BRANCH-AUTOMATION & ROBOTICS

Specialization: Automation & Robotics

Second Semester							
	Theory				Practical		
Course Name	**Hours/ Week L/T**	**Credit Theory**	**University Marks**	**Internal Evaluation**	**Hours/ Week L/T**	**Credit Practical**	**Marks**
Specialization Core-1 Automation & Manufacturing	4-0	4	100	50	-	-	-
Specialization Core-2 Mechanical Measurement & Control System	4-0	4	100	50	-	-	-
Elective-I (Specialization related) 1.Advanced Computer Concept for Automation 2.Mechatronics 3.Modelling, Simulation & Analysis of Manufacturing System	4-0	4	100	50	-	-	-
Elective-II (Departmental related) 1. Total Quality Management 2. Embedded System Design 3. Mechanical Vibration	4-0	4	100	50	-	-	-
Elective-III (from any Department) 1.Computer Aided Production Operation Management 2.Finite Element Methods in Engineering 3. Project Management	4-0	4	100	50	-	-	-
Lab-2 (Specialization lab to be decided by the Department)					4	4	150
Seminar/Project					4	4	150
Total							
Total Marks: 1050							
Total Credits: 28							

AUTOMATION & MANUFACTURING

1.Introduction: Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations, introduction to automation productivity.**Material handling systems:** Overview of Material Handling - Rotary feeders, oscillating force feeder, vibratory feeder, elevator type and Centrifugal type feeders, Principles and Design Consideration, Material Transport Systems, Storage Systems.

2.Automated Manufacturing Systems: Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS, FMS and its Planning and Implementation, Flow lines & Transfer Mechanisms, Fundamentals and Analysis of Transfer Lines, product design for automatic assembly.**Control Technologies in Automation:** Industrial Control Systems, Process Industries Verses Discrete-Manufacturing Industries, Continuous Verses Discrete Control, Computer Process and its Forms. Sensors, Actuators and other Control System Components.

3.Evaluation of automatic production: product manufacturabiiity, orientation devices- active and passive devices, parts orientation and escapement.**Pneumatic and hydraulic components and circuits:**Boolean algebra, pneumatic sensors and amplifiers, jet destruction devices, logic devices, schimit triggering devices, developing pneumatic circuits for automatic die casting machine.

4.Modeling and Simulation for manufacturing Plant Automation: Introduction/ need for system Modeling, Building Mathematical Model of a manufacturing Plant, Modern Tools- Artificial neural networks in manufacturing automation, AI in manufacturing, Fuzzy decision and control, robots and application of robots for automation.

REFERENCE BOOKS:

1. Handbook of design, manufacturing and Automation : R.C.Dorf, John Wiley and Sons.
2. Automation, Production Systems and Computer Integrated Manufacturing, M.P.Groover, Pearson Education.
3. Industrial Automation : W.P. David, John Wiley and Sons.
4. Computer Based Industrial Control, Krishna Kant, EEE-PHI
5. An Introduction to Automated Process Planning Systems,Tiess Chiu Chang & Richard A. Wysk
6. Manufacturing assembly Handbook:- BrunoLotter
7. Anatomy of Automation, Amber G.H & P. S. Amber, Prentice Hall.
8. Performance Modeling of Automated Manufacturing Systems,Viswanandham, PHI.

MECHANICAL MEASUREMENT & CONTROL SYSTEM

Module I

Typical Applications of Instrument Systems, Functional Elements of a Measurement System, Brief Description of the Functional Elements of the Instruments, Classification of Instruments, Microprocessor -Based Instrumentation, Standards and Calibration. Static and Dynamic Characteristics of Instruments: Static Performance Parameters, Impedance Loading and Matching, Selection and Specifications of Instruments, Dynamic Response, and Compensation. Transducer Elements: Analog Transducers, Digital Transducers, Basic detector transducer elements: Electrical transducer, Sliding Contract devices, Variable-inductance transducer elements, the differential transformer, Variable-reluctance transducers, Capacitive transducers. The piezoelectric effect, photo-electric transducer, electronic transducer element. Intermediate Elements: Amplifier, Operational Amplifier, Diffential and Integrating Elements, Filters, A-D and D-A Converters The simple current sensitive circuit, the ballast circuit, the voltage-dividing potentiometer circuit, The voltage balancing potentiometer circuit, Resistance bridges. Indicating, Recording and Display Elements: Meter Indicators. The vacuum tube voltmeter, CRO, Electronic Switch, CRO recording techniques, Oscillographs. Digital Recorders

Module II

Strain Measurement :The electrical resistance strain gauge. The metallic resistance strain gauge, Selection and Installation factors for metallic strain gauge, Circuitry, metallic strain gauge. The strain gauge ballast circuit, the staring gauge bridge circuit, Temperature compensation. **Measurement of Pressure :**Pressure measurement systems, Pressure measurement transducers, Elastic diaphragms, strain gauge pressure cells, measurement of high pressure, Measurement of low pressures, dynamic characteristics of pressure measuring systems. **Measurement of Fluid Flow :**Flow characteristics obstruction meters, Obstruction meter for compressible fluids- Orifice, Venturi meter and Pitot tube, The variable-area meter, Turbine Flow meters. **Temperature Measurement :**Use of bimetals pressure thermometers, Thermocouples, Pyrometry, Calibration of temperature measuring devices.
Force, Power, Speed and Torque Measurement : Load Cell, Dynamometers, Tachometer and Tacho-generator, Stroboscope, The seismic instrument.- Vibrometers and accelerometers .

Module III

Description of open and closed loop control systems and their block diagrams. Use of block diagram and signal flow graph to find overall transfer function.
1st and 2nd order systems and their response to step and sinusoidal input, error analysis, static and dynamic error coefficients. Routh's stability criterion. The Root-Locus method, Bode Plot and Nyquist plot, Gain margin and phase margin.

Textbooks

1. Instrumentation Measurement and Analysis, B.C.Nakra and KK.Chaudhry, TMH,3rd Ed.

Reference :

1. Mechanical Measurements, T.G. Beckwith and N. Lewis Buck, Oxford and IBH Pub Co.
2. Modern Control Engineering, K.K. Ogata, prentice Hall India

ADVANCED COMPUTER CONCEPT FOR AUTOMATION

Module-I

Introduction to computer Automation, Elements of Automation and Types of Automation, Importance of Computers in Automation, Computer Networks and Topology Types. Computer Graphics, Display Adapters, Video Display Modes.

Object Oriented Programming Introduction: Necessity of Object Oriented Programming, Procedural Language and Object Oriented Approach, Characteristics of Object Oriented Languages. OOP's Concepts: Objects, Classes, Inheritance, Overloading, Virtual Functions, and Polymorphism.

Module-II

OOP's features for Automation: Templates and Exceptions, C++ Input and output concepts, OOPS for Automation. Introduction to JAVA Features of JAVA, OOPS through JAVA.

Database Management System Introduction: Comparison of File System, Database Management System, Characteristic Features of Database Management Systems. Database Design: Relational Database, Logical Database Design, Data Base Models, DBMS Languages and Interfaces. Data Base Security and Authorization. Data Ware House.

Module-III

Operating Systems and Protocols: Basic Concepts of batch Systems, Multi Programming, Time-Sharing, Distributed and Real Time Systems.

Operating System Structures: Operating System Components and Services & brief discussion about protocols-FTP, TCP/IP & HTTP.

Text Books / References:

1. C++ Programming-Bjarne Stroustrup, Addison Wesley.
2. Fundamentals of DBMS – Ramez Elmasri and Navathe, Addison Wesley.
3. Operating System Concepts – Silberschatz, Galvin, Gagne, Sixth edition, John Wiley.
4. Computer Graphics, C version – Donald Hearn, M. Pauline Baker, Pearson Education.
5. Object Oriented Programming with C++ - E. Balaguruswamy, TMH.
6. Object Oriented Programming with C++ - Robert Lafore, PHI
7. Operating Systems-A concept based approach", D M Dhamdhere, TMH
8. Internet Working with TCP/IP – Douglas, PHI
9. Introduction to DBMS – Date C.J. Addison Wesley

MECHATRONICS

Module 1

Evolution of Mechatronics, components of mechatronic system, types of mechatronic products, Signal theory, signal analysis and processing, Laplace transformation, Z-transformation modulation and de-modulation. Electrical components and Electronic device –Resister, inductor and capacitor, reactance and impedance. Basic electronics devices junction diodes, Bipolar transistors

Module II

Basic Digital Technology : Digital number system, Binary number system, Hexadecimal number system, Binary addition, Boolean Algebra, Logic function, Universal GATES, FLIP-FLOP, Registers counters. System modeling : Frequency response, Mechanical system, electrical system, Thermal system, Fluid system.

Module III

Actuators- Electric motors; D.C. Motors, Stepper motor, , Hydraulic actuators, Pneumatic actuators Transducer and Sensors : Principles, difference between transducer and sensors, transducer types – photo emissive, photo conductive, photovoltaic, thermistors, Thermocouple, Inductive, capacitive, Peizoelectric, Hall effect transducers, Ionization transducer, Encoders- Incremental encoder, Optical encoder, Bimetallic strip, Strain gauge, load cell. Programmable Logic controller : Basic Structure - Programming : Ladder diagram Timers, Internal Relays and Counters - Shift Registers - Master and Jump Controls, data handling , Analog input / output , PLC Selection &Application. Microprocessor ad Microcontroller : Microprocessor based Digital control, registers, Program counter, Intel -8085 microprocessor

Text Books

1. A Text Books of Mechatronics, R.K.Rajput, S.Chand & company
2. Mechatronics, N.G. P.C Mahalik, Tata McGraw Hill
3. Mechatronics, D.G. Alciator, M.B. Histand, Tata McGraw Hill

Reference Books :

1. Mechatronics, A.Smaili & F Mrad, Oxford University Press
2. Mechatronics, K.P.ramchandran, G,K Vijay Raghavan, M. S Balachandra
3. Mechatronics An Intigrated approach, Clarence W de Sliva, CRC Press

MODELLING, SIMULATION & ANALYSIS OF MANUFACTURING SYSTEM

Module I

Basic simulation modeling, Discrete event simulation, Simulation of queuing and te Carlo simulations. inventory systems, Continuous, Discrete-continuous and Mon Statistical models in simulation, Discrete and continuous distributions, Poisson process, Empirical distribution, Generation of pseudo random numbers, Analysis of simulation data, Parameter estimation, Goodness-of-fit tests, Multivariable time series models.

Module II

Overview of feedback control systems, Dynamics of mechanical systems, Differential equations and state variable form, Models of electromechanical, Heat-and fluid flow models, Linearization and scaling, Models from experimental data, Dynamic response using pole-zero locations, Time domain specifications, Classical 3-term controllers and its digital implementation, Stability analysis by Routh Criterion.

Modules III

Simulation of manufacturing and material handling systems, Goals and performance measures, Modeling downtime and failures, Trace driven models, Case studies.

Text Books :

1. Discrete-Event system simulation by Jerry Banks, J.S. Carson, B.L. Nelson and D.M. Nicol (Pearson Publications).
2. Feedback control of dynamic systems by G.F. Franklin, J.D. Powell, A-Naeini, Pearson Publications.
3. Simulation modeling and analysis by A.M. Law, W.D. Kelton, Tata McGrawHill

TOTAL QUALITY MANAGEMENT

Fundamentals of TQM; Some important philosophies and their impact on quality (Deming, Juran, Crossby),Features of Malcom Balridge quality award; Identification and measurement of quality costs; Issues related to products, processes, organization, leadership and commitment for total quality achievement; Tools and techniques used in TQM, seven tools, new seven, essential features of QCC, ZD, Kaizen, and JIT programmes; Fundamental concepts about Quality Function Deployment (QFD); Components of Total Quality System (TQS) in organizations, Quality Auditing : Introduction to ISO 9000 and 14000 standards, Case studies.

Books

1. Managing Total Quality, Rampersad, Hubert and Narasimhan, TMH

2. Quality Planning and Analysis, Juran J M and Gryna F M, TMH

EMBEDDED SYSTEM DESIGN

MODULE – I (13 hours)

Introduction to Embedded Computing: Terms and scope, Application areas, Growing importance of embedded systems. Specifications: Requirements, Models of computation, State Charts: Modeling of hierarchy, Timers, Edge labels and StateCharts semantics, Evaluation and extensions, General language characteristics: Synchronous and asynchronous languages, Process concepts, Synchronization and communication, Specifying timing, Using non-standard I/O devices, SDL, Petri nets: Introduction, Condition/event nets, Place/transition nets, Predicate/transition nets, Evaluation, Message Sequence Charts, UML, Process networks: Task graphs, Asynchronous message passing, Synchronous message passing, Java, VHDL: Introduction, Entities and architectures, Multi-valued logic and IEEE 1164, VHDL processes and simulation semantics, System C, Verilog and System Verilog, Spec C, Additional languages, Levels of hardware modelling, Language comparison, Dependability requirements.

MODULE – II (13 hours)

Embedded System Hardware: Introduction, Input: Sensors, Sample-and-hold circuits, A/D-converters, Communication: Requirements, Electrical robustness, Guaranteeing real-time behaviour, Examples, Processing units: Application-Specific Circuits (ASICs), Processors, Reconfigurable Logic, Memories, Output: D/A-converters, Actuators.Standard Software: Embedded Operating Systems, Middleware, and Scheduling: Prediction of execution times, Scheduling in real-time systems: Classification of scheduling algorithms, Aperiodic scheduling, Periodic scheduling, Resource access protocols, Embedded operating systems: General requirements, Real-time operating systems, Middleware: Real-time data bases, Access to remote objects

MODULE – III (14 hours)

Implementing Embedded Systems: Hardware/Software Co-design: Task level concurrency management, High-level optimizations: Floating-point to fixed-point conversion, Simple loop transformations, Loop tiling/blocking, Loop splitting, Array folding, Hardware/software partitioning: Introduction, COOL, Compilers for embedded systems: Introduction, Energy-aware compilation, Compilation for digital signal processors, Compilation for multimedia processors, Compilation for VLIW processors, Compilation for network processors Compiler generation, retargetable compilers and design space exploration, Voltage Scaling and Power Management: Dynamic Voltage Scaling, Dynamic power management (DPM), Actual design flows and tools: SpecC methodology, IMEC tool

flow, The COSYMA design flow, Ptolemy II, he OCTOPUS design flow.Validation: Introduction, Simulation, Rapid prototyping and emulation, Test: Scope, Design for testability and Self-test programs, Fault simulation, Fault injection, Risk- and dependability analysis, Formal verification.

Textbooks:

1.Peter Marwedel, Embedded System Design, Springer, 2006 http://ls12-www.cs.uni-dortmund.de/~marwedel/kluwer-es-book/

Recommended Reading:

1.Wayne Wolf, Computers as Components, Morgan Kaufmann, 2001 http://www.ee.princeton.edu/~wolf/embedded-book

2. G. De Micheli, Rolf Ernst and Wayne Wolf, eds, Readings in Hardware/Software Co-Design, Morgan Kaufmann, Systems-on-Silicon Series Embedded

3. Frank Vahid and Tony D. Givargis, System Design: A Unified Hardware/Software Introduction, Addison Wesley, 2002.

4. Michael Barr, Programming Embedded Systems in C and C++, O'Reilly, 1999.

5. David E. Simon, An Embedded Software Primer, Addison Wesley, 1999.

6. Jack Ganssle, The Art of Designing Embedded Systems, Newnes, 2000.

7. K. Short, Embedded Microprocessor System Design, Prentice Hall, 1998. C. Baron, J. Geffroy and G. Motet, Embedded System Applications, Kluwer, 1997.

MECHANICAL VIBRATION

Module – I

INTRODUCTION & IMPORTANCE OF MECHANICAL VIBRATION: Brief history of Mechanical Vibration, Types of Vibration, Simple Harmonic Motion (S.H.M.), Principle of superposition applied to S.H.M., Beats, Fourier Analysis, Concept of degree of freedom for different vibrating systems.**UNDAMPED FREE VIBRATION OF SINGLE DEGREE FREEDOM SYSTEMS**: Modeling of Vibrating Systems, Evaluation of natural frequency – differential equation, Energy & Rayleigh's methods, Equivalent systems. **DAMPED FREE VIBRATION OF SINGLE DEGREE FREEDOM SYSTEMS**: Different types of damping, Equivalent viscous damping, structural damping, Evaluation of damping using free and forced Vibration technique, Concept of critical damping and its importance, study of vibration response of viscous damped systems for cases of under damping, critical damping and over damping, Logarithmic decrement.

Module – II

FORCED VIBRATION OF SINGLE DEGREE FREEDOM SYSTEMS: Steady state solution with viscous damping due to harmonic force, reciprocating and rotating unbalance mass, vibration isolation and transmissibility due to harmonic force excitation and support motion. Vibration measuring instruments – vibrometer and accelerometer. Whirling of shaft with single disc and without damping, Concept of critical speed and its effect on the rotating shaft. **UNDAMPED VIBRATION OF TWO DEGREE FREEDOM SYSTEMS**: Free vibration of spring coupled and mass coupled systems, Longitudial, Torsional and transverse vibration of two degree freedom systems, influence coefficient technique, Un-damped vibration Absorber.

Module – III

INTRODUCTION TO MULTI-DEGREE FREEDOM SYSTEMS: Normal mode vibration, Co-ordinate coupling-close coupled and far coupled systems, Orthogonality of mode shapes, Methods of matrix iteration, Holzer's method and Stodola method. Torsinal vibration of two, three and multi-rotor systems. Dunkerley's lower bound approximate method. **CONTINOUS SYSTEMS**: Vibration of strings, longitudinal vibration of rods, torsional vibration of rods, transverse vibration of Euler-beams.

Text Books:

1. Theory of vibration with Applications: W.T. Thomson and Marie Dillon Dahleh, Pearson Education 5th ed. 2007.

2. Introductory Course on theory and Practice of Mechanical Vibrations. J.S. Rao & K. Gupta, New Age International Publication, New Delhi, 2007.

Reference Books:

1. Mechanical Vibrations: S.S. Rao, Prarson Education Inc, 4th ed. 2003

2. Mechanical Vibrations: S. Graham Kelly, Schaum's outline series, Tata McGraw Hill, Special Indian ed., 2007

3. Mechanical Vibrations: V.P. Singh, Dhanpat Rai & company Pvt. Ltd. 3rd ed., 2006

4. Elements of vibration Analysis: Leonard Meirovitch, Tata McGraw Hill, Special Indian ed., 2007

COMPUTER AIDED PRODUCTION OPERATION MANAGEMENT

MODULE 1:

INTRODUCTION :Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs - Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership - Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

MODULE 2:

TQM :Customer satisfaction - Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement - Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement - Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership - Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures - Basic Concepts, Strategy, Performance Measure.

MODULE 3:

STATISTICAL PROCESS CONTROL (SPC): The seven tools of quality, Statistical Fundamentals - Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

MODULE 4:

TQM TOOLS: Benchmarking - Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) - House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) - Concept, Improvement Needs and FMEA - Stages of FMEA.

MODULE - 5:

QUALITY SYSTEMS: Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System - Elements, Implementation of Quality System, Documentation, Quality Auditing, TS 16949, ISO 14000 - Concept, Requirements and Benefits.

TEXT BOOKS

1. Dale H.Besterfiled, et al., Total Quality Management, Pearson Education, Inc. 2003. (Indian reprint 2004). ISBN 81-297-0260-6.

REFERENCES

1. James R.Evans & William M.Lidsay, The Management and Control of Quality, (5th Edition), South-Western (Thomson Learning), 2002 (ISBN 0-324-06680-5).
2. Feigenbaum.A.V. "Total Quality Management, McGraw Hill, 1991.
3. Oakland.J.S. "Total Quality Management Butterworth - Hcinemann Ltd., Oxford. 1989.
4. Narayana V. and Sreenivasan, N.S. Quality Management - Concepts and Tasks, New Age International 1996.
5. Zeiri. "Total Quality Management for Engineers Wood Head Publishers, 1991.

FINITE ELEMENT METHODS IN ENGINEERING

MODULE 1:

Basic Concepts: The standard discrete system, Finite Elements of an elastic continuum displacement approach, Generalization of the finite element concepts-weighted residual and variational approaches,

MODULE 2:

Element types: triangular, quadrilateral, sector, curved, isoparametric elements and numerical integration. Automatic mesh generation schemes.

MODULE 3:

Application to structural mechanics problems: plane stress and plane strains, Axisymmetric stress analysis, three dimensional stress analysis, bending of plates.

MODULE 4:

Introduction to the use of FEM in steady state field problems – heat conduction, fluid flow and nonlinear material problems, plasticity, creep etc. Computer procedures for Finite element analysis.

Text Books:

1. Finite Element Method: Its Basis and Fundamentals. O. C. Zienkiewicz, R. L. Taylor and J. Z. Zhu. Elsevier, 2005.

2. Finite Element Methods – J. N. Reddy. Tata Mc-Graw Hill.

3. Introduction to the Finite Element Method–C.S. Desai & J.F.Abel .East West Pvt. Ltd., 1972

PROJECT MANAGEMENT

MODULE 1:

Project Feasibility Analysis: Technical feasibility, commercial and financial viability, Environment Analysis.

MODULE 2:

Project Engineering: Project Management Techniques: PERT, CPM, Project Scheduling Crashing, PERT / COST, LOB. Projects financing alternatives, Sources of finance, their advantages, Choice of Financing mix, Capital budgeting.

MODULE 3:

Costing: Fixed and variable cost. Break even analysis, Overhead allocation Techniques. Project Organisation, management and control: Project organisation and control staffing, monitoring: cost, time and control and progress monitoring techniques.

MODULE 4:

Product and service pricing: Availability and quality based pricing for services. Capacity planning and expansion, capacity decision considering and models.

Books:

1. Prasanna Chandra: Project Engineering and Management, Prentice Hall

2. Levy and Weist: Management guide to PERT / CPM, Prentice Hall