



RAMAIAH
Institute of Technology

CURRICULUM

Academic Year 2019– 2020

**DEPARTMENT OF ELECTRONICS AND
INSTRUMENTATION ENGINEERING**

V & VI Semester B. E.

RAMAIAH INSTITUTE OF TECHNOLOGY
(Autonomous Institute, Affiliated to VTU)
BANGALORE – 54

About the Institute:

Ramaiah Institute of Technology (RIT) (formerly known as M.S.Ramaiah Institute of Technology) is a self-financing institution established in Bangalore in the year 1962 by the industrialist and philanthropist, Late Dr. M S Ramaiah. The institute is accredited with “A” grade by NAAC in 2016 and all engineering departments offering bachelor degree programs have been accredited by NBA. RIT is one of the few institutes with prescribed faculty student ratio and achieves excellent academic results. The institute was a participant of the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. All the departments have competent faculty, with 100% of them being postgraduates or doctorates. Some of the distinguished features of RIT are: State of the art laboratories, individual computing facility to all faculty members. All research departments are active with sponsored projects and more than 304 scholars are pursuing PhD. The Centre for Advanced Training and Continuing Education (CATCE), and Entrepreneurship Development Cell (EDC) have been set up on campus. RIT 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 over 1,35,427 books with subscription to more than 300 International and National Journals. The Digital Library subscribes to several online e-journals like IEEE, JET etc. RIT is a member of DELNET, and AICTE INDEST Consortium. RIT has a modern auditorium, several hi-tech conference halls and all are air-conditioned with video conferencing facilities. It has excellent hostel facilities for boys and girls. RIT Alumni have distinguished themselves by occupying high positions in India and abroad and are in touch with the institute through an active Alumni Association. RIT obtained Academic Autonomy for all its UG and PG programs in the year 2007. As per the National Institutional Ranking Framework, MHRD, Government of India, Ramaiah Institute of Technology has achieved 64th rank in 2019 among the top 100 engineering colleges across India.

About the Department:

Department of Instrumentation Technology was established in the year 1992 and renamed as Electronics and Instrumentation Engineering in the year 2014 by VTU. The department has been accredited by NBA. The synergy of the progressive management, committed faculty, staff, and students are ensuring in excellent academic results year after year. The department is well equipped with modern laboratories and has one of best state of art PLC and SCADA laboratory with Allen Bradley PLCs and SCADA from Schneider Electric. The department has an active MoU with Mitsubishi Electric India Pvt Ltd.

The goal and objective of the department is to prepare the students Industry-ready by aligning **Electronics and Instrumentation Engineering** education program to the current technology and the best practices in the area of **Embedded system, Sensor technology and Industrial Automation** technologies in general and specially for deployment of these technologies in building Industrial Automation Systems with latest advances in **Information, Communication and Networking**.

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

RIT 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 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 2017-21**

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	2	9	14						25
Second	4	9	12						25
Third		4		21					25
Fourth		4		21					25
Fifth				22	4				26
Sixth				15	4		6		25
Seventh	2			10	12				24
Eighth						4	15	6	25
Total	8	26	26	89	20	4	21	6	200

**SCHEME OF TEACHING
V SEMESTER**

Sl. No.	Course Code	Course Name	Category	Credits					Contact Hours
				L	T	P	S	Total	
1.	EI51	DSP based System Design	PC-C	3	1	0	0	4	5
2.	EI52	Object oriented programming with C++ & Data Structures	PC-C	3	1	0	0	4	5
3.	EI53	Industrial Instrumentation – II	PC-C	4	0	0	0	4	4
4.	EI54	Process Control	PC-C	3	0	0	1	4	3
5.	EI55	Scientific Instrumentation	PC-C	3	0	0	0	3	3
6.	EIExx	Department elective	PC-E	3	0	0	1	4	3
7.	EIL56	Control systems Lab	PC-C	0	0	1	0	1	2
8.	EIL57	Industrial Instrumentation – II Lab	PC-C	0	0	1	0	1	2
9.	EIL58	DSP Based System Design Lab	PC-C	0	0	1	0	1	2
Total				19	2	3	2	26	

Elective Code	Elective Title
EIE01	Biomedical Instrumentation
EIE02	Digital Communication Systems
EIE03	Robotics

**SCHEME OF TEACHING
VI SEMESTER**

Sl. No.	Course Code	Course Name	Category	Credits					Contact Hours
				L	T	P	S	Total	
1.	EI61	Advanced Embedded Controllers	PC-C	3	0	0	1	4	3
2.	EI62	Advanced Control Systems	PC-C	3	1	0	0	4	5
3.	EI63	PLC & SCADA	PC-C	3	0	0	1	4	3
4.	EI64	Mini Project	PW	0	0	6	0	6	12
5.	EIExx	Department elective	PC-E	4	0	0	0	4	4
6.	EIL65	Advanced Embedded Controllers Lab	PC-C	0	0	1	0	1	2
7.	EIL66	Advanced Control Systems Lab	PC-C	0	0	1	0	1	2
8.	EIL67	PLC & SCADA Lab	PC-C	0	0	1	0	1	2
Total				13	1	9	2	25	

Elective Code	Elective Title
EIE04	Artificial Neural Networks & Fuzzy Logic
EIE05	Digital Image Processing
EIE06	HDL Programming
EIE34	Internet of Things

V Semester

DSP BASED SYSTEM DESIGN

Course Code: EI51

Credit: 3:1:0:0

Prerequisite: Signal Processing (EI42)

Contact Hours: 42+14

Course Coordinator: Mr. G. Shivaprakash

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, 3rdEdition 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, 20018.

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

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

1. Compute DFT, IDFT and DFT using DIT-FFT algorithm. (PO-1,3,4,5,10, PSO- 1,3)
2. Compute DFT using DIF-FFT, N composite algorithm. 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 TMS320C6713. (PO-1,3,4,5,10, PSO-1,3)
5. Program TMS320C6713 DSK using assembly program. Some basic applications of DSPs. (PO-1,3,4,5,10, PSO-1,3)

OBJECT ORIENTED PROGRAMMING WITH C++ AND DATA STRUCTURES

Course Code: EI52

Credit: 3:1:0:0

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.

Tutorials:

1. Program to demonstrate 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 operators
8. Program to demonstrate the overloading of binary operators.
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 Binary Tree.
15. Program to demonstrate the sorting algorithm and searching algorithm.

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, 3rdEdition 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

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

1. Be proficient in using the basic constructs of C/C++ to develop programs. (PO-1,2,3,4,5,9,10,12, PSO-1,3)
2. Understand and develop programs based on the concepts of class and objects. (PO-1,2,3,4,5,9,10,12, PSO-1,3)
3. Understand and develop programs based on the concepts of operator overloading, pointers and friend functions. (PO-1,2,3,4,5,9,10,12, PSO-1,3)
4. Understand and develop programs based on the concepts of polymorphism and inheritance. (PO-1,2,3,4,5,9,10,12, PSO-1,3)
5. Employ a brief knowledge of various data structures when constructing a program. (PO-1,2,3,4,5,9,10,12, PSO-1,3)

INDUSTRIAL INSTRUMENTATION-II

Course Code: EI53

Credit: 4:0:0:0

Contact Hours: Industrial Instrumentation-I (EI44)

Contact Hours: 56

Course Coordinator: Dr. H. S. Niranjana Murthy

Course Content

Unit I

Theory of Head Type Flow Meters – orifice plate – venturi tube – flow nozzle – dall tube – installation of head flow meters – piping arrangement for different fluids – pitot tube. **Quantity Meters**-Positive displacement flow meters – constructional details and theory of operation of nutating disc, reciprocation piston, oval gear and helix type flow meters.

Unit II

Electrical Type Flow Meter: Principle and constructional details of electromagnetic flow meter – different types of excitation – schemes used – different types of ultrasonic flow meters – laser Doppler anemometer systems – vortex shedding flow meter – target flow meter – solid flow rate measurement – guidelines for selection of flow meter, suitable signal conditioner.

Unit III

Area Flow Meters & Mass Flow Meters: Inferential meter – turbine flow meter – Rota meter – theory and installation – angular momentum mass flow meter – coriolis mass flow meters – thermal mass flow meter – volume flow meter plus density measurement – calibration of flow meters – dynamic weighing method, Suitable signal conditioner.

Unit IV

Level Measurement: Gauge glass technique coupled with photo electric readout system – float type level indication – different schemes – level switches level measurement using displacer and torque tube – bubbler system. Boiler drum level measurement – differential pressure method – hydra step systems – electrical types of level gauges using resistance, capacitance, nuclear radiation and ultrasonic sensors -PH meters, conductivity measurements- Viscosity terms – say bolt viscometer – Rota meter type viscometer -Suitable signal conditioners.

Unit V

Measurement of Humidity and Moisture: Humidity terms – dry and wet bulb psychrometers – hot wire electrode type hygrometer – dew cell – electrolysis type hygrometer – commercial type dew point meter – moisture terms – different methods of moisture measurement – moisture measurement in granular materials, solid penetrable materials like wood, web type material. suitable signal conditioner.

Pollution Monitoring: Air quality monitoring, waste water measurement- Biochemical oxygen demand-chemical oxygen demand- total oxygen demand analyzers.

Text Books

1. E.O.Doeblin, Measurement systems application and design, 4th Edition TMH.
2. D.Patranabis, Principles of Industrial Instrumentation, 2nd Edition, Tata McGraw Hill.
3. John. P. Bentley, Principle of Measurement System, 3rd Edition, Pearson 2007.
4. Bela. G. Liptak, Process Measurement.

Course Outcomes

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

1. Analyze the working of head type flow meters and quantity meters. (PO-1,2,3,4,10,12, PSO-1,3)
2. Analyze the working of electrical type flow meters. (PO-1,2,3,4,10,12, PSO-1,3)
3. Analyze the working of area flow meters and mass flow meters. (PO-1,2,3,4,10,12, PSO-1,3)
4. Understand the function of level measurement techniques and suggest a suitable level measurement device for given application. (PO-1,2,3,4,10,12, PSO-1,3)
5. Understand the operation of humidity, moisture and pollution monitoring transducers and suggest a suitable transducer for a given application. (PO-1,2,3,4,10,12, PSO-1,3)

PROCESS CONTROL

Course Code: EI54

Credit: 3:0:0:1

Prerequisite: Control Systems (EI45)

Contact Hours: 42

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 $\frac{1}{4}$ 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).

Text Books

1. Stephanopoulos, 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

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

1. Model the physical process and study its dynamic behavior. (PO-1,2,4,5,10, PSO-1,3)
2. Analyze and design of digital controller for a given process to be controlled. (PO-1,4, PSO-1)
3. Apply various controller tuning methods for given process to be controlled. (PO-1,4,9, PSO- 1,3)
4. Apply the complex control scheme in controlling the process. (PO 1,4,9, PSO 1,3)
5. Select suitable FCE/ the control valves for a given process. (PO 1,2,4,5,9,10,12, PSO 1,3)

SCIENTIFIC INSTRUMENTATION

Course Code: EI55

Credit: 3:0:0:0

Prerequisite: Engineering Physics (PY12)

Contact Hours: 42

Course Coordinator: Mr. M. D. Nandeesh

Course Content

Unit 1

Visible Ultraviolet Spectrophotometers: Introduction to Chemical Instrumental Analysis, advantages over classical methods, classification, various units used in chemical analysis, Electromagnetic radiation, Beer Lambert law, absorption instruments, colorimeters, spectrophotometers, UV-visible instrument component, photo-colorimeters, single and double beam instruments.

Unit II

Spectrometric Methods: IR spectroscopy: Principle, IR sources, IR detectors, Atomic absorption and Emission Spectroscopy: Principle, types, Flame photometer, DC arc and AC arc excitation, plasma excitation.

Unit III

Separative Methods: Mass Spectrometer (MS): Principle, ionization methods, mass analyzer types - magnetic deflection type, time of flight, quadrupole, double focusing, detectors, Chromatography: Classification, Gas chromatography: principle, constructional details, GC detectors, High Performance Liquid Chromatography (HPLC): principle, constructional details, and detectors.

Unit IV

Principles of Lasers: Emission and absorption of radiation, population inversion, optical feedback, laser modes and classes of lasers-Nd-YAG, ruby, He-Ne laser and argon laser.

Unit V

Application of Lasers: Application in medical fields. Single mode operation, frequency stabilization, mode locking, Q switching, measurement of distance and holography.

Text Books

1. Principles of instrument analysis – Skoog, Holler and Nieman, 4th edition 2006, Thomson publication.
2. Optoelectronics an introduction- J Wilson and J F B Hawkes 2nd edition, Prentice-Hall (2001).

References

1. Instrumental methods of analysis by H. H. Willard, L. L. Merritt & J. A. Dean, CBS Publications Edition 2012.

Course Outcomes

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

1. Acquire knowledge about the widely used spectrometric Instruments. (PO-1,10, PSO-1,3)
2. Understand the working principle of different types of spectrometers. (PO-1,10, PSO-1,3)
3. Apply the concept of spectrometer and chromatography. (PO-1,10,12, PSO-1,3)
4. Understand the principles and working of lasers and its types. (PO-1,12, PSO-1,3)
5. Relate the properties of lasers to their performance and intended applications. (PO-1, 6, 10,12, PSO-1,2,3)

BIOMEDICAL INSTRUMENTATION

Course Code: EIE01

Credit: 3:0:0:1

Prerequisite: Nil

Contact Hours: 42

Course Coordinator: Mrs. K. M. Vanitha

Course Content

Unit I

Bioelectric Signals and Electrodes: Sources of biomedical signals, Basic instrumentation system, General constraints in 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. bedside patient monitoring systems, Central monitors, 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 flow meters, NMR blood flow meters, Laser Doppler blood flow meters, Blood cell counters-Types of blood cell, methods of cell counting, coulter counter.

Unit IV

Cardiac Output, Cardiac Pacemakers and Defibrillators: Indicator dilution method, Dye dilution method, Thermal dilution techniques, Measurement of continuous cardiac output derived from the aortic pressure waveform, Impedance technique. Need for 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, multi element transducer system, X-ray machine, CT scanner, High frequency heat therapy, short wave, microwave diathermy, ultrasonic therapy unit, electro diagnostic therapeutic apparatus, pain relief through electrical stimulation.

Text Books

1. R. S. Khandpur, Handbook of Biomedical Instrumentation, 3rd Edition, 2014, Tata McGraw-Hill.

References

1. Lesely Cromwell & others, Principles of applied biomedical instrumentation, 2nd Edition, John Wiley.
2. J. G. Webster, Encyclopedia of medical devices and instrumentation, John Wiley, 1999.

Course Outcomes

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

1. Understand and analyze the origin of bio-potentials and explain the role of bio-potential electrodes. (PO-1,10, PSO-1,3)
2. Acquire knowledge of biomedical instruments for bio signal acquisitions and patient assist devices for living systems. (PO-1,10, PSO-1,3)
3. Analyze and interpret the signals acquired from biomedical instruments. (PO-1,5,10, PSO-1,3)
4. Judge and identify the patient safety, Environmental, legal and ethical issues related to biomedical instrumentation. (PO-1,6,8,10, PSO-1,2,3)
5. Use technology to help the medical world in the diagnosis and therapy of diseases. (PO-1,10, PSO-1,3)

DIGITAL COMMUNICATION SYSTEMS

Course Code: EIE02

Credit: 3:0:0:1

Prerequisite: Nil

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.
2. 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

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

1. Gain knowledge about the building blocks of digital communication system. (PO-1,2,3,10,12, PSO-1,3)
2. Understand different types of digital modulation and demodulation techniques. (PO-1,2,3,10,12, PSO-1,3)
3. Understand and explain Data Communications System and its components. (PO-1,2,3,10,12, PSO-1,3)
4. Acquire knowledge of modern information technologies for information retrieval & dissemination. (PO-1,2,3,10,12, PSO-1,3)
5. Understand the methods of detecting different types of error correcting codes. (PO-1,2,3,10,12, PSO-1,3)

ROBOTICS

Course Code: EIE03

Credit: 4:0:0:0

Prerequisite: Nil

Contact Hours: 56

Course Coordinator: Mr. M. D. Nandeesh

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-resolver velocity sensors-tachometer and Hall Effect sensor, acceleration and forces sensors-hall effect-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 transformation matrix- DH representation- homogenous transformation for various arm configurations.

Unit IV

Kinematics: Direct and inverse kinematics- forward position analysis - inverse position analysis - Jacobian matrix – acceleration analysis.

Unit V

Motion planning: Joint space planning - Cartesian space planning -Position and Orientation trajectories - Point-to-point Planning - continuous path generation. Collision avoidance algorithms.

Text Books

1. Introduction to Robotics – S K Saha, 2nd Edition 2008, Mc Graw Hill Education Pvt Ltd.
2. Robotics control, sensing vision and Intelligence- K S Fu, R C Gonzalez and C S G Lee- Mc Graw Hill International Edition

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

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

1. Understand the principles and applications of robots. (PO-1, 10,12, PSO-1,3)
2. Analyze the principles of various Sensors and their applications in robots. (PO-1, 12, PSO-1,3)
3. Apply DH parameter and homogenous transforms for robotic applications. (PO-1,2,10, PSO-1,3)
4. Acquire knowledge in kinematic motions of robot. (PO-1,2,3.6, PSO1,2)
5. Emphasize on trajectory and motion planning for robot. (PO-1,2, PSO-1)

CONTROL SYSTEMS LAB

Course Code: EIL56

Credit: 0:0:1:0

Prerequisite: Nil

Contact Hours: 14

Course Coordinator: Mrs. K. M. Vanitha

List of experiments

- 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 first order system.
- 5 Constant gain compensation in time and frequency domain.
- 6 Compensating networks-Characteristics.
- 7 Design of compensation networks.
- 8 Study of PD, PI, PID controller Characteristic.
- 9 Study of dead beat response.
- 10 Microprocessor based servo system.
- 11 Speed control system (open loop and closed loop).
- 12 Real time control of Inverted pendulum (Demo experiment).
- 13 Real time control of Gyroscope (Demo experiment).
- 14 Process curve tuning using oscillatory and damped method.

Course Outcomes

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

1. Understand and analyze dynamic behavior of 1st and 2nd order system in time and frequency domain using simulation tool. (PO-1,2,5,10, PSO-1,3)
2. Design a compensation network. (PO-1,2,10, PSO-1,3)
3. Design and tune controllers. (PO-1,2,3,10, PSO-1,3)

INDUSTRIAL INSTRUMENTATION-II LAB

Course Code: EIL57

Credit: 0:0:1:0

Prerequisite: Nil

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 Humidity.
- 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 of different PH.
- 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

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

1. Understand measurement of flow using Orifice and Venturi tube. (PO-1,2,3,4,10, PSO-1,3)
2. Verify Bernoulli's theorem and measure the Reynold's number of fluid flow. (PO-1,2,3,4,10, PSO-1,3)
3. Understand measurement of viscosity, pH and conductivity. (PO-1,2,3,4,10, PSO-1,3)
4. Understand measurement of humidity and moisture. (PO-1,2,3,4,10, PSO-1,3)
5. Understand and analyze the flow valve characteristics, level and flow measurement and control in multi process control system. (PO-1,2,3,4,10, PSO-1,3)

DSP BASED SYSTEM DESIGN LAB

Course Code: EIL58

Credit: 0:0:1:0

Prerequisite: Nil

Contact Hours: 14

Course Coordinator: Mr. 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

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

1. Code in C and SCILAB to compute convolution, correlation, FFT, and spectrum. (PO-1,2,5,9,10, PSO-1,3)
2. Implement IIR and FIR digital filters to meet given performance specifications. (PO-1,2,3,5,9,10, PSO-1,3)
3. Write a SCILAB program for signal generation and manipulation and implement real time DSP algorithms like echo and wave generation. (PO-1,2,5,9,10, PSO-1,3)

VI- Semester

ADVANCED EMBEDDED CONTROLLERS

Course Code: EI61

Credit: 3:0:0:1

Prerequisite: Embedded Controllers (EI43)

Contact Hours: 42

Course Coordinator: Ms. Elavaar Kuzhali .S

Course Content

Unit I

ARM Embedded Systems: The RISC design philosophy, The ARM design philosophy, embedded system hardware, embedded system software, ARM Architecture. **ARM Processor Fundamentals:** Registers, current program status register, pipeline, exceptions, interrupts and vector table, core extensions. **Introduction to ARM Instruction Set:** Data Processing Instructions, Branch Instructions.

Unit II

Introduction to ARM Instruction Set: Load Store Instructions, Software Interrupt Instruction, Program Status Register Instructions, Loading Constants, and Conditional Execution. **Introduction to the THUMB Instruction set:** Thumb register Usage, ARM-Thumb Interworking, other branch instructions, Data Processing Instructions, Single register Load –store Instructions, Multiple register Load Store Instructions, Stack Instructions, and Software Interrupt Instruction, Introduction to Embedded C.

Unit III

Interrupts & Exception Handling: Exception Handling, Interrupts, Interrupt handling schemes (till reentrant handling scheme). **LPC 2148-** Design of system using GPIO's (LCD interface, 4 x 4 Keypad), Timers.

Unit IV

LPC 2148- ADC, DAC, UART, SPI. **Embedded / Real – Time operating system Concepts:** Architecture of the Kernel, Tasks & Task Scheduler, Interrupt service Routine, Semaphores, and Mutex.

Unit V

Embedded / Real – Time Operating System Concepts –Mailboxes, Message Queues, Event Registers, Pipes, Signals, Timers, Memory Management, Multithreading and Priority Inversion Problem. **RTOS Programming:** Task Creation & Deletion, multiple tasks creation, synchronization with task, Task scheduling, mutex, semaphores, message queues - Pipes – Porting RTOS on microcontroller based development board.

Text Books

1. Andrew N.Sloss, ARM system Developers Guide, Elsevier, 2008
2. K.V.K.K.Prasad, Embedded Real-Time Systems: Concepts, Design & Programming, Dreamtech press, 2005.
3. Jean J Labrose, MicroC/OS – II the Real Time KERNEL, CMP Books second edition.

Course Outcomes

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

1. Analyze ARM design philosophy, design rules and describe the functions of ARM embedded hardware and software components. (PO-1, 5, PSO-1)
2. Write programs using ARM / THUMB instruction set. (PO-1,2,3,4,5,9,10,12, PSO-1,3)
3. Analyze the various ways of handling exceptions and interrupts in ARM processor. (PO-1,2,3,4,5,9,10,12, PSO-1,3)
4. Develop embedded C programs to interact with various built in peripherals (GPIO's, DAC, ADC, Timer/Counter, and UART) of ARM7 LPC 2418. (PO-1,2,3,4,5,9,10,12, PSO-1,3)
5. Port and write programs using RTOS (μ C/OS-II) on ARM based development boards. (PO-1,2,3,4,5,9,10,12, PSO-1,3)

ADVANCED CONTROL SYSTEMS

Course Code: EI62

Credit: 3:1:0:0

Prerequisite: Control Systems (EI45)

Contact Hours: 42 + 14

Course Coordinator: Mr. Ovhal Ajay Ashok

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 invariant 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

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

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)

PLC AND SCADA

Course Code: EI63

Credit: 3:0:0:1

Prerequisite: Nil

Contact Hours: 42

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, Power supply module, Processor module, Logical sensors-logical actuators- PLC operation.

Unit II

Introduction to Programming and logic: PLC programming-IEC 1131-3 programming standards, Conventional ladder vs. PLC ladder. Series and parallel functions of OR, AND, NOT, XOR logics, analysis of rungs, the basic relay instruction, Normally Open & Normally Close instructions, output latching & unlatching instructions, FBD programming, interface programs.

Unit III

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

Unit IV

Introduction to SCADA: Fundamental principles of modern SCADA systems – SCADA hardware – SCADA software – Modem use in SCADA systems- DCS concepts as LAN of PLC's, Comparison of the terms SCADA, DCS, PLC and smart instrument – SCADA system – benefits of SCADA system – Remote terminal units, PLCs used as RTUs – The SCADA software package, Redundancy, System response time, Expandability of the system – twelve 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.

Reference Books

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

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

1. Acquire the knowledge on basic architecture of PLC, SCADA and DCS. (PO-1,10, PSO-1,3)
2. Perform the programming for PLC and SCADA. (PO-1,2,3,5,10, PSO-1,3)
3. Design a process automation system for real time situations. (PO-1,2,3,4,5,7,9,10,12, PSO-1,2,3)
4. Acquire the knowledge on basics of communication protocols used for Automation systems. (PO-1,8,12, PSO-1,3)
5. Understand the typical layout of a control room and maintenance of the system. (PO-1,7, PSO-1,2)

MINI PROJECT

Course Code: EI64

Credit: 0:0:6:0

Prerequisite: Nil

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.

Subject	No. of Hours/ Week		Duration of exam	Marks		Total marks	Credits
	Lecture	Practical/Field work		IA	Exam		
Mini-project (EI64)	-	12	3 hours	50	50	100	0:0:6:0

Course Outcomes

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

1. Write a literature survey focusing on the chosen problem domain. (PO: 1,2,3,4, PSO:1)
2. Analyze, design and implement identified problem using suitable 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. Solve social, industrial, research problems. (POs –4,5,11,12, PSO: 1,2,3)
5. Develop a research/development mindset and engage in continuous learning. (POs –5,6,10,11,12, PSO: 1,2,3)

ARTIFICIAL NEURAL NETWORKS & FUZZY LOGIC

Course Code: EIE04

Credit: 4:0:0:0

Prerequisite: Control Systems (EI45)

Contact Hours: 56

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

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

1. Differentiate between Biological Neural Network and Artificial Neural Network (ANN) and acquire knowledge about the 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 an ANN technique for different applications. (PO-3,4,9, PSO-1,3)
4. Solve 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)

DIGITAL IMAGE PROCESSING

Course Code: EIE05

Credit: 3:1:0:0

Prerequisite: Signal Processing (EI42)

Contact Hours: 42+14

Course Coordinator: Dr. Jyothirmayi .M

Course Content

Unit I

Digital Image Fundamentals And Transforms: Digital image fundamentals: representation - elements of visual perception - simple image formation model - Image sampling and quantization - basic relationships between pixels - imaging geometry. Review of matrix theory results: Row and column ordering - Toeplitz, Circulant and Block matrices. Review of Image transforms: 2D-DFT, FFT, Walsh, Hadamard, Haar, DCT.

Unit II

Image Enhancement Techniques: Image enhancement: Spatial domain methods: point processing - intensity transformations, histogram processing, image subtraction, image averaging; Spatial filtering- smoothing filters, sharpening filters. Frequency domain methods: low pass filtering, high pass filtering, homomorphic filtering. Generation of spatial masks from frequency domain specifications.

Unit III

Image Restoration: A model of the image degradation/restoration process, noise models, restoration in the presence of noise—only spatial filtering, Wiener filtering, constrained least squares filtering, geometric transforms, Estimating the degradation function. Fundamentals of Colour image processing: colour models - RGB, CMY, YIQ, HIS - Pseudo color image processing - intensity slicing, gray level to color transformation.

Unit IV

Image Compression: Fundamentals, image compression models, error-free compression, lossy predictive coding, image compression standards- Fundamentals of JPEG, MPEG, Fractals.

Unit V

Image Segmentation And Representation: Image segmentation: Detection of discontinuities - point, line and edge and combined detection; Edge linking and boundary description - local and global processing using Hough transform Thresholding - Region oriented segmentation - basic formulation, region growing by pixel aggregation, region splitting and merging.

Lab Practice using MATLAB will be considered only for internals.

Text Books

1. Rafael C Gonzalez, Richard E Woods 2nd Edn, Digital Image Processing - Pearson Education, 2000.
2. RafealC.Gonzalez, Richard E.Woods, Steven,Digital Image Processing using Matlab,TMH.

References

1. A.K..Jain,Fundamentals of Digital Image Processing.PHI, New Delhi.
2. Image Processing Analysis and Machine Vision – MillmanSonka, Vaclav hlavac, Roger Boyle, Broos/colic, Thompson Learniy, 1999.
3. William K Pratt, Digital Image Processing John Willey, 2001..

Course Outcomes

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

1. Understand and implement fundamentals and transform domain representations for digital images. (PO-1,2,3,5,10, PSO-1,3)
2. Examine and implement image enhancement techniques in frequency and spatial domain. (PO-1,2,3,5,10, PSO-1,3)
3. Implement and evaluate the methodologies for image restoration and understand the principles of color models. (PO-1,2,3,5,10, PSO-1,3)
4. Understand the principles of image compression techniques for general images. (PO-1,2,3,5,10, PSO-1,3)
5. Understand and analyze segmentation algorithms for digital images. (PO-1,2,3,5,10, PSO-1,3)

HDL PROGRAMMING

Course Code: EIE06

Credit: 3:0:1:0

Prerequisite: Nil

Contact Hours: 42+14

Course Coordinators: Ms. J. V. Alamelu and Dr. Jyothirmayi .M

Course Content

Unit I

Overview of Digital Design with Verilog HDL: Evolution of Computer aided digital design – Emergence of HDLs – Typical design flow – Importance of HDLs – Verilog HDLs Design Methodologies – modules: Modules – Ports – Rules – Hierarchical Names – Instances – components of simulation – example – basic concepts – Behavioral modeling.

Unit II

Behavioral modeling: Structured procedures – Procedural assignments – Timing Controls – conditional statement – Multiway branching - Loops – Sequential and parallel blocks - Difference between Tasks and Functions – Tasks – Functions – Automatic Functions – Constant Functions – Signed Functions, (Examples with sequential and combinational circuits BCD-7 segment, parity codes with real time examples.).

Unit III

Gate Level Modeling: Gate Types – Gate Delays – Examples - Continuous assignments – Delays – Expressions, Operators, Operands – Operator Types – Examples – test benches – Generate blocks – Examples (sequential and combinational circuits with real time examples).

Unit IV

Logic Synthesis with Verilog HDL: Logic Synthesis – Verilog HDL Synthesis – Interpretation of Verilog Constructs – Synthesis Design Flow – examples – Verification of the Gate Level Netlist – Modeling tips for logic synthesis – Example of sequential circuit synthesis - Types of Delay models – modeling – Timing Checks – Delay back annotation.

Unit V

Design Examples: FSM – Moore FSM and Mealy FSM - Multiplier – state transition diagram - test bench and Verilog code – Design of SRAM – basic microprocessor architecture - Design of Vending machine – Traffic signal controller.

Lab programs

For all the programs the testbench is mandatory

- 1 BCD-7 segment display.
- 2 Parity detection.
- 3 Gray code and binary code conversions.
- 4 Ripple carry counter.
- 5 Comparator.
- 6 Multiplexers.
- 7 Gate level modeling with different delays (Ripple carry adder).
- 8 Examples with task (Shift registers).
- 9 Examples with functions (Arithmetic logic unit).
- 10 Vending machine.
- 11 Traffic signal controller.

Text Books

1. “Digital Design An Embedded Systems Approach Using Verilog”, Peter J Ashenden, Elsevier.
2. “Verilog HDL – A Guide to Digital Design and synthesis” – Samir Palnitkar, Second edition Pearson Education.
3. “HDL Programming VHDL and Verilog”, Nazeih M Botros, Dreamtech press 2006.

References

1. “Fundamentals of Digital Logic with Verilog Design” – Stephen Brown, Zvonko Vranesic, TMH.

Course Outcomes

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

1. Understand the basics of digital design and lexical conventions of HDL.(PO-1,2,3,10, PSO-1,3)
2. Design, apply and test combinational circuits in HDL to verify the functionality. (PO-1,2,3,5,10, PSO-1,3)
3. Write efficient RTL codes for sequential circuits and test using test benches. (PO-1,2,3,5,10, PSO-1,3)
4. Apply the concepts of tasks and functions in designing large digital systems. (PO-1,2,3,5,10, PSO-1,3)
5. Justify the usage of EDA tools in digital circuit functional verification and logic synthesis with design tradeoffs. (PO-1,2,3,5,10, PSO-1,3)

INTERNET OF THINGS

Course Code: EIE34

Credit: 3:1:0:0

Prerequisite: Nil

Contact Hours: 42+14

Course Coordinator: Ms. Elavaar Kuzhali .S

Course Content

Unit I

Introduction & concepts: Definition and Characteristics of IoT, Things in IoT, IoT Protocols, IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies, IoT Levels and Deployment Templates IoT and M2M, SDN and NFV for IoT, IoT System Management.

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, Linux on Raspberry Pi, Raspberry Pi Interfaces: Serial, SPI, I2C **Programming Raspberry Pi with Python:** Controlling LED, Interfacing Switch, Interfacing Light Sensor, Client-Server Application

Unit IV

Cloud and Data Analytics: Introduction to cloud storage Models and Communication APIs, MQTT protocol, CoAP protocol, IP based WPAN and WLAN, Routers & Gateways, Sensor Cloud, Python Web Application Framework –Django/Flask, Web Services for IoT, SkyNet Messaging Platform. **Data Analytics for IoT:** Apache, Hadoop, Oozie, Storm, Real-Time Data Analysis, Tools for IoT, IoT Security

Unit V

IoT Case Studies: Home Automation: Smart Lighting, Home Intrusion Detection; Cities: Smart Parking Environment: Weather Monitoring System, Weather Reporting Bot, Air Pollution Monitoring, Forest Fire Detection; Agriculture – Smart Irrigation, IoT Printer

Lab programs

1. Python Programming with Raspberry Pi.
2. Exploring the different components of Raspberry pi, Setting up of the board and booting the board.
3. Implement a Python program for blinking an LED to a Raspberry Pi platform and make suitable assumptions. Implement a Python program for interfacing an LED and a Switch to a Raspberry Pi platform.
4. Implement a Python program for switching light based on LDR reading in Raspberry Pi platform make suitable assumptions.
5. Implement a Python program for sending an eMail when a switch which is connected to a Raspberry Pi platform is pressed. Make suitable assumptions.
6. 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.
7. Write a Python program for implementing a temperature dependent auto cooling system using a Raspberry Pi platform.
8. 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.
9. Write a program to communicate information from cloud to node.
10. Write a Python program to Detect the intruder when there is no surrounding lighting using Raspberry Pi.
11. 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.
12. Mobile APP development for IOT

Text Book

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

References

1. Perry Lea ,”Internet of Things for Architects: Architecting IoT Solutions by Implementing Sensors, Communication Infrastructure, Edge Computing, Analytics, and Security” Packt publishing Ltd, 2018.
2. Jeeva Jose,” Internet of Things”, Khanna Publishing House, 2018.
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.
5. [http://www.internet-of-things-research.eu/pdf/IERC_Cluster_Book_2014_Ch.3_SRIA_WEB . pdf](http://www.internet-of-things-research.eu/pdf/IERC_Cluster_Book_2014_Ch.3_SRIA_WEB.pdf).

Course Outcomes

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

1. Understand and analyze the Architectural Overview of IoT and its characteristics (PO-1,2,3,5,9,10,12, PSO-1,3)
2. Write python programs using Raspberry Pi for some IoT based prototypes (PO-1,2,3,4,5,9,10,12, PSO-1,3)
3. Understand and analyze the role of IoT data analytics and Tools. (PO-1,2,3,4,5,9,10,12, PSO-1,3)
4. Illustrate the application of IoT and identify Real World Design Constraints. (PO-1,2,3,4,5,6,7,9,10,12, PSO-1, 3)

ADVANCED EMBEDDED CONTROLLERS LAB

Course Code: EIL65

Credit: 0:0:1:0

Prerequisite: Nil

Contact Hours: 14

Course Coordinator: Ms. Elavaar Kuzhali .S

List of experiments**Part A: Assembly language programs:**

- 1
 - i) Swap two numbers without using an intermediate register.
 - ii) To find the factorial of a given number.
 - iii) Convert word of little endian format to big endian format.
- 2 Generate 12 bit Hamming code from a given 8 bit code.
- 3
 - i) Move a string from given memory location to another location.
 - ii) To Add N numbers of data stored consecutively in memory location.
 - iii) Translate the given C code to assembly,
for (i=0;i<8;i++){a[i]=b[7-i];}
- 4
 - i) Move a block of data from memory location to another location using LOAD multiple and STORE multiple instructions.
 - ii) Exchange a block of data between memory locations.
- 5
 - i) Arrange a given set of data in ascending order.
 - ii) Arrange a given set of data in descending order.
- 6
 - i) Implement subroutine nesting using stack.
 - ii) To implement ARM –THUMB interworking to find the smallest.
 - iii) To handle swi instruction in the program.

Part B: C Programs

- 7 To familiarize I/O ports of LPC 2148 - on/off control of LEDs using switches.
- 8 To display a given string using the LCD display interface.
- 9 Interface key pad and to display the key pressed on LCD.
- 10 Waveform generation using the internal DAC of LPC 2148.
- 11 To convert a given analog voltage to digital using ADC of LPC 2148.
- 12 Using timers to generate a specified delay.
- 13 Using timer/counter/capture module of LPC 2148 to count the number of pulses and display on LCD.
- 14 Use of UART of LPC 2148 for transmitting and receiving data.
- 15 Porting of RTOS on microcontroller based development board.
- 16 Task Creation & Deletion, Task Information details.
- 17 Task Scheduling, Multithreading.

Course Outcomes

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

1. Design, implement, and debug ARM/THUMB assembly level programs using Keil software. (PO-1,2,3,4,5,9,10,12, PSO-1,3)
2. Design, develop, and debug embedded C programs to interact with various built in and external peripherals of ARM7 LPC2418 kit. (PO-1,2,3,4,5,9,10,12, PSO-1,3)
3. Port and write basic programs using RTOS (μ C/OS-II) on ARM based development boards. (PO-1,2,3,4,5,9,10,12, PSO-1,3)

ADVANCED CONTROL SYSTEMS LAB

Course Code: EIL66

Credit: 0:0:1:0

Prerequisite: Nil

Contact Hours: 14

Course Coordinator: Mr. Ovhal Ajay Ashok

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 meter

Course Outcomes

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

1. Analysis response of the system using state variable method. (PO-2,3,4,5,9,10, PSO-1,3)
2. Design state observer. (PO2,3,4,5,9,10, PSO-1,3)
3. Analyze stability of system using DF method. (PO-2,3,4,5,9,10, PSO-1,3)
4. Analyze stability of nonlinear system using Lypunov method. (PO-2,3,4,5,9,10, PSO-1,3)
5. Design / analysis of optimal control and adaptive control system. (PO-2,3,4,5,9,10, PSO-1,3)

PLC AND SCADA LAB

Course Code: EIL67

Credit: 0:0:1:0

Prerequisite: Nil

Contact Hours: 14

Course Coordinator: Ms. Vibha B. Raj and Ms. J. V. Alamelu

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 pick & place process using SIMBOX.
- 6 Introduction to Mitsubishi Software development environment, implementation of Basic Boolean functions.
- 7 PLC ladder logic programming to control the elevator using RS Logix and GX Works.
- 8 PLC ladder logic programming to control the bottle filling process using RS Logix and GX Works.
- 9 PLC ladder logic programming to control the coffee vending machine process.
- 10 Configuring SCADA for I/O acquisition.
- 11 Ladder logic programming to control simple ON-OFF process using SCADA.
- 12 Ladder logic programming to control water level in overhead tank using SCADA.
- 13 Program a switch and dimming control of home automation using Schneider Electric PLC (Demo)
- 14 Develop logic to implement heater control for change in humidity in building management system using Schneider Electric PLC (Demo)

Course Outcomes

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

1. Perform PLC programming using Rockwell Automation Software and Mitsubishi Software. (PO-1,3,5,10,12, PSO-1,3)
2. Perform SCADA programming using the software Clear SCADA. (PO-1,3,5,10,12, PSO-1,3)
3. Design and implement a prototype simulation plant process. (PO-1,2,3,4,5,7,9,10,11,12, PSO-1,2,3)