RAMAIAH
Institute of Technology

CURRICULUM

for the Academic year 2021 – 2022

ELECTRONICS AND INSTRUMENTATION ENGINEERING

V & VI 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 2019-23

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

V SEMESTER

Sl. No.	Course Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1.	EI51	DSP based System Design	PCC	3	1	0	4	5
2.	EI52	Object Oriented Programming with C++	PCC	3	0	1	4	5
3.	EI53	Intellectual Property Rights	HSMC	3	0	0	3	3
4.	EI54	Process Control	PCC	3	1	0	4	5
5.	EIE55x	Department Elective	PEC 1	3	0	0	3	3
6.	XXOExx	XXX	OEC 1	3	0	0	3	3
7.	EIL56	Control Systems Lab	LAB	0	0	1	1	2
8.	EIL57	Process Instrumentation Lab	LAB	0	0	1	1	2
9.	EIL58	DSP based System Design Lab	LAB	0	0	1	1	2
			Total	**18**	**2**	**4**	**24**	

Elective Code	Elective Title
EIE551	Biomedical Instrumentation
EIE552	Digital Communication Systems
EIE553	Robotics

Open Elective Code	Open Elective Title (offered for other department students)
EIOE01	Biomedical Instrumentation

SCHEME OF TEACHING

VI SEMESTER

Sl. No.	Course Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1	EI61	Power Electronics and Drives	PCC	3	1	0	4	5
2	EI62	PLC and SCADA	PCC	4	0	0	4	4
3	EIE63x	Group 1	PEC 2	2	1	0	3	4
4	EIE64x	Group 2	PEC 3	3	0	0	3	3
5	XXOExx	XXX	OEC 2	3	0	0	3	3
6	EI65	Mini Project/ NPTEL/ Elective	PROJ	0	0	4	4	8
7	EIL66	Power Electronics and Drives Lab	Lab	0	0	1	1	2
8	EIL67	PLC and SCADA Lab	Lab	0	0	1	1	2
9	EIL68	Virtual Instrumentation Lab	Lab	0	0	1	1	2
			Total	**15**	**2**	**7**	**24**	

Elective Code	Group 1 - Elective Title	Elective Code	Group 2 - Elective Title
EIE631	Digital Image Processing	EIE641	Artificial Neural Networks & Fuzzy logic
EIE632	Internet of Things	EIE642	Cyber physical systems
EIE633	Data structures and algorithms	EIE643	Aircraft and Automobile Instrumentation

Open Elective Code	Open Elective Title (offered for other department students)
EIOE02	Industrial Automation

V Semester

DSP BASED SYSTEM DESIGN

Course Code: EI51 **Credit: 3:1:0**
Prerequisite: Signal Processing (EI42) **Contact Hours: 42+14**
Course Coordinator: Dr. Shivaprakash. G

Course Content

Unit I

DFT and its properties: Introduction, Relation between DTFT and DFT, twiddle factor, Properties of DFT. IDFT [1,2]. Problems on properties of DFT. **Fast Fourier transforms**: Definition of FFT (introduction to FFT) computation complexity of FFT, Radix-2 decimation in time FFT for 8 points [1,2].

Unit II

Fast Fourier transforms: Radix-2 DIF-FFT for 8 points, comparison of DIT & DIF, FFT for N a composite number [1,2]**. FIR Filters**: Introduction, Magnitude response and phase response of digital filters, frequency response of linear phase FIR filters, Design techniques for FIR filters- windowing method (only Hamming, Hanning, rectangular), Frequency sampling method [1,2].

Unit III

Realization of filters: Basic network elements, Direct form I for IIR, Direct form II for IIR, Cascade form for IIR, Parallel form for IIR [1, 2]. Coding the filter implementation in MATLAB from basics. **FIR structures**: direct form & linear phase form, Cascade form for FIR [1, 2]. Coding the filter implementation in MATLAB from basics.

Unit IV

TMS320 Family Overview: Overview of the TMS320C6x Generation of Digital Signal Processors, Features and Options of the TMS320CC6713.

CPU Data Paths and Control: General-Purpose Register Files, Functional Units, Register File Cross Paths, Memory, Load, and Store Paths, Data Address Paths, TMS320C6713 Control Register File, Pipeline/Timing of Control Register Accesses, Addressing Mode Register (AMR), Control Status Register (CSR), E1 Phase Program Counter (PCE1), TMS320C67x Control Register File Extensions (FADCR, FAUCR, FMCR) [4].

Unit V

TMS320C6713 Fixed-Point Instruction Set: Instruction Operation and Execution Notations, Mapping Between Instructions and Functional Units, Delay Slots, Parallel Operations, Conditional Operations, Resource Constraints, Addressing Modes, Individual Instruction Descriptions (50 instructions), Simple assembly language programs using fixed point instructions [4]. **TMS320C6713 Floating-Point Instruction Set:** Instruction Operation and Execution Notations, Mapping Between Instructions and Functional Units, Overview of IEEE Standard Single- and Double-Precision Formats, Delay Slots, TMS320C6713 Instruction Constraint, Individual Instruction Descriptions (30 instructions), Simple assembly language programs using floating point instructions [4]. **Applications of programmable DSP devices:** DSP system, DTMF, DSP based bio-telemetry receiver, A speech processing system, an image processing system. DSP based power meter **[**3].

Tutorials:

1. Computation of DFT and IDFT using the defining equation
2. DFT and IDFT computation using matrix method, linearity property, Circular even, odd, reversal computation.
3. Circular convolution, time reversal property, circular time shift property
4. Circular correlation, circular frequency shift., complex conjugation
5. Multiplication of two sequences, Parseval's theorem, Symmetry properties.
6. DIF-FFT numerical
7. DIT-FFT numerical
8. N composite case(N=6,12)
9. FIR filter design, windowing method
10. FIR filter designing frequency sampling method
11. FIR realization,
12. IIR filter realization.
13. Programming using floating and fixed point instructions
14. DTMF generation and detection, Goetzel algorithm explained MATLAB

Text Books

1. Proakis and Manolakis, Digital signal processing, 3rd Edition Prentice Hall of India, 2007.
2. S.Salivahanan, A.Vallavaraj, Digital signal processing, McGraw-Hill , 2009.
3. Avatar Singh and S. Srinivasan, Digital signal processing, Thomson, 2018.
4. TMS320C6000 CPU and instruction set Reference Guide, Literature Number: SPRU189F.

References

1. Alan V. Oppenheim, Ronald W Schafer, Digital signal processing, Prentice Hall of India, 2011

Course Outcomes (COs):

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

1. Compute DFT, IDFT using DIT/DIF-FFT algorithm**. (PO-1,3,4,5,10, PSO- 1,3)**
2. Design FIR filters**. (PO-1,3,4,5,10, PSO-1,3)**
3. Realize FIR and IIR filters. **(PO-1,3,4,5,10, PSO-1,3)**
4. Explain the architecture of DSP (TMS320C6713). **(PO-1,3,4,5,10, PSO-1,3)**
5. Write assembly language Program for DSP starter kit (TMS320C6713). **(PO-1,3,4,5,10, PSO-1,3)**

OBJECT ORIENTED PROGRAMMING WITH C++

Course Code: EI52 **Credit: 3:0:1**
Prerequisite: Fundamentals of Computing (CS26) **Contact Hours: 42+14**
Course Coordinator: Mrs. Elavaar Kuzhali .S

Course Content

Unit I

C++ Programming Basics: Need for Object Oriented Programming, Procedural languages, Characteristics of OOP, Data types, Manipulators.
Functions: Passing Arguments, Returning values, Reference Arguments, Overloaded Functions, Inline Functions, Variable and Storage Classes.

Unit II

Objects and Classes: Objects as Data types, Constructors, Destructors, Overloaded Constructors. **Arrays:** Arrays as class member data, Passing Arrays, Arrays as objects, C-Strings, Standard C++ String Class.

Unit III

Operator Overloading, Friend Functions: Overloading of Unary Operators, Binary Operators, Friend Functions, Static Functions.
Pointers: Pointers and Arrays, Pointers and Functions, Pointers and C-type Strings, Memory Management, Pointers to objects, Assignment and Copy Initialization, This Pointer.

Unit IV

Inheritance and Polymorphism: Inheritance, Derived Class and Base Class, Overriding member functions, Scope resolution, Levels of Inheritance, Types of Inheritances, Virtual Functions, Pure Virtual Functions, Abstract Class, Static and Dynamic binding.

Unit V

Data Structures & Algorithms: Algorithm, Analysis, Linked Lists, Stacks, Queues, Trees – Binary Trees, Tree Traversal, Sorting – Bubble Sort & Insertion Sort, Searching – Linear Search, Binary Search.

Practical classes:

1. Program to demonstrate creation of variable of various data types and various types of argument passing to functions
2. Program to demonstrate function overloading

3. Program to create a simple class and demonstrate the accessing of data members and member functions.
4. Program to create a simple class and demonstrate the usage of constructors and destructors.
5. Program to demonstrate the creation of array of objects concept.
6. Program to create a string class that mimics the Standard C++ string class.
7. Program to demonstrate the overloading of unary and binary operators.
8. Program to demonstrate pointers, dynamic memory allocation
9. Program to demonstrate the concept of operator overloading and friend function.
10. Program to demonstrate the usage of memory management operators.
11. Program to demonstrate the concept of inheritance.
12. Program to demonstrate the concept of virtual functions.
13. Program to demonstrate the concept of Linked lists.
14. Program to implement stack and Queue.

Text Books

1. Robert Lafore, Object Oriented Programming in TURBO C++ - Galgotia Publications, 2002.
2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 3rd Edition Pearson Education Asia, 2007.

References

1. E Balaguruswamy, Object Oriented Programming with C++, 3rd Edition, TMH 2006.
2. Herbert Schildt, C++ The Complete Reference, 4th Edition, Tata McGraw Hill, 2003.

Course Outcomes (COs):

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

1. Understand the OOP principles and basic constructs of C/C++. **(PO-1,3,5,9,10, PSO-1,3)**
2. Develop solutions for the problems based on Class and Objects. **(PO-1,3,5,9,10, PSO-1,3)**
3. Apply the concepts of operator overloading, pointers and friend functions to solve a given problem. **(PO-1,3,5,9,10, PSO-1,3)**
4. Develop solutions for the problems based on the concepts of polymorphism and inheritance. **(PO-1,3,5,9,10, PSO-1,3)**
5. Write programs based on various data structures and algorithms. **(PO-1,3,5,9,10 PSO-1,3)**

INTELLECTUAL PROPERTY RIGHTS

Course Code: EI53 **Credit: 3:0:0**
Prerequisite: Constitution of India (HS23) and Engineering design (AL21) **Contact Hours: 42**
Course Coordinator: Dr. H. S. Niranjana Murthy

Course Content

Unit I

Basic Principles of IPR Laws: History of IPR-GATT, WTO, WIPO & Trips Role of IPR in Research & Development & Knowledge era, Concept of property, Marx's theory of property, Constitutional Aspects of Intellectual property, Different forms of IPR – copyright, trade mark, Industrial Designs, Layout designs of Integrated circuits, Patents, Geographical Indications, Traditional Knowledge, Plant varieties, Trade secrets.

Unit II

Copyright: Evolution of copy right law in India, Justifications, Subject matter of copyright, Terms of protections, Concepts-originality/Novelty idea expression, Fixation & fair Use, Copyrights in software protection,
Author and Ownership of copy right: Ownership of copy right, contract of service, contract for service, rights conferred by copy right, terms of copy right, assignment of copy right, licensing by owners, license in published and unpublished works, License to reproduce certain works. Infringement of copyright and acquisition in Indian context,
Cyber Law: Introduction to Cyber law of India, Advantages of Cyber Laws, IT act of India, 2000.

Unit III

Trade Mark: Introduction, Functions of a trademark, Essentials of a trademark, Justification: Economic, Quality & advertising, Descriptive & Generic trademark, Certification trademark and collective marks, Fundamental principle of trademark law, Concepts of subject matter acquisition, Implication and benefits of registration, Procedure for registration, infringements of trade marks & defences, relief in suits for infringement.
Geographical Indicators: salient features of the 1999bill, meaning of GI, prohibited geographical indicators, grounds of refusal for registration.

Unit IV

Patents: Introduction, origin and meaning of the term patent, objective of a patent law, the legislative provisions regulating patents, principles underlying the patent law in India, patentable invention. Inventions which are not patentable, patent of addition, process patent. **Procedure for obtaining patent:** Submission of application, filing provisional and complete specification, publication and examination of the application, communication to the applicant, opposition proceedings to the grant of the patent, grant and term of patent, **Provisional and complete specification:** Definition of

Specification, kinds of specification, provisional specification, complete specification, claims, conditions for amendment

Unit V

Industrial Designs: Introduction, Justification, Subject matter of design law definition Excluded subject matter Law relating to industrial design and registration in India Infringement of design rights

Semiconductor & IC Layout Designs: semiconductor topography design rights. Infringement.

Text Books

1. Prabuddgha Ganguli, Intellectual Property Rights, TMH Publishing co. Ltd. 2001.
2. Dr.B.L.Wadhera, Intellectual Property Law Handbook, Universal law Publishing Co. Ltd. 2002.
3. Prof.T.Ramakrishna, Basic Principles and acquisition of Intellectual Propery Rights, CIPRA, NLSIU, 2005.

References

1. P. Narayan Intellectual property Law 3rd Edition Eastern Law house 2001.
2. David Bainbridge, Intellectual Property, 5th Edition, Indian reprint 2003, Pearson edition.
3. Dr. T. Ramakrishna, Ownership and Enforcement of Intellectual Property Rights, CIPRA, NLSIU, 2005

Course Outcomes (COs):

At the end of the course the student will be able to

1. Identify the need and importance of various forms of IPR. **(PO-1,2, 6,8, PSO-1,2,3)**
2. Understand the features of IP and process of registration of IP. **(PO-1,2,6,8, PSO-1,2,3)**
3. Apply the drafting concepts for any product of electronics & Instrumentation domain. **(PO-1,2,6,8, PSO-1,2,3)**
4. Illustrate the different infringement scenarios in IPR domain. **(PO-1,2,6,8, PSO-1,2,3)**
5. Familiarize with latest legal cases in the field of IPR **(PO-1,2,6,8, PSO-1,2,3)**

PROCESS CONTROL

Course Code: EI54 **Credit: 3:1:0**
Prerequisite: Control Systems (EI45) **Contact Hours: 42+14**
Course Coordinator: Dr. A. Saravanan

Course Content

Unit I

Physical Modeling and Dynamic Response: Need for process control – mathematical model of first order level, pressure and thermal processes – interacting and non-interacting systems. Dynamic response of a first order process- first order plus dead time process, second order process, pure capacitive process, pure dead time- inverse response; Padé approximation. Development of Empirical model - Model development using linear and nonlinear regression fitting first and second order models using step test results.

Unit II

Digital Controllers: Elements of process control loop- concept of servo and regulatory problems. Review of basic analog controllers (P, PI, PD, PID control modes). Components of direct digital control system, benefits of DDC-PID control, position algorithm, velocity algorithm- z transform based control algorithms.

Unit III

Optimum Controller Settings: Evaluation criteria – IAE, ISE, ITAE and ¼ decay ratio – determination of optimum settings for mathematically described processes using time response and frequency response – Tuning – Process reaction curve method – Ziegler Nichols method –Damped oscillation method. Compensation for large dead time and inverse response, Smith Predictor.

Unit IV

Multiloop Control: Feed-forward control – ratio control- cascade control – inferential control – split-range control – Adaptive control- multivariable control concept. Design of cross controller, relative gain array (RGA). Selection of control loops.

Unit V

Final Control Element: DC servo motor- solenoid valve- I/P converter – pneumatic and electric actuators – valve positioner – control valves, Types : Globe, Ball, Butterfly control valves– characteristics of control valves, control valve sizing – cavitations and flashing – selection criteria. Instrumentation symbols. Introduction to Process Flow Diagram (PFD) and Piping & Instrumentation Diagram (P&ID).

Tutorials:

1. Develop a mathematical model for the first order systems.
2. Develop a mathematical model for the second order systems.
3. Which controller is sufficient for pure capacitive process, thermal and level process? Prove that.
4. Problems on Non- Integrating systems
5. Problems on Integrating systems
6. Determine the performance of Proportional controller for the first order and second order process.
7. Determine the performance of Integral controller for the first order and second order process.
8. Determine the performance of Derivative controller for the first order and second order process.
9. Problems on Process Reaction curve method.
10. Problems on Ziegler- Nicholas tuning method.
11. Problems on Damped oscillation method.
12. Derive Time integral performance criteria based on ISE, IAE, ITAE.
13. Design of cross controllers.
14. Develop Relative Gain Array (RGA) matrix.

Text Books

1. Stephanopoulis, G, Chemical Process Control, Prentice Hall of India, New Delhi, 2006.
2. Coughanowr, D. R. and L. B. Koppel, Process systems Analysis and Control, TMH, 2nd Edition, 1991.
3. Krishna Kant, Computer based Industrial Control, Prentice Hall (I), 2004.

Course Outcomes (COs):

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

1. Model the physical process and study its dynamic behavior. **(PO-1,2,4,5, PSO-1,3)**
2. Design digital controller for a given process. **(PO-1,4, PSO-1)**
3. Apply various controller tuning methods for given process. **(PO-1,4,9, PSO- 1,3)**
4. Analyze complex control scheme used in process control. **(PO 1,4,9, PSO 1,3)**
5. Select suitable final control element for a given process. **(PO 1,2,4,5,9, PSO 1,3)**

BIOMEDICAL INSTRUMENTATION

Course Code: EIE551 **Credit: 3:0:0**
Prerequisite: Knowledge of Basic Sensors **Contact Hours: 42**
Course Coordinator: Dr. M. D. Nandeesh & Ms. K. M. Vanitha

Course Content

Unit I

Bioelectric Signals and Electrodes: Sources of biomedical signals, Basic instrumentation system, General constraints in the design of biomedical instrumentation systems. Origin of bioelectric signals, Types of bioelectric signals, Electrode-Tissue interface, Polarization, Skin contact impedance, Silver-silver chloride electrodes, Electrodes for ECG, EEG, EMG, Microelectrodes Patient Safety Electric shock hazards, Leakage currents.

Unit II

ECG, EEG & Patient Monitoring System: Electrical activity of the heart, Genesis & characteristics of Electrocardiogram (ECG), Block diagram description of an Electrocardiograph, ECG lead system, Multi-channel ECG machine Genesis of Electroencephalogram (EEG), Block diagram description of an EEG, 10-20 electrode systems, and computerized analysis of EEG, Measurement of heart rate, Measurement of pulse rate.

Unit III

Blood Pressure & Blood Flow: Direct & Indirect method, Automatic blood pressure measuring apparatus using Korotkoff's method, Rheographic method, Oscillometric method, Ultrasonic Doppler shift method, Measurement of Respiration rate, Electromagnetic blood flow meters, Ultrasonic blood flowmeters, NMR blood flow meters, Laser Doppler blood flow meters.

Unit IV

Cardiac Output, Cardiac Pacemakers and Defibrillators: Indicator dilution method, Dye dilution method, Thermal dilution techniques, Impedance technique. Need for the cardiac pacemaker, External pacemaker, Implantable pacemaker, Types of Implantable pacemakers, Programmable pacemaker, Rate-responsive pacemakers, AC & DC defibrillators.

Unit V

Imaging Systems and Physiotherapy Equipment: Ultrasonic imaging system, basic pulse-echo system, block study of a mode scan equipment, X-ray machine, CT scanner,

High-frequency heat therapy, short wave, microwave diathermy, ultrasonic therapy unit, electro diagnostic therapeutic apparatus.

Text Books

1. Khandpur, R.S., Handbook of Biomedical Instrumentation, Tata McGraw-Hill, New Delhi, Second edition, 2003.
2. Lesile Cromwell, Biomedical instrumentation and measurement, Prentice Hall of India, New Delhi, 2007.

References

1. Joseph.J, Carr and John M.Brown, Introduction to Biomedical equipment technology, Pearson Education Inc. 2004.
2. John G.Webster, Medical Instrumentation Application and Design, John Wiley and Sons,(Asia) Pvt.Ltd., 2004.

Course Outcomes (COs):

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

1. Explain the basics of bio-potentials and bio-potential electrodes. **(PO-1,10, PSO-1,3)**
2. Understand the procedures and techniques for bio signal acquisitions and patient assist devices. **(PO-1,10, PSO-1,3)**
3. Analyze the signals acquired from biomedical instruments. **(PO-1,5,10, PSO-1,3)**
4. Describe the working principles used for different medical procedures. **(PO-1,6,8,10, PSO-1,2,3)**
5. Identify suitable technology for the right diagnosis and therapy of diseases. **(PO-1,10, PSO-1,3)**

DIGITAL COMMUNICATION SYSTEMS

Course Code: EIE552 **Credit: 3:0:0**
Prerequisite: Basic Electronics (EC15) & Signal Processing (EI42) **Contact Hours: 42**
Course Coordinator: Dr. Jyothirmayi. M

Course Content

Unit I

Introduction: Analog communications versus digital communications, conversion of analog signal to digital form, baseband signal, band pass signal, Block diagram of digital communications, overview, Signal processing operations in digital communications, quantitative analysis of modulation schemes.

Unit II

Pulse Modulation: Sampling process, Pulse Amplitude Modulation. TDM, PPM, Generation and detection of PPM, Quantization Process, Quantization Noise, PCM. PCM encoding generation and decoding, Delta Modulation, Differential Pulse-code Modulation.

Unit III

Digital Modulation Schemes: Digital modulation formats-coherent binary modulation techniques, Coherent quadrature modulation techniques, Non coherent binary modulation techniques.

Unit IV

Basic Concepts of Data Communications, Interfaces and Modems: Data Communication Networks, Protocols and Standards, UART, USB, I2C, I2S, Line Configuration, Topology, Transmission Modes, Digital Data Transmission, DTE-DCE interface, Categories of Networks –TCP/IP Protocol suite and Comparison with OSI model.

Unit V

Coding: Source Coding, Huffman Coding, Channel Coding. Channel Capacity Calculation. Error control coding-example, methods of controlling error, types of errors, types of codes. Linear block codes, Binary cyclic codes. **Error Correction:** Types of Errors, Vertical Redundancy Check (VRC), LRC, CRC, Checksum, Error Correction using Hamming code.

Text Books

1 Haykin, Digital Communications, Wiley India Edition, 2009 reprint.
1. B. A.Forouzan, Data Communication and Computer Networking, 2nd Edition. 2003, TMH.

References

1. B.Sklar, Digital Communications, 2nd Edition, Pearson Education, New Delhi, 2009.
2. Prakash C. Gupta,Data Communications and Computer Networks, 2006, PHI.
3. John G.Proakis, Digital Communications, 3rd Edition, McGraw Hill, 1995.

Course Outcomes (COs):

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

1. Understand the basics of digital communication system. **(PO-1,2,3,12, PSO-1,3)**
2. Explain the different types of digital modulation and demodulation techniques. **(PO-1,2,3,12, PSO-1,3)**
3. Describe data communications system and its components. **(PO-1,2,3,12 PSO-1,3)**
4. Understand various techniques for information retrieval & dissemination. **(PO-1,2,3,12, PSO-1,3)**
5. Analyze error detection and correction methods in information systems. **(PO-1,2,3,12, PSO-1,3)**

ROBOTICS

Course Code: EIE553 **Credit: 3:0:0**
Prerequisite: Engineering Physics (PY12) **Contact Hours: 42**
Course Coordinator: Dr. M. D. Nandeesh and Mrs. Vibha B Raj

Course Content

Unit I

Basic Concepts: Definition of robotics- classification of robotics- degrees of freedom –Links-Joints-rigid body-manipulator-various subsystems of robotics-Power sources-Hydraulic, pneumatic, electric drives.

Unit II

Internal and External Sensors: Internal sensors-Position sensors- incremental encoder-absolute encoder, Synchros-resolvers –Range sensing techniques-touch sensors Proximity sensors- ultrasonic sensors-laser sensors for range measurements- machine vision sensors.

Unit III

Transformation: Rotation matrix- composite rotation matrix- Rotation matrix with Euler angles representation -homogenous coordinates- homogenous transformation matrix- homogenous translation matrix- Composite Homogenous transformation matrix.

Unit IV

DH parameters: DH parameter representation-homogenous transformation for various arm configurations.
Kinematics: Direct and inverse kinematics- forward position analysis - inverse position analysis.

Unit V

Jacobian: Jacobian matrix – velocity analysis - acceleration analysis
Motion planning: Joint space planning- cubic polynomial, Quintic polynomial - Cartesian space planning- Single axis rotation –Path primitives- point-to-point vs. continuous path planning.

Text Books

1. Introduction to Robotics by S K Saha, Mc Graw Hill Educatin 2nd edition,2014
2. Robotics control, sensing, vision and intelligence by K S Fu, R C Gonzalez, C S G Lee, McGraw Hill international

References

1. Mikell P, Weiss G M , Nagel R N, Industrial Robotics: Technology, Programming, and Applications 2nd Edition 2012.
2. Ghosh, Control in Robotics and Automation: Sensors based integration, Academic Press, Edition, 2011
3. Deb S R, Robotics Technology and flexible automation, Second Edition, 2010

Course Outcomes (COs):

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

1. Understand the principles and applications of robots. **(PO-1,2, PSO-1)**
2. Understand the principles of various sensors in robots. **(PO-1,2, PSO-1)**
3. Apply homogenous transforms for robotic applications. **(PO1,2,8,9,10, PSO-1,3)**
4. Apply DH parameters in kinematic motions of robot. **(PO-1,2,3,6,8,9,10, PSO-1,2)**
5. Emphasize on trajectory and motion planning for robot. **(PO-1,2, PSO-1)**

CONTROL SYSTEMS LAB

Course Code: EIL56 **Credit: 0:0:1**
Prerequisite: Control Systems (EI45) **Contact Hours: 14**
Course Coordinator: Mrs. K M Vanitha

Course Content

1. Frequency response characteristics of a first order system.
2. Time response characteristics of a first order system.
3. Frequency response characteristics of a second order system.
4. Time response characteristics of a second order system.
5. Design and implementation of RC Lead Compensator.
6. Design and implementation of RC Lag Compensator
7. Implementation of Lag – Lead Compensator
8. Study of PD, PI, PID controller Characteristic.
9. Draw Root Locus of given transfer function. Observe the effect of adding a zero, adding pole and adding both zero and pole
10. Draw Bode plot of given transfer function. Observe the effect of adding a zero, adding pole and adding both zero and pole
11. Dynamic response of first and second order interacting and non-interacting level tanks
12. Open loop control of DC Servo Position System
13. Closed loop control of DC Servo system with PID controller.
14. Process curve tuning using oscillatory and damped method.

Course Outcomes (COs):

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

1. Analyse time and frequency response of first and second order systems. **(PO-1,2,5; PSO-1,3)**
2. Design compensation network and simulate compensators for the system. **(PO-1,2,5; PSO-1,3)**
3. Understand the impact of PID controller and effect of controller tuning. **(PO-1,2,5; PSO-1,3)**

PROCESS INSTRUMENTATION LAB

Course Code: EIL57 **Credit: 0:0:1**
Prerequisite: Process Instrumentation (EI44) **Contact Hours: 14**
Course Coordinator: Dr. H. S. Niranjana Murthy

List of experiments

1 Experiment to measure Flow using Orifice.
2 Experiment to measure Flow using Venturi tube.
3 Experiment to verify Bernoulli's theorem.
4 Experiment to study different types of flow and determine the Reynold's Number.
5 Experiment to measure viscosity using Saybolt viscometer.
6 Experiment to measure relative Humidity by capacitive sensor.
7 Experiment to measure moisture content in given sample of soil.
8 Experiment to measure PH of solutions using PH electrode.
9 Experiment to measure conductivity of solutions.
10 Experiment to measure Level using differential pressure transmitter.
11 Experiment to study characteristics of different valves.
12 Experiment to study characteristics of electrical valve.
13 Experiment to measure flow using rotameter.
14 Experiment to measure relative humidity using dry and wet bulb psychrometer.

Course Outcomes (COs):

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

1. Understand the measurement of flow, viscosity, humidity, moisture, PH, conductivity and level. **(PO-1,2,3,9,10, PSO-1,3)**
2. Analyse the performance characteristics of various valves**. (PO-1,2,3,9,10, PSO-1,3)**
3. Theoretically verify a few basic theorems. **(PO-1,2,3,9,10, PSO-1,3)**

DSP BASED SYSTEM DESIGN LAB

Course Code: EIL58 **Credit: 0:0:1**
Prerequisite: DSP based System Design (EI51) **Contact Hours: 14**
Course Coordinator: Dr. G. Shivaprakash

List of experiments

1 Familiarization with SCILAB
2 Familiarization with code composer studio (CCS)
3 Experiment to compute the linear convolution (C program). Verify results using SCILAB.
4 Experiment to compute the circular convolution (C program). Verify results using SCILAB.
5 Experiment to compute the correlation (C program). Verify results using SCILAB.
6 Signal generation with given specification and basic operations on signals using SCILAB.
7 Experiment to determine the linear convolution using FFT (FFT library function call).
8 Experiment to determine the spectrum of given sequence using FFT (FFT library function call).
9 Experiment to design and test Butterworth I and II order low pass filter.
10 Real-time Sine wave generation using look up table method.
11 Experiment to generate and detect DTMF signal using SCILAB software only.
12 Experiment to design and test FIR filter using hamming windowing techniques.
13 Experiment to design and test FIR filter using hanning windowing techniques.
14 Real-time echo generation using DSPs.

Course Outcomes (COs):

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

1 Write programs (C/SCILAB) to compute convolution, correlation, FFT, and spectrum. **(PO-1,2,5,9,10, PSO-1,3)**
2 Design and implement IIR and FIR digital filters to meet given performance specifications. (**PO-1,2,3,5,9,10, PSO-1,3)**
3 Write programs (SCILAB) for signal generation/manipulation and real-time DSP algorithms. **(PO-1,2,5,9,10, PSO-1,3)**

BIOMEDICAL INSTRUMENTATION

Course Code: EIOE01 **Credit: 3:0:0**
Prerequisite: Knowledge of Basic Sensors **Contact Hours: 42**
Course Coordinator: Dr. M D Nandeesh

Course Content

Unit I

Electrophysiological and Biopotential Recording: The origin of biopotentials; biopotential electrodes; instrumentation and isolation amplifiers; ECG, EEG, EMG, PCG, EOG- lead systems and recording methods, typical waveforms and signal characteristics.

Unit II

Bio-Chemical and Non Electric Parameter Measurements: pH, pO2, pHCO3, electrophoresis, colorimeter, photometer, auto analyzer, blood flow meter, cardiac output, respiratory measurement, blood pressure, temperature, pulse, blood cell counters, differential count.

Unit III

Assist Devices: Cardiac pacemakers, DC Debrillators, dialyser, heart-Lung machine, hearing aids.

Unit IV

Physical Medicine and Bio-Telemetry: Diathermies- Short-wave, ultrasonic and microwave type and their applications, medical simulator, Telemetry principles, frequency selection, bio-telemetry, radio-pill and tele-simulation, electric safely.

Unit V

Recent Trends in Medical Instrumentation: Thermograph, endoscopy unit, laser in medicine, surgical diathermy, cryogenic application, introduction to telemedicine.

Text Books

1. Khandpur,R.S., Handbook of biomedical Instrumentation, Tata McGraw-Hill, New Delhi, Second edition, 2003.
2. Lesile Cromwell, Biomedical instrumentation and measurement, Prentice Hall of India, New Delhi, 2007.

References

1. Joseph.J, Carr and John M.Brown, Introduction to Biomedical equipment technology, Pearson Education Inc. 2004.
2. John G.Webster, Medical Instrumentation Application and Design, John wiley and sons,(Asia) Pvt.Ltd., 2004.

Course Outcomes (COs):

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

1. Explain the basics of bio-potentials and bio-potential electrodes. **(PO-1,10, PSO-1,3)**
2. Understand the procedures and techniques for bio signal acquisitions and patient assist devices. **(PO-1,10, PSO-1,3)**
3. Analyze the signals acquired from biomedical instruments. **(PO-1,5,10, PSO-1,3)**
4. Describe the working principles used for different medical procedures**. (PO-1,6,8,10, PSO-1,2,3)**
5. Identify suitable technology for the right diagnosis and therapy of diseases. **(PO-1,10, PSO-1,3)**

VI Semester

POWER ELECTRONICS AND DRIVES

Course Code: EI61 **Credit: 3:1:0**
Prerequisite: Basic Electronics (EC15) **Contact Hours: 42+14**
Basic Electrical Engineering (EE25)
Course Coordinator:

Course Content

Unit I

Power Semiconductor Devices: Applications of Power Electronics, Power semiconductor devices, Control Characteristics, types of power electronic circuits, peripheral effects, Power Transistors: Power BJT's–switching characteristics, switching limits, power MOSFET's–switching characteristics, gate drive. IGBT's, di/dt and dv/dt limitations, isolation of gate and base drives, simple design of gate and base drives.

Unit II

Thyristors: SCR, SCR characteristics, TRIAC, TRIAC characteristics, UJT, two-transistor model, Thyristor firing circuits: R, R-C and UJT triggering circuit. Thyristor commutation Circuits.

Unit III

Rectifiers and Choppers: Rectifiers: Single Phase Operation–Power Factor–Effect of Source Inductance–Single and Multi-Quadrant Operation with DC Motor Load – Steady State Analysis. DC-DC Converters: Buck, Boost, Buck-Boost, Cuk Converters–Circuit Configuration and Analysis – Choppers – Single and Multi-Quadrant Operation with DC Motor Load – Steady State Analysis.

Unit IV

Electric Drives and its Dynamics: Electric Drives: Concepts, Advantages of Electric drives, parts of Electric drives, choice of Electric drives, Dynamics of Electric drives: torque equations, multi-quadrant operation, drive parameters, load torques, steady state stability, speed control of electric drives, Selection of Motor power rating: thermal model, classes of motor duty, determination of motor rating, Closed loop Control of Drives, Three phase induction motor, Variable frequency drives, DC motors concepts and brushless DC motors.

Unit V

Inverters and Application of Power Electronic Converters: Inverters – Single Phase Bridge Inverters – PWM Inverters, Uninterrupted Power Supply (UPS), Residential & Industrial applications: space heating & air conditioning, high frequency fluorescent lighting, Induction heating, electric welding, Integral half cycle controllers.

Tutorial List

Sr. No	Topic
1.	Problems on Power BJT circuits.
2.	Problems on Power MOSFET circuits.
3.	Problems on Power IGBT circuits.
4.	Problems on di/dt and dv/dt protection circuits.
5.	Problems on SCR firing circuits.
6.	Problems on UJT firing circuits.
7.	Problems on Half wave controlled rectifier with R and RL load
8.	Problems on Semi converter with R and RL load
9.	Problems on Full converter with R and RL load
10.	Problems step down chopper.
11.	Problems on step up chopper.
12.	Problems on step up-step down chopper.
13.	Problems on single phase half bridge inverter.
14.	Problems on single phase full bridge inverter.

Text Books

1. Muhammad. H, Rashid, Power Electronics Handbook, Butterworth-Heinemann, Third edition, 2011.
2. G.K Dubey, Fundamentals of Electrical Drives, Narosa publishing house, 2nd Edition.

References

1. Ned Mohan, Tore M. Undeland and William P. Robbins, Power Electronics Converters, Applications and Design, John Wiley and Sons, Third Edition, 2002.
2. Bimbhra P. S, Power Electronics, Khanna Publishers, Fourth Edition, 2006.
3. Vedam Subrahmanyam, Electric Drives, Concepts and applications, Tata McGraw-Hill, Second Edition, 2009.
4. Vedam Subrahmanyam, Thyristor Control of Electric Drives, Tata McGraw Hill, First Edition, Reprint 2008.

5. Singh. M.D, Khanchandani. K.B, Power Electronics, Tata McGraw-Hill, Second Edition, 2008.
6. BimalBose, Power Electronics and Motor Drives-Advances and Trends, Academic press, 2006.
7. Williams. B.W, Power Electronics: Devices, Drivers, Applications and Passive Components, Macmillan, Second Edition, Reprint 2007.

Course Outcomes (COs):

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

1. Understand the operation of power semiconductor devices. **(PO-1,2,3,4,9, PSO-1,3)**
2. Understand various triggering, commutation circuits for thyristors. **(PO-1,2,3,4,9, PSO-1,3)**
3. Analyze different types of power convertors. **(PO-1,2,3,4,9, PSO-1,3)**
4. Describe the basics of industrial drives and its dynamics. **(PO-1,2,3,4,9, PSO-1,3)**
5. Explore various applications of power electronics circuits. **(PO-2,3,4,9, PSO-1,3)**

PLC & SCADA

Course Code: EI62 **Credit: 4:0:0**
Prerequisite: Process Instrumentation (EI44) **Contact Hours: 56**
Course Coordinator: Mrs. Vibha B Raj

Course Content

Unit I

Introduction to PLC: PLC hardware, configuration, Analog& digital input modules, Analog & digital output modules Communication interfaces, Processor module, Power supply module, Logical sensors-logical actuators.

Unit II

Introduction to Programming and logic: PLC programming-IEC 1131-3 programming standards, Conventional ladder v/s. PLC ladder. LD and FBD concepts, Start-Stop logic, Latch-Unlatch instructions, Interface programs.

Unit III

Instructions: ON delay timer, OFF delay timer, retentive ON timer, Counter Up, Counter Down, Compare, Compute, Move, Logical, Math instructions using ladder programming and FBD programming, simple application programs.

Unit IV

Introduction to SCADA: Fundamental principles of modern SCADA systems, SCADA hardware, hierarchy, DCS, Features, considerations and benefits of SCADA systems, software package, redundancy, RTU, Master and Sub-master station, Comparison of terms PLC, SCADA, DCS and smart instrument, Golden rules.

Unit V

SCADA protocols: Introduction to protocols, HDLC, CSMA/CD, DNP, Error detection.

Central control Room facility, Maintenance and troubleshooting: Recommended installation practice, Ergonomic requirements, Design of the computer displays, Alarming and reporting philosophies, troubleshooting the telemetry system-The RTU and component modules-The master sites-The central site-The operator station and software-Maintenance tasks-The maintenance unit system.

Text Books

1. Introduction to Programmable Logic Controllers by Garry Dunning, 3rd edition, 2009, CENGAGE Learning, ISBN- 13; 978-81-315-0302-7.
2. Practical SCADA for Industry, David Bailey and Edwin Wright, An imprint of Elsevier, 2003, ISBN 07506 58053

References

1. Programmable Logic Controllers, JR Hackworth, 4th impression, 2008, Pearson Education, ISBN 978-81-7758-771-5.
2. Programmable Logic Controllers, W Bolton, 4TH edition, 2008, Elsevier, ISBN: 978-0-7506-8112-4.

Course Outcomes (COs):

The students will be able to:

1. Understand the working of PLC and its I/O modules. **(PO1,2, PSO-1)**
2. Program PLC and SCADA with LD and FBD programming languages. **(PO-1,2,3,5, PSO-1)**
3. Design a process automation system in simulation environment. **(PO3,5,7,9,10, PSO-1,2,3)**
4. Understand the evolution of DCS and SCADA**. (PO-1,12, PSO-1)**
5. Understand the communication protocols and maintenance of an Automation system. **(PO-1,7, PSO-1,2)**

DIGITAL IMAGE PROCESSING

Course Code: EIE631 **Credit: 2:1:0**
Prerequisite: DSP based System Design(EI51) **Contact Hours: 28+14**
Course Coordinator: Dr. M. Jyothirmayi

Course Content

Unit I

Digital Image Fundamentals: Image processing: Introduction, Fundamental steps, Components. Elements of visual perception, image sampling and quantization, some basic relationships between pixels. Intensity Transformations Some Basic Intensity Transformation Functions, Histogram Processing

Unit II

Spatial Filtering: Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters. **Filtering in the Frequency Domain**: Preliminary Concepts, Image Smoothing using Frequency Domain Filters, Image Sharpening Using Frequency Domain Filters.

Unit III

Image Restoration and Reconstruction: A model of the image degradation/ restoration process, noise models, restoration in the presence of noise only - spatial filtering, Minimum Mean Square Error (Wiener) Filtering. Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing

Unit IV

Image Segmentation: Fundamentals, Point, Line, and Edge Detection, Segmentation by Thresholding, Region-Based Segmentation, Segmentation Using Watershed Algorithm. **Representation and Description:** Representation, Some Simple Descriptors, Shape Numbers, Fourier Descriptors

Unit V

Object Recognition: Patterns and Pattern Classes, Matching: Minimum distance classifier, correlation. **Color Image Processing**: Color Fundamentals, Color Models, Pseudo color Image Processing.

Tutorial Classes

1. Introduction to MATLAB
2. To create a program to display grayscale image using read and write operation.
3. To study the basic Image Processing techniques: Resizing, rotation.
4. To study the basic Image Processing techniques: Quantization.
5. To study the basic Image Processing techniques: Image transformation.
6. To create a vision program to find histogram value and display histograph of a grayscale image
7. To create a vision program to find histogram value and display histograph of a color image
8. To Implement smoothing or averaging filter in spatial domain.
9. To fill the region of interest for the image.
10. Program for edge detection algorithm.
11. Program for morphological operation: erosion and dilation
12. Image restoration- Wiener filter
13. Color image processing-To obtain the R, B, G colour values and resolved colour values from a colour box by choosing any colour
14. To create a program for segmentation of an image using watershed transform

Text Book:

1. Rafael C Gonzalez and Richard E Woods, "Digital Image Processing", Pearson Education, 3rd Edition.
2. Vipula Singh, "Digital Image Processing with MatLab and LabVIEW" Cengage, First edition.

Reference Books:

1. Rafael C Gonzalez, Richard E Woods and Steven L Eddins, "Digital Image Processing using MATLAB", Pearson Education.

Course Outcomes (COs):

The students should be able to:

1. Understand the fundamentals concepts of digital image processing systems. **(PO-1,2,3,5,10, PSO-1,3)**
2. Implement image enhancement techniques in frequency and spatial domain **(PO-1,2,3,5,10, PSO-1,3)**
3. Implement the methodologies for image restoration. **(PO-1,2,3,5,10, PSO-1,3)**
4. Analyse image segmentation techniques. **(PO-1,2,3,5,10, PSO-1,3)**
5. Understanding object recognition and color image processing techniques. **(PO-1,2,3,5,10, PSO-1,3)**

INTERNET OF THINGS (IoT)

Course Code: EIE632 **Credit: 2:1:0**
Prerequisite: Knowledge of Embedded Systems & FOC Contact Hours: 28+14
Course Coordinator: Dr. M K Pushpa and Dr.M.Jyothirmayi

Course Content:

Unit I

Introduction & concepts: Introduction, Definition and Characteristics of IoT, Physical design of IoT: Things in IoT, IoT Protocols, Logical design of IoT: IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies: wireless sensor networks, Cloud computing, IoT Levels and Deployment Templates.

Unit II

Developing Internet of Things: IoT Platform Design Methodology, Specifications: Requirements, Process, Domain, Information, Services, Level, Functional, Operational, Integration, Application Development.
Python Language: Data Types & Data Structures, Control Flow, Functions, Modules, Packages, File Handling, Date & Time Operations, Classes, Python Packages of Interest for IoT

Unit III

IoT Physical Devices and End Points: Basic Building Blocks of an IoT Device, Raspberry Pi **Programming Raspberry Pi with Python:** Controlling LED, Interfacing Switch, Interfacing Light Sensor LDR, Interfacing Temperature and Humidity sensor.

Unit IV

IoT Physical Servers & Cloud offerings: Introduction to cloud storage Models, service models: SaaS, PaaS, IaaS, WAMP-AutoBahn for IoT, WAMP Session between Client/Router, WAMP Protocol, Publish-Subscribe messaging using WAMP-AutoBahn. WAMP-AutoBahn Framework. Thingspeak Cloud for IoT.

Unit V

Python Web Application Framework –Django/Flask, Web Services for IoT, Amazon Web Services(AWS), IBM Bluemix, SkyNet IoT Messaging Platform, Introduction to Data analytics. **IoT Case Studies**: Home Automation: Smart Lighting, Cities: Smart Parking, Environment: Weather Monitoring System, Agriculture – Smart Irrigation.

Tutorial Classes

1. Introduction to IoT components and devices.
2. Exploring the different components of Raspberry pi, Setting up of the board and booting the board.
3. Python Programming with Raspberry Pi.
4. Python Programming with Raspberry Pi.
5. Implement a Python program for blinking an LED to a Raspberry Pi platform make suitable assumptions
6. Implement a Python program for interfacing an LED and a Switch to a Raspberry Pi platform.
7. Implement a Python program for switching light based on LDR reading in Raspberry Pi platform make suitable assumptions.
8. Implement a Python program for sending an eMail when a switch which is connected to a Raspberry Pi platform is pressed. Make suitable assumptions.
9. Write a Python program for capturing a LDR sensor data every 2 minutes using Raspberry Pi and send it to a server / cloud which will write it to a text file and plot a graph for the same.
10. Write a Python program for implementing a temperature dependent auto cooling system using a Raspberry Pi platform.
11. Write a Python program for capturing a temperature and humidity sensor data every 2 minutes using Raspberry Pi and send it to a server which will write it to a text file.
12. Write a program to communicate information from cloud to node.
13. Write a Python program to Detect the intruder when there is no surrounding lighting using Raspberry Pi.
14. Write a program to Create an UI for controlling lights in different rooms. If lighting is less, alert the user to turn on light in that particular room using Raspberry Pi.

Text Book:

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things: A Hands-on Approach”, Universities Press, 2015

Reference Books:

1. Ovidiu Vermesan, Peter Friess, “Internet of Things-From Research and Innovation to Market Deployment”, River Publishers Series in Communication.
2. http://www.internet-of-things-research.eu/pdf/IERC_Cluster_Book_2014_Ch.3_SRIA_WEB. pdf
3. Adrian McEwen, Hakim Cassimally, “Designing the Internet of Things”, ISBN 978-81-265-5686-1 Wiley Publication.
4. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014.

Course Outcomes (COs):

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

1. Understand the Architectural Overview of IoT and its characteristics **(PO-1,2,3, PSO-1)**
2. Design and program Raspberry Pi for some IoT based prototypes **(PO-1,2,3,4,5,9,12, PSO-1,3)**
3. Analyze the role of IoT physical servers and Cloud. **(PO-1,2,3,4,5, 12, PSO-1,3)**
4. Illustrate the application of IoT. **(PO-1,2,3,4,5,12, PSO-1, 3)**
5. Analyze Web application services. **(PO-1,2,3,4,5, 12, PSO-1, 3)**

DATA STRUCTURES & ALGORITHMS

Course Code: EIE633 **Credit: 2:1:0**
Prerequisite: OOP with C++ **(EI52) Contact Hours: 28 + 14**
Course Coordinator: Mrs. Elavaar Kuzhali.S.

Course Content

Unit I

Stack: Structures and Pointers revisited, Introduction to Data Structures. Stacks: Definition, Representation and operations on stack, Implementation of stack using array. Applications of stack: Recursion: Definition, factorial of given number, Fibonacci Series, Infix, Prefix, Postfix expressions, Conversions: Infix to postfix, Evaluation of postfix expression, Iteration v/s recursion techniques.

Unit II

Queue: Queues: Definition, Representation and operation on Linear queues, Implementation of queue using array, Circular Queue, Priority Queue: Ascending PQ, Descending PQ, Multi-Level PQ, Application of Queue

Unit III

Linked List: Dynamic Memory Allocation Revisited, Introduction to Linked List, Arrays v/s Linked List, Operation on Linked List: Insert, Delete, Display, Doubly Linked List, Circular Linked List, Circular Doubly Linked List. Applications on Linked List: Reversing, Concatenation, Merging, Searching, Sorting, Evaluation of Polynomials, Linked Implementation of Stacks, Linked Implementation of Queues

Unit IV

Trees: Definition, Types of Trees, Representation of trees using array and Linked List, Operation on Binary Trees: Create, Display, Insert, Delete. Binary Search Tree: Definition, Operation on Binary Search Trees: Create, Display, Insert, Delete. Tree Traversal: Preorder, Post order, Implementing tree traversal using recursion. Equivalence between binary search algorithm and BST, Applications of Binary Trees and Binary Search Trees

Unit V

B & B+ Trees: B-Tree: Searching, Insertion and Deletion; B+ Tree: Searching, Insertion and Deletion; Hashing, Hash Function, Collision, Probability of Collision, Collision handling techniques, Progressive Overflow, Buckets, Chained Progressive Overflow.

Tutorial List:

Implement the following experiments:

1. Primitive operations on Stacks and Linear Queue using arrays.
2. Evaluation of a valid Postfix expression using stacks.
3. Conversion of a valid Infix expression to Postfix Expression using stacks. Program should support parenthesized free expressions with the operators: +, -, *, /,%(Remainder),^(Power) and alphanumeric operands.
4. Factorial and Fibonacci using recursion.
5. Circular queue and Priority queue using arrays.
6. Singly Linked List with the following operations: a. Inserting a node (Any desired position) b. Deleting a node (Any desired position) c. Display
7. Represent and evaluate a given Polynomial using Singly Linked List. To check if a Singly Linked List is a Palindrome or not.
8. Circular Linked List with the following operations: a. Inserting a node (Any desired position) b. Deleting a node (Any desired position) c. Display
9. Doubly Linked List with the following operations: a. Inserting a node (Any desired position) b. Deleting a node (Any desired position) c. Display
10. To insert a given element into an ordered Doubly Linked List. To delete every second node from Singly Linked list
11. Stack and Queue using Singly Linked List, Stack & Queues using Circular Linked List.
12. Binary Tree operations: a. Creation b. Traversal (Inorder, Preorder and Postorder).
13. Creation of Expression tree and evaluate it. Replace each node in binary tree with the sum of its inorder predecessor and successor
14. Creation and display of Binary Search Tree

Text Books

1. Data Structures: A Pseudocode Approach with C by Richard.F.Gilberg, Behrouz.A.Forouzan, 2nd edition 2007.
2. Data Structures using C and C++ by YedidyahLangsam and Moshe J. Augenstein and Aaron M.Tenanbaum, PHI / Pearson 2008 Reprint.
3. Data Structures and Program Design by C R.Kruse, C.L Tondo and B.Leung, Second Edition, Pearson Education, 2007.

References

1. Introduction to Algorithms by T. H Cormen, C. E. Leiserson and R. L. Rivest, 2nd Edition, Prentice Hall India 2009.

2. Data Structures Using C by R. Krishnamoorthy, Tata McGraw-Hill Education, 2010.
3. NPTEL online course "Programming and Data Structures", http://nptel.ac.in/courses/106105085/

Course Outcomes (COs):

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

1. Implement stack data structures and its applications. **(PO-1,3, 5, 9,10, PSO-1,3)**
2. Explain the working principle of various types of queues, their applications and implementations**. (PO-1,3, 5, 9,10, PSO-1,3)**
3. Implement various types of linked lists using dynamic memory allocation. **(PO-1,3, 5, 9,10, PSO-1,3)**
4. Implement various nonlinear structures. **(PO-1,3, 5, 9,10, PSO-1,3)**
5. Develop solutions for the problem based B-trees, B+ trees. **(PO-1,3, 5, 9,10, PSO-1,3)**

ARTIFICIAL NEURAL NETWORKS & FUZZY LOGIC

Course Code: EIE641 **Credit: 3:0:0**
Prerequisite: Control Systems (EI45) **Contact Hours: 42**
Course Coordinator: Dr. A. Saravanan

Course Content

Unit I

Introduction: Basic building blocks of ANN, ANN terminologies, comparison between Artificial & Biological neural networks, Learning Rules, Network Architectures, Fundamental Models of ANN, Neural Net for Pattern Classification- Hebb Net, Perceptron, Adaline.

Unit II

Feed Forward and Feedback Networks: Madaline network –Architecture, training algorithm, Back propagation network- Architecture, training algorithm, Discrete Hopfield network – architecture, training algorithm and energy analysis, Radial Basis Function network - Architecture, training algorithm.

Unit III

Fuzzy Set and Fuzzy Relations: Basic concepts of Fuzzy logic state & random process, Fuzzy sets & Crisp sets, Fuzzy set operation, properties of Fuzzy sets, mapping of classical sets to function, Classical Relations and Fuzzy Relations, Fuzzy Tolerance, Features of Membership Functions.

Unit IV

Fuzzy Systems: Crisp Logic, Predicate Logic, Fuzzy Logic, Fuzzy Rule based system, Fuzzification& De-fuzzification Methods, lambda cuts for fuzzy sets, lambda cuts for fuzzy relations.

Unit V

Fuzzy Control Systems: Control System Design Problem, Simple Fuzzy logic Controller, Examples of Fuzzy Control System Design, Design of fuzzy Logic controller – Fuzzy Control of Water Heater, Fuzzy Traffic Control, Fuzzy Aircraft Control, Fuzzy Cruise Controller.

Text Books

1. S.N. Sivanandam, Sumithi, Deepa, Introduction to Neural networks using Matlab, Tata McGraw- Hill 2006.

2. Timothy J Ross, Fuzzy Logic with Engineering Applications, WILEY INDIA, Second Edition, 2007.

References

1. Laurene Fausett, Fundamentals of Neural Networks, Architectures, Algorithms, and Applications, Pearson Education, 2004.
2. S.Rajasekaran, G.A. Vijayalakshmi Pai, - Neural networks, Fuzzy Logic and Genetic Algorithms Synthesis and Applications, PHI, 14th Printing 2010.
3. M.Gopal, Digital Control and state variable methods, Tata McGraw- Hill, 2005.

Course Outcomes (COs):

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

1. Describe Biological Neural Network, Artificial Neural Network (ANN) and Neural Networks for Pattern Classification. **(PO-1,2,4,9, PSO-1, 3)**
2. Develop functionality of artificial neural networks with respect to Back-prop, Hopfield, and RBF. **(PO-1,2,3,4,9, PSO-1,3)**
3. Implement ANN technique for different applications. **(PO-3,4,9, PSO-1,3)**
4. Evaluate problems based on fuzzy set and fuzzy relations**. (PO-2,4,5,9, PSO-1,3)**
5. Implement fuzzy logic control for different applications. **(PO-1,3,4,5,9, PSO-1,3)**

CYBER PHYSICAL SYSTEMS

Course Code: EIE642 **Credit: 3:0:0**
Prerequisite: Digital System Design (EI34) **Contact Hours: 42**
Course Coordinator: Dr. M Jyothirmayi & Ms. J. V. Alamelu

Course Content

Unit I

Introduction to cyber physical systems – applications-design process – modelling, design and analysis concepts. Modelling dynamic behaviors- continuous dynamics - Newton mechanics – Actor models – properties of systems - Feedback control.

Unit II

Modelling discrete dynamics- Discrete systems – Finite state machine – extended state machines – Nondeterminism – Examples and applications.

Unit III

Hybrid systems – modal models – classes of hybrid system - Composition of state machines - Concurrent composition – Hierarchical state machines - Concurrent models of composition.

Unit IV

Energy Cyber Physical Systems – Introduction, Simulation model-scenarios, Smart Micro-grids, Cyber-Physical System for Transportation Applications.

Unit V

Medical Cyber Physical Systems-Introduction, Systems Description, Key design drivers and quality attributes, Practioners Implications.

Text Books

1. Lee & Seshia, Introduction to Embedded Systems - A Cyber-Physical Systems Approach, second Edition, version2.0.

References

1. Fei Hu, Cyber-Physical Systems: Integrated Computing and Engineering Design, CRC Press.
2. Cyber Physical Systems-Foundations, Principals and Applications by Houbing Song, Rawat, Jeschke, Elesevier Publications (Unit4)

3. Cyber Physical Systems by Raj Rajkumar, Dionisio de Niz, Mark Klein Pub Addison Wesley, (Unit-5)

Course Outcomes (COs):

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

1. Understand the concepts of cyber physical system**. (PO-2,3,10, PSO-1,3)**
2. Use different actor models. **(PO-2,3,10, PSO-1,3)**
3. Implement finite state machines. **(PO-2,3,6, 10,12, PSO-1,2,3)**
4. Understand the applications of cyber physical system. **(PO-2,3,6,8, 10,12, PSO-1,2,3)**
5. Understand the knowledge of CPS for medical applications. **(PO-2,3,6, 10, PSO-1,2,3)**

AIRCRAFT AND AUTOMOBILE INSTRUMENTATION

Course Code: EIE643 **Credit: 3:0:0**
Prerequisite: Electronic Measurement (EI35) and Industrial Instrumentation (EI36) **Contact Hours: 42**
Course Coordinator: Dr. M. D. Nandeesh &: Dr. H. S. Niranjana Murthy

Course Content

Unit I

Instrument Display Panels and Layout: Qualitative and quantitative display, director, display, heading display and instrument grouping basic air data system, pitot-static probe, heating circuit arrangement. airspeed indicator

Unit II

Flight Instrumentation: Gyroscope and its property, transport wandering, gyro horizon erection system for gyro horizon, torque motor and leaving switch system, electromagnet method, turn and bank indicator, ARNIC protocol.

Unit III

Measurement of Engine Speed, Temperature and Fuel quality: Electrical tachometer system, servo-operated tachometer, method and application of temperature measurement, temperature sensing element, servo-operated indicator, radiation pyrometer, Quality indicative system, capacitive type fuel quantity by weight.

Unit IV

Fundamentals of Automotive Electronics: Fundamental of Automotive sub-systems Engine Management System (Gasoline & Diesel), Open-loop and closed-loop systems components for electronic engine management, vehicle motion control, Transmission (Manual & Automatic), Suspension Systems, Entertainment Systems, ABS, Safety & Warning Systems, Heating and Air-conditioning, Instrument Clusters.

Unit V

Electronic Fuel Injection and Ignition Systems: Feedback Carburetor control system, throttle body ignition and multi-port or point fuel injection, Fuel injection systems, injection system controls, Types of solid-state ignition systems and their principle of operation, electronic spark timing control system. **Vehicle Motion Control and Stabilization Systems:** Adaptive cruise control, Electronic transmission control, Vehicle stabilization system, Antilock braking system, traction control system, Electronic stability program,

Text Books

1. EHJ Pallet, Aircraft Instrumentation and integrated systems, Longman Scientific and Technical.
2. S Nagabhushana and L K Sudha, Aircraft Instrumentation and system, I K International Publication House Pvt Ltd, Edition 2010
3. William B. Riddens, Understanding Automotive Electronics, 5th Edition, (Butterworth Heinemann Woburn), (1998).
4. BOSCH, Automotive Handbook, 6th Edition., Bentley Publishers, 2006

References

1. W H Courtyard, Pitman and sound, Aircraft instrumentation design.
2. Young A.P and Griffiths. L, Automobile Electrical Equipment, English Language Book Society and New press.

Course Outcomes (COs):

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

1. Understand the functioning of the flight instruments and display devices**. (PO-1,7,10,12, PSO-1,2,3)**
2. Describe the working of the flight instrumentation system**. (PO-1,2,7,10, PSO-1,2,3)**
3. Illustrate the techniques of measuring speed, temperature and fuel flow in engine of aircraft. **(PO-1,2,7,10,12, PSO-1,2,3)**
4. Explain the working of mechanical systems and electronic systems in automobiles. **(PO-1,2,7,10,12, PSO-1,2,3)**
5. Illustrate the working of Vehicle Motion Control and Stabilization Systems. **(PO-1,2,7,10,12, PSO-1,2,3)**

MINI PROJECT

Course Code: EI65 **Credit: 0:0:4**
Prerequisite: Engineering Design (AL21)
Course Coordinator: Dr. A. Saravanan

Students will complete the technical project under the guidance of the faculty member in the department. The quality of the work will be judged in three presentations made to the panel consisting of the guide and other faculty members in the project domain.
This requires an approximate 12 hours/week of practical work. Internal assessment carries 50 marks and exam (of duration 3 hours) carries 50 marks.

Course Outcomes (COs):

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

1. Conduct literature survey for any chosen domain. **(PO- 1,2,3,4, PSO- 1)**
2. Analyze the identified problem, the gap and the avenues of solution using current technology. **(PO- 1,2,3,4,5, PSO- 1,2,3)**
3. Communicate effectively and work in a multidisciplinary team. **(PO- 2,3,4,5,8,9,11, PSO- 1,2,3)**
4. Propose solutions for social, industrial, research problems. **(PO – 4,5,11,12, PSO- 1,2,3)**
5. Develop a research/development mindset and engage in continuous learning. **(PO –5,6,10,11,12, PSO- 1,2,3)**

POWER ELECTRONICS AND DRIVES LAB

Course Code: EIL66 **Credit: 0:0:1**
Prerequisite: Power Electronics & Drives (EI61) **Contact Hours: 14**
Basic Electrical Engineering (EE25)
Course Coordinator:

List of Experiments

1. Static characteristics of Power MOSFET and IGBT.
2. Static characteristics of Silicon Controlled Rectifier.
3. Static characteristics of TRIAC.
4. RC half-wave triggering circuits.
5. RC full-wave triggering circuits.
6. Line synchronized UJT triggering circuit.
7. Commutation circuits for SCR (i)LC circuit (ii) Impulse commutation circuit.
8. Single phase fully controlled rectifier (R and RL Loads).
9. Series Inverter.
10. Generation of Firing Signals for Thyristor using Digital circuits
11. Voltage (Impulse) commuted chopper.
12. Buck converter.
13. Variable frequency drive.
14. DC motor control using Class-A chopper controlled dc motor drive.

Course Outcomes (COs):

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

1. Characterize Power electronics devices. **(PO-1,2,3,4,9,10, PSO-1,3)**
2. Analyze the triggering and commutation circuits for Power electronics devices. **(PO-1,2,3,4,9,10, PSO-1,3)**
3. Test single phase fully controlled rectifiers and inverters. **(PO-1,2,3,4,9,10, PSO- 1,3)**

PLC & SCADA Lab

Course Code: EIL67 **Credit: 0:0:1**
Prerequisite: PLC & SCADA (EI62) **Contact Hours: 14**
Course Coordinator: Mrs. Vibha B Raj

List of Experiments:

1. Introduction to Rockwell Automation Software development environment, implementation of Basic Boolean functions.
2. PLC ladder logic & FBD programming to control the production line process using SIMBOX.
3. PLC ladder logic & FBD programming to control the rejection process using SIMBOX.
4. PLC ladder logic & FBD programming to control the batching process using SIMBOX.
5. PLC ladder logic & FBD programming to control the traffic monitoring system using SIMBOX.
6. PLC ladder logic & FBD programming to control the pick and place process using SIMBOX.
7. Introduction to Mitsubishi Software development environment, implementation of Basic Boolean functions.
8. PLC ladder logic programming to control the elevator using RS Logix and GX Works.
9. PLC ladder logic programming to control the bottle filling process using RS Logix and GX Works.
10. PLC ladder logic programming to control the coffee vending machine process using RS Logix and GX Works.
11. PLC ladder logic programming to control the drilling machine process using RS Logix and GX Works.
12. Configuring SCADA for I/O acquisition.
13. Ladder logic programming to control simple ON-OFF process using SCADA.
14. Ladder logic programming to control water level in overhead tank using SCADA.

Text Books

1. Introduction to Programmable Logic Controllers by Garry Dunning, Thomson, 2nd edition, Thomson, ISBN: 981-240-625-5
2. Practical SCADA for Industry, David Bailey and Edwin Wright, An imprint of Elsevier, 2003, ISBN 07506 58053

Course Outcomes (COs):

The students should be able to:

1. Utilize Rockwell Automation Software and Mitsubishi Software for PLC programming**. (PO-1,3,5,10,12, PSO-1,3)**
2. Utilize Clear SCADA software for SCADA programming. **(PO1,3,5,10,12, PSO-1,3)**
3. Implement a prototype simulation plant process. **(PO3,5,7,9,10, PSO-1,2,3)**

VIRTUAL INSTRUMENTATION LAB

Course Code: EIL68 **Credit: 0:0:1**
Prerequisite: Industrial Instrumentation (EI36) and Control Systems (EI45) **Contact Hours: 14**
Course Coordinator: Dr. Christina Grace Charlet

Course Content

1. Introduction of LabView, National Instruments and implementation of different types of controls and indicators.
2. Understand implementation of Logic gates and loops.
3. Implementation of modular programming using sub VIs.
4. Realization of Traffic signal control logic for understanding loops and delays.
5. Implementation of image acquisition, animation and basic image processing.
6. Implementation of advanced Image processing.
7. Implement cluster control.
8. Using Control Design and Simulation (CDSim) module, building open loop systems and incorporating delay and disturbance
9. Using Control Design and Simulation (CDSim) module, building closed loop systems
10. Understanding waveform plotting by generating sine waveform with options to vary amplitude, offset, initial time, number of points and sampling. Use this as a sub-VI and maximum and minimum values and associated time.

Hardware exercises:

11. Using myRIO for configuration of analog inputs and outputs, for display and manipulation.
12. Realization of Traffic signal control logic by connecting LEDs to myRIO.
13. Using Control toolkit and a temperature sensor and heater simulate temperature control system using a PID controller.
14. IoT using myRIO by sending accelerometer data to cloud and manipulating a servo motor from cloud.

References:

1. Virtual instrumentation using LabVIEW by Jovitha Jerome.

Course Outcomes (COs):

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

1. Simulate basic sensor applications using LabVIEW. **(PO-1,3,5,9,12 PSO-1,3)**
2. Implement basic control experiments using LabVIEW. **(PO-1,3,5,9,12 PSO-1,3)**
3. Acquire data from sensors and control actuators using myDAQ. **(PO-1,3,5,9,12 PSO-1,3)**

INDUSTRIAL AUTOMATION

Course Code: EIOE02 **Credit: 3:0:0**
Prerequisite: Basic Electronics (EC15) **Contact Hours: 42**
Basic Electrical Engineering (EE25)
Course Coordinator: Ms. J.V. Alamelu and Dr. H. S. Niranjana Murthy

Course Content

Unit I

Industrial processes: Definition, Industry classification, Application oriented (Manufacturing and Utility industry), Operational (Continuous – discrete – batch), Physical (Local and Distributed). **Process automation systems:** Definition, Process without and with automation, Need and benefits of automation. Automation steps: Information acquisition and analysis, Decision making, Control execution. **Process signals:** Definition, Classifications, Input and output, Digital/discrete, Analog/continuous, Pulse.

Unit II

Automation system structure: Definition, Subsystems: Input Instrumentation subsystem, Control subsystem, Human interface subsystem, Control subsystems. Instrumentation: Structure and components, Physical signal conversion, Signal interfacing standards, Signal conditioning, Process isolation and instrumentation protection, Final control elements (pumps, motors, control valves and solenoid). Human machine interface: Definition, need, hardware based, Software based, Operator panels. Control system: Definition, need, Functions, Structure, Data acquisition and control unit (DACU) Data acquisition unit (DAU), Functional Subsystem, Power supply subsystem, Processor subsystem, Input/output subsystem, Communication subsystem, Supporting subsystem.

Unit III

Control strategies: Definition, need, Open loop control, closed loop or feedback control, Discrete control Sequential: control with interlocks Continuous control: Two step and multi-step control, Analog loop control, Evolution of control systems: Mechanical, hydraulic, and pneumatic based, relay based, solid-state based, micro-processor based, Comparisons. Special purpose DACUs: Need, Programmable Logic Controller (PLC), Loop controller, Controller, Remote Terminal Unit (RTU)

Automation strategies: Need, classification, architectures and protocols, Industrial data communication, Centralized control systems, Distributed Control Systems (DCS), Network Control Systems (NCS), Front-end processing, Supervisory Control and Data Acquisition (SCADA) systems, DCS and NCS, Modern control centre.

Unit IV

Case studies: SCADA applications in industry automation (Railway traction system/power distribution system), PLC based Industrial application (Power plant/ Petrochemical) with VFD (based on automation systems), Material handling and identification technologies - Manufacturing, assembly and conveying systems, Motion control system, Robot controller architectures - Robots in manufacturing automation - Motion planning for robots, Quality control systems.

Unit V

New Developments: IT-OT convergence, Internet of Things (IoT), Industrial IoT, Industry 4.0: Various industrial revolutions, Features, challenges and difficulties of industry 4.0 (Interoperability, information transparency, decentralized decision making, Cloud computing for industry 4.0, Smart manufacturing, Smart logistics, Smart cities, Smart components, auto-diagnosis and configurability, Cyber-physical systems.

Text Books

1. Overview of Industrial process automation, by KLS Sharma, IIIT, Bangalore

References

1. Process control Instrumentation Technology, CD Johnson, Pearson Education
2. Instrument Engineers Handbook – Vol. 1: Process Measurement and Analysis, Vol. 2: Process Control, by BG Liptak, Butterworth Heinemann
3. Fundamentals of Industrial Control, DA Coggan, ISA
4. Understanding Distributed Processor Systems for Control by SM Herb, ISA

Course Outcomes (COs):

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

1. Understand the different types of automation processes and systems. **(PO-1,3,6,9, PSO-1,2,3)**
2. Analyze different building blocks of Automation system structure. **(PO-1,3,6,9, PSO-1,2,3)**
3. Analyze the concepts of different control and automation strategies utilized in Industrial environment. **(PO-1,3,6,9, PSO-1,2,3)**
4. Apply the concepts of automation systems in real world applications. **(PO-1,3,6,9, PSO-1,2,3)**
5. Understand recent developments in Industrial automation **(PO-1,3,6,9, PSO-1,2,3)**