RAMAIAH
Institute of Technology

CURRICULUM

for the Academic year 2021 – 2022

ELECTRONICS AND INSTRUMENTATION ENGINEERING

III & IV 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 2020-24

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	11						**22**
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							12	3	**15**
Total	**10**	**25**	**21**	**78**	**15**	**6**	**16**	**4**	**175**

SCHEME OF TEACHING
III SEMESTER

Sl. No.	Course Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1.	EI31	Engineering Mathematics III	BS	3	1	0	4	5
2.	EI32	Analog Electronic Circuits	PC-C	4	0	0	4	4
3.	EI33	Linear Networks	PC-C	3	1	0	4	5
4.	EI34	Digital System Design	PC-C	4	0	0	4	4
5.	EI35	Electronic Measurements	PC-C	3	0	0	3	3
6.	EI36	Industrial Instrumentation	PC-C	4	0	0	4	4
7.	EIL37	Analog Electronic Circuits Lab	PC-C	0	0	1	1	2
8.	EIL38	Digital System Design Lab	PC-C	0	0	1	1	2
Total				**21**	**2**	**2**	**25**	

Note:

1. **The Non Credit Mandatory Course, Additional Mathematics – I** is prescribed for III Semester Lateral Entry Diploma students admitted to III Semester of BE Program. The student shall register for this course along with other III semester courses. The students shall attend classes for the course during the semester and complete all formalities of attendance and CIE to appear for SEE. This Course shall not be considered for vertical progression, but completion of the course shall be mandatory for the award of the degree.

l. No.	Course Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1	AM31	Additional Mathematics - I	BSC	0	0	0	0	3

2. **AICTE Activity Points to be earned by students admitted to BE program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines):**
Every regular student, who is admitted to the 4-year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. Students entering 4 years Degree Program through lateral entry are required to earn 75 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students 8th Semester grade card. The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled. Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. Incase student fail to earn the prescribed activity points; eight semester Grade Card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the Eight Semester grade card.

SCHEME OF TEACHING
IV SEMESTER

Sl. No.	Course Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1.	EI41	Engineering Mathematics IV	BS	3	1	0	4	5
2.	EI42	Signal Processing	PC-C	2	1	0	3	4
3.	EI43	Embedded Controllers	PC-C	4	0	0	4	4
4.	EI44	Process Instrumentation	PC-C	4	0	0	4	4
5.	EI45	Control Systems	PC-C	3	1	0	4	5
6.	EI46	Analytical Instrumentation	PC-C	4	0	0	4	4
7.	EIL47	Embedded Controllers Lab	PC-C	0	0	1	1	2
8.	EIL48	Industrial Instrumentation Lab	PC-C	0	0	1	1	2
			Total	**20**	**3**	**2**	**25**	

Note:

1. **The Non Credit Mandatory Course, Additional Mathematics – II** is prescribed for IV Semester Lateral Entry Diploma students admitted to BE Program. The student shall register for this course along with other IV semester courses. The students shall attend classes for the course during the semester and complete all formalities of attendance and CIE to appear for SEE. This Course shall not be considered for vertical progression, but completion of the course shall be mandatory for the award of the degree.

No.	Course Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1	AM41	Additional Mathematics - II	BSC	0	0	0	0	3

2. **AICTE Activity Points to be earned by students admitted to BE program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines):**
Every regular student, who is admitted to the 4-year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. Students entering 4 years Degree Program through lateral entry are required to earn 75 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students 8th Semester grade card. The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled. Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. Incase student fail to earn the prescribed activity points; eight semester Grade Card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the Eight Semester grade card.

III Semester

ENGINEERING MATHEMATICS - III

Course Code: EI31 **Credit: 3:1:0**
Prerequisite: Knowledge of Calculus **Contact Hours: 42+14**
Course Coordinators: Dr. M.V. Govindaraju & Dr. M. Girinath Reddy

Course Content

Unit I

Numerical solution of Algebraic and Transcendental equations: Method of false position, Newton - Raphson method.
Numerical solution of Ordinary differential equations: Taylor's series method, Euler's and modified Euler's method, fourth order Runge-Kutta method.
Statistics: Curve fitting by the method of least squares, fitting linear, quadratic and geometric curves. Correlation and Regression. Applications to Engineering problems.

Unit II

Linear Algebra: Elementary transformations on a matrix, Echelon form of a matrix, rank of a matrix, Consistency of system of linear equations, Gauss elimination and Gauss – Seidel method to solve system of linear equations, Eigenvalues and Eigenvectors of a matrix, Rayleigh power method to determine the dominant Eigen value of a matrix, Diagonalization of square matrices, Solution of system of ODEs using matrix method. Applications to Engineering problems.

Unit III

Complex Variables-I: Functions of complex variables, Analytic function, Cauchy-Riemann equations in Cartesian and polar coordinates, Consequences of Cauchy-Riemann equations, Construction of analytic functions.
Transformations: Conformal transformation, Discussion of the transformations - $w = z^2, w = e^z$ and $w = z + \frac{a^2}{z}$ $(z \neq 0)$, Bilinear transformation.

Unit IV

Complex Variables-II: Complex integration, Cauchy theorem, Cauchy integral formula, Taylor and Laurent series (statements only), Singularities, Poles and residues, Cauchy residue theorem.

Unit V

Fourier Series: Convergence and divergence of infinite series of positive terms, Periodic function, Dirichlet's conditions, Fourier series of periodic functions of period 2π and arbitrary period. Half range Fourier series. Applications to Engineering problems: Fourier series for Periodic square wave, Half wave rectifier, Full wave rectifier, Saw-tooth wave with graphical representation, Practical harmonic analysis.

Text Books

1. Erwin Kreyszig –Advanced Engineering Mathematics – Wiley publication – 10^{th} edition-2015.
2. B. S. Grewal – Higher Engineering Mathematics – Khanna Publishers – 44^{th} edition – 2017.

Reference Books

1. Glyn James – Advanced Modern Engineering Mathematics – Pearson Education – 4^{th} edition – 2010.
2. Dennis G. Zill, Michael R. Cullen - Advanced Engineering Mathematics, Jones and Barlett Publishers Inc. – 3^{rd}edition – 2009.
3. Dennis G. Zill and Patric D. Shanahan- A first course in complex analysis with applications- Jones and Bartlett publishers-second edition-2009.

Course Outcomes (COs):

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

1. Apply numerical techniques to solve Engineering problems and fit a least squares curve to the given data. **(PO-1,2 & PSO-1,3)**
2. Test the system of linear equations for consistency and solve system of ODE's using matrix method. **(PO-1,2 & PSO-1,3)**
3. Examine and construct the analytic functions. **(PO-1,2 & PSO-1,3)**
4. Classify singularities of complex functions and evaluate complex integrals. **(PO-1,2 & PSO-1,3)**
5. Construct the Fourier series expansion of a function/tabulated data. **(PO-1,2 & PSO-1,3)**

ANALOG ELECTRONIC CIRCUITS

Course Code: EI32 **Credit: 4:0:0**
Prerequisite: Basic Electronics (EC15) **Contact Hours: 56**
Course Coordinators: Dr. Pushpa M. K.

Course Content

Unit I

Field Effect Transistor: Construction, working principle and characteristics of JFET, Comparison of JFET and BJT, Biasing of JFET, JFET small signal model, Analysis of FET Common source, Common drain and Common gate amplifier. Basic Differential amplifier circuit using BJT. Introduction to Simulation using Multisim simulator.

Unit II

OP-amp and its Parameters: Block diagram of Opamp, Characteristics of ideal OPAMP, Open loop and closed loop configurations, Opamp Parameters- input offset voltage, output offset voltage, input offset current, input bias current, Differential input resistance, input capacitance, input voltage range, Offset voltage adjustment, large signal voltage gain, CMRR, PSRR, output voltage swing, output resistance, output short circuit protection, Transient response, slew rate, Gain-Bandwidth product.
Op-amp Applications: Differential amplifiers- one opamp, two opamp, Instrumentation amplifiers, Instrumentation amplifier using transducer bridge, V to I converters, constant current sources, Comparators, Schmitt triggers, square wave generator.

Unit III

Active Filters using Op-amps: Comparison of Active & Passive filters, I and II order Butterworth Low Pass Filter, High Pass Filter, Band Pass Filter and Band Elimination Filter.
Oscillators: Principles of Oscillators, Wien Bridge, RC phase shift oscillator, Colpitts oscillator using transistor, Hartley oscillator using transistor, Crystal oscillators.

Unit IV

555 Timer and Applications: Functional block diagram, Monoshot multivibrator and applications, Astable multivibrator and applications. Voltage to Frequency and Frequency to voltage converter.
PLL (565 PLL): Basic principle, Phase detectors, Integrated circuit PLL, applications of PLL.

Unit V

Voltage Regulators: Need for Voltage regulators, Block diagram of a linear regulator, Classification of regulators- Series Regulator, Shunt Regulator. IC voltage regulators - 78XX, 79XX, IC regulator used as a current source, Fixed IC regulator used as adjustable regulator, General purpose regulator IC723- Pin details, Low voltage and High voltage regulators. Current limit protection, Current foldback, Current boosting, Introduction to Switching mode regulator, RLC type switching regulator

Text Books:

1. Ramakanth A Gayakwad, Opamps and Linear Integrated Circuits,4th Edition, PHI.
2. Robert L Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, 9th Edition, PHI, 2006.

Reference Books:

1. MILLMAN - HALKIAS, Integrated Electronics, 33rd reprint TMH 1991.
2. Sergio Franco, Design with operational amplifiers and analog integrated circuits, 4th edition, Tata McGraw Hill.

Course Outcomes (COs):

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

1. Design amplifiers. **(PO-1,2,3,4, PSO-1)**
2. Analyze various signal conditioning circuits. **(PO-1,2,3,4, PSO-1)**
3. Design filters and oscillators. **(PO-1,2,3,4, PSO-1)**
4. Understand the operation of 555 Timers and PLL. **(PO-1,2,3,4, PSO-1)**
5. Describe the operation and design of voltage regulators. **(PO-1,2,3,4, PSO-1)**

LINEAR NETWORKS

Course Code: EI33 **Credit: 3:1:0**
Prerequisite: Basic Electrical Engineering (EE25) **Contact Hours: 42+14**
Course Coordinators: Mrs. K M Vanitha

Course Content

Unit I

Passive Networks: V-I characteristics of idealized elements of networks, Sources: Independent (Ideal & practical), Dependent sources, Basic Laws (including Source transformation), Loop Analysis & Nodal Analysis with linearly dependent & independent sources for DC & AC networks (Concept of Supermesh & Supernode), Star-Delta transformation, Duality in electrical networks.

Unit II

Network Theorems: Superposition Theorem, Thevenin's & Norton's theorem, Maximum Power transfer theorem, Reciprocity & Millman's theorem, Resistance measurement.

Unit III

Transient Behavior and Initial Conditions: Behavior of circuit elements under switching condition & their representation, Evaluation of initial and final conditions in RL, RC and RLC circuits for DC & AC Excitation. **Resonant Circuits:** Series & Parallel resonance, Frequency response of Series & Parallel circuits, Radio Receiver, Touch tone telephone.

Unit IV

One Port Networks: Review of Laplace transforms, Initial & final value theorem, convolution theorem, Periodic & Aperiodic waveforms, Time response of One-Port passive networks, Frequency domain behavior, Network stability.

Unit V

Two Port Networks: Definition of Z, Y, h & T parameters, modeling with these parameters, Relationships between 2 port network parameters, Interconnection of 2 port networks, Transistor circuits.

Tutorials list:

1. Numerical on Source transformation, Star- Delta transformation and Duality
2. Numerical on Loop analysis with linearly dependent & independent sources for DC and AC networks
3. Numerical on Node analysis with linearly dependent & independent sources for DC and AC networks
4. Numerical on Superposition theorem
5. Numerical on Thevenin's & Norton's theorem
6. Numerical on Maximum Power transfer theorem
7. Numerical on Reciprocity & Millman's theorem
8. Numerical on initial and final conditions in RL, RC and RLC circuits for DC & AC Excitation
9. Numerical on Series, Parallel resonance
10. Numerical on initial and final value theorem, convolution theorem
11. Numerical on Periodic & Aperiodic waveforms
12. Numerical on Periodic & Aperiodic waveforms
13. Numerical on two port network
14. Numerical on two port network

Text Books

1. N.O. Sadiku, Charles K. Alexander & Matthew, Fundamentals of Electric Circuits, 4thEdition, TMH publishers, 2013.
2. Hayt, Kemmerley and Durbin, Engineering Circuit Analysis, TMH 8th Edition, 2015.

References

1. David K. Cheng, Analysis of Linear Systems, Narosa Publishing House, 11th reprint, 2002
2. Bruce Carlson, Circuits, Thomson Learning, 2000. reprint 2002
3. M.E. Van Valkenburg, Network analysis, PHI/Pearson Education, 3rd Edition, reprint 2002.

Course Outcomes (COs):

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

1. Apply basic electrical laws and reduction techniques to linear circuits. **(PO-1,2; PSO-1,3)**
2. Apply network theorems to simplify electric circuits. **(PO-1,2; PSO-1,3)**
3. Analyse transient behaviour of electric circuits and resonance conditions. **(PO-1,2; PSO-1,3)**
4. Use Laplace transform to analyse electric circuits. **(PO-1,2; PSO-1,3)**
5. Evaluate two port network parameters. **(PO-1,2; PSO-1,3)**

DIGITAL SYSTEM DESIGN

Course Code: EI34 **Credit: 4:0:0**
Prerequisite: Basic Electronics (EC15) **Contact Hours: 56**
Course Coordinators: Dr. M. Jyothirmayi

Course Content

Unit I

Introduction to Different Logic Families: Electrical characteristics of logic gates – logic levels and noise margins, fan-out, propagation delay, transition time, power consumption and power-delay product. TTL inverter - circuit description and operation, TTL NAND - circuit description and operation, Open collector TTL and Tristate TTL, MOS NAND and NOR Circuits: circuit description and operation, CMOS inverter - circuit description and operation, CMOS NAND and NOR - circuit description and operation. **Combination Logic:** Review of K-maps (up to 4 variables), Map entered variables. **Introduction to Verilog:** Structure of Verilog module, Operators, data types, Styles of description- Data flow description, Behavioral description.

Unit II

Combinational Functions: Arithmetic Operations Adders: parallel adders, serial, Fast adders, and Subtractor: - using 1's and 2's compliment, Comparators – 2 bit and four bit, two bit Multiplier, Verilog Description for above circuits. **Multiplexers**-Realization of 2:1, 4:1 and 8:1 using gates & Applications. **Demultiplexers**: - Realization of 1:2, 1:4 and 1:8 using basic gates & Applications, Verilog description of Multiplexers and Demultiplexers.

Unit III

Encoding and Decoding Circuits: Binary coded decimal codes, BCD – Gray vice versa, BCD – Excess 3; Encoders: Realization and Priority Encoders, Decoders: BCD – Decimal, BCD – Seven segment, Seven segment display. Programmable Logic Devices: PLA, PAL Verilog description of Encoders and Decoders.

Unit IV

Sequential Logic Circuits: Latches and Flip-Flops: SR-latch, D-latch, D flip-flop, JK flip-flop, T flip- flop Master slave FF, Edge trigger and Pulse trigger FF, Registers and Shift Registers: PISO, PIPO, SISO, SIPO, Right shift and left shift, Universal Shift register Ring and Johnson counters**. Counters, design and their applications**: Modulo N counters – Synchronous and Asynchronous counters.

Unit V

Synchronous Sequential Circuits: Moore and Mealy Machines: Definition of state machines, state machine as a sequential controller Design of state machines: state table, state assignment, transition/excitation table, excitation maps and equations, logic realization; Design examples-Algorithmic state machines – Algorithmic state machines, ASM Charts, Examples using ASM charts.

Text Books

1. Donald D Givone, Digital Principals and Design,12th reprint, TMH,2008
2. Morris Mano, Logic and Computer design fundamentals, 4th edition, PHI,2006
3. Nazeih M. Botros, HDL Programming VHDL And Verilog 2009 reprint, Dreamtech press.

References

1. Tocci, Digital systems principle & applications, 8th Edition, PHI 2004
2. Donald P Leach, Albert Paul, Malvino, Goutam Saha, Digital Principles and Applications, 6th Edition TMH, 2006.

Course Outcomes (COs):

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

1. Acquire knowledge to perform reduction of logic functions using simplification techniques. **(PO-1,2,9, PSO-1,3)**
2. Design combinational and sequential circuits. **(PO-1,2,3,5,9, PSO-1,3)**
3. Analyze combinational and sequential circuits. **(PO-1,2,3,5,9, PSO-1,3)**
4. Write Verilog programs to realize combinational circuits. **(PO-1,2,3,5,9,12 PSO-1,3)**
5. Use the concepts of state transition for analysis and design of synchronous and asynchronous sequential circuits. **(PO-1,2,3,9,12 PSO-1,3)**

ELECTRONIC MEASUREMENTS

Course Code: EI35 **Credit: 3:0:0**
Prerequisite: Basic Electronics (EC15) **Contact Hours: 42**
Course Coordinators: Mrs. Vibha B. Raj

Course Content

Unit I

Introduction: Introduction to Measurement and electronic measurement techniques, Elements of generalized measurement system, I/O configuration of measuring instruments and measuring systems, Methods of correction for interfering and modifying inputs, Static and Dynamic characteristics, Types of errors in measurement, calculate errors in measurement.

Unit II

Introduction to and factors for the selection of transducers: Transducers, Classification: primary-secondary, active-passive and analog-digital. **Measurement of R, L & C:** DC bridges: Wheat Stone bridge, problems, Megger, Earth resistance measurements, Q-meter measurement of R, L and C. **Oscilloscope:** Oscilloscope, Digital storage oscilloscope, Measurement of frequency, phase, voltage and current using CRO.

Unit III

Measuring Instruments: AC Voltmeter using rectifiers, True RMS responding voltmeter, Electronic Multi-meter, types of digital voltmeters: Single-ramp, Dual-ramp, Low current measurements: leakage currents & its guarding, generated currents, applications: photomultiplier tubes; Low voltage measurements: thermoelectric EMFs, magnetic fields, ground loops, applications: standard cell comparisons.

Unit IV

Function Generator & Data converters: Function generator, **ADCs**: Classifications, specifications, Flash Type ADC, Successive approximation ADC, General Applications of ADCs. **DACs**: Classifications, specifications, Binary weighted type DAC, R-2R type DAC, General Applications of DACs.

Unit V

Data Acquisition Systems: Introduction to DAS, Analog Switches and Multiplexers, Sampling fundamentals, Sample and Hold circuit & specifications, case study of typical data acquisition systems, Data loggers.

Text Books

1. "Modern Electronic Instrumentation and Measurement Techniques", W.D. Cooper, PHI/Pearson, 2015
2. "Measurement systems application and design", E.O.Doebline 5th edition TMH
3. "Electronic Measurements and Instrumentation", Oliver-Cage, Volume-12, Tata McGraw Hill

References

1. "A course in Electrical & Electronics measurement and Instrumentation", A.K Sawhney, 19th revised edition 2011, reprint 2014, Dhanpat Rai & Sons.
2. "Low level measurement Handbook", 7th edition, Keithley Instruments.

Course Outcomes (COs):

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

1. Understand various aspects of generalized measurement system. **(PO-1,2,3, PSO-1)**
2. Understand various parameter measurements with bridge circuits and CRO. **(PO1,2,3, PSO-1)**
3. Describe the basic principle and operation of DVMs and low level measurements of V and I. **(PO-1,2, PSO-1)**
4. Describe the functioning of function generator and data converters. **(PO1,2,3, PSO-1)**
5. Explain data acquisition systems and data logger systems. **(PO-1,2, PSO-1)**

INDUSTRIAL INSTRUMENTATION

Course Code: EI36 **Credit: 4:0:0**
Prerequisite: Engineering Physics (PY12) **Contact Hours: 56**
Course Coordinators: Dr. H. S. Niranjana Murthy and Dr. Christina Grace

Course Content

Unit I

Introduction & Calibration: Overview of instrumentation, Instrument Classification, Transducer classification, Calibration procedures, Calibrating instruments; **Displacement:** Standards, Resistive Potentiometer, LVDT and signal conditioning circuits, Capacitive transducers and Wein bridge oscillator, Applications of Displacement transducer.

Unit II

Pressure: Standards, Different methods of pressure measurement, Different types of manometers, Elastic pressure transducers: Bourdon tube, Diaphragm type; Electrical transducers: Capacitance based, Piezoelectric based, Strain gauge based; MEMS based capacitive and piezoresistive pressure sensor; High pressure measurement, Differential pressure transmitters: Pneumatic nozzle-flapper amplifier, relay; Vacuum pressure measurement: Pirani, Ionization, McLeod, Knudsen gauge.

Unit III

Temperature: Standards, Thermal expansion methods: Bimetallic, Liquid in glass, Pressure thermometers; Thermocouple – laws, reference junction considerations, thermoelectric series, thermopiles, Resistance Temperature Detector – theory, different constructions, signal conditioning, Thermistor, Junction semiconductor sensors, Thermowells, Radiation based temperature measurement – Laws, Blackbody Concepts, Different types of Optical pyrometers: Total – Frey's, Selective – Disappearing filament & IR, Ratio type. MEMS based thermal sensor.

Unit IV

Strain Gauge: Introduction, Gauge sensitivity, Types of strain gauges and rosettes, Signal conditioning circuits, Temperature Compensation, Applications of Strain Gauge. **Vibration:** Vibration: characteristics, types, mathematical model, importance of measurement, choice of transducers; Seismic transducers: displacement pickup, velocity pickup, acceleration pickup - strain gauge, piezoelectric; MEMS based accelerometers, gyroscope and inertial measurement unit.

Unit V

Force, Torque: Basic methods of Force measurement, Load cells, Strain gage based force measurements: advantages, types, classifications, specifications, signal conditioning; Hydraulic and Pneumatic load cells, Piezoelectric type, Basics of torque measurement, Torque measurement: strain gauge – slip ring arrangement, rotary transformer, telemetry type. **Humidity and Moisture:** Definitions and basic theory, dry and wet bulb psychrometers, hot wire electrode type hygrometer, dew cell, electrolysis type hygrometer, commercial type dew point meter, Different methods of moisture measurement. MEMS based humidity sensor.

Text Books

1. E.O. Doebline, Measurement systems application and design, 4th Edition, TMH
2. B.C. Nakra and K.K. Choudhury, Instrumentation Measurement and Analysis, Tata McGraw-Hill Education, 2nd Edition, 2003

References

1. John. P. Bentley, Principle of Measurement System, 3rd Edition, Pearson, 2007
2. Bela. G. Liptak, Process Measurement Handbook.
3. N.E. Battikha, The condensed handbook of measurement and control, 4th Edition, ISA, 2018

Course Outcomes (COs):

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

1. Explain the theory behind various measurement techniques. **(PO-1,2,3,9,10 PSO-1,3)**
2. Describe the working principle and construction of various measuring instruments. **(PO-1,2,3,9,10 PSO-1,3)**
3. Illustrate the importance, characteristics and advantages of measuring instruments for a given application. **(PO-1,2,3,9, PSO-1,3)**
4. Evaluate for output or input variables of measuring instruments for a given condition**. (PO-1,2,3,4, PSO-1,3)**
5. Design signal conditioning circuits for measuring instruments. **(PO-1,2,3,4, PSO-1,3)**

ANALOG ELECTRONIC CIRCUITS LAB

Course Code: EIL37 **Credit: 0:0:1**
Prerequisite: Basic Electronics (EC15) **Contact Hours: 14**
Course Coordinators: Dr. Pushpa M. K.

List of Experiments:

1. Opamp Applications: Integrator, differentiator.
2. Current amplifier -I to V convertor, V to I convertor.
3. Simulate Integrator, Differentiator, I to V and V to I convertors.
4. Instrumentation amplifier (Using IC).
5. Schmitt trigger and square wave generator.
6. Simulate IT amplifier, Schmitt Trigger and square wave generator.
7. Active filters – 2^{nd} order: Low pass filter, High pass filter.
8. Realization of oscillators using Opamp Wein Bridge and Crystal Oscillator.
9. Simulate filters and oscillators.
10. Low and high voltage regulator using IC723.
11. Monostable and Astable multi-vibrator using IC555 timer.
12. Simulate regulators and multivibrators.
13. V to F and F to V convertor using IC331.
14. Simulate V to F and F to V convertors.

Course Outcomes (COs):

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

1. Design and test various analog circuits for the given specifications. **(PO-1,2,3,4,5,12, PSO-1,3)**
2. Design and test IC555 and voltage regulator for given specification. **(PO-1,2,3,4,5, PSO-1)**
3. Simulate circuits using Software tools. **(PO-1,2,3,4,5,10,12, PSO-1,3)**

DIGITAL SYSTEM DESIGN LAB

Course Code: EIL38 **Credit: 0:0:1**
Prerequisite: Basic Electronics (EC15) **Contact Hours: 14**
Course Coordinators: Dr. Jyothirmayi. M

List of Experiments

Part-A: Hardware

1. Realization of Boolean expressions
2. Adder/ Subtractor: Full/half adders/ subtractors using logic gates, universal gates
3. Parallel Adder/ Subtractor using IC 7483
4. Multiplexer/ Demultiplexer: Use IC 74153, 74139 and solve Boolean expressions
5. Comparators using IC 7485
6. Flip flops, Shift registers, ring and Johnson counters
7. Counters using IC7493/ 74193

Part-B: Software

Software Simulation, Implementation in Test bench and FPGA kit

1. Basic gates, Adders and Subtractors
2. Ripple carry adder using data flow description
3. Multiplexers using behavioral description
4. Encoders/ Decoders/ Priority encoders
5. Code converters and Comparators
6. Up and Down Counters; Shift operations
7. Interfacing with hardware (Stepper motor /7 segment display-demo)

Text Books

1. Digital Design by Morris Mano
2. HDL with Digital Design VHDL & Verilog by N.Botros

Course Outcomes (COs):

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

1. Design and implement combinational circuits. **(PO-1,2,3,5,10, PSO-1,3)**
2. Design and implement different sequential circuits. **(PO-1,2,3,5,10, PSO-1,3)**
3. Realize combinational circuits, shift registers and counters using Verilog in FPGA kits. **(PO1,2,3,5,10, PSO-1,3)**

ADDITIONAL MATHEMATICS - I

Course Code: AM31 **Credit: 0:0:0**
Prerequisite: Knowledge of Mathematics **Contact Hours: 40**

Unit-I
Differential Calculus-I -08 Hrs

Successive differentiation, n^{th} derivatives of some standard functions, Leibnitz theorem, Polar curves. Angle between the radius vector and the tangent, angle between curves, length of the perpendicular from pole to the tangent, pedal equations. Taylor's and Maclaurin's expansions.

Unit-II
Integral Calculus -08 Hrs

Introduction, Reduction formula, Reduction formula for $\int sin^n x\, dx$, Reduction formula for $\int cos^n x\, dx$, Reduction formula for $\int sin^n x cos^m x\ dx$, Evaluation of double and triple integrals.

Unit-III
Vector Algebra-08 Hrs

Scalar and vectors. Vector addition and subtraction. Multiplication of vectors (Dot and Cross products). Scalar and vector triple product-simple problems. Vector functions of a single variable. Derivative of a vector function, geometrical interpretation. Velocity and acceleration.

Unit –IV
Vector Differentiation-08Hrs

Scalar and vector fields, gradient of a scalar field, directional derivative, divergence of a vector field, solenoidal vector, curl of a vector, irrotational vector, Laplace's operator. Vector identities connected with gradient, divergence and curl.

Unit- V
First Order Differential Equations-08 Hrs

Solution of first order and first degree differential equations, variable separable methods, homogeneous equations, linear and Bernoulli's equations, exact differential equations.

Text Books:

1. B.S. Grewal – Higher Engineering Mathematics, Khanna Publishers, 44th edition, 2017.
2. Erwin Kreyszig –Advanced Engineering Mathematics, Wiley publication, 10th edition, 2015.

References:

1. H.K. Dass – Higher Engineering Mathematics – S Chand Publications - 1998.
2. B.V. Ramana – Engineering Mathematics – Tata McGrawHill Publishing Co. Ltd. – New Delhi – 2008.

Course Outcomes (COs):

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

1. Find the length of the perpendicular from pole to tangent and determine the series expansion of differentiable functions **(PO-1, 2)**
2. Evaluate multiple integrals **(PO-1, 2)**
3. Analyze and solve problems related to Vector Algebra. **(PO-1, 2)**
4. Apply vector differentiation to identify solenoidal and irrotational vectors. **(PO-1, 2)**
5. Solve the first order and first degree ordinary differential equations. **(PO-1, 2)**

IV Semester

ENGINEERING MATHEMATICS-IV

Course Code: EI41 **Credit: 3:1:0**
Prerequisite: Knowledge of Calculus & Probability **Contact Hours: 42+14**
Course Coordinators: Dr. M.V. Govindaraju & Dr. Aruna A S

Course Content

Unit I

Finite Differences and Interpolation: Forward and backward differences, Interpolation, Newton-Gregory forward and backward interpolation formulae, Lagrange's interpolation formula and Newton's divided difference interpolation formula (no proof).
Numerical Differentiation and Numerical Integration: Derivatives using Newton-Gregory forward and backward interpolation formulae, Newton-Cotes quadrature formula, Trapezoidal rule, Simpson's1/3rd rule and Simpson's 3/8th rule. Applications to Engineering problems.

Unit II

Fourier Transforms: Infinite Fourier transform, Infinite Fourier sine and cosine transforms, Properties, Inverse transform, Convolution theorem, Parseval's identity (statements only). Applications to Engineering problems. Fourier transform of rectangular pulse with graphical representation and its output discussion, Continuous Fourier spectra-example and physical interpretation. Limitation of Fourier transforms and the need of Wavelet transforms.
Z-Transforms: Definition, Standard Z-transforms, Single sided and double sided, Linearity property, Damping rule, Shifting property, Initial and final value theorem, Convergence of Z-transforms, Inverse Z-transform, Convolution theorem and problems, Application of Z-transforms to solve difference equations. Applications to Engineering problems.

Unit III

Random Variables: Random variables (discrete and continuous), Probability density function, Cumulative distribution function, Mean, Variance and Moment generating function.
Probability Distributions: Binomial and Poisson distributions, Uniform distribution, Exponential distribution, Gamma distribution and Normal distribution. Applications to Engineering problems.

Unit IV

Joint probability distribution: Joint probability distribution (both discrete and continuous), Conditional probability and Conditional expectation.
Stochastic Processes: Introduction, Classification of stochastic processes, discrete time processes, Stationary, Ergodicity, Autocorrelation and Power spectral density.
Markov Chain: Probability vectors, Stochastic matrices, Regular stochastic matrices, Markov chains, Higher transition probabilities, Stationary distribution of regular Markov chains and absorbing states. Markov and Poisson processes. Applications to Engineering problems.

Unit V

Series Solution of ODEs and Special Functions: Series solution, Frobenius method, Series solution of Bessel differential equation leading to Bessel function of first kind, Orthogonality of Bessel functions, Series solution of Legendre differential equation leading to Legendre polynomials, Orthogonality of Legendre Polynomials, Rodrigue's formula**.**

Text Books:

1. R. E. Walpole, R. H. Myers, R. S. L. Myers and K. Ye – Probability and Statistics for Engineers and Scientists – Pearson Education – Delhi – 9th edition – 2012.
2. B. S. Grewal-Higher Engineering Mathematics-Khanna Publishers-44th edition-2017.
3. Wavelets: A Primer- AK Peters/CRC Press, 1st Edition-2002.

Reference Books:

1. Erwin Kreyszig –Advanced Engineering Mathematics – Wiley publication – 10th edition-2015
2. Glyn James- Advanced Modern Engineering Mathematics-PearsonEducation-4th edition-2010
3. Kishor S. Trivedi – Probability & Statistics with reliability, Queuing and Computer Science Applications – John Wiley & Sons – 2nd edition – 2008.

Course Outcomes (COs):

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

1. Find functional values, derivatives, areas and volumes numerically from a given data. **(PO-1,2 & PSO-1,3)**
2. Evaluate Fourier transforms and use Z-transforms to solve difference equations. **(PO-1,2 & PSO-1,3)**
3. Analyze the given random data and its probability distributions. **(PO-1,2 & PSO-1,3)**
4. Determine the parameters of stationary random processes and use Markov chain in prediction of future events. **(PO-1,2 & PSO-1,3)**
5. Obtain the series solution of ordinary differential equations. **(PO-1,2 & PSO-1,3)**

SIGNAL PROCESSING

Course Code: EI42 **Credit: 2:1:0**
Prerequisite: Engg. Mathematics I & II (MA11 & MA21) **Contact Hours: 28+14**
Course Coordinators: Dr. Shivaprakash. G

Course Content

Unit I

Introduction: Signals and Systems, Classification of Signals: Continuous & discrete, deterministic and random signals, Odd and even signals, Periodic & aperiodic signals, Causal & Non-causal, Power & Energy signal. Operations on signals: Operations on independent variable, Operations on dependent variable. Elementary CT signals: Unit step, ramp, impulse, exponential signal and sinusoidal signals. Elementary DT signals: Unit step, ramp, impulse, exponential signal and sinusoidal signals. Systems viewed as interconnection of operations.

Unit II

Classification of Systems: CT & DT systems. **Properties of systems:** Linear & non-linear systems, time-variant & time-invariant systems, Causal & Non-causal, stable & unstable systems. Impulse response representation of LTI system. Differential equation representation of LTI systems, Difference equation representation of LTI system. Discrete time Convolution and Correlation.

Unit III

Introduction to Fourier representations, Fourier transforms, Properties of FT: linearity, Timeshift, Frequency shift, Scaling, Differentiation in the time domain, differentiation in the frequency domain, integration in the time domain, convolution, multiplication, Parseval's theorem, duality, symmetry. DTFT representation, properties of DTFT: linearity, time shift, frequency shift, scaling, differentiation in the frequency domain, convolution, multiplication, Parseval's theorem, duality, symmetry.

Unit IV

Applications of signal processing to communication systems: Introduction, types of modulation, benefits of modulation, Full Amplitude modulation, DSSC modulation, Quadrature carrier multiplexing, Single sideband modulation, Vestigial sideband modulation. Multiplexing: Time division multiplexing, frequency division multiplexing.

Unit V

Infinite Impulse response (IIR) Filters: Introduction to digital filters, IIR filter design by approximation of derivatives. Butterworth low pass IIR filter design by impulse invariant transformation and Bilinear transformation. Introduction to frequency transformations.

Text Books

1. Signals and Systems, Symon Haykin and Barry Van Veen, 2/e, John Wiley and Sons.
2. Digital signal processing- S. Salivahanan, A.Vallavaraj and C. Gnanapriya (Chapter 5), Mcgraw Hill.

References

1. Signals and Systems: Alan V. Oppenheim, Alan S. Willsky, and with S. Hamid, PHI
2. Digital signal processing-Proakis and Monolakis, 3rd edition, Prentice Hall of India, 2007
3. Digital signal processing-Alan V. Oppenheim, Ronald W. Schafer, Prentice Hall of India, 1978.

Course Outcomes (COs):

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

1. Classify various types of signals and systems based on their characteristic features. **(PO-1,3,4,9,10; PSO-1,3)**
2. Perform different operations on a signal. **(PO-1,3,4,9,10; PSO-1,3)**
3. Represent continuous and discrete signals in the Fourier domain. **(PO-1,3,4,9,10; PSO-1,3)**
4. Identify the signal processing concepts used in communication systems. **(PO-1,3,4,9,10; PSO-1,3)**
5. Design IIR system to meet the given specifications. **(PO-1,3,4,9,10; PSO-1,3)**

EMBEDDED CONTROLLERS

Course Code: EI43 **Credit: 4:0:0**
Prerequisite: Fundamentals of Computing (CS26) **Contact Hours: 56**
Course Coordinators: Ms. Elavaar Kuzhali. S

Course Content

Unit I

Introduction: Introduction to Microprocessors and Microcontrollers, RISC vs CISC**, 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, ARM processor families

Unit II

Introduction to ARM instruction Set: Data Processing Instructions, Branch Instructions, Load Store Instructions, Software Interrupt Instruction, Program Status Register Instructions, Loading Constants, ARMv5E Extensions, and Conditional Execution.

Unit III

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.

Unit IV

Interrupts & Exception Handling: Exception Handling Interrupts, Interrupt handling schemes- Non-nested Interrupt Handler Nested Interrupt Handler, reentrant handling scheme.

Unit V

LPC 2148-Design of system using GPIO's (Interface to SWITCH, LED's, LCD interface, 4 x 4 Keypad), Timers, ADC, DAC, UART, SPI.

Text Books

1. "Andrew N.Sloss", ARM system Developers Guide, Elsevier, 2008
2. "William Hohl", ARM Assembly Language – Fundamentals and Techniques, CRC Press, 2009
3. "J.R.Gibson", ARM Assembly language An Introduction, CENGAGE Learning, 2010.

Course Outcomes (COs):

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

1. Understand the various aspects of ARM architecture **(PO-1, 5, PSO-1)**
2. Write programs using ARM instruction set. **(PO-1,3,5,9,10, PSO-1,3)**
3. Write programs using THUMB instruction set. **(PO-1,3,5,9,10, PSO-1,3)**
4. Analyze the various ways of handling exceptions and interrupts in ARM processor. **(PO- 1,3,5,9,10, PSO-1,3)**
5. Write embedded C programs to interact with Built-in-Peripherals of ARM7-LPC2418. **(PO-1,3,5,9,10, PSO-1,3)**

PROCESS INSTRUMENTATION

Course Code: EI44 **Credit: 4:0:0**
Prerequisite: Industrial Instrumentation (EI36) **Contact Hours: 56**
Course Coordinators: Ms. J V Alamelu and Dr. H. S. Niranjana Murthy

Course Content

Unit I

Basic Concept of Fluid Mechanics & Flow of Fluids: Introduction, properties of fluids, viscosity, fluids pressure at a point, properties, laws of pressure, types of fluids, types of fluid flow, rate of flow, equation of continuity, velocity and acceleration, types of motion, linear translation, deformation, angular deformation, rotation, vorticity, forced and free vortex flow

Unit II

Flow of Fluids: Dynamics of flow, equations of motion, Euler's equation, Bernoulli's equation. **Head Type & Quantity Flow meters**: Orifice plate, Venturi tube, Flow nozzle, Pitot tube, Positive displacement flow meters – nutating disc and reciprocation piston.

Unit III

Area & Mass Flow Meters: Turbine flow meter, Rotameter, Coriolis mass flow meters, Thermal mass flow meter, Volume flow meter plus density measurement
Electrical Type Flow Meter: Electromagnetic flow meter – different types of excitation, schemes used, Ultrasonic flow meters, Vortex shedding flow meter, solid flow rate measurement, calibration of flow meters – dynamic weighing method.

Unit IV

Level measurement: Gauge glass technique coupled with photo electric readout system, Float type level indication, Level switches, Level measurement using displacer and torque tube, Bubbler system, Differential pressure type level transducers, Boiler drum level measurement, Electrical types of level gauges using resistance, capacitance, nuclear radiation and ultrasonic sensors, Radar type level measurement, Level measurement using laser.

Unit V

pH and viscosity measurement: pH meters, conductivity measurements, Saybolt viscometer, Rotameter type viscometer, Suitable signal conditioners.

Instrument selection, Installation & Maintenance: Guidelines for selection of instruments, Data sheets handling, Ingression protection, Enclosures. Installation – Equipment identification, Pre-installation testing, Execution, Wiring, Tubing, Checkout – lockout & tagout procedures. Maintenance – Implementation, Types, Records, Hazards, Electrical isolation, Programmable electronic systems

Text Books

1. Bansal.R.K, Fluid Mechanics and Hydraulic Machines, Laxmi Publications, 2005
2. E.O.Doebline, Measurement systems application and design, 4^{th} Edition TMH.
3. D.Patranabis, Principles of Industrial Instrumentation, 2^{nd} Edition, Tata McGraw Hill.

References

1. Radhakrishnan, E., Introduction to fluid Mechanics, Prentice Hall, India 2005.
2. Rajput R.K.,Fluid Mechanics and Hydraulic Machines, S.Chand and Co., India.
3. John. P. Bentley, Principle of Measurement System, 3^{rd} Edition, Pearson 2007.
4. Bela .G. Liptak, Process Measurement.
5. N.E. Battikha, The condensed handbook of measurement and control, 4^{th} Edition, ISA, 2018.

Course Outcomes (COs):

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

1. Solve basic fluid mechanics problems using physical principles of fluid mechanics. **(PO-1,2,3,6,7,9, PSO- 1,2,3)**
2. Describe the working principle of flow, level, pH and viscosity meters. **(PO-1,2,3,6,7,9, PSO- 1,2,3)**
3. Explain the importance, advantages and special features of each instrument as used in industries. **(PO-1,2,3,4, PSO-1,3)**
4. Elucidate the calibration procedures, guidelines for selection, installation and maintenance of instruments. **(PO-3,4,6,7,12, PSO-1,2,3)**
5. Design suitable signal conditioning circuits for flow, level, pH and viscosity type instruments for a specific application. **(PO-2,3,4,10, 12, PSO-1,3)**

CONTROL SYSTEMS

Course Code: EI45 **Credit: 3:1:0**
Prerequisite: Linear Networks (EI33) **Contact Hours: 42+14**
Course Coordinators: Mrs. K.M. Vanitha

Course Content

Unit I

Modeling of Systems: Types of Control Systems, Mathematical models of physical systems – Introduction- Differential equations of physical systems (Mechanical systems, Friction, Translational systems) (Mechanical accelerometer, Levered systems excluded), Mathematical models of Rotational systems- Gear trains, Analogous systems. **Block Diagrams and signal flow graphs:** Transfer functions, Block diagram algebra, Signal flow graphs (State variable formulation excluded).

Unit II

Time Response of Feedback Control Systems: Standard test signals, Steady state errors and error constants, Unit step response of First and second order systems, Time response specifications of second order systems, P, PI, PD and PID Compensation, Analysis using MATLAB.

Unit III

Stability Analysis: Concept of Stability, Routh-Hurwitz Criterion, Root Locus Technique, Construction of Root Locus & Stability, Dominant Poles, Application of Root Locus Diagram – Nyquist Stability Criterion - Relative Stability, Analysis using MATLAB.

Unit IV

Frequency Domain Analysis: Correlation between time and frequency response, Frequency Response – Bode Plot, Polar Plot, Nyquist Plot – Frequency Domain specifications from the plots – Constant M and N Circles – Nichol's Chart – Use of Nichol's Chart in Control System Analysis. Series, Parallel, series-parallel Compensators - Lead, Lag, and Lead Lag Compensators, Analysis using MATLAB.

Unit V

Design of Feedback Control System: Approaches to system design**,** lead, lag, lead-lag compensator networks and example. Lead, lag, lead-lag compensator design using Bode and Root Locus Techniques, design for deadbeat response.

Tutorials list:

1. Numerical on Block diagram
2. Numerical on Signal flow graph
3. Numerical on Mathematical modeling
4. Numerical on Static error coefficients and generalized error coefficients.
5. Numerical on Second order system
6. Numerical on Controllers (P, PI, PD, PID)
7. Numerical on RH criteria
8. Numerical on Root locus
9. Numerical on Bode plots
10. Numerical on Nyquist plot
11. Numerical on Polar plot
12. Numerical on Lag compensation using Bode plot and root locus
13. Numerical on Lead compensation using bode plot and root locus
14. Numerical on Lag-Lead compensation using bode plot and root locus

Text Books

1. J. Nagrath and M.Gopal, Control Systems Engineering, New age International (P) Limited, Publishers, fifth edition – 2007
2. K. OGATA, Modern Control engineering, Pearson Education Asia, 5th Edition.

References

1. Richard C. Dorf, Robert H. Bishop, Modern Control Systems, Pearson education,2004
2. Farid and Kuo, Automatic Control Systems,9th Edition, John Wiley and Sons.

Course Outcomes (COs):

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

1. Derive the transfer function and mathematical models of physical systems. **(PO-1,2,5; PSO-1,3)**
2. Determine transient and steady state behavior of the system. **(PO-1,2,5; PSO-1,3)**
3. Analyze the time domain stability of the system using RH criteria and root locus techniques. **(PO-1,2,5; PSO-1,3)**
4. Find the frequency domain specifications. **(PO-1,2,5; PSO-1,3)**
5. Design control system in time and frequency domain. **(PO-1, 2,3,5; PSO-1,3)**

ANALYTICAL INSTRUMENTATION

Course Code: EI46 **Credit: 4:0:0**
Prerequisite: Engineering Physics (PY12) **Contact Hours: 56**
Course Coordinators: Dr. M. D. Nandeesh and Dr. Christina Grace

Course Content

Unit I

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

Unit II

Spectrometric Methods: Atomic absorption and Emission Spectroscopy: Principle, types, Flame photometer, DC arc and AC arc excitation, plasma excitation. X-ray spectrometer- Principles, instruments, Fluorescence, absorption, diffraction, auger emission spectrometer**.** Application of spectroscopy in air quality monitoring.

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 and applications of lasers: Emission and absorption of radiation, population inversion, optical feedback, laser modes and classes of lasers-Nd-YAG, ruby, HeNe laser and argon laser**,** application in medical fields**.** Single mode operation, frequency stabilization, line shaping function, mode locking, Q switching, measurement of distance and holography.

Unit V

Microscopy and techniques: Fundamentals of optics, Optical microscopy, Dark field & fluorescence microscopy, Scanning electron microscopy -Instrumental details, Sample preparation, Transmission electron microscopy, Scanning probe microscopy, Scanning tunneling microscopy, Atomic force microscopy, Applications.

Textbook

1. Principles of instrument analysis – Skoog, holler and Nieman, 4th edition 2006, Thomson publication
2. Lasers and optical instrumentation- S Nagabhushana, N Sathyanarayana – I K International Publishing House Pvt. Ltd.

References

1. Instrumental methods of analysis by H. H. Willard, L. L.Merritt & J. A. Dean, CBS Publications 7th Ed 1988
2. Instrumental Methods of chemical analysis- H Kaur- Pragathi Edition

Course Outcomes (COs):

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

1. Explain the molecular or atomic processes behind various chemical analysis and microscopy. **(PO-1,2,4,7 PSO1,2)**
2. Describe the working principles and construction of various analytical and microscopic instruments. **(PO-1,2,4 PSO1,2)**
3. Map out the general flow of procedures involved in analytical measuring instruments and microscopes. **(PO-1,2,4 PSO1,2)**
4. Illustrate the necessity and importance of different components used in each analytical instrument and microscopes**. (PO-1,2,4, PSO1,2)**
5. Identify appropriate measuring instruments for given applications. **(PO-1,2,6,7 PSO1,2)**

EMBEDDED CONTROLLERS LAB

Course Code: EIL47 **Credit: 0:0:1**

Prerequisite: Fundamentals of Computing (CS26) **Contact Hours: 14**

Course Coordinators: 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

Text Books

1. "Andrew N.Sloss", ARM system Developers Guide, Elsevier, 2008
2. LPC214X User Manual – NXP Semiconductors

Course Outcomes (COs):

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

1. Write ARM/THUMB assembly level programs using Keil software. **(PO-1,3,5,9,10, PSO-1,3)**
2. Write embedded C programs to interact with Built-in-Peripherals (GPIO's, DAC, ADC, Timer/Counter, and UART) of ARM7 LPC 2418. **(PO-1,3,5,9,10, PSO-1,3)**
3. Write programs to handle exceptions and interrupts in ARM processor. **(PO-1,3,5,9,10, PSO-1,3)**

INDUSTRIAL INSTRUMENTATION LAB

Course Code: EIL48 **Credit: 0:0:1**
Prerequisite: Industrial Instrumentation (EI36) **Contact Hours: 14**
Course Coordinators: Dr. H. S. Niranjana Murthy

List of experiments

1. Displacement measurement using Potentiometer.
2. Displacement measurement using LVDT.
3. Strain gauge load cell.
4. Linear and Angular displacement using capacitive transducer.
5. Absorbance measurement using optical sensors.
6. Pressure transmitter/ transducer -calibration.
7. Rough vacuum measurement using vacuum pressure transducer.
8. Temperature measurement using RTD.
9. Temperature measurement using Thermistor.
10. Temperature measurement using Thermocouple.
11. Temperature measurement using AD590.
12. Temperature measurement using IR sensor.
13. Displacement, Velocity and Acceleration measurement using Vibration sensor.
14. Strain measurement using Cantilever beam.

Text Book:

1. B.C.Nakra and N.K. Choudhary, Instrumentation Measurement and Analysis, Tata McGraw Hill Education, 4th Edition, 2016

Course Outcomes (COs):

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

1. Understand the Measurement of temperature, displacement, strain and pressure. **(PO-1,2,3,9,10, PSO-1,3)**
2. Calibrate different measuring instruments. **(PO-1,2,3,9,10, PSO-1,3)**
3. Analyse the performance characteristics of different measuring instruments. **(PO-1,2,3,9,10, PSO-1,3)**

ADDITIONAL MATHEMATICS - II

Course Code: AM41 **Credit: 0:0:0**

Prerequisite: Knowledge of additional Mathematics - I (AM31)

Contact Hours: 40

Unit I

Differential calculus - 08 Hrs

Partial differentiation, Euler's theorem, total differential coefficient, differentiation of composite and implicit functions, Jacobian and Properties. Taylor's theorem for function of two variables, maxima and minima for functions of two variables.

Unit II

Vector integration – 08 Hrs

Line integrals, surface integrals and volume integrals. Green's theorem, Stokes' and Gauss divergence theorem (without proof) and problems, orthogonal curvilinear coordinates.

Unit III

Laplace transforms - 08 Hrs

Definitions, Laplace transforms of elementary functions, derivatives and integrals, periodic function, unit step function, inverse transforms, applications of Laplace transforms to solve differential equations.

Unit IV

Higher Order Differential Equations - 08 Hrs

Higher order linear differential equations, method of variation of parameters, Cauchy's and Legendre's homogeneous differential equations.

Unit V

Probability - 08Hrs

Introduction. Sample space and events. Axioms of probability. Addition and multiplication theorems. Conditional probability-illustrative examples. Bayes theorem –examples.

Text Books:

1. B.S. Grewal – Higher Engineering Mathematics, Khanna Publishers, 44^{th}edition, 2017.

2. Erwin Kreyszig –Advanced Engineering Mathematics, Wiley publication, 10^{th} edition, 2015.

References:

1. H.K. Dass – Higher Engineering Mathematics – S Chand Publications - 1998.
2. B.V. Ramana – Engineering Mathematics – Tata McGrawHill Publishing Co. Ltd. – New Delhi – 2008.

Course Outcomes (COs):

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

1. Find Jacobian, extreme values and power series expansion of a function. **(PO-1, 2)**
2. Exhibit the interdependence of line, surface and volume integrals using integral theorems. **(PO-1, 2)**
3. Use the concept of Laplace transforms to solve initial and boundary value problems **(PO-1, 2)**
4. Solve Linear differential equations with constant and variable coefficients **(PO-1, 2)**
5. Demonstrate the understanding of axioms and rules of probability to solve problems. **(PO-1, 2)**