCE BOOKS

1. Rao Singiresu S, “Engineering Optimization: Theory and Practice”, New Age International (P) Limited, Publishers New Delhi, 2010.
2. Deb Kalyanamoy, “Optimization for Engineering Design: Algorithms and Examples”, Prentice Hall of India Pvt. New Delhi, 2009
3. Johnson, Ray C., “Optimum Design of Mechanical Elements”, John Wiley & Sons, New York, 1990.
4. Goldberg D.E., “Genetic Algorithms in Search, Optimization and Machine”, Barnen, Addison-Wesley, New York, 2005.

REFERENCE JOURNALS AND WEBSITES

1. Journal of Mechanical Design - www.asmedl.org
2. Journal of Design for Manufacturability-www.informationworld.com
3. International Journal of fuzzy systems
4. 1. www.searchengineoptimization.com
   2. www.plosntds.org
   3. www.mahalo.com

11VL025 DIGITAL IMAGE PROCESSING

(Common to M.E. Mechatronics, Applied Electronics and Computer Science and Engg.)

3 0 0 3

PREREQUISITE

Digital Signal Processing

Objectives:

- To introduce the fundamentals and techniques of digital image processing.
- To understand the various 2D image transformations.
- To study the concepts of image processing techniques like image enhancement and restoration.
- To study the various techniques in image segmentation and representation.
- To understand the various techniques of Image compression and its standards.

MODULE– I **15**

Introduction: Elements of Digital Image processing – Elements of visual perception: light - luminance – brightness, contrast, hue, saturation – Mach band effect – simultaneous contrast. Color image fundamentals – RGB model and HIS model – converting colors from HIS to RGB. Two dimensional sampling theory – practical limits in sampling and reconstruction.

Image Transforms: Two dimensional systems - Block matrices and Kronecker products. Two dimensional orthogonal and unitary transforms – DFT, cosine, sine,Walsh, problems

MODULE– II **15**

2D Transforms: Hadamad, Haar and KL transforms, Radon transforms, problems

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.

Image Segmentation: Point, line and edge detection –Image segmentation based on thresholding– Region based segmentation – region growing – region splitting and merging.

MODULE– III **15**

Image Representation: Representation: chain codes – polynomial approximations – signatures – boundary descriptors – Regional descriptors: Texture regional descriptor.

Image Compression: Image Compression – Need for data compression – Run length encoding – Huffman coding – Arithmetic coding – predictive coding- transform based compression, Image compression standards – JPEG 2000, MPEG 4. - vector quantization – block truncation coding, Wavelet based image compression.

TOTAL: 45

REFERENCE BOOKS

1. Gonzalez, Rafel C. and Woods, Richard E., "Digital Image Processing", Second Edition, Prentice Hall, New York, 2006.
2. Jain, Anil K., "Fundamentals of Digital Image Processing", Prentice Hall of India, New Delhi, 2003.
3. Rosenfield, Azriel and Kak, Avinash C., “Digital Picture Processing”, Academic Press Inc, New York, 1982.
4. Jayaraman. S, Esakkirajan. S, and Veerakumar. T, “Digital Image Processing” Tata McGraw-Hill, New Delhi 1st ed 2009