



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited A++ Grade by NAAC | 12B Status by UGC | Approved by AICTE

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School of Mechanical Engineering Department of Mechatronics

1.2.1 List of New Courses Introduced in the Academic Year 2022 – 2023

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1	B.E. Mechatronics	SMRA1201	Fundamentals of Automation & Control	2
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SMRA1201

FUNDAMENTALS OF AUTOMATION AND CONTROL

L T P Credits Total Marks

3 0 0 3 100

COURSE OBJECTIVES

Be aware of the scope and usefulness of industrial automation and its consequences.

To apply automation technologies.

Learn the most common sensors and ways of wiring.

Differentiate the different types of actuators.

UNIT 1 MODELING AND ANALYSIS OF DYNAMIC SYSTEMS 9 Hrs.

Fundamental concepts in dynamic systems: systems, models, linearity, static behavior, dynamic behavior, modeling of continuous dynamic systems, Definition of transfer function. Block diagrams, Time response in linear systems.

UNIT 2 AUTOMATIC CONTROL 9 Hrs.

Concepts of feedback. Robustness, stability, accuracy, ability to follow set-points, PID control. Empirical tuning and analytical tuning, Feedback loop instrumentation, Control structures.

UNIT 3 INDUSTRIAL AUTOMATION 9 Hrs.

Concept of industrial automation, Continuous and discrete systems, Integrated production systems: CAD/CAM, CAE and CIM, General structure of an automated system, Examples of automated production systems.

UNIT 4 COMPONENTS OF AN AUTOMATED SYSTEMS 9 Hrs.

Control devices – open loop, closed loop, feedback control, Sensors- Types of sensors, Selection of Sensors, Application of sensors, Actuators- Types of actuators, Application of actuators.

UNIT 5 COMPUTER BASED INDUSTRIAL CONTROL 9 Hrs.

Introduction & Automatic Process Control, Building Blocks of Automation Systems: LAN, Analog & Digital I/O Modules, SCADA Systems & RTU. Distributed Control System: Functional Requirements, Configurations & some popular Distributed Control Systems. (SLE: Display Systems in Process Control Environment.)

Max: 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Select & identify suitable automation hardware for the given application.

CO2 - Describe & explain potential areas of automation.

CO3 - Differentiate various control aspects of automation.

CO4 - Demonstrate the self-learning capability of Industrial Automation.

CO5 - SCADA architecture, communication in SCADA, develops any application based on SCADA along with GUI using SCADA software.

CO6 - Understand evolution and architecture of DCS, hierarchical control in DCS, programming DCS through function Block Diagram (FBD) method.

TEXT / REFERENCE BOOK

1. Automation, Production Systems and Computer Integrated Manufacturing- M.P.Groover, Pearson Education.5th Edition, 2009.
2. Computer Based Industrial Control- Krishna Kant, EEE-PHI, 2nd Edition, 2010.
3. An Introduction to Automated Process Planning Systems- Tiess Chiu Chang & Richard A. Wysk.
4. Performance Modeling of Automated Manufacturing Systems, -Viswanandham, PHI, 1st Edition, 2009.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each – No choice 20 Marks.

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks 80 Marks

L T P Credits Total Marks

3 0 0 3 100

COURSE OBJECTIVES

To familiarize with the actuators, control valves and different types of controllers.

To learn about the architecture of PLC and its working.

To write programs using ladder logic.

To design a PLC based control system.

UNIT 1 ACTUATORS AND CONTROL VALVES 8 Hrs.

Control valve: Control valve Characteristics (Inherent & Installed) Control valve terminology: Range ability, Turndown, valve capacity, viscosity index, AO, AC (Fail Safe Action) etc. Classification of control valve based on: valve body, Construction, type of actuation and application. Construction & applications of Globe: Single, double, 3way, angle, Gate, Needle, Diaphragm, Rotary valves, Ball, Butterfly. Types of actuators: Construction, Advantages, Disadvantages & applications: Spring Diaphragm & Smart actuators. Positioners, Volume boosters, Pressure boosters, reversing relay, Solenoid valves, Air lock, Position indicating switches, Electro pneumatic converter, Hand wheel, Motors.

UNIT 2 CONTROLLERS 9 Hrs.

Controllers: Discontinuous: ON/OFF, Multi-position Control, Floating Control, Continuous Controller: P, I, D controllers, Composite controllers, Anti-reset windup, Rate before Reset, Concept of Bump less transfers in PID controller, Effect of process characteristics on PID combination, Selection & application of controller actions.

UNIT 3 BASICS OF PROGRAMMABLE LOGIC CONTROLLER (PLC) 9 Hrs.

PLC Architecture and specifications – PLC hardware components Analog & digital Input/ Output modules - Power supplies – I/O slots, CPU & memory module – Programming devices –General PLC programming procedures - programming on-off outputs, Auxiliary commands and functions - creating ladder diagrams from process control descriptions – PLC programming Simple instructions – Manually operated switches – Mechanically operated a Proximity switches – Latching relays.

UNIT 4 PLC INTERMEDIATE FUNCTIONS 11 Hrs.

Arithmetic functions - number comparison functions - skip and MCR functions - data move systems. PLC Advanced intermediate functions- utilizing digital bits - sequencer functions - PLC Advanced functions: alternate-programming languages - operation. PLC basic programming – digital logic Gates – Boolean algebra. Basic PLC functions-register basics-timers-counts.

UNIT 5 APPLICATIONS OF PLC 8 Hrs.

Simple materials handling applications, Automatic control of warehouse door, Automatic lubrication of supplier Conveyor belt, motor control, Automatic car washing machine, Bottle label detection and process control application - Case Study of Bottle Filling System, Field Bus and HART Protocol.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the working of actuators, control valves, controllers, PLC.

CO2 - Explain the use of actuators, control valves, controllers.

CO3 - Select an appropriate controller for a process.

CO4 - Apply the knowledge of PLC in control.

CO5 - Develop a program using ladder logic.

CO6 - Design a control system using PLC.

TEXT/ REFERENCE BOOKS

1. Process control and Instrument technology, C.D. Johnson, TMH.

2. Instrumentation for Process measurement and control, N.A. Anderson, CRC Press.

3. Introduction to Programmable Logic Controller, Gary Dunning, DELMAR Cengage Learning.

4. Programmable Logic Controller, Webb, PHI Reference Books.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each – No Choice 20 Marks

PART B: 2 Questions from each unit of internal choice, each carrying 16 marks 80 Marks

L T P Credits Total Marks

3 0 0 3 100

COURSE OBJECTIVES

To impart knowledge regarding the various types of system and different transfer function analyzing techniques associated with control systems.

To analyze the response and error of various types of system in time domain.

To understand the stability analysis of frequency domain systems.

UNIT 1 SYSTEM CONCEPTS 9 Hrs.

Basic Elements of Control System – Open loop and Closed loop systems - Differential equation - Transfer function,

Modeling of Electric systems, Translational and rotational mechanical systems - Block diagram reduction Techniques - Signal flow graph- Mason's Gain Formula.

UNIT 2 TIME RESPONSE ANALYSIS OF CONTROL SYSTEMS 9 Hrs.

Standard test signals, Time response of first order and second order systems with unit step as input, Time domain

specification, steady state errors and static error constants, Concept of stability- P, PI, PD and PID controllers.

UNIT 3 FREQUENCY RESPONSE AND STABILITY ANALYSIS OF CONTROL SYSTEM 9 Hrs.

Frequency Response of the System - Correlation between Time and Frequency Response - Gain and Phase Margin – Bode Plot The concept of stability- Routh Hurwitz stability Criterion - Root Locus Analysis.

UNIT 4 CLASSIFICATION OF SIGNALS 9 Hrs.

Continuous time signals (CT signals) and Discrete time signals (DT signals) –Basic operations on signals-elementary

signals- Step, Ramp, Pulse, Impulse, Exponential – Classification of CT and DT signals – Periodic, aperiodic signals Deterministic and Random signals-even and odd signals – Real and Complex signals – Energy and power signals.

UNIT 5 FOURIER TRANSFORM AND LAPLACE TRANSFORM 9 Hrs.

Continuous time Fourier Transform –Properties of CTFT-Inverse Fourier transform- unilateral and bilateral Laplace

Transform analysis with examples – Basic properties – Parseval's relation -Inverse Laplace transform using partial fraction expansion method – Relation between Fourier transform and Laplace transform.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the types of control systems in different domains.

CO2 - Analyse the response of any linear time invariant system.

CO3 - Determine and analyse the stability of the system.

CO4 - Perform the analysis of the control system by Routh Hurwitz and Root Locus.

CO5 - Understand mathematical description and representation of continuous and discrete time signals.

CO6 - Analyze the spectral characteristics of continuous-time periodic and a periodic signal using Fourier transform and laplace transform.

TEXT / REFERENCE BOOKS

1. I.J.Nagarath and M.Gopal, "Control System Engineering" New Age International (p) Limited Publishers, 2nd Edition, 2009.
2. Kausuhio Ogata, "Modern Control Engineering", Prentice Hall of India PVT. Ltd, 5th Edition, 2010.
3. Richard Dorf, "Modern Control Systems", Pearson Education Ltd, 11th Edition 2009.
4. M.N. Bandyopadhyay, "Control Engineering, Theory and Practice" PHI, 4th Print, 2006.
5. N.K.Sinha, "Control Systems", New Age International Private Limited Publishers, 3rd Edition, 200, reprint 2008.
6. A.Nagoorkani, "Control System", RBA Publications, 3rd Edition, reprint 2012.
7. U.A.Bakshi and S.C.Goyal, "Control System Engineering", Technical Publication, 2nd Revised reprint 2007.
8. Allan V. Oppenheim et al, 'Signals and Systems', 2nd Edition, Prentice Hall of India Pvt. Ltd., 1997.
9. P.Ramesh Babu et al, 'Signals and Systems', 4th Edition, Scitech publishers, 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice 20 Marks

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks 80 Marks

L T P Credits Total Marks

0 0 4 2 100

COURSE OBJECTIVES

To teach basics about the mechatronics systems and its interfacing.

To teach basic concepts of lab view software and its applications.

To teach fundamentals about image processing techniques.

SUGGESTED LIST OF EXPERIMENTS

- a. Basic cylinder sequencing operations using pneumatic trainer kit.
- b. Simulation of basic hydraulic and pneumatic circuits using software.
- c. Experiment on cylinder sequencing for A+ B+ A- B- using pneumatic trainer kit.
- d. Proportional Integral Derivative (PID) controller interfacing.
- e. Basic operations and interfacing of sensors in lab view.
- f. Study of Boolean operations in lab view.
- g. Speed control of stepper and servo motor using microprocessor kit.
- h. A/D and D/A Conversion.
- i. Assembly language programming of 8085 – Addition – Subtraction – Multiplication – Division – Sorting – code conversion.
- j. Design and testing of fluid power circuits to control (i) Velocity (ii) direction and (iii) force of single and double acting actuators.
- k. Study of Image Processing Technique.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand basics about pneumatic and hydraulic circuits.

CO2 - Understand basics about valves and controls.

CO3 - Understand the concepts of using PID controllers.

CO4 - Understand the knowledge of servo and stepper drives.

CO5 - Understand the concept of using Lab views.

CO6 - Understand the basics of analogue to digital convertors

L T P Credits Total Marks

0 0 4 2 100

COURSE OBJECTIVES

To introduce different types of robotics and demonstrate them to identify different parts and Components.

To write programming for simple operations like pick and place, rotomim etc.

Use of Adam's software and MAT Lab software to model the different types of robots and calculate work

volume for different robots.

To study the features of CNC Machine Tool.

To expose students to modern control systems (Fanuc).

To know the application of various CNC machines like CNC lathe, CNC Milling etc.

SUGGESTED LIST OF EXPERIMENTS – ROBOTICS LAB

1. Study of Robot anatomy and programming methods.
2. Study of sensor operations using LEGO kits.
3. Study of Actuators using LEGO kits.
4. Programming of basic motion commands using Teach pendant.
5. Programming for pick and place and palletizing operation in Robot.
6. Programming the robot for a drilling and Milling application.
7. Programming on operation for cutting and welding application.
8. Programming a parallel kinematic robot for a pick and place application.
9. Introduction to MATLAB for Image processing.
10. Reduction and Noise and Grey levels using Mat lab.

SUGGESTED LIST OF EXPERIMENTS - CAM LAB

CNC LATHE

i) Part Programming for;

- ☐ Facing
- ☐ Turning
- ☐ Step Turning
- ☐ Taper Turning
- ☐ Chamfering
- ☐ Threading
- ☐ Grooving
- ☐ Boring
- ☐ Drilling

CNC MILLING

i) Part Programming for;

- ☐ Point to Point Motions
- ☐ Linear Motions
- ☐ Contour Motions
- ☐ Peck Drilling
- ☐ Rectangular Pocketing
- ☐ Circular Pocketing

□ Mirroring

COURSE OUTCOMES

On completion of the course, student will be able

CO1 - Provide sufficient knowledge of industrial robot.

CO2 - Understand basic knowledge of robot programming.

CO3 - Understand the concepts of work volume, configuration of industrial robot.

CO4 - Understand the latest development in CNC system.

CO5 - Understand the basic concepts of CNC programming and machining.

CO6 - Prepare CNC Part Programming and preform manufacturing.

L T P Credits Total Marks

3 0 0 3 100

COURSE OBJECTIVES

To introduce the complete operation of various industries.

To provide an exposure to the process and instrumentation & control applications in various industries like

paper, petrochemical, iron and steel, mining, pharmaceutical, nuclear and power plant industries.

UNIT 1 OVERVIEW DESCRIPTION OF INDUSTRIAL PROCESSES 11 Hrs.

Description of process in Paper Industries Description of process in petrochemical industries: Description of process in iron and steel and mining industries - Description of process in pharmaceutical and nuclear industries.

UNIT 2 INSTRUMENTATION IN PAPER INDUSTRIES 7 Hrs.

Measurement of Basic weight, thickness, density, Porosity, smoothness, softness, hardness and compressibility; selection of suitable measurement hardware for flow, pressure, level, temperature, density, solids, consistency – moisture analyzers oxidation - reduction potential and pH.

UNIT 3 INSTRUMENTATION IN PETROCHEMICAL INDUSTRIES 7 Hrs.

P & I diagram of petroleum refinery, measurement and control of absolute pressure, density, conductivity, differential pressure and flow of evaporators. Measurement and control of column pressure, liquid distillate, vapor distillate.

UNIT 4 INSTRUMENTATION IN IRON AND STEEL AND MINING INDUSTRIES 11 Hrs.

Iron and steel: Selection of suitable measurement hardware for temperature, pressure, level, flow, weighing and proportioning – special gauges for measurement of thickness and shape. Mining Industry: Weighing - conveyor belts - metal detectors – level sensors – nuclear density detectors – flow meters, Coal analyzer - thermogravimetry – gross calorific value - total Sulphur analysis - ash analyzer - online monitor- air quality monitoring- Sampling of ambient air – general air sampling system - Flue gas oxygen analyzer - analysis of impurities in feed water and steam - dissolved oxygen analyzer - chromatography - PH Meter - pollution monitoring instruments.

UNIT 5 INSTRUMENTATION IN PHARMACEUTICAL, NUCLEAR AND POWER PLANT INDUSTRIES 9 Hrs.

Pharmaceutical Industries: Flow measurement - pressure measurement – smoke detector Nuclear Industries: Radiation detection instruments – Area monitors and in-place detectors – Temperature measuring devices – level sensors. Power Plant Industries: Metal temperature measurements, flow of feed water – fuel, air, steam with correction factor for temperature and pressure.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - List the basic operation of various industries.

CO2 - Summarize the process parameters with appropriate sensors/transducers.

CO3 - Explain the measurement of different process parameters for specified industries.

CO4 - Analyze the working of different Instruments used in specified industries.

CO5 - Compare diverse measurement techniques/control of process parameters.

CO6 - Develop an appropriate measurement technique in an industry.

TEXT / REFERENCE BOOKS

1. Liptak B G, "Instrumentation in the processing industries", Chilton book Company, 1973.
2. Considine D. M., "Process/Industrial Instruments and control Handbook", McGraw Hill, 5th Edition 1999.
3. Hower P. Kallen, "Hand Book of Instrumentation and Control", Tata McGraw Hill, 1961.
4. Liptak B G, "Instrument Engineer's Handbook, Vol. 2: Process Control and Optimization", CRC Press, 2006.
5. Baskara Rao, "Petrochemicals", Khanna Publishers, New Delhi, 1987.
6. Liptak B.G, "Process Measurement and Analysis", 3rd Edition, Chilton Book Co., 2003.
7. Considine D. M, "Hand Book of Applied Instrumentation", Tata McGraw Hill, 1984.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each – No Choice 20 Marks

PART B: 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

L T P Credits Total Marks

3 0 0 3 100

COURSE OBJECTIVES

To identify different types of biomedical units such as pathological, diagnostic, therapeutic and prosthetic devices.

To educate students the different mechanism to measure and monitor different biomedical parameters.

UNIT 1 INTRODUCTION 9 Hrs.

Cell structure – electrode – electrolyte interface, electrode potential, resting and action potential
Different electrodes for measurement, Classification of Biomedical instruments, ECG, EEG, EMG – machine description – methods of measurement.

UNIT 2 SENSORS AND TRANSDUCERS 9 Hrs.

Basic transducer principles Types — resistive, inductive, capacitive, fiber-optic, photoelectric, chemical, active and passive transducers and their description and feature applicable for biomedical instrumentation Sensor applications in medicine – External and implantable sensors.

UNIT 3 ORTHOTICS AND PROSTHETICS 9 Hrs.

Need and Classification of orthotics and prosthetics, Gait Cycle, Upper and Lower limb Prosthetic devices. Upper and Lower limb Orthotic devices, FES system, Design of manual and powered wheelchairs.

UNIT 4 MEDICAL IMAGING 9 Hrs.

Computed Tomography, Spiral or Helical, Angiography., Magnetic resonance imaging, Nuclear medical imaging, Ultrasound Imaging, Thermography, Endoscopy, Laparoscopy.

UNIT 5 APPLICATIONS & CASE STUDIES 9 Hrs.

Robots in surgery, Nano robots in medicine, Rehabilitation robots, Navigation Handheld snake like robots, Smart sensors for detecting kidney stones, Active prosthetic Knee, Smart system for cardiovascular plaque detection.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Comment on various measurement systems used in diagnostics.

CO2 - Describe the sensors and transducers used in biomedical engineering.

CO3 - Design suitable orthotic and prosthetic devices and applications.

CO4 - Explain the working of different imaging techniques in Biomedical Engineering.

CO5 - Analyse the applications of mechatronics in medicine.

CO6 - Design medical equipment using the mechanical aspects gained.

TEXT / REFERENCE BOOKS

1. Siamak Najarian “Mechatronics in Medicine – A Bio medical Engg. approach”, McGraw – Hill Education, 2011.

2. R.S. Khandpur, Handbook of biomedical Instrumentation, Tata McGraw Hill Publication company Ltd, New Delhi, 2014.
3. Joseph J. Carr, John Michael Brown, Introduction to Biomedical Equipment Technology 4th Edition, Pearson Education, 2012.
4. John G. Webster, Biomedical Instrumentation, Wiley Publications.2007.
5. Textbook of rehabilitation, Sunder, Jaypee Publications, 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice 20 Marks

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks 80 Marks

L T P Credits Total Marks

3 0 0 3 100

COURSE OBJECTIVES

To understand the fundamental concepts and gain experimental knowledge of stress/strain developed in engineering materials and structures.

To gain knowledge of stress/strain measuring gauges.

To handle measuring gauges to measure stress/strain and apply various methods.

To gain the knowledge of Moire and Photoelasticity techniques.

To gain the knowledge of Brittle and Birefringent coating methods.

UNIT 1 OVERVIEW OF EXPERIMENTAL STRESS ANALYSIS 7 Hrs.

Introduction - Concept of stress and strain – stress and strain relations - Experimental stress analysis - Advantages – Methods - Simplification of problems - Selection of Experimental Techniques.

UNIT 2 STRAIN MEASUREMENT AND RECORDING INSTRUMENTS 10 Hrs.

Introduction - Principle - Types of strain gauges – Applications – Materials - Strain Sensitivity - Bridge Sensitivity - Gauge factor – Calibration and Temperature compensation - Wheatstone Bridge and Potentiometer Circuits - Rosettes strain gauges and analysis - Strain Gauge Selection - Stress Gauges - Load Cells - Data Acquisition - Six Component Balance - Recording Instruments - Static and Dynamic recording at various frequencies.

UNIT 3 MOIRE METHODS 10 Hrs.

Introduction - Mechanism of formation of Moire fringes - Geometrical approach to Moire fringe analysis - Displacement field approach to Moire fringe analysis - Out of plane measurements Tardy's Method - Babinet Soleil Method - Sharpening and multiplication of Moire - Fringes, Experimental procedure and techniques.

UNIT 4 PHOTO ELASTICITY METHODS 10 Hrs.

Introduction – Two- and three-dimensional photoelasticity - Concept of light - Methods - Materials for Photo elasticity - Photo elastic Effects -Temporary double refraction - Stress optic law - Effects of stressed model in a plane Polariscope - Fringe multiplication - Isochromatic fringe patterns - Isoclinic fringe patterns - Compensation techniques - Calibration methods - Separation and Shear Difference Methods - Scaling model to prototype stresses.

UNIT 5 BRITTLE AND BIREFRINGENT COATING METHODS 8 Hrs.

Introduction - Types of Coating methods – Brittle and Birefringent coatings -Test procedures– applications – Failure theories - Coating Materials- Coating stresses and strains - effect of coating thickness -Crack pattern –Crack detection– Calibration procedures –Brittle coating data analysis- Fringe-order determinations and stress separation method.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the basics of experimental stress analysis.

CO2 - Remember and explain overall concepts of stress/strain analysis and recording instruments by using experimental means of stress and strain gauges.

CO3 - Discuss the theory and practice of Moire methods and evaluate stress/strain.

- CO4 - Analyze the theory and practice of Photoelasticity analysis methods for various materials.
CO5 - Describe and compare the Brittle and Birefringent coatings and working of strain gauges.
CO6 - Develop a procedure to solve the practical problems.

TEXT / REFERENCE BOOKS

1. Sadhu Singh, "Experimental Stress Analysis", Khanna Publishers, New Delhi, ISBN: 9788174091826, 2015.
2. James W. Dalley and William. F. Riley, "Experimental Stress Analysis", ISBN-13: 978 - 0970067586, College House Enterprises Llc, June 30, 2001.
3. Jindal, U C, "Experimental Stress Analysis", ISBN-9332501246, 9789332501249, Pearson Education, India, 2012.
4. Srinath. L. S, Raghava. M. R., Lingaiah. K, Gargesha. G, Pant. B and Ramachandra, K, "Experimental Stress Analysis", ISBN: 9780074519264, Tata McGraw Hill, New Delhi, 1984.
5. Richard C. Dove and Paul H. Adams, "Experimental Stress Analysis and Motion Measurement: Theory, Instruments and Circuits, Charles E. Merrill, 1964, Digitized: 30 Nov 2007.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each – No choice 20 Marks

PART B: 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

L T P Credits Total Marks

3 0 0 3 100

COURSE OBJECTIVES

To understand Basic Concepts of Artificial Intelligence and Expert Systems.

To provide knowledge on Various Techniques and Tools involved in Artificial Intelligence.

UNIT 1 INTRODUCTION 9 Hrs.

Introduction: History, Definition of AI, Emulation of human cognitive process, knowledge search tradeoff, stored knowledge, semantic nets. An abstract view of modeling, elementary knowledge. Computational logic, analysis of compound statements using simple logic connectives, predicate logic, knowledge organization and manipulation, knowledge acquisition.

UNIT 2 PROGRAMMING AND LOGICS IN ARTIFICIAL INTELLIGENCE 9 Hrs.

LISP and other programming languages- introduction to LISP, syntax and numerical function, LISP and PROLOG

distinction, input output and local variables, Interaction and recursion, property list and arrays alternative languages,

formalized symbolic logics- properties of WFRS, non-deductive inference methods. Inconsistencies and uncertainties- Truth maintenance systems, default reasoning and closed world assumption, Model and temporary logic.

UNIT 3 SEARCH METHODS AND KNOWLEDGE REPRESENTATION 9 Hrs.

Fuzzy logic - concepts, Introduction to Fuzzy logic with examples, probabilistic reasoning, Bayesian probabilistic inference, Dempster Shafer theory, possible world representation, Ad-Hoc methods. Structure knowledge: Graph, frames and related structures, Object oriented representation- object classes, message and methods, simulation examples using OOPS programs, OOP languages. Search and control strategies - Concepts, search problems, uniformed or Blinded search, searching AND – OR graphs.

UNIT 4 KNOWLEDGE ORGANISATION AND COMMUNICATION IN EXPERT SYSTEMS 9 Hrs.

Matching techniques- Need for matching, matching problem, partial matching, Fuzzy matching, RETE matching algorithm. Knowledge organization- Indexing and retrieval techniques, integration of knowledge in memory organization systems, Perception, communication and Expert systems. Overview of Linguistics, Basic passim techniques, semantic analysis and representation structures, natural language generation and system.

UNIT 5 PATTERN RECOGNITION AND LEARNING TECHNIQUES 9 Hrs.

Pattern recognition system- understanding speech recognition, Image transformation, low level processing, medium and high-level processing, vision system architecture, Rule based system architecture, knowledge acquisition and validation, knowledge system building tools, use of AI and ES in manufacturing and design, types of learning- general learning model, performance measures, learning automate genetic algorithm, learning by induction - LEX, ID3, INDUCE systems.

Max. 45 Hrs.

COURSE OUTCOMES:

On completion of the course, student will be able to

- CO1 - Understand the Basics about Artificial Intelligence and Expert Systems.
- CO2 - Understand the Programming Logics in Artificial Intelligence.
- CO3 - Understand Various search methods in Artificial Intelligence.
- CO4 - Understand the Knowledge about the Expert Systems.
- CO5 - Understand the Image processing and analysis.
- CO6 - Understand the latest developments in Knowledge systems and Tools.

TEXT / REFERENCE BOOKS

1. Russel (Stuart), 'Artificial Intelligence- Modern approach, Pearson Education series in AI', 3rd Edition, 2009.
2. Dan W Patterson, 'Introduction to Artificial intelligence and Expert systems', Prentice Hall of India Pvt. Ltd, 2001
3. Eugene Charniak, Drew Mc Dermot, 'Introduction to Artificial intelligence', Addison Wesley Longman Inc., 2009
4. George. F, William. A. Stubblefield, 'Artificial intelligence and the design of expert systems', The Benjamin Cummins Publishing Co., Inc 2nd Edition, 1992.
5. Robert J Schalkoff, 'Artificial intelligence An Engineering Approach', McGraw Hill International Edition, 1990.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs

PART A: 10 Questions of 2 marks each – No Choice 20 Marks

PART B: 2 Questions from each unit of internal choice, each carrying 16 marks 80 Marks

L T P Credits Total Marks

3 0 0 3 100

COURSE OBJECTIVES

To understand and develop knowledge on the various flexible manufacturing systems and its applications.

To get introduced to the simulation process and FMS database.

To explore the future prospects of AI and Expert systems in FMS.

UNIT 1 INTRODUCTION 9 Hrs.

FMS– development of manufacturing systems – benefits – major elements – types of flexibility– part selection problems – FMS application and flexibility – single product, single batch, N – batch scheduling problem – knowledge-based scheduling system.

UNIT 2 COMPUTER CONTROL AND SOFTWARE FOR FLEXIBLE MANUFACTURING SYSTEMS 9 Hrs.

Introduction – composition of FMS– hierarchy of computer control –computer control of work center and assembly lines – FMS supervisory computer control – types of software specification and selection – Object oriented control architecture trends.

UNIT 3 FMS SIMULATION AND DATA BASE 9 Hrs.

Application of simulation–model of FMS–simulation software – limitation – manufacturing data systems–data flow–FMS database systems–planning for FMS database- predictive control algorithms for on line scheduling of FMS.

UNIT 4 GROUP TECHNOLOGY AND JUSTIFICATION OF FMS 9 Hrs.

Introduction – matrix formulation – mathematical programming formulation –graph formulation – knowledge-based system for group technology – economic justification of FMS- application of possibility distributions in FMS systems justification Measuring flexibility and performance of FMS.

UNIT 5 APPLICATIONS OF FMS AND FACTORY OF THE FUTURE 9 Hrs.

FMS application in machining, sheet metal fabrication, prismatic component production – aerospace application – Case studies. FMS development towards factories of the future – artificial intelligence and expert systems in FMS – design philosophy and characteristics for future.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Identify the need and role of Flexible Manufacturing System in Industry.

CO2 - Assess the concepts and linkage of software in FMS.

CO3 - Demonstrate the simulation process involved and its data flow.

CO4 - Justify the importance of FMS and its importance in group technology.

CO5 - Compare and categories the level of FMS needed in an manufacturing industry.

CO6 - Appreciate and explore the penetration of AI in FMS.

TEXT / REFERENCE BOOKS

1 Jha, N.K. “Handbook of flexible manufacturing systems”, Academic Press Inc., 2012.

- 2 Radhakrishnan P. and Subramanyan S., “CAD/CAM/CIM”, Wiley Eastern Ltd., New Age International Ltd., 2010.
- 3 Raouf, A. and Ben-Daya, M., Editors, “Flexible manufacturing systems: recent development”, Elsevier Science, 2015.
- 4 Jan Beier, “Simulation approach towards energy flexible manufacturing systems”, Springer Publications, 2017.
- 5 H.K. Shivanand, “Flexible Manufacturing System”, New Age International Publishers, 2011.
- 6 Taiichi Ohno, “Toyota production system: beyond large-scale production”, Productivity Press (India) Pvt. Ltd. 2013.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each-No choice 20 Marks

PART B: 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

L T P Credits Total Marks

3 0 0 3 100

UNIT 1 REVIEW OF DIGITAL INSTRUMENTATION 6 Hrs.

Representation of analog signals in the digital domain – Review of quantization in amplitude and time axes, sample and hold, sampling theorem, ADC and DAC.

UNIT 2 FUNDAMENTALS OF VIRTUAL INSTRUMENTATION 10 Hrs.

Concept of virtual instrumentation – PC based data acquisition – Typical on board DAQ card – Resolution and sampling frequency - Multiplexing of analog inputs – Single-ended and differential inputs – Different strategies for sampling of multi-channel analog inputs. Concept of universal DAQ card - Use of timer-counter and analog outputs on the universal DAQ card.

UNIT 3 CLUSTER OF INSTRUMENTS IN VI SYSTEM 10 Hrs.

Interfacing of external instruments to a PC – RS232, RS 422, RS 485 and USB standards - IEEE 488 standard – ISO-OSI model for serial bus – Introduction to bus protocols of MOD bus and CAN bus.

UNIT 4 GRAPHICAL PROGRAMMING ENVIRONMENT IN VI 10 Hrs.

Concepts of graphical programming – Lab-view software – Concept of VIs and sub VI - Display types – Digital – Analog – Chart – Oscilloscopic types – Loops – Case and sequence structures - Types of data – Arrays – Formulae nodes – Local and global variables – String and file I/O.

UNIT 5 ANALYSIS TOOLS AND SIMPLE APPLICATIONS IN VI 9 Hrs.

Fourier transform - Power spectrum - Correlation – Windowing and filtering tools – Simple temperature indicator – ON/OFF controller – P-I-D controller - CRO emulation - Simulation of a simple second order system – Generation of HTML page.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Recall Digital Instrumentation.

CO2 - Understand the concept of Virtual Instrumentation.

CO3 - Select an appropriate interfacing technique.

CO4 - Apply the knowledge of programming in VI.

CO5 - Develop a program using VI.

CO6 - Design a system using VI.

TEXT / REFERENCE BOOKS

1. S. Gupta and J.P Gupta, 'PC Interfacing for Data Acquisition and Process Control', Instrument society of America, 1994.
2. Peter W. Gofton, 'Understanding Serial Communications', Sybex International.
3. Robert H. Bishop, 'Learning with Lab-view', Prentice Hall, 2003.
4. Kevin James, 'PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control', Newness, 2000.
5. Gary W. Johnson, Richard Jennings, 'Lab-view Graphical Programming', McGraw Hill Professional Publishing, 2001.

6. Jerome J., Virtual Instrumentation using Lab VIEW, Prentice Hall India Private Ltd., New Delhi, 2010.
7. Sanjay Gupta, Virtual Instrumentation using Lab view, Tata McGraw-Hill Education, 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each – No Choice 20 Marks

PART B: 2 Questions from each unit of internal choice, each carrying 16 marks 80 Marks

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School of Mechanical Engineering
Department of Mechatronics

Minutes of Board of Studies Meeting held on 04-06-2022 (Saturday)

Meet Time: 9.30 a.m. to 11.30 noon

The meeting started with the welcome address delivered by Dr. S. Prakash, Professor and Dean (Session Chair). He introduced the new course and the revised courses offered to Mechatronics students to the BOS panel members. The following are the BOS members were present during the Mechatronics BOS meeting.

Sl. No.	Name	Designation	Institution	Role
1	Dr. S. Prakash	Professor and Dean	Sathyabama Institute of Science & Technology	Chair person
2	Dr. L. Vijayaraghavan	Professor	IIT Madras, Chennai	BoS Member (External)
3	Dr. N. GaneshKumar	Associate Professor	PSG Tech, Coimbatore	BoS Member (External)
4	Dr. B. Kanimozhi	Professor	Sathyabama Institute of Science & Technology	Member
5	Dr. M Sangeetha	Associate Professor	Sathyabama Institute of Science & Technology	Member
6	Dr. J. R. Deepak	Associate Professor	Sathyabama Institute of Science & Technology	Member

Agenda:

- Review of Curriculum for the upcoming semester courses for B.E. Mechatronics to be discussed
- New courses have been proposed for the Course for B.E. Mechatronics
 - SMRA1201 Fundamentals of Automation & Control
 - SMRA1401 Automation and Programmable Logic Controller
 - SMRA1402 Signal and Control System Engineering
 - SMRA2501 Mechatronics and Simulation lab
 - SMRA2701 Robotics and CAM Lab

Dr. S. Prakash proposed a new course entitled **SMRA1201 Fundamentals of Automation & Control (Theory Course)** and **SMRA1401 Automation and Programmable Logic Controller**

(Theory Course) based on the current industrial requirements. The proposed in 2019 regulation **SMRA1201 - Fundamentals of Automation and Control** new **(Theory Course)** course replaces the **SMR1101 Digital Electronics** offered in 2018 syllabus in the second semester as the students has to learn the basics of Automation and Control which will be a prerequisite for the upcoming papers. Dr. S. Prakash also suggested a new course **SMRA1401 Automation and Programmable Logic Controller** in the fourth semester as the students has to learn the basics of PLC and Automation.

Dr. M. Sangeetha proposed a new theory course entitled **SMRA1402 Signal and Control System Engineering (Theory Course)** a new practical course entitled **SMRA2501 Mechatronics and Simulation lab (Practical Course)** and **SMRA2701 Robotics and CAM Lab (Practical Course)** based on the futuristic requirements for the students **SMRA2501 Mechatronics and Simulation lab** course was revised and proposed from the **2018 regulation** practical course **SME4058 Mechatronics Lab** as the students has to learn the basics of Fluid Sim Software enhances the programing skill which will help the student to become a Hydraulic and pneumatic system Designer for automation industries. Students will be able simulation package by constructing the system models for the specified

Dr. N. Ganesh Kumar, Associate Professor from PSG Tech appreciated the idea of introducing the courses **SMRA2701 - Robotics and CAM Lab (Practical Course)** and **SMRA1701 - Robotics and Machine Vision System (Theory Course)** saying that skill set of the mechatronics engineering students of Sathyabama Institute of science and technology will match the current needs of the robotics and Automation Industry.

Dr. L. Vijayaraghavan, Professor from IIT Madras, Chennai and Dr. N. Ganesh Kumar, Associate Professor from PSG Tech (External BOS members) reviewed all the course and approved the inclusion of the new course in 2019 Regulation. The Board members appreciated the inclusion of the new courses in 2019 Regulation.



Convener/Dean



HOD




Expert Members



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)

Accredited "A" Grade by NAAC | 12B Status by UGC | Approved by AICTE

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**School of Mechanical Engineering
Department of Mechatronics**

Minutes of Board of Studies Meeting held on 10-12-2022 (Saturday)

Meet Time: 10.30 a.m. to 12.00 noon

The meeting started with the welcome address delivered by Dr. S. Prakash, Professor and Dean (Session Chair). He introduced the new course and the revised courses offered to Mechatronics students to the BOS panel members. The following are the BOS members were present during the Mechatronics BOS meeting.

Sl. No.	Name	Designation	Institution	Role
1	Dr. S. Prakash	Professor and Dean	Sathyabama Institute of Science & Technology	Chair person
2	Dr. L. Vijayaraghavan	Professor	IIT Madras, Chennai	BoS Member (External)
3	Dr. N. GaneshKumar	Associate Professor	PSG Tech, Coimbatore	BoS Member (External)
4	Dr. B. Kanimozhi	Professor	Sathyabama Institute of Science & Technology	Member
5	Dr. M Sangeetha	Associate Professor	Sathyabama Institute of Science & Technology	Member
6	Dr. J. R. Deepak	Associate Professor	Sathyabama Institute of Science & Technology	Member

Agenda:

- Review of Curriculum for the upcoming semester courses for B.E. Mechatronics to be discussed
- Professional Electives Courses proposed for B.E. Mechatronics
 - SMRA3001 Instrumentation in Industries
 - SMRA3004 Medical Mechatronics

- SMRA3005 Experimental stress analysis
- SMRA3003 Artificial Intelligence and Expert systems
- SMRA4001 Flexible Manufacturing systems
- SMRA3002 Virtual Instrumentation

Dr. S. Prakash proposed the following **Professional Electives Courses** such as SMRA3001 Instrumentation in Industries, SMRA3004 Medical Mechatronics, SMRA3005 Experimental stress analysis, SMRA3003 Artificial Intelligence and Expert systems, SMRA4001 Flexible Manufacturing systems, SMRA3002 Virtual Instrumentation to the board members. The Board members appreciated the inclusion of the Professional Electives new courses in 2019 Regulation.

Dr. L. Vijayaraghavan, Professor from IIT Madras, Chennai and Dr. N. Ganesh Kumar, Associate Professor from PSG Tech (External BOS members) reviewed all the course and approved the inclusion of the new course in 2019 Regulation. The Board members appreciated the inclusion of the new courses in 2019 Regulation.



Convener/Dean



HOD



Dr. N. Ganesh Kumar N



Expert Members