RAMAIAH
Institute of Technology

CURRICULUM

for the Academic year 2021 – 2022

ELECTRONICS AND INSTRUMENTATION ENGINEERING

VII & VIII SEMESTER B.E

RAMAIAH INSTITUTE OF TECHNOLOGY
(Autonomous Institute, Affiliated to VTU)
Bangalore – 560054.

About the Institute

Dr. M. S. Ramaiah a philanthropist, founded 'Gokula Education Foundation' in 1962 with an objective of serving the society. M S Ramaiah Institute of Technology (MSRIT) was established under the aegis of this foundation in the same year, creating a landmark in technical education in India. MSRIT offers 17 UG programs and 15 PG programs. All these programs are approved by AICTE. All eligible UG and PG programs are accredited by National Board of Accreditation (NBA). The institute is accredited with **'A^{+}' grade by NAAC in March 2021** for 5 years. University Grants Commission (UGC) & Visvesvaraya Technological University (VTU) have conferred Autonomous Status to MSRIT for both UG and PG Programs since 2007. The institute is a participant to the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. The institute has 380 competent faculty out of which 60% are doctorates. Some of the distinguished features of MSRIT are: State of the art laboratories, individual computing facility for all faculty members, all research departments active with sponsored funded projects and more than 300 scholars pursuing Ph.D. To promote research culture, the institute has established Centre of Excellence for Imaging Technologies, Centre for Advanced Materials Technology, Centre for Antennas and Radio Frequency systems (CARFS), Center for Cyber Physical Systems & Schneider Centre of Excellence. **M S Ramaiah Institute of Technology has obtained "Scimago Institutions Rankings" All India Rank 65 & world ranking 578 for the year 2020.**

The Entrepreneurship Development Cell (EDC) and Section 8 company "Ramaiah Evolute" have been set up on campus to incubate startups. **M S Ramaiah Institute of Technology secured All India Rank 8th for the year 2020 for Atal Ranking of Institutions on Innovation Achievements (ARIIA), by MoE, Govt. of India.** MSRIT has a strong Placement and Training department with a committed team, a good Mentoring/Proctorial system, a fully equipped Sports department, large air-conditioned library with good collection of book volumes and subscription to International and National Journals. The Digital Library subscribes to online e-journals from Elsevier Science Direct, IEEE, Taylor & Francis, Springer Link, etc. MSRIT is a member of DELNET, CMTI and VTU E-Library Consortium. MSRIT has a modern auditorium and several hi-tech conference halls with video conferencing facilities. The institute has excellent hostel facilities for boys and girls. MSRIT Alumni have distinguished themselves by occupying high positions in India and abroad and are in touch with the institute through an active Alumni Association. **As per the National Institutional Ranking Framework (NIRF), MoE, Government of India, M S Ramaiah Institute of Technology has achieved 65th rank among 1143 top Engineering institutions of India for the year 2021 and is 1st amongst the Engineering colleges affiliated to VTU, Karnataka.**

About the Department

The Department was established in the year 1992 as Instrumentation Technology and was renamed Electronics and Instrumentation Engineering (EIE) in the year 2014 by VTU. The department offers UG course which is recognized by AICTE and accredited by NBA, four times (up to 2022). The department is recognised as a Research Centre by VTU, Belagavi and offers Ph.D and MSc.(Engg.) by research programs. All the faculty members are postgraduates and more than 70% are doctorates and are actively engaged in R&D activities.

The department is focussed on empowering the students with technical knowledge and practical skills in the areas of Instrumentation Technology and Industrial Automation System in line with Industry 4.0. The department is equipped with modern laboratories including Allen Bradley PLCs, SCADA from Schneider Electric, Ocean Optics Optical Spectrometer and research software such as Neuroshell predictor and classifier to name a few.

The course and curriculum are multi-disciplinary and revolves around electronics, computers and embedded systems. The focus is on the design and control of automated systems. In line with Industry 4.0 standards, the department is also focussed on offering courses on automation, bridging the gap between academia and industries. The emphasis is on hands-on training with PLCs, SCADA, Robotics, Automation and IoT. With wide exposure to theory and hands-on training in modern laboratories, the students are well equipped to get into core industries and/or higher studies in India and abroad.

Our Board of Studies involves experts from IISc, HAL, ISRO, DRDO and our alumni giving inputs to the curriculum design and modifications. The department has an MoU with Mitsubishi Electric India Private Limited and Schneider Electric India Private Limited and has several consultancy projects and linkages with industries. Consultancy projects are in the areas of internet of things (IoT), PLC based pneumatic and hydraulic experimental setup, low cost accessories for biomedical devices, and automation. The department also has an active membership in the International Society of Automation (ISA) and the Society of Instrumentation Professionals (ISOI -IISc).

VISION OF THE INSTITUTE

To be an Institution of International Eminence, renowned for imparting quality technical education, cutting edge research and innovation to meet global socio-economic needs

MISSION OF THE INSTITUTE

MSRIT shall meet the global socio-economic needs through

- Imparting quality technical education by nurturing a conducive learning environment through continuous improvement and customization
- Establishing research clusters in emerging areas in collaboration with globally reputed organizations
- Establishing innovative skills development, techno-entrepreneurial activities and consultancy for socio-economic needs

QUALITY POLICY

We at M S Ramaiah Institute of Technology strive to deliver comprehensive, continually enhanced, global quality technical and management education through an established Quality Management System complemented by the synergistic interaction of the stake holders concerned

VISION OF THE DEPARTMENT

To become centre of excellence in the field of Electronics and Instrumentation Engineering for education and research.

MISSION OF THE DEPARTMENT

To empower and imbibe students with technical knowledge and practical skills in the field of Electronics and Instrumentation Engineering, enabling them to work as professionals in globally competitive environment and contribute to the society through research and higher studies.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

PEO 1: To analyze and solve problems in Electronics and Instrumentation Engineering related to industry and research by applying knowledge in mathematics, physical science and engineering.

PEO 2: To design and commission an industrial automation system.

PEO 3: To communicate effectively, work with team, practice professional ethics, and engage in lifelong learning.

PROGRAM OUTCOMES (POs):

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1: Identify, analyze, design and implement—problems in diverse and multidisciplinary background emphasizing control and industrial automation, using modern tools.

PSO2: Understand the impact of engineering solutions in societal, environmental context and manage the projects efficiently.

PSO3: Adhere to professional ethics, lifelong learning, team building skills and communicate effectively.

Curriculum Course Credits Distribution

Batch 2018-22

Semester	Humanities Social Sciences & Management (HSMC)	Basic Sciences/ Lab (BS)	Engineering Sciences/ Lab (ES)	Professional Courses- Core (Hard core, soft core, Lab) (PC-C)	Professional Courses - Electives (PC-E)	Other Electives (OE)	Project Work (PW)	Internship/ other activities (IS/ECA)	Total semester load
First		9	11						**20**
Second	2	8	10						**20**
Third		4		21					**25**
Fourth		4		21					**25**
Fifth	3			15	3	3			**24**
Sixth				11	6	3	4		**24**
Seventh	3			10	6			1	**20**
Eighth							14	3	**17**
Total	**8**	**25**	**21**	**78**	**15**	**6**	**18**	**4**	**175**

SCHEME OF TEACHING
VII SEMESTER

Sl. No.	Course Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1.	EI71	Industrial Data Networks	PCC	4	0	0	4	4
2.	EI72	Advanced Control Systems	PCC	3	1	0	4	5
3.	EI73	Entrepreneurship & Management	HSMC	3	0	0	3	3
4.	EIE74x	Department elective Group 1	PEC4	3	0	0	3	3
5.	EIE75x	Department elective Group 2	PEC5	3	0	0	3	3
6.	EIL76	Industrial Data Networks Lab	LAB	0	0	1	1	2
7.	EIL77	Advanced Control Systems Lab	LAB	0	0	1	1	2
8.	EISE	Seminar	SEM	0	0	1	1	
			Total	**16**	**1**	**3**	**20**	

Elective Code	Group 1 - Elective Title	Elective Code	Group 2 - Elective Title
EIE741	Machine Learning	EIE751	VLSI design
EIE742	Wireless Sensor Networks	EIE752	Electromagnetic Interference and compatibility in system design
EIE743	Statistical Process Control	EIE753	Power plant and Petrochemical Instrumentation
		EIE754	Biomaterials and Biosensors

SCHEME OF TEACHING

VIII SEMESTER

Sl. No.	Subject Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1	EIIN	Internship or NPTEL course	IN	*	*	*	3	
2	EIP	Project	PROJ	0	0	14	14	
			Total				**17**	

*** Note: Internship**

1. The student can do the internship during the summer vacation between 2nd and 3rd sem or between 4th and 5th sem or between 6th and 7th sem or during 8th semester.
2. The duration of the internship is minimum of 4 weeks.
3. The marks awarded for internship are considered/ added in the 8th semester.
4. The report of the internship needs to be submitted during the 8th semester.
5. The evaluation rubrics have to be specified by the department.
6. The department needs to constitute a committee for the evaluation process.

VII Semester

INDUSTRIAL DATA NETWORKS

Course Code: EI71 **Credit: 4:0:0**
Prerequisite: Knowledge of Digital communication, Automation **Contact Hours: 56**
Course Coordinator: Ms. J.V. Alamelu

Course Content

Unit-I

Data Network Fundamentals: Industry 4.0 – Architecture, basics, Network hierarchy and switching – Open system interconnection model of ISO OSI model [including Fiber optic communication]– Network Topologies and IEEE standards [IEEE 802.3,802.4,802.5].

Unit - II

Internetworking: Network Devices – Open system configuration with bridges and Gateways – Routing algorithms – Network addressing – IPV4, IPV6- TCP/IP [Industrial ETHERNET] - Special requirements of Networks used in control.

Unit – III

Industrial Field Bus & Protocols: Field Bus Introduction – General Field Bus architecture – Basic requirements of field bus standard – Field bus topology – Foundation field bus HSE – MODBUS TCP – PROFINET – Ether CAT-Inter connectivity - comparisons.

Unit – IV

Industrial Network Protocols: Architecture and requirements, applications of CAN - PROFIBUS - SERCOS - IEEE1588 and other recent Industrial standards.

Unit – V

HART and Group Displays Evolution of signal standards: HART communication protocol– Communication modes – HART Networks – Control system interface – HART and OSI standard comparison. Group Displays – used in DCS, Wireless wireless standards – OPC-UA concepts, Implementation with Case studies.

Text Books

1. A.S. Tanenbaum, Computer Networks, Pearson Education, 2014.
2. Steve Mackay Edwin Wright Deon Reynders John Park, Practical Industrial Data Networks Design, Installation and Troubleshooting, Elsevier, 2004.

References

1. G. K. McMillan, Process/Industrial Instruments Hand book, Tata McGraw Hill, New York.
2. www.sercos.org
3. Romily Bowden, HART Application Guide and OSI communication Foundation.

Course Outcomes (COs):

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

1. Analyze the functionality and different protocols of ISO OSI Reference model**. (PO-2,3,4,9, PSO-1,3)**
2. Evaluate problems on subnetting, routing with different routing protocols. **(PO-2,3,4,9, PSO-1,3)**
3. Analyze the features of different protocols through Field buses based on Ethernet standards. **(PO-2,3,4,9,12, PSO-1,3)**
4. Describe the operations of various protocols based on serial communication and optical fibers. **(PO-2,3,4,6,8,9,12, PSO-1,3)**
5. Explain the concepts of DCS, HMI, HART protocol used in Automation industries. **(PO-2,3,4,6,8,9,12, PSO-1,3)**

ADVANCED CONTROL SYSTEMS

Course Code: EI72 **Credit: 3:1:0**
Prerequisite: Control Systems (EI45) **Contact Hours: 42 + 14**
Course Coordinator: Dr. H. S. Niranjana Murthy

Course Content

Unit I

State Variable Analysis: Concept of state – State Variable and State Model – State space representation of systems described by scalar differential equations - State models for linear and continuous time systems – Examples from Mechanical and Electrical Systems- Solution of state and output equation – State transition matrix.

Unit II

Controllability and Observability: Controllability and observability of linear time invarient systems; conditions for complete controllability and complete observability. Pole Placement – State observer Design of Control Systems with observers.

Unit III

Non-linear Systems: Common physical non-linearity, derivation of describing functions for common non-linearity –Describing function analysis of non-linear systems – Conditions for stability – Stability of oscillations.

Unit IV

Stability Analysis: Introduction, definition, first and second methods of Liapunov: stability analysis of linear system using Liapunov's second method. Stability analysis of Nonlinear system using second method of Liapunov –Liapunov's stability theorem, Generation of V-function using some formalized methods, Minimization of V function, Computation of stability domain.

Unit V

Optimal and Adaptive Control: Introduction to optimal systems, Types of performance indexes, Introduction to adaptive control, MARC architecture, MIT rule, Direct and Indirect adaptive control, Model reference adaptive control

Tutorial list:

1. State model of ODE, Electrical Systems
2. State model of Mechanical Systems
3. Transfer function calculation
4. Solution and output equation

5. Controllability
6. Observability
7. Controller and Observer Design
8. Describing Function for nonlinearities
9. Stability of oscillations
10. Nonlinear System Equilibrium Point
11. Liapunov Theorem, Stability using Liapunov theorem
12. Krasovskii's Theorem
13. Optimal Control
14. Adaptive Control

Text Books

1. I.J. Nagrath and M. Gopal, Control Systems Engineering, New Age International Publishers, 2003.
2. Ashish Tewari, Modern control Design with Matlab and Simulink, John Wiley, New Delhi, 2002.
3. M.Gopal, Modern control system theory, New Age International Publishers, 2002.

Course Outcomes (COs):

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

1. Model the physical process in state space form and solve state space equation. (PO-1,4,9, PSO-1,3)
2. Design of state observer control system. (PO-1,2,4,5, PSO-1)
3. Analyze stability analysis of control system using describing function method. (PO-1,4,5,9,10, PSO-1,3)
4. Analyze stability of non-linear system using Liapunov method. (PO-1,4,5,10, PSO-1,3)
5. Design optimal control using various performance measures and adaptive control system. (PO-1,2,4,5,9,10, PSO-1,3)

ENTREPRENEURSHIP AND MANAGEMENT

Course Code: EI73 **Credit: 3:0:0**
Prerequisite: Knowledge of engineering design and patents **Contact Hours: 42**
Course Coordinator: Dr. H. S. Niranjana Murthy

Course Content

Unit I

MANAGEMENT: Introduction - Meaning - Nature and Characteristics of Management, Scope and Functional Areas of Management - Management as a Science, Art of Professional Management and Administration - Roles of Management, Levels of Management, Development of Management Thought - Early Management Approaches - Modern Management Approaches. **Planning:** Nature and Purpose of Planning Process-Objectives - Types of Plans (Meaning only) - Decision Making - Importance of Planning -Steps in Planning and Planning Premises - Hierarchy of Plans

Unit II

ORGANIZING AND STAFFING: Nature and Purpose of Organization - Principles of Organization - Types of Organization - Departmentation - Committees - Centralization versus Decentralization of Authority and Responsibility - Span of Control - MBO and MBE (Meaning only), Nature and Importance of Staffing - Process of Selection & Recruitment (in brief).

Unit III

DIRECTING AND CONTROLLING: Meaning and Nature of Directing - Leadership Styles, Motivation Theories, Communication - Meaning and Importance - Coordination, Meaning and Importance and Techniques of Coordination. Meaning and Steps in Controlling - Essentials of a sound Control System - Methods of establishing Control.

Unit IV

ENTREPRENEURSHIP: Entrepreneur - Meaning of Entrepreneur; Evolution of the Concept, Functions of an Entrepreneur, Types of Entrepreneur, Intrapreneur - an Emerging Class. Concept of Entrepreneurship - Evolution of Entrepreneurship, Development of Entrepreneurship, Stages in Entrepreneurial Process; Role of Entrepreneurs in Economic Development; Entrepreneurship in India; Entrepreneurship - Its Barriers. **SMALL SCALE INDUSTRY:** Definition, Characteristics; Need and Rationale: Objectives; Scope; Role of SSI in Economic Development. Advantages of SSI; Steps to start an SSI -Government Policy towards SSL; Different Policies of SSI; Government Support for SSI during 5 Year Plans, Impact of Liberalization, Privatization, Globalization on SSL, Effects of WTO / GATT, Supporting Agencies of Government for SSI. - Meaning, Nature of Support; Objectives; Functions; Types of Help; Ancillary Industry and Tiny Industry (Definition only).

Unit V

INSTITUTIONAL SUPPORT: Different Schemes; TECKSOK; KIADB; KSSIDC; KSIMC; DIC Single Window Agency: SISI; NSIC; SIDBI; KSFC. **PREPARATION OF PROJECT:** Meaning of Project; Project Identification; Project Selection; Project Report; Need and Significance of Report; Contents; Formulation; Guidelines by Planning Commission for Project Report; Network Analysis; Errors of Project Report; Project Appraisal, Identification of Business Opportunities - Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study and Social Feasibility Study.

Text Books

1. Principles of Management - P.C. Tripathi, P.N. Reddy; Tata McGraw Hill.
2. Dynamics of Entrepreneurial Development & Management - Vasant Desai: Himalaya Publishing House.
3. Entrepreneurship Development - Small Business Enterprises - Poornima M Charantimath - Pearson Education - 2006.

References

1. Management Fundamentals - Concepts, Application, Skill Development - Robert Lusier: Thomson
2. Entrepreneurship Development - S S Khanka - S.Chand & Co.
3. Management - Stephen Robbins: Pearson Education / PHI - 17th Edition, 2003

Course Outcomes (COs):

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

1. Understand the functional areas of management and role of managers in managing people, planning processes and resources within a diverse organization. **(PO-1,9,11, PSO-1,2,3)**
2. Analyze the nature, purpose & objectives of Planning, Organizing & Staffing. **(PO-1,9,11, PSO-1,2,3)**
3. Develop the factual leadership qualities for development of organizations. **(PO-1,9,11, PSO-1,2,3)**
4. Identify the importance of Entrepreneurship & role of Small Scale Industries in Economic Development **(PO-1,9,11,PSO-1,2,3)**
5. Demonstrate the project identification, selection, project management, network analysis and Identify the Institutional support to start a Small Scale Industry **(PO-1,9,11, PSO-1,2,3)**

MACHINE LEARNING

Course Code: EIE741 **Credit: 3:0:0**
Prerequisite: Engineering mathematics **Contact Hours: 42**
Course Coordinator: Mrs. Elavaar Kuzhali.S

Course Content

Unit I

Introduction: Introduction to machine learning. Examples of machine learning applications, key terminologies, key tasks of machine learning, choosing right algorithms, steps in developing machine learning applications, why Python, getting started with NumPy. **Classifying with k-Nearest Neighbors:** Classifying with distance measurements, A Handwriting Recognition Systems - Examples

Unit II

Splitting datasets one feature at a time: Decision trees: Tree construction, plotting trees in Python with Matplotlib annotations, Testing and storing the classifier, Example – Prediction using decision trees. Classifying with probability theory: naïve Bayes: classifying with Bayesian decision theory, Conditional probability, Classifying with conditional probabilities, Document classification with naïve Bayes, Classifying text with Python, Examples – classification with naïve Bayes.

Unit III

Logistic regression: Classification with logistic regression and the sigmoid function: a tractable step function, Using optimization to find the best regression coefficients, Examples - classification with Logistic regression. Support vector machines: Separating data with the maximum margin, Finding the maximum margin, Efficient optimization with the SMO algorithm, Speeding up optimization with the full Platt SMO, Using kernels for more complex data, Example – Handwriting Classification.

Unit IV

Predicting numeric values - regression: Finding best-fit lines with linear regression, Locally weighted linear regression, Shrinking coefficients to understand our data, The bias/variance tradeoff, Examples. Tree-based regression: Locally modeling complex data, Building trees with continuous and discrete features, Using CART for regression, Building the tree, Executing the code, Tree pruning, Model trees, Examples

Unit V

Grouping unlabeled items using k-means clustering: The k-means clustering algorithm, Improving cluster performance with post processing, Bisecting k-means, Examples. Using principal component analysis to simplify data: Dimensionality

reduction techniques, Principal component analysis, Moving the coordinate axes, Performing PCA in NumPy, Examples.

Text Books

1. Peter Harrington, Machine Learning in Action, Manning Publications, 2012, ISBN 9781617290183

References

1. Ethem Alpaydin, Introduction to Machine Learning, 2nd Edition, PHI Pvt. Ltd-New Delhi, 2010
2. Christopher Bishop, Pattern Recognition and Machine Learning, CBS Publishers & Distributors-New Delhi
3. Tom M Mitchell, Machine Learning, McGraw-Hill, Inc. New York, NY, USA ©1997

Course Outcomes (COs):

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

1. Understand the fundamental concepts and challenges of machine learning. **(PO 1,2,5, 9,10,12, PSO 1,3)**
2. Understand and develop solutions for classification problems using different approaches. **(PO 1,2,3,4,5,9,10,12, PSO 1,3)**
3. Analyze and develop solutions for finding best parameters to classify data. **(PO 1,2,3,4,5,9,10,12, PSO 1,3)**
4. Understand how to apply a variety of learning algorithms for prediction. **(PO 1,2,3,4,5,9,10,12, PSO 1,3)**
5. Apply dimensionality reduction techniques and develop clustering methods as well as approaches to simplify data. **(PO 1,2,3,4,5,9,10,12, PSO 1,3)**

WIRELESS SENSOR NETWORKS

Course Code: EIE742 **Credit: 3:0:0**
Prerequisite: Knowledge of Digital communication **Contact Hours: 42**
Course Coordinator: Ms. J. V. Alamelu

Course Content

Unit I

Overview of Wireless Sensor Networks: Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, WSN applications: industrial, biomedical, body sensor, other applications.

Unit II

Architectures: Single-Node Architecture-Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture -Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.

Unit III

Networking Sensors: Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC, The Mediation Device Protocol.

Unit IV

WSN Protocols: IEEE 802.15.4 MAC – Zigbee, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing, Introduction to Time Synchronization, Localization and Positioning, Sensor Tasking and Control, WSN security.

Unit V

Sensor Network Platforms and Tools: Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming, Case studies.

Text Books

1. Holger Karl & Andreas Willig, Protocols And Architectures for Wireless Sensor Network", John Wiley, 2005.
2. Feng Zhao & Leonidas J. Guibas, Wireless Sensor Networks- An Information Processing Approach, Elsevier, 2007.

References:

1. Kazem Sohraby, Daniel Minoli, &Taieb Znati, Wireless Sensor Networks-Technology, Protocols and Applications, John Wiley, 2007.
2. Anna Hac, Wireless Sensor Network Designs, John Wiley, 2003.

Course Outcomes (COs):

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

1. Explain WSN architecture and its applications. **(PO-2,3,4, 9 PSO-1,3)**
2. Analyze network protocol and address physical layer issues. **(PO-2,3,4, 9 PSO-1,3)**
3. Apply the concepts of various protocols on MAC, routing, time synchronization, aggregation and distributed tracking. **(PO-2,3,4, 9 PSO-1,3)**
4. Describe usage of protocols such as zigbee, 6LoWPAN and other receny protocols in WSN environment. **(PO-2,3,4, 9,12 PSO-1,3)**
5. Understand Tiny OS, sensor network middleware and programming with nesC for WSN. **(PO-2,3,4, 9,12 PSO-1,3)**

STATISTICAL PROCESS CONTROL

Course Code: EIE743 **Credit: 3:0:0**
Prerequisite: Process Control (EI54) **Contact Hours: 42**
Course Coordinator: Dr. A. Saravanan

Course Content

Unit I

Quality Improvement in the Modern Business Environment: The Meaning of Quality and Quality Improvement, Dimensions of Quality, Quality Engineering Terminology, A Brief History of Quality Control and Improvement, Statistical Methods for Quality Control and Improvement, univariate process monitoring and control.

Unit II

Methods And Philosophy of Statistical Process Control: Introduction, Chance and Assignable Causes of Quality Variation, Statistical Basis of the Control Chart Basic Principles, Choice of Control Limits, Sample Size and Sampling Frequency, Rational Subgroups Analysis of Patterns on Control Charts, Discussion of Sensitizing Rules for Control Charts, Control Chart Application, The Rest of the Magnificent Seven, Implementing SPC in a Quality Improvement Program, An Application of SPC, Applications of Statistical Process Control and Quality Improvement Tools in Transactional and Service Businesses.

Unit III

Control Charts for Variables: Control Charts for $\overline{X}$ and R, Statistical Basis of the Charts, Development and Use of $\overline{X}$ and R Charts, Charts Based on Standard Values, Interpretation of $\overline{X}$ and R Charts, The Effect of Nonnormality on $\overline{X}$ and R Charts, The Operating-Characteristic Function, The Average Run Length for the $\overline{X}$ Chart, Control Charts for–x and s, Construction and Operation of $\overline{X}$ and s Charts, The $\overline{X}$ and s Control Charts with Variable Sample Size, Summary of Procedures for $\overline{X}$ and R, and s Charts, Applications of Variables Control Charts.

Unit IV

Control Charts for Attributes: The Control Chart for Fraction Nonconforming, Development and Operation of the Control Chart Variable Sample Size, Applications in Transactional and Service Businesses, The Operating-Characteristic Function and Average Run Length Calculations, Control Charts for Nonconformities (Defects).

Unit V

Other Statistical Process Monitoring and Control Technique: The Cumulative Sum Control Chart, Basic Principles: The CUSUM Control Chart for Monitoring the Process Mean, The Tabular or Algorithmic Cusum for Monitoring the Process Mean, Recommendations for Cusum Design, Exponential weighted moving average [EWMA], EWMA for Monitoring the Process Mean, design of EWMA, combining EPC[Engineering process control] and SPC, MINITAB software.

Text Books

1. Douglas Montgomery, Introduction to Statistical Process Control 7th Edition, Wiley publications.

References

1. John s. Oakland, Statistical process control, sixth Edition, Routledge.
2. Leslie m. Licinsk, Statistical process control.,P.Eng..
3. Peihua Qiu, Introduction to Statistical Process Control, CRC Press

Course Outcomes (COs):

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

1. Explain quality, standards and statistical process control technique. **(PO-1,2,4,5,11,12, PSO-1,2,3)**
2. Develop SPC Tools for any manufacturing process. **(PO-1,2,4,5,11 PSO-1,2,3)**
3. Implement control charts for industry applications. **(PO 1,2,4,5,11 PSO 1,2,3)**
4. Develop control charts for attributes. **(PO-1,2,4,5,9,11 PSO-1,2,3)**
5. Describe various statistical process monitoring and control techniques. **(PO-1,2,4,5,9,11 PSO-1,2,3)**

VLSI DESIGN

Course Code: EIE751 **Credit: 3:0:0**
Prerequisite: Digital System Design (EI34) **Contact Hours: 42**
Course Coordinator: Ms. K. M. Vanitha

Course Content

Unit I

Introduction: Introduction, VLSI Design flow, VLSI Design styles. NMOS fabrication. Basic CMOS technology: The P-well process, the N-well process. Process flow: Basic steps-CMOS N-well process, Layout design rules, MOS transistor: Metal oxide semiconductor structure, MOS system under external bias, Structure and operation of MOSFET.

Unit II

MOS Transistor: Threshold voltage, Body effect. MOSFET current voltage characteristics, Scaling, MOSFET capacitances. MOS Inverters: Static characteristics, Noise immunity, Noise margin, Resistive load inverter, N-type load, CMOS inverter, BiCMOS inverters, Latch up in CMOS circuits.

Unit III

Dynamic Switching Characteristics: Sheet resistance, standard unit capacitance, delay unit, inverter delays Delay time, rise time and fall time, switching power dissipation. Determination of pull up to pull down ratio for an NMOS inverter driven by another NMOS inverter. Determination of pull up to pull down ratio of an NMOS inverter driven through one or more pass transistors. CMOS inverter design: Switching characteristics, estimation of CMOS inverter delay, Driving large capacitive loads, super buffers.

Unit IV

Combinational MOS Logic Circuits: NMOS depletion load circuits, complex CMOS circuits, Pass transistor, Transmission gate. MOS circuit design process: Need for design rules, stick diagram(NMOS and CMOS), mask layout (CMOS). Sequential circuits: The Bistability principle, SR latch, CMOS D latch, edge triggered flip flop. Dynamic logic circuits: Basic principle of PT circuits, Dynamic CMOS circuit techniques: CMOS TG logic.

Unit V

Semiconductor Memories: Introduction, Dynamic Random access memory (DRAM), Static Random access memory (SRAM), Read only memories, Non-volatile read write memories. Design for testability: Fault type and models, Controllability, Observability, Ad hoc testing, Scan based techniques.

Text Books

1. Sung-Mo Kang, Yusuf Leblebici, CMOS digital integrated circuits-Analysis and design, TMH 3rd edition 2003.

References

1. Weste and Eshranhian, Principles of CMOS VLSI Design, Pearson Education, 1999.
2. Kamran Eshraghian, Dougles and A. Pucknell, Essential of VLSI circuits and system, PHI, 2005.

Course Outcomes (COs):

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

1. Discuss the aspects of VLSI design flow and the steps in CMOS fabrication technology **(PO-1,2,8 PSO-1,3)**
2. Analyse the static and switching performance parameters of resistive load, N type load, CMOS and BiCMOS inverters. **(PO-1,2,8, PSO-1,3)**
3. Design static CMOS combinational and sequential logic at the gate level. **(PO-1,2,3,8, PSO-1,3)**
4. Understand dynamic logic circuit concepts and CMOS Dynamic logic families. **(PO-1,2,3,8, PSO-1,3)**
5. Interpret the need for testability and different testing methods in VLSI. **(PO-1,2,3,4,8, PSO-1,3)**

ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY IN SYSTEM DESIGN

Course Code: EIE752 **Credit: 3:0:0**
Prerequisite: Power Electronics and drives (EI61) **Contact Hours: 42**
Course Coordinator: Dr. H. S. Niranjana Murthy

Course Content

Unit I

EMI/EMC Concepts: EMI-EMC definitions and Units of parameters; Sources and victim of EMI; Conducted and Radiated EMI Emission and Susceptibility; Transient EMI, ESD; Radiation Hazards.

Unit II

EMI Coupling Principles: Conducted, radiated and transient coupling; Common ground impedance coupling; Common mode and ground loop coupling; Differential mode coupling; Near field cable to cable coupling, cross talk; Field to cable coupling; Power mains and Power supply coupling.

Unit III

EMI Control Techniques: Shielding, Filtering, Grounding, Bonding, Isolation transformer, Transient suppressors, Cable routing, Signal control.

Unit IV

EMC Design of PCBs: Component selection and mounting; PCB trace impedance; Routing; Cross talk control; Power distribution decoupling; Zoning; Grounding; VIAs connection; Terminations.

Unit V

EMI Measurements and Standards: Open area test site; TEM cell; EMI test shielded chamber and shielded ferrite lined anechoic chamber; Tx /Rx Antennas, Sensors, Injectors / Couplers, and coupling factors; EMI Rx and spectrum analyzer; Civilian standards-CISPR, FCC, IEC, EN; Military standards-MIL461E/462.

Text Books

1. V.P.Kodali, Engineering EMC Principles, Measurements and Technologies, IEEE Press, Newyork, 1996.

References

1. Henry W.Ott., Noise Reduction Techniques in Electronic Systems, A Wiley Inter Science. Publications, John Wiley and Sons, Newyork, 1988.
2. Bemhard Keiser, Principles of Electromagnetic Compatibility, 3rd Edition, Artech house, Norwood,1986

Course Outcomes (COs):

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

1. Identity location of EMI. **(PO-1,2,4,5,6,7, PSO-1,2)**
2. Analyze EMI coupling between source to other devices. **(PO-1,2,3,4,5, PSO-1)**
3. Analyze various methods to control EMI. **(PO-1,2,4,5,6,7, PSO-1,2)**
4. Design of PCB with EMC. **(PO-1,2,4,5,6,7,11,12, PSO-1,2,3)**
5. Measure EMI and use various standard to test the device for EMI-EMC compliance. **(PO- 1,2,4,5,6,7, PSO-1,2)**

POWER PLANT AND PETROCHEMICAL INSTRUMENTATION

Course Code: EIE753 **Credit: 3:0:0**
Prerequisite: Electronic measurements (EI35) and Industrial Instrumentation (EI36) **Contact Hours: 42**
Course Coordinator: Dr. H.S. Niranjana Murthy & Dr. M. D. Nandeesh

Course Content

Unit-I

Power Generation: Hydro, thermal, nuclear, solar and wind power. Importance of instrumentation in thermal power plants, nuclear power plants, block diagram, **Analyzers:** Flue gas analyzer, -analyzers of impurities in feed water and steam- oxygen analyzer- chromatography-PH meter- fuel analyzers-pollution monitoring, radiation detector, smoke density measurement –dust monitor.

Unit II

Boiler Control: Combustion control, air-fuel ratio control-furnace draft control- drum level control-main steam and reheat steam temperature control, superheater control, aerator, de-aerator control, DCS /NCS in power plant, interlock mechanism in boiler control. **Turbine**: Measurement of turbine speed, vibration- shell temperature and control- team pressure control, lubricating oil temperature control- cooling system.

Unit III

Introduction to petrochemical industries: Petroleum Exploration, production and Refining, Sub-process, final product, by-products, constituents of Crude Oil. Atmospheric Distillation of Crude oil, Vacuum Distillation process, Thermal Conversion process.

Unit IV

Controls of Chemical Reactors: Temperature Control, Pressure Control, Control of Dryers, Batch Dryers, Atmospheric and Vacuum, Continuous Dryers Control of Distillation Column, Temperature Control, Process control, Feed control, Reflux Control, Reboiler Control.

Unit V

Control of Pumps and evaporators: Centrifugal pump: On-Off level control, Pressure control, Flow control, Throttling control. Rotary pumps: On-Off pressure control. Reciprocating Pumps: On-Off control and Throttling control. Effluent and Water Treatment Control: Chemical Oxidation, Chemical Reduction, Naturalization, Precipitation, Biological control. Evaporators, Types of Evaporators

Text Books

1. Sam G. Dukelow, The control of Boilers, ISA 1991.
2. Modern power station practice, vol-6, Instrumentation, Controls and testing, Pergamon Press, Oxford,1971.
3. Elonka S.M. and Kohal A.L. Standard Boiler Operations, McGraw- Hill,1994
4. Dr. Ram Prasad, Petroleum Refining Technology, Khanna Publisher, 1st Edition,2000.
5. Liptak B.G., Instrumentation in Process Industries, Chilton Book Company,1973

Course Outcomes (COs):

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

1. Analyze various power generation methods and controls. **(PO-1,2,7,9, PSO-1,2,3)**
2. Understand various measurement solutions for physical parameters monitored in the power plants. **(PO- 1,2,3,4, PSO-1)**
3. Understand the basics requirements of petrochemical industries. **(PO-1,10, PSO-1,3)**
4. Illustrate the working of chemical reactors, control heat exchangers and evaporators. **(PO-1,10, PSO-1,3)**
5. Analyze the performance of various control pumps in industries. **(PO-1,10, PSO-1,3)**

BIOMATERIALS AND BIOSENSORS

Course Code: EIE754 **Credit: 3:0:0**
Prerequisite: Knowledge of sensors **Contact Hours: 42**
Course Coordinator: Dr. M. D. Nandeesh

Course Content

UNIT – I

Introduction to biomaterial science: Characteristics of biomaterials, Metallic biomaterials, Ceramic biomaterials, Polymeric biomaterials, Biodegradable polymeric biomaterials, Biological biomaterials

UNIT – II

Tissue replacements: Hard tissue replacements: Bone repair & joint implants, Dental Implants, Soft tissue replacements: Blood interfacing implants, non-blood interfacing implants

UNIT – III

Introduction: Substitutive medicine, outlook for organ replacement, design consideration, evaluation process. **Artificial Heart and Circulatory assist devices**: Engineering design, Engineering design of artificial heart and circulatory assist devices, blood interfacing implants – introduction, total artificial hearts & ventricular assist devices, vascular prostheses

Unit -IV

Fundamentals of Biosensors: Introduction and recent developments in biosensors, Electrochemical Biosensor, Optical-based Biosensor, Biorecognition Elements in a Biosensor, Immobilisation Methods, Principles of Biorecognition

UNIT – V

Applications of Biosensors: Biosensors for Food/Water Safety, Biosensors for Detection of Foodborne/Waterborne Pathogens, Biosensors for Mycotoxin Detection, Biosensors for the Defence Industries, Biosensors for Clinical Diagnostics, Biosensors for Environmental Monitoring.

Text books

1. Joseph D Bronzino, 'Biomedical Engineering Handbook', , CRC press, 1995
2. Duane Knudson, “Fundamentals of Biomechanics”, 2nd edition, Springer publications

Reference books

1. Ratner & Hoffman, "Biomaterial Science, Academic press, 1996
2. Bansi D Malhotra and Anthony R F Turner Advances in Biosensors edited, JAI Press INC (Imprint of Elsevier Science)
3. Tran Minh Canh, Biosensors, Chapman & Hall Publication 1993 edition, 2013

Course outcomes (COs):

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

1. Understand the characteristics of different materials that can be used as substitutes for failed organs in human beings. **(PO1,2,3,12, PSO1,3)**
2. Assess the possibility of tissue replacement-based applications in healthcare. **(PO2,3, PSO1)**
3. Interpret the mechanical concepts related to development of artificial heart and circulatory devices in human beings. **(PO2,3, PSO1)**
4. Understand the concept of Biosensors, constructional details and know the various types of biosensors. **(PO1,12, PSO1)**
5. Describe the concepts of Enzyme sensors and potentiometric enzyme electrodes. **(PO1,12, PSO1)**

INDUSTRIAL DATA NETWORK LAB

Course Code: EIL76 **Credit: 0:0:1**
Prerequisite: PLC and SCADA Lab (EIL67) **Contact Hours: 14**
Course Coordinator: Ms. J. V. Alamelu

List of Experiments

1. Controllers and OOP in DCS based in tags
2. Remote Supervision of Client / Server solutions
3. Handling of alerts and alarms
4. Operator panel/control station based solutions
5. Implementation of Industrial network protocols.
6. Implementation of Industry applications with message communication with MODBUS
7. Usage of Instruction set for any application
8. Implementation of Instruction set with Factory Talk software
9. Usage of timers and counters in operator panel
10. Report generations
11. Trends and Graphs in operator panel
12. Producer consumer for communication
13. Home Automation Schneider setup – Demo based
14. Building Automation Schneider setup – Demo based.

Course Outcomes (COs):

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

1. Configure, utilize object tags with RS logix 5000 series and factory talk view studio for industrial applications. **(PO-2,3,4,5,9, PSO-1,3)**
2. Utilize instruction set and communication modes within PLCs in DCS environment. **(PO-2,3,4,5,9,12, PSO-1,3)**
3. Implement graphical panel for HMI in remote environment. **(PO-2,3,4,5,9,10,12, PSO-1,3)**

ADVANCED CONTROL SYSTEMS LAB

Course Code: EIL77 **Credit: 0:0:1**
Prerequisite: Control Systems Lab (EIL56) **Contact Hours: 14**
Course Coordinator: Dr. H. S. Niranjana Murthy

List of experiments

1. Transient response analysis in state space
2. State space model to transfer function conversion
3. Obtain a closed loop response for a given TF using states space
4. Observability and Controllability investigation
5. State feedback controller design
6. State feed-back and Observer controller design
7. Linear and Non-linear systems simulations
8. Investigate the stability of system with nonlinearities: relay, saturation, deadzone, hysteresis and existence of limit cycle using DF technique
9. Verify Sylvester theorem for the definiteness of the Lyapunov Function
10. Determine the stability of the system and construct the Lyapunov function for Linear Time Invariant system.
11. On-Off temperature controller
12. Proportional, PI temperature Controller
13. Adaptive control experiment
14. LQR (Linear Quadratic Regulator) control system

Course Outcomes (COs):

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

1. Analysis and design of system using state model. (PO-2,3,4,5,9,10, PSO-1,3)
2. Analyze stability of linear and nonlinear systems using DF and Lypunov methods. (PO-2,3,4,5,9,10, PSO-1,3)
3. Design and analysis of controllers. (PO-2,3,4,5,9,10, PSO-1,3)

VIII – Semester

INTERNSHIP

Course Code: EIIN **Credit: 0:0:3**
Prerequisite: Knowledge of Basic Engineering Sciences
Course Coordinator: Dr. Shivaprakash. G

Students can do the internship for one month. The report of the internship with certificate from the company needs to be submitted to the department, along with a presentation to a departmental evaluation panel.
Note: For guidelines regarding selection of internship, refer to the "AICTE-Internship Policy guidelines & procedures (2021)".

Course Outcomes (COs):

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

1. Integrate theory and practice. **(PO – 1, 2, 3, 4, 5, PSO – 1)**
2. Develop work habits and attitudes necessary for success in a career. **(PO – 6, 7, 9, 10, PSO – 2, 3)**
3. Develop communication, interpersonal and other critical skills in the job**. (PO – 8, 9, 10, PSO – 2, 3)**
4. Assess their abilities and interest in their field of study. **(PO – 3, 11, 12, PSO – 1, 3)**
5. Develop leadership, decision-making and interpersonal skills. **(PO – 9, 11, 12, PSO – 3)**

PROJECT WORK

Course Code: EIP **Credit: 0:0:14**
Prerequisite: Mini Project (E165)
Course Coordinator: Dr. Jyothirmayi. M

The students are guided and encouraged to work in teams, to define the problem, analyze, design, develop and implement. The implementation can be in the form of hardware module and/or software simulations. They are encouraged to incorporate innovative ideas and sustainable, environment friendly solutions. The project evaluation takes place continuously with three reviews, and finally with project demonstration and external evaluation. The modules built by the students are demonstrated at the end of the academic year and evaluated for Semester end exam. It is important to note that, a significant part of the credits that is to be earned before their graduation is dedicated to projects.

The students are also motivated to convert their project work to Patentable product, to publish papers in journals; present in conferences; or exhibit their work in various project competitions or exhibitions. The department also offers a 'Best Project' award and evaluation for the same is performed by an external examiner, based on the rubrics formed in the department**.**

Course Outcomes (COs):

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

1. Identify a problem related to industries and/or societal needs, select a suitable method for implementation through conducting elaborate literature/ market survey. **(PO-1,2,3,4,5,6,7,10,12 PSO-1,2,3)**
2. Design and simulate functional blocks or sub-systems of the proposed solution. **(PO-2,3,8,9,10,11, PSO-1,2,3)**
3. Perform experiments, integrate and test systems. **(PO-2,3,4,5,10, PSO-1,3)**
4. Develop skills required for consistent documentation, result analysis and redesign, project management and problem solving. **(PO-1,2,4,9,10, PSO-1,2,3)**
5. Communicate technical information by means of written and oral presentations**. (PO-2,6,7,8,10, 11,12, PSO-2,3)**