# MALNAD COLLEGE OF ENGINEERING, HASSAN

**(An Autonomous Institution Affiliated to VTU, Belgaum)**

## Autonomous Programmes

## Bachelor of Engineering

# DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

SYLLABUS

V& VI Semester (2021 Admitted Batch)

(3rd Year)

**Academic Year 2023-24**

**MALNAD COLLEGE OF ENGINEERING, HASSAN**
(An Autonomous Institution Under VTU, Belagavi)

**Department of Electronics & Instrumentation Engineering**

## VISION of the Department

The Department will be a center of excellence for Electronics and Instrumentation studies driven by research in association with industry and society

## MISSION of the Department

1. To augment infrastructure in emerging technologies .
2. To provide student centered environment for effective learning by giving hands-on experience.
3. To develop research culture and create facilities for transforming idea into products to cater to society and industrial needs.
4. To collaborate with industry, academia and research organizations for contribution to the higher order learning and research.
5. To prepare students to meet the challenges of dynamic industrial requirements and higher education.

## PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

**The Students are expected to Possess:**

1. Capacity to undertake automation jobs having competency in design of controllers, installation, commissioning, operation and maintenance of process plants in coordination with interrelated domain team.
2. Social responsibility, leadership capability and integrity in their professional career.
3. Acumen to pursue higher education in interrelated domains of instrumentation.
4. Ability to design and implement projects relevant to industry and community taking into account social, ethical and environmental considerations.
5. Knowledge of computational platforms and software applications related to domain needs.

## PROGRAM OUTCOMES (POs)

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **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.
3. **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.

4. **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.
5. **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.
6. **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.
7. **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.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **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.
11. **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.
12. **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.

## PROGRAMME SPECIFIC OUTCOMES (PSOS)

PSO1: Adopt concepts of measurement and transduction for instrumentation.
PSO2: Employ knowledge of instrumentation for process automation.

**Scheme of Evaluation (Theory Courses)**

| Assessment | Marks |
|---|---|
| THREE CIE's conducted for a total of 40 marks | 40 |
| Activities as decided by course faculty | 10 |
| SEE | 50 |
| Total | 100 |

**Scheme of Evaluation (Laboratory Courses)**

| Assessment | Marks |
|---|---|
| Continuous Evaluation in every lab session by the Course coordinator | **10** |
| Record Writing | **20** |

| | |
|---|---|
| Laboratory CIE conducted by the Course coordinator | **20** |
| SEE | **50** |
| **Total** | **100** |

| Examination | Maximum Marks | Minimum marks to qualify |
|---|---|---|
| **CIE** | **50** | **20** |
| **SEE** | **50** | **20** |

**FIFTHSEMESTER**

| Course Category | Course Code | CourseTitle | L-T-P | Credits | Contact Hours |
|---|---|---|---|---|---|
| **PCC** | **21EI501** | **ARM Microcontroller** | **4-0-0** | **4** | **4** |
| **PCC** | **21EI502** | **Fundamentals of Signals and DSP** | **3-0-1** | **4** | **5** |
| **PCC** | **21EI503** | **Control Systems** | **3-0-1** | **4** | **5** |
| **PCC** | **21EI504** | **Data Converters and Virtual Instrumentation** | **3-0-1** | **4** | **5** |
| **PCC** | **21EI505** | **Mini Project-I** | **0-0-1** | **2** | **2** |
| **HSMC** | **21EVS** | **Environmental Studies(Mandate non-credit course)(Group – A)** | **0-1(A)-0** | **AUDIT** | **2** |
| **PI** | **21INT2** | **SummerInternship-II** | **0-0-1** | **3** | **-** |
| **UHV** | **21SCR** | **Social Connect and Responsibility** | **1-0-0** | **1** | **1** |
| | | | **Total** | **22** | **24** |

**SIXTHSEMESTER**

| Course Category | Course Code | CourseTitle | L-T-P | Credits | Contact Hours |
|---|---|---|---|---|---|
| **PCC** | **21EI601** | **Industrial Communication Systems** | **3-0-0** | **3** | **3** |
| **PCC** | **21EI602** | **Analytical Instrumentation** | **3-0-0** | **3** | **3** |
| **PCC** | **21EI603** | **Advanced Control Systems** | **3-0-0** | **3** | **3** |
| **PCC** | **21EI604** | **Embedded System Design Laboratory** | **0-0-2** | **1** | **2** |
| **PI** | **21EI605** | **Mini Project-II** | **0-0-2** | **2** | **4** |
| **PEC** | **21EI65X** | **Professional Elective 1** | **3-0-0** | **3** | **3** |

| | | | | | |
|---|---|---|---|---|---|
| **PEC** | **21EI66X** | **Professional Elective 2** | **3-0-0** | **3** | **3** |
| **AEC** | **21ASK** | **Analytical Ability and Soft Skills** | **0-1-0** | **1** | **2** |
| **OEC** | **21OEXX** | **Open Elective–I** | **3-0-0** | **3** | **3** |
| **HSMC** | **21CIP** | **ConstitutionofIndia andProfessionalEthics (Mandatenon-creditcourse) (Group-A)** | **0-1(A)-0** | **AUDIT** | **2** |
| **OEC** | **21SWY** | **SWAYAM(NPTELonly)** | **0-1(A)-0** | **AUDIT** | **-** |
| | | | **Total** | **22** | **30** |

| **Professional Elective Courses** | | | |
|---|---|---|---|
| **Group I** | | **Group II** | |
| **21EI651** | **OOP and Data Structures** | **21EI661** | **Computer Networks** |
| **21EI652** | **Micro & Smart System Tech.** | **21EI662** | **Digital Image Processing** |
| **21EI653** | **Embedded System Design** | **21EI663** | **Safety Instrumentation** |
| **21EI654** | **Computer Organization** | **21EI664** | **Concepts of Operating Systems** |
| **21EI655** | **Internet of Things** | **21EI665** | **Foundation of Innovations** |
| **21EI656** | **Process Control** | **21EI666** | **Programming with Python** |
| **21EI657** | **Robotics** | **21EI667** | **E-waste Management** |
| **Open Elective Courses** | | | |
| **21OEEI61** | **Industrial Instrumentation** | **21OEEI65** | **Network Analysis** |
| **21OEEI62** | **Medical Electronics** | **21OEEI66** | **E-waste Management** |
| **21OEEI63** | **Analog Signal Conditioning** | **21OEEI67** | **Micro Sensors and Micro Actuators** |
| **21OEEI64** | **Introduction to VHDL Programming** | | |

Note: HSM: Humanities, Social Sciences&Management Course, BS: Basic Science Course, ES: Engineering Science Course, PC: Professional Core Course, PE: Professional Elective Course, OE: Open Elective Course; PW: Project/Mini Project Work, SR: Seminar Technical

| **Course Title:** | **ARM MICROCONTROLLER** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| **Course Code:** | **21EI501** | **4** | **0** | **0** | **4** |
| **Hours / week: 4** | **CIE: 50 Marks SEE: 50 MarksExam hours: 3 Total hours: 52** | | | | |

**Prerequisites**: Logic Design, Microprocessor

**Course outcomes:** Upon the completion of this course student will be able to:

CO1: Distinguish process architecture and programming model.

CO2: Illustrate ARM processor'sinstructions.

CO3: Developassembly level program for simple applications.

CO4: Explain ARM architecture support for high level language and system development.

CO5: Illustrate ARM7 processor core and its specified applications.

**Module 1**

The ARM Architecture: The Acorn RISC Machine, Architectural inheritance, The ARM programmer's model and ARM development tools.

**6 hours**

ARM Assembly Language Programming: Data processing instructions, Data transfer instructions, Control flow instructions and Writing simple assembly language programs. **7 hours**

**Module2**

ARM Organization and Implementation: 3-stage pipeline ARM organization, 5-stage pipeline ARM organization, ARM instruction execution, ARM design implementation.

**7 hours**

Architectural Support for High-Level Languages: Abstraction in software design, Data types, Expressions, Conditional statements and Loops, Functions and procedures, Use of memory, Run-time environment and Programming examples. **7 hours**

**Module 3**

The Thumb Instruction Set: The Thumb bit in the CPSR, The Thumb programmer's model, Thumb instructions, Thumb implementation and Thumb applications.

**6 hours**

Architectural Support for System Development: The ARM memory interface, The Advanced Microcontroller Bus Architecture, The ARM reference peripheral specification, Hardware system prototyping tools and The ARMulator.

**6 hours**

**Module D**

ARM Processor Core - ARM7TDMI, Embedded ARM Applications: The VLSI Ruby II Advanced Communication Processor and the VLSI ISDN Subscriber Processor.

**7 hours**

Embedded ARM Applications: The OneC™ VWS22100 GSM chip and The Ericsson-VLSI Bluetooth Baseband Controller.

**6hours**

**Text Book:**

1. ARM System on Chip Architecture: 2nd Edition - Steve Furber - Addison Wesley Longman Publishers

**Reference Books:**

1. ARM System Developer's Guide – Andrew N. Sloss, Dominic Symes and Chris Wright - Morgan Kaufmann Publications
2. ARM Architecture Reference Manual - ARM Ltd.
3. ARM Software Development Toolkit Version 2.0 – ARM Ltd.

**E Books:**

1. http:// nptel.ac.in/courses/webcourse-contents/IIT.../microcontrollers
2. http://freevideolectures.com/Course/3018/Microprocessors-and-Microcontrollers

**MOOCs:**

1. Embedded Systems - Shape The World https://www.edx.org/course/embedded-systems-shape-world-utaustinx-ut-6-02x
2. Electronic Interfaces: Bridging the Physical and Digital Worlds
https://www.edx.org/course/electronic-interfaces-bridging-physical-uc-berkeleyxee40lx-0

| EI 501 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PO12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | 3 | | | | | | | | | | | | 2 | 3 |
| CO2. | 3 | | | | | | | | | | | | | |
| CO3. | | | | | 3 | | | | | | | | | |
| CO4. | 3 | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO5. | 3 | | | | | | | | | | | | | |

| Course title: | Fundamentals of Signals and DSP | L | T | P | C |
|---|---|---|---|---|---|
| Course Code: | 21EI502 | 3 | 0 | 2 | 4 |
| Hours / week: 5 | CIE: 50 Marks SEE: 50 Marks Exam hours: 3 Total hours: 40+12 | | | | |

**Prerequisites:** Engineering Mathematics

**Course outcomes:** Upon the completion of this course student will be able to**:**

CO1: Sketch, classify and perform operations on signals and characterize LTI systems.

CO2: Apply DFT - IDFT and FFT- IFFT concepts on discrete time signals.

CO3: Design and realize various FIR and IIR filters.

CO4: Develop programs for Signal generation, Time domain operations and filter design using MATLAB.

CO5: Adopt professional ethics and responsibilities to communicate and deliver as individual and in group.

## MODULE-1

**Introduction**: Definitions of a signal and a system, classification of signals, basic Operations on signals, elementary signals, Classification and characterization of systems, characterize the system based on properties.

**Self-Study Component**: Systems viewed as Interconnections of operations.

**10 Hours**

## MODULE-2

**Time-domain representations for LTI systems:** Impulse response representation, Concepts of Convolution, Computation of Convolution Sum and its properties. Differential equation Representation, System response by solving differential equation.

**System Realization:** Direct, Parallel and Cascade form for FIR & IIR Systems.

**Self-Study Component**: Circular convolution and Correlation of two given sequences, Solution of difference equation

**10 Hours**

## MODULE-3

**Signal Transforms:** DFT, Properties of DFT, and IDFT.

**Computation of FFT:** Decimation in Time FFT, Decimation in Frequency FFT, IFFT.

**Self-Study Component**: DCT: Features, advantages, DCT-2

**10 Hours**

## MODULE-4

**FIR filters:** Properties, Filter Design using Windows (Rectangular, Hamming and Hanning)

**IIR Filters-I:** Specification and design techniques, Design of Butterworth low pass filters and Chebyshev low pass filters using Analog filter design techniques, Comparison of IIR and FIR filters.

**Self-Study Component**: Transform of Low pass to High pass, Band pass and Band rejection filters

**10 Hours**

**List of Experiments**

1. Verify the Sampling theorem.
2. Determine linear convolution, Circular convolution and Correlation of two given sequences. Verify the result using theoretical computations.
3. Determine the linear convolution of two given point sequences using FFT algorithm.
4. Determine the correlation using FFT algorithm.
5. Design and implementation of FIR filter using Windowing technique for the given order and cut-off frequency.

6. Design and implementation of Butterworth 1st and 2nd order low pass filter.
7. Design and implementation of Butterworth 1st and 2nd order high pass filter.
8. Design and implementation of Chebyshev 1st and 2nd order low pass filter.
9. Design and implementation of Chebyshev 1st and 2nd order high pass filter.

**Text Books:**

**1. Signals and Systems**, Simon Haykin and Barry Van Veen, John Wiley & Sons, 2001.Reprint 2002
**2. Modern Digital Signal Processing**, V. Udayashankara, Second Edition, PHI

**Reference Book:**

1. **Signals and Systems**, Roborts, TMH, 2004
2. **Digital Signal Processing**, S K MITRA, McGraw-Hill 4th Edition.2002 Reprint.

**E Books:**

1. NPTEL lecture Video on Signals and Systems by Prof. S.C.Dutta Roy, and Prof. T.K. Basu, IIT Kharagpur.
2. http://www.satishkashyap.com/2012/04/iit-video-lectures-on-signals-and.html
3. http://www.nptel.ac.in/courses/108105065/
4. http://cnx.org/contents/a80b2905-e6aa-4f4e-8460-f2e13980c389@1/Laboratorymeasurement-of-impu
5. The Scientist and Engineer's Guide to Digital Signal Processing By Steven W. Smith, Ph.D.
6. Digital Signal Processing Principles, Algorithms, and Applications Third Edition John G. Proakis Northeastern University Dimitris G. Manolakis.
7. http://freevideolectures.com/Course/2339/Digital-Signal-Processing-IITKharagpur

| EI 502 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | | 3 | | | | | | | | | | | | |
| CO2. | | 3 | | | | | | | | | | | | |
| CO3. | | | 2 | | 3 | | | | | | | | 2 | 3 |
| CO4. | | 3 | | | | | | | | | | | | |
| CO5. | | | | | | | | 2 | 2 | | | | | |

| Course Title: | CONTROL SYSTEMS | L | T | P | C |
|---|---|---|---|---|---|
| Course Code: | 21EI503 | 3 | 0 | 2 | 4 |
| Hours / week: 4 | CIE: 50 Marks SEE: 50 Marks Exam hours: 3 Total hours:40 + 12 Slots(Practical Sessions) | | | | |

**Prerequisites**: Mathematics & Network Analysis

**Course outcomes:** Upon the completion of this course student will be able to:

CO1: Distinguish control system with and without feedback and their roll
CO2: Develop the mathematical model of various systems using topological model approach
CO3: Evaluate the transient and study state responses of systems in time domain
CO4: Determine the stability and the range of gain for stability of higher order systems based on the specific criteria
CO5: Examine the relation between the location of roots and stability of a system using analytical/graphical approach
CO6: Evaluate the stability of open loop and close loop system using graphical approaches in frequency domain

**MODULE 1**

| | |
|---|---|
| **Introduction to Control Systems and Modelling:** Control System; Definition and basic components of control systems, Open loop control system versus closed control system, Feedback and its effects, Classifications of control system.Definition of Modelling, Types of modeling of physical systems Mechanical systems:<br>**Modeling of Systems:**Definition of Transfer function, Mathematical Modelling of Mechanical Systems; Translational systems, Modelling of idealized elements, D'Alembert's Principle, Differential equations of systems (Mechanical accelerometer, Levered systems excluded), Rotational systems, (Gear trains excluded), Analogous modeling oωf Mechanical Systems: F-V and F-I Analogous systems, Transfer function of Electrical, Mechanical systems and Electro-mechanical systems( DC motors and Solenoid) using Block diagram approach. | 10 Hours |
| **MODULE 2** | |
| **Time-domain analysis of Control System-1:** Standard test signals,First Order System(FOS); Unit step, ramp and impulse response and their interrelations, Second Order System(SOS); Unit step responses of SOS(excluding the derivation of over damped case), Transient response specificationsof Second Order System, TR analysis in terms of variations in damping ratio ($\xi$) and undamped natural frequency($\omega_n$)<br>**Time-domain analysis of Control System-2:**Steady state response of SOS and its specification, Causes for Steady state error, analysis of Steady state error in terms of inputs and nature of systems, Type of system and steady state error constants.<br>Analysis of locations of roots in s-plane on Transient and steady – state error od SOS. | 10 Hours |
| **MODULE 3** | |
| **Stability of Linear Control Systems:**DefinitionandConcepts of stability, Types of Stability, Different methods for the evaluation of stability of a system,Routh-Herwitz criterion; Necessary and sufficient conditionsfor Absolute Stability,determining the range of gain for stability of a system, Relative stability analysis using Routh's stability criterion.<br><br>**Root Locus Technique:** Introduction, Concept of root locus in terms of gain, Construction rules ofroot loci. Evaluation of stability of various systems (Open loop transfer function) using Root Locus technique and analysis | 10 Hours |
| **MODULE 4** | |
| **Frequency Response analysis of control System-1:**<br>**Bode Plot technique:** Introduction, Correlation between time and frequency response, Bode plots; Gain cross over frequency, Phase cross over frequency, Gain margin and Phase margin, Assessment of relative stability using Bode Plots.<br>**Frequency Response analysis of control System-2:**<br>**Nyquist Stability Criterion:** Mathematical preliminaries, polar plot, Nyquist Stability criterion, (Inverse polar plots excluded), Assessment of relative stability using Nyquist criterion. | 10 Hours |

**Lab Component:**

*Note: Evaluation of this course is done based on the rubrics which will be shared with the students by the course faculty.

| | Experiments |
|---|---|
| 1 | For a 2nd order system (RLC circuit), Varying $\zeta$, keeping $\omega_n$constant<br>[a] To Determine the step response and its transient response specifications for various cases<br>[b] To Verify theoretically for under damped case |
| 2 | For a 2nd order system (RLC circuit), Varying $\omega_n$ ,keeping $\zeta$ constant<br>[a]To Determine the step response and its transient response specifications for various cases<br>[b] To Verify theoretically for under damped case |
| 3 | To Analyze the stability of SOS for a step input by<br>a. Varying $\zeta$, keeping $\omega_n$constant<br>b. Varying $\omega_n$ ,keeping $\zeta$ constant |
| 4 | To design and determine the frequency response of a lead network |
| 5 | To design and determine the frequency response of a lag network |
| 6 | To design and determine the frequency response of a lead-lag network |
| 7 | Design of relay driving circuits using opto-couplers, for relays of lower current rating |
| 8 | Design of relay driving circuits using opto-couplers, for relays of higher current rating |
| 9 | Design of relay driving circuits using LDR. |
| 10 | Realization of non-linear function-Dead zone using op-amps. |
| 11 | Realization of non-linear function- saturation using op-amps. |
| 12 | Determine the response of P, PI and PID controller for step input |

**CO-PO, PSO Mapping**

| EI 503 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | | | 3 | | | | | | | | | | | |
| CO2. | | 3 | | | 1 | | | | | | | | | |
| CO3. | | | | | | | | | 3 | 2 | | | | 3 |
| CO4. | | | | | | | | 3 | | | | | | |
| CO5. | | | | | | | | | | 3 | | | | |
| CO6. | | 3 | | | | | | | | | | | | |

**Text Book:**

**1. Control Systems Engineering**, J. Nagarath and M.Gopal, New Age International (P) Limited, Publishers – 4th Edition, 2105

**Reference Books:**

1. **Modern Control Engineering**, K. Ogata, Pearson Education Asia/ PHI,2102,4th Edition.
2. **Automatic Control Systems**, Benjamin C Kuo, ,PHI,7rd Edition,210

**E Books:**

1. http://en.wikibooks.org/wiki/Control_Systems
2. http://www.electrical4u.com/control-system-closed-loop-open-loop-controlsystem/#practical-examples-of-open-loop-control-system
3. http://www.facstaff.bucknell.edu/mastascu/eControlHTML/CourseIndex.html

**MOOCs:**
1. www.nptel.com/IITK
2. https://www.edx.org/course/
3. http://nptel.ac.in/courses/108103007/1
4. https://www.mooc-list.com/tags/control-system?static=true
5. https://www.class-central.com/mooc/2178/upv-x-dynamics-and-control
6. http://nptel.ac.in/courses/108102143/

| Course Title: | DATA CONVERTERS AND VIRTUAL INSTRUMENTATION | L | T | P | C |
|---|---|---|---|---|---|
| Course Code: | 21EI504 | 3 | 0 | 2 | 4 |
| Hours / week: 3 | CIE: 50 Marks SEE: 50 Marks Exam hours: 3 Total hours: 40+12 | | | | |

**Prerequisites**: Logic Design, Electronic Measurements.
**Course Outcomes:** Upon the completion of this course student will be able to:
CO1: Explain the specifications and working of ADCs and DACs.
CO2: Apply DAC and ADC for specific applications.
CO3: Explain the fundamentals of graphical programming language.
CO4: IllustrateLab VIEW programming constructs for Virtual Instrumentation subprograms.
*Note: Evaluation of lab component of this course is done based on the rubrics which will be shared with the students by the course faculty.

## MODULE 1

**General considerations and Converter Specifications:** Introduction, basic converter considerations, digital logic levels and control logic. Specifications: Accuracy, acquisition time, aperture time, code skipping/code elongation, common mode range, conversion time, glitch and de-glitcher, droop rate, monotonicity, settling time, stability and switching time.

**Digital to Analog Converters:** D/A conversion techniques, DAC components and accuracy considerations. Numerical examples on DAC.

**Self Study Component:** Noise, Resolution, Quantization error, Slew rate

**10 Hours**

## MODULE 2

**Analog to Digital Converters:** A/D conversion techniques, types of ADC and error sources in ADC. Numerical examples on ADC.
**Applications of DAC: Data distribution, frequency synthesizer, digital to shaft position converter, liquid flow control and programmed power supplies.**

**Self Study Component: CRT displays, signal generator, A/D converters**

**10Hours**

## MODULE 3

**Applications of ADC:** Electronic weighing system, automatic calibrator for multi-channel signal conditioning system, ratio-metric measurement, data acquisition system and automotive diagnostic test systems.

**Introduction to Lab view**: Data flow and Graphical Programming Language, working of Lab view Examples-Temperature System and frequency response Virtual Instrumentation-using Lab view in the real world, the evolution, Data Acquisition, GPIB, Communication using serial port, ,PXI and VXI Lab view Add-on tool kits, Lab view real-time, FPGA,PDA and Embedded.

**Self Study Component:** Digital voltmeters, Digital micrometer, Plasma TV panel display, Real world Applications of Lab View

**10 Hours**

## MODULE 4

**Lab view Environment-I**:Front Panels ,block diagrams ,Lab view projects ,Sub VIs, the Icon and the Connector, Alignment Grid and Pull down Menu's.

**Lab view Environment-II**: Floating Palettes, the Tool bar, Popup Menus, Express VIs, Displaying Sub VIs as expandable nodes

**Self Study Component:** Activity-Front Panel and block diagram basics.

**10 Hours**

**Text Books:**


1. **Hand book of A/D & D/A converters**. HNATEK,John Wiley,2nd Edition,1985
2. **Labview for Everyone :Graphical Programming made easy and Fun**.(Third Edition)Author-Jeffrey Travis and Jim Kring.Publishers-Pearson Education.


**Reference Books:**


1. **Principles of data conversion system design**,Behzadrazavi IEEE press 1995.
2. **Lab view manual**- National Instruments


**LAB COMPONENT:**

1. Sample and Hold Circuits with discrete components
2. Analog multiplexer.
3 .Programmable gain amplifier (PGA) using Analog multiplexer.
4 .Digital to analog converter (DAC-0800).
5. R-2R Ladder Network and Binary weighted resistance DAC.
6. Basic programming and simulation experiments
7. Measurement of temperature using Thermistor.
8. Measurement of temperature using Thermocouple.
9. Measurement of load using strain gauges.

| EI 502 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PO12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | | 3 | | | | | | | | | | | 2 | 3 |
| CO2. | | 3 | | | | | | | | | | | | |
| CO3. | | | 2 | | 2 | | | | | | | | | |
| CO4. | | | | | 3 | | | | | | | | | |

| Course Title: | MINI PROJECT I | L | T | P | C |
|---|---|---|---|---|---|

| Course Code: | 21EI505 | | | 0 | 0 | 2 | 1 |
|---|---|---|---|---|---|---|---|
| Hours / week: 2 | CIE: 100 | SEE: N/A | Exam hours: N/A | | | | |

Course Outcomes: Upon the completion of this course student will be able to:
CO1: Identify the need based problem
CO2: Develop engineering model considering needs of society, environment and ethics as a team
CO3: Summarize thework, document and present.
CO4: Demonstrate the management principles.
CO5: Develop solution by considering sustainable design
CO6: Identify necessity of lifelong learning from technological perspective

Guidelines to Carryout the Mini-Project:

1. A group of 3 or 4 students is expected to design and demonstrate working of a mini project.
2. Course Advisors will advise students on preparation of synopsis, design and implementation of the undertaken project work.
3. Each group has to independently carryout the project work in the allotted time of 3 hours/week.
4. The mini-project work is to be based the concepts and Hands-on experience in Laboratory courses already studied.
5. A duly signed report consisting of salient features and results is to be submitted before final demonstration.
6. The pattern of evaluation is as follows:
   - Project proposal write-up & presentation - 21 Marks
   - Interim evaluation - 21 Marks
   - Final evaluation - 60 Marks
7. The panel of evaluation consists of HOD, course advisor, coordinator and two senior faculties (Nominated by HOD).

| EI 505 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | | 3 | 2 | 1 | | | | | | | | | 2 | 2 |
| CO2. | | | 3 | | | 2 | 1 | 2 | 2 | | | | | |
| CO3. | | | | | | | | | | 3 | | | | |
| CO4. | | | | | | | | | | | 3 | | | |
| CO5. | | | | | | | | | | | | 3 | | |

**21AAD-Analytical Ability Development (0-1-0) 1**

**CIE: 100 Marks** **Hours/Week: 3**

**Total Hours: 45**

**Course Outcomes:** At the end of course, student will be able to:

| # | Course Outcomes | Mapping to POs | Mapping to PSOs |
|---|---|---|---|
| 1. | Apply analytical skills to solve problems | 10 | - |

Speed, distance and time, Numbers, Clock and calendar, Permutations & combinations, Probability, Ratios and proportions, Profit & loss, Percentage, Simple & compound interest,

**Scheme of Evaluation:**

**CIE**- 5 quizzes each for 10 marks.

**21EVS** **(0-0-2) 0**

## ENVIRONMENTAL STUDIES

**Course Outcomes (COs)**

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

| | | |
|---|---|---|
| CO1. | Apply with representing the dimension of the societal health, safety, legal and cultural issues as engineer to the given Engineering problem of environmental concern. | PO6 PO8 |
| CO2. | Evaluate the need for sustainable development having understood the adverse effects of present day development on the environment and by Self reflection on the individual day to day practices | PO7 PO12 |
| CO3. | Develop and present report effectively as member/ leader of the team on the optimal use resources at individual and group level using modern tools. | PO5 PO9 PO10 |
| CO4. | Demonstrate the adoption of ethics and lifelong practice of learning, the role and responsibility towards the environment as an engineering professional. | PO8 PO12 |

**Module 1:**

**Environment :**Definition, Eco system – components of ecosystem, Balanced eco system.
Impact of human activities on environment – Agriculture – Housing – Industry – Mining and Transportation. :

**04 hrs**

**Module 2:**

**Environmental Pollution**: Water pollution-, Air pollution – Land pollution- Noise Pollution. :

**6 hrs**

**Module 3:**

**Global Environmental Issues**: Water & Waste Water Management. Climate change and Global Warming, Acid rain & Ozone layer depletion: controlling measures. Land Management, Solid Waste Management, E – Waste Management & Biomedical Waste Management – Sources, Characteristics & Disposal methods, Population Growth, Urbanization, : **08 hrs**

**Module 4:**

**Environmental Protection- Legal aspects:** Environmental impact assessment and sustainable development. Environmental Acts & Regulations- Water act and Air act. Role of government and Nongovernmental Organizations (NGOs) , Environmental Education & Women Education. :

**08hrs**

**Textbooks**


1. R Rajagopalan, "Environmental Studies – From Crisis to Cure", Oxford University Press, 2105
2. S.M. Prakash "Environmental Studies" Elite publishers, Mangalore. 2107


**Reference Books** :


1. Benny Joseph "Environmental Studies" Tata Mc Graw hill
2. P. Venugopala Rao "Principles of Environmental Science and Engineering" Prentice hall of India.
3. P. Meenakshi "Elements of Environmental Science and Engineering" Prentice hall of India Private Limited, New Delhi, 2106
4. Erach Bharucha, "Text Book of Environmental Studies", for UGC, University press, 2105


| | | | |
|---|---|---|---|
| **Course Title** | **Social Connect & Responsibility** | | |
| **Course Code** | **22SCR** | **L-T-P** | **(0-0-2)1** |
| **Exam** | **3 Hrs.** | **Hours/Week** | **2** |

| SEE | 50 Marks | Total Hours | 15 |
|---|---|---|---|

**Course Objective:** Provide a formal platform for students to communicate and connect withtheir surroundings and create a responsible connection with society

**Course outcomes:** At the end of course, student will be able to:

| # | Course Outcomes | Mapping toPO's | Mapping toPSO's |
|---|---|---|---|
| 1 | Describe societal challenges and build solutions to alleviate these complex social problems through immersion, design & technology. | 6 | - |
| 2 | Communicate and connect with their surroundings. | 7,12 | - |

## MODULE – 1

**Plantation and adoption of a tree:** Plantation of a tree that will be adopted by a group of students. They will also make an excerpt either as a documentary or a photo blog describing the plant's origin, its usage in daily life, and its appearance in folklore and literature.

## MODULE – 2

**Heritage walk and crafts corner:** Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsman, photoblog and documentary on evolution and practice of various craft forms.

## MODULE -3

**Organic farming and waste management:** Usefulness of organic farming, wet waste management in neighboring villages, and implementation in the campus.

## MODULE -4

**Water Conservation:** knowing the present practices in the surrounding villages and implementation in the campus, documentary or photo blog presenting the current practices. **Food Walk** City's culinary practices, food lore, and indigenous materials of the region used in cooking.

## Course Conduction

A total of 14-20 hrs engagement per semester is required for the course. Students will be divided into teams and each team will be handled by two **faculty mentors**. Faculty mentors will design the activities for evaluation.

**Guideline for Assessment Process:**

**Continuous Internal Evaluation (CIE):** After completion of, the social connect, the student shall prepare, with daily diary as reference, a comprehensive report in consultation with the mentor/s to indicate what he has observed and learned in the social connect period. The report should be signed by the mentor.

**VI Semester Syllabus**

| Course Title: | INDUSTRIAL COMMUNICATION SYSTEMS | L | T | P | C |
|---|---|---|---|---|---|
| Course Code: | 21EI601 | 3 | 0 | 0 | 3 |
| Hours/week:3 | CIE: 50 Marks SEE: 50 Marks Exam hours: 3 Total hours: 40 | | | | |

Course Outcomes: Upon the completion of this course student will be able to:
**CO1:** Distinguish various process control devices and data communication modes.
**CO2:** Explain the relevance of Modbus and Profibus in process industries.
**CO3:** Identify fundamentals of HART and field bus.
**CO4:** Illustrate safety systems and advancements in process control.

**Module-1**

**Modern instrumentation and control systems**: control of process devices, Distributed control systems (DCSs), Programmable logic controllers (PLCs), Supervisory control and data acquisition (SCADA) system, Smart instrumentation systems, Open systems interconnection (OSI) model, Protocols, Standards.

**Data Communication and Networking:** Introduction, Communication Networks, Signal transmission, Data transmission, Data Communication protocol, Inter-process Communication, Cyber security
**Self-study components:** Self and Redundant networks

**10 Hours**

**Module-2**

**Modbus overview:** Modbus protocol structure, Function codes, troubleshooting: common problem and faults: Faulty communication interfaces, tools used in troubleshoot
**Self-study components:** Troubleshooting**:** Missed wire communication

**Profibus overview:**Introduction, Profibus, protocol stack, Profibus communication model, Relationship between application process and communication, Communication objects.
**Self-study components:** Real time applications in process industries.

**10 Hours**

**Module-3**

**HART overview:** HART protocol, Physical layer, Data link layer, Application layer, troubleshoots.
**Self-study components:** Wireless HART protocol

**Fieldbus Technology:** Introduction, Centralized Input-Output, Remote Input-Output, Fieldbus Input-Output, Fieldbus communication, Fieldbus device integration
**Self-study components:** Wireless Sensor networks, Industrial Ethernet**.**

**10 Hours**

**Module-4**

.

**Safety systems**: Process safety management, Risk, Risk assessment, Risk reduction, Safety Instrumented system, Safety Integrity Levels, Safety Instrumented Function, Safety Standards, Integrated Control and Safety Systems,
**Self-study components**:Machine Safety Management: Challenges, risk assessment and reduction

**Information Technology-operation technology:** Introduction to operation technology and information technology, before convergence, gap, bridging the gap, after convergence benefits, security, ISA 95 standard, before, after benefits
**Self-study components:**Internet of things, industrial internet of things. Industry 4.0

**10 Hours**

**Text Books:**

1. **Practicle Industrial data networks design, installation and troubleshooting-** Steve Mackay, Edwin Wright DeonReynders , John Park Australia.
2. **Overview of Industrial Process Automation**- KLS Sharma, Second Edition, Elsevier

**Reference Books:**

1. **Data communication and Networking,** Forouzan,5th Edition, Pearson Education, 2113.
2. **Computer Networks**, James J Kishore, Keith W Rose, Pearson Education, 2113**.**

**MOOCs:**

1. https://www.classcentral.com/course/swayam-industrial-automation-and-control.
2. https://www.classcentral.com/course/fundamentals-network-communications-9267
3. https://www.classcentral.com/course/network-protocols-architecture-9159

**E Books:**

1. **Computer buses** by William Buchanan
2. **Industrial Communication Technology Handbook**, BY Richard Zurawski,, Second Edition.

| EI 601 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | | 2 | | | | | | | | | |
| CO2 | | | | | 2 | | | | | | | | | |
| CO3 | | | | | 3 | | | | | | | | | |
| CO4 | | | | | | 3 | | | | | | 2 | 2 | 2 |

| Course Title: | ANALYTICAL INSTRUMENTATION | L | T | P | C |
|---|---|---|---|---|---|
| Course Code: | 21EI602 | 3 | 0 | 0 | 3 |
| Hours / week: 3 | CIE: 50 Marks SEE: 50 Marks Exam hours: 3 Total hours: 40 | | | | |

**Course Outcomes:** Upon completion of this course, students should be able to:
CO1: Determine different components from the constituents of compound using visible and UV range
CO2: Explain working principle of atomic absorption and mass spectrometry
CO3: Illustrate Raman's scattering to determine molecular weights of various compounds
CO4: Determine different components using retention time, and thermo analytical methods
CO5: Identify industrial gases using analytical techniques.

**Module 1**

**10Hours**

**Colorimeters and Spectrophotometers (Visible-UV):** Electromagnetic radiation, Laws relating to Absorption of Radiation, Absorption Instruments. Ultraviolet and Visible Absorption Spectroscopy, Colorimeters Photometers, Spectrophotometers, Source of Error in Spectro photometric Measurements.

**Module 2**

**10 hours**

**Atomic Absorption Spectrophotometers:** Atomic Absorption Spectroscopy, Atomic Absorption Instrumentation, Sources of Interference.

**Raman Spectrometer:** Raman effect, Raman Spectrometer, PC based Raman Spectrometer, Infrared and Raman Micro spectrometry.

**Module 3**

**10Hours**

**Mass Spectrometer:** Basic Mass Spectrometer, Principle of operation, Types of mass spectrometers, Components of Mass spectrometers

**Gas Chromatographs:** Chromatography, Basic Definitions of Chromatography, Gas Chromatography, Basic Modules of a Gas Chromatograph, Methods of Measurement of Peak areas.

**Module 4**
**10 hours**

**Thermo-analytical Instruments:** Thermo-analytical Methods, Thermo gravimetric Analysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimeter, Simultaneous Thermal Analysis Mass Spectrometer.

**Industrial gas analyzer:** Types of gas analyzers, Paramagnetic oxygen analyzer, Magnetic wind instruments, The Electrochemical methods, Infrared gas analyzers

**Text Book:**

1. Hand book of Analytical Instrumentation: R.S. Khandpur, Second Edition, TMH, 2106.

**Reference Book:**

1. Instrumental Methods of Chemical Analysis: Gurdeep R. Chatwal, Sham K. Anand, Himalaya Publishing House, 5th Edition,2105

| EI 602 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | | | | | | | | | | | | | |
| CO2 | 2 | | | | | | | | | | | | | |
| CO3 | 3 | | | | | | | | | | | | | |
| CO4 | 2 | | | | | | | | | | | 2 | 2 | 2 |
| CO5 | | | | | 2 | | | | | | | | | |

| Course Title: | ADVANCED CONTROL SYSTEMS | L | T | P | C |
|---|---|---|---|---|---|
| Course Code: | 21EI603 | 3 | 0 | 2 | 4 |
| Hours / week: 4 | CIE: 50 Marks SEE: 50 Marks Exam hours: 3 Total hours: 40+12 | | | | |

**Prerequisites**: Control systems, Mathematics

**Course Outcomes:** Upon completion of this course, student should be able to

CO1: Design compensator for desired transient and steady state responses using root locus and frequency domain

CO2: Construct the state space model for continuous and discrete time system

CO3: Evaluate the time responses of continuous and discrete time system using state variable approach

CO4: Design the state variable feedback for pole placement in desired locations

*Note: Evaluation of lab component of this course is done based on the rubrics which will be shared with the students by the course faculty.

| Module 1 | |
|---|---|
| **Design of Lead / lag / lead- lag compensators:**Design of Lead, lag, lead lag network and compensators using Root locus techniques (including problems)Design steps of Lead, lag, lead lag compensators using Frequency domain(Bode) techniques (excluding problems).<br>**State space method for LTI continuous time systems:** Introduction to state space, state space representation of electrical/Mechanical/Electromechanical systems using physical variables, state | 10 hours |
| **Module 2** | |

| | |
|---|---|
| **Analysis of LTI continuous time systems using state space method-1**: Conversion of state variable Models to Transfer functions, Conversion of Transfer functions to state variable models: First companion form, second companion form and canonical form.<br>**Analysis of LTI continuous time systems using state space method -2**:<br>Transformation of state space models: Concept of Similarity Transformation, Invariance properties, computation of diagonalizing matrix: Eigen values and Eigen vectors for distinct/repeated roots, Transformation of physical / phase variables-based state space models into canonical variables-based state space models | 10 hours |
| **Module 3** | |
| **Solution of state equations:** Solution of state equations for homogeneous and non homogeneous systems, Computation of State Transition matrix ($e^{At}$) using Laplace Transformation, Similarity transformation and Caley-Hamilton theorem methods, Problems on finding the Solution of state equations for both homogeneous and non homogeneous systems by computing STM.<br>**Analysis of continuous time systems:** State transition matrix (STM) and its properties, Controllability and Observability: definitions, Kalman's test, Gilberts test for both distinct and repeated roots and using s plane. Duality property | 10 hours |
| **Module 4** | |
| **State space method for discrete time systems:** Introduction, state space representation using physical variables, state diagram, Conversion of state variable Models to Pulse Transfer functions, Conversion of Pulse Transfer functions to state variable models: First companion form, second companion form and canonical form..<br>**Pole placement design and state observers for both Continuous and Discrete time systems:** Introduction, Stability improvement by state feedback, Necessary and sufficient conditions for arbitrary Pole – Placement, Design of State regulator Design and State Observers | 10 hours |

**Textbooks:**

**1.Digital control and state variable methods**, Madan Gopal, PHI, 2nd Edition, 2105.
**2.Discrete time Control Systems**, K.Ogata, PHI publication, 2nd Edition, 2105.

**Reference Books:**

**1. Modern Control Engineering** , K. Ogata, PHI publication, 3rd Edition, 2102.
**2. Modern Control Engineering**, Roy Choudhury, PHI, 2nd Edition ,2104.

| | **Lab Experiments Using MATLAB** |
|---|---|
| 1 | For the given 2nd order system, Varying ζ, keeping $\omega_n$constant<br>[a] To determine ζ,, $\omega_{n,\text{ and}}$ transient response specifications for various cases<br>[b] To plot the step response<br>[c] To evaluate the stability (location of Poles) |
| 22 | For the given closed loop 2nd order system<br>[a] To Determine unit step response and for various values of ζ<br>[b] To plot the step response<br>[c] To determine the accuracy approximately |
| 3 | To design and obtain the frequency response of a lead network |
| 4 | To design and determine the frequency response of a lag network |
| 5 | To verify the design of lead/lag/lead0lag compensators for a given system |
| 6 | For a given transfer functions<br>[a] To plot the root locus with and without compensation and<br>[b] To verify using theoretical analysis<br>[c] To evaluate the stability |
| 7 | For a given transfer functions<br>[a] To plot the bode diagram with and without compensation and<br>[b] To verify using theoretical analysis<br>[c] To evaluate the stability |
| 8 | For a given transfer functions<br>[a] To plot the Nyquist diagram with and without compensation and<br>[b] To verify using theoretical analysis<br>[c] To evaluate the stability |
| 9 | To Transform the given system model<br>[a] State space model in to transfer function |

| | |
|---|---|
| | [b] transfer function into State space model |
| 10 | To obtain the unit step response of the given state space model |
| 11 | To determine the eigen values, eigen vectors and transformation matrix for a given SS model |
| 12 | To evaluate the controllability and observability of a given ss model |

| EI 604 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | | | 3 | | | | | | | | | | | |
| CO2. | | | 3 | | | | | | | | | | | |
| CO3. | | 3 | | | 1 | | | | | | | | | |
| CO4. | | 3 | | 2 | | | | | | | | | | 3 |

| Course Title: | EMBEDDED SYSTEM DESIGN LAB | L | T | P | C |
|---|---|---|---|---|---|
| Course Code: | 21EI604 | 0 | 0 | 2 | 1 |
| Hours / week: 3 | CIE: 50 Marks SEE: 50 Marks Exam hours: 3 Total Slots: 13 | | | | |

**Prerequisites**: Microprocessors and Microcontrollers.
**Course Outcomes:** Upon completion of this lab, student should be able to:
CO1: Develop Keil program usingARMCsyntax.
CO2: Design embedded systemto interface input and output peripherals
CO3: Adapt delivered instructions for working and writing reports
*Note: Evaluation of this course is done based on the rubrics which will be shared with the students by the course faculty.

1. Control the direction and speed of DC motor.
2. Display count value from 0000H-FFFFH and vice versa on 7 segment display.
3. Display binary count value on LED display.
4. Rotate the stepper motor in clockwise and anti-clockwise direction.
5. Generate sine, square, triangle wave forms by using internal DAC.
6. Display alphanumeric characters on LCD display.
7. Show the occurrence of external interrupt by turning ON of LED and buzzer for 1 sec.
8. Interface 4×4 keypad and display pressed key on LCD display.
9. Generate a pulse of given period and duty cycle using on chip PWM module.

**Note:-**Hardware experiments are to be conducted using LPC2148 microcontroller based trainer units.

| Course Title: | MINI PROJECT II | L | T | P | C |
|---|---|---|---|---|---|
| Course Code: | 21EI605 | 0 | 0 | 4 | 2 |
| Hours / week: 3 | CIE: 100 SEE: N/A Exam hours: N/A | | | | |

Course Outcomes: Upon the completion of this course student will be able to:
CO1: Identify the need based problem
CO2: Develop engineering model considering needs of society, environment and ethics as a team
CO3: Summarize thework, document and present.
CO4: Demonstrate the management principles.
CO5: Develop solution by considering sustainable design
CO6: Identify necessity of lifelong learning from technological perspective

Guidelines to Carryout the Mini-Project:

8. A group of 3 or 4 students is expected to design and demonstrate working of a mini project.
9. Course Advisors will advise students on preparation of synopsis, design and implementation of the undertaken project work.
10. Each group has to independently carryout the project work in the allotted time of 3 hours/week.

11. The mini-project work is to be based the concepts and Hands-on experience in Laboratory courses already studied.
12. A duly signed report consisting of salient features and results is to be submitted before final demonstration.
13. The pattern of evaluation is as follows:
    - Project proposal write-up & presentation - 21 Marks
    - Interim evaluation - 21 Marks
    - Final evaluation - 60 Marks
14. The panel of evaluation consists of HOD, course advisor, coordinator and two senior faculties (Nominated by HOD).

| Course Title: | OOP AND DATA STRUCTURES | L | T | P | C |
|---|---|---|---|---|---|
| Course Code: | 21 EI651 | 3 | 0 | 0 | 3 |
| Hours / week: 3 | CIE: 50 Marks SEE: 50 Exam hours: 3 Total hours: 40 | | | | |

**Course Outcomes:** Upon completion of this course, students should be able to:
CO1: Distinguish between programming Paradigms, user-defined data types and functions
CO2: Develop C++ programs using classes, objects and polymorphism concepts
CO3: Develop C++ programs using the concepts of code re-usability and pointers
CO4: Illustrate elementary data structures
CO5: Develop C++ programs to multidisciplinary domain applications

**Module-1**

**C++ programming basics**: Need for object oriented programming, procedural languages, characteristics of OOP, preprocessor directives, data types, manipulators.

**5Hours**

**Structures**: Structures as user defined data types, enumerated data types, Functions: passing arguments, returning values, reference arguments, overloaded functions, inline functions.

**5Hours**

**Module 2**

**Objects and classes**: Objects as data types, constructors, destructors, overloaded constructors. Arrays: Arrays as class member data types, passing arrays, arrays as objects, strings.

**5Hours**

**Operator overloading**: Over loading of unary operators, binary operators and data conversion.

**5Hours**

**Module 3**

**Inheritance**: Derived and base class, levels of inheritance, multiple inheritance, Hybrid inheritance and virtual base class.

**5Hours**

**Pointers:** Pointers in C++, pointers to objects, files and streams, input/output operations.

**5Hours**

**Module 4**

**Data structures-1:** Data representation stacks and linked list.

**5Hours**

**Data structures-2:** Queues: Single ended, D-queue and Priority queues; binary trees and its representation.

**5Hours**

**Text Books:**
1. **Object oriented programming in TURBO C++**, Robert Lafore, Galgotia Publications, 2nd Edition.
2. **Data Structures, Algorithms and Applications in C++**, SartajSahni, Tata McGraw Hill Publications. 2nd Edition.

**Reference Books:**
1. **C++ Programming**, BjrneStrounstrap, Addison-Wesley Publications, 3rd Edition.

2. **Object Oriented Programming with C++**, E Balaguruswamy, Tata McGraw Hill Publications, 3rdEdition.

**E-Books:**
1. www.ddegjust.ac.in/studymaterial/mca-3/ms-17.pdf
2. https://programesecure.com/balaguruswamy-c-pdf-free-download/

**MOOCs**
1. https://www.mooc-list.com/course/object-oriented-programming-edx
2. https://www.mooc-list.com/course/object-oriented-programming-java-coursera
3. http://nptel.ac.in/video.php?subjectId=108102143
4. http://nptel.ac.in/courses/108101037/41
5. http://nptel.ac.in/courses/106102164/

| Course Title: | MICRO AND SMART SYSTEMS TECHNOLOGY | L | T | P | C |
|---|---|---|---|---|---|
| Course Code: | 21EI652 | 3 | 0 | 0 | 3 |
| Hours / week: 3 | CIE: 50 Marks SEE: 50 MarksExam hours: 3 Total hours: 40 | | | | |

**Prerequisites**: Transducer and Instrumentation, Control Systems
**Course Outcomes**: Upon completion of this course, students should be able to:
- CO1. Explain micro systems and their role in automobile and biomedical fields
- CO2. Explain the various fabrication technologies and micro machining technologies of micro systems.
- CO3. Illustrate the working of micro sensors and micro actuators.
- CO4. Develop suitable signal conditioning circuits for micro sensors.
- CO5. Explain various packaging technologies of micro devices.

**MODULE-1**

**Introduction to MEMS and Micro systems:** MEMS and Micro systems. Comparison of Micro systems and Microelectronics. Evolution of micro-manufacturing. Multi-disciplinary aspects. Micro systems and Miniaturization, Applications areas.

**Hours**

**Micromachining Technologies-I:** Silicon as a material for micro machining, Lithography, Ion Implantation, Diffusion, Oxidation, Thin-film deposition and Etching.

**5 Hours**

**MODULE-2**

**Micromachining Technologies – II:** Bulk micromachining, Silicon micromachining, wafer bonding and LIGA Process.

**5 Hours**

**Micro Sensors, Actuators, Smart Materials and Systems-1:** Silicon capacitive accelerometer, Piezo-resistive pressure sensor, Conductometric gas sensor, Portable blood analyzer. Electrostatic comb-drive.

**5 Hours**

**MODULE-3**

**Micro Sensors, Actuators, Smart Materials and Systems-2:** Principle means for micro actuation, micro grippers, Piezo-electric based inkjet print-head, Magnetic micro relay, Silicon micro-mirror arrays. Smart Materials and systems.

**5 Hours**

**Electronics Circuits and Control for Micro and Smart Systems-1:** Semiconductor Devices: Operational amplifiers. Basic Op-Amp circuits. Difference amplifier, Instrumentation amplifier as a differential voltage amplifier, Wheat stone bridge for measurement of change in resistance.

**5 Hours**

**MODULE-4**

**Electronics Circuits and Control for Micro and Smart Systems-2:** Phase locked loop, ADC, Differential charge measurement, Circuits for measuring frequency shift, Introduction to control theory: Mathematical Description, Representation, State Space Modeling, and Implementation of Controllers**.**

**5 Hours**

**Integration and Packaging of Micro Electro- Mechanical Systems:** Integration of microelectronics, Special issues in Microsystems packaging, Types of Microsystems Packaging: Packaging technologies: Wire Bonding, Flip-Chip Assembly, ball-Grid Array, Embedded Overlay, Wafer-Level Packaging.

**5 Hours**

**Text Books:**

1. **Micro and Smart Systems,** G K Ananthasuresh et al., John-Wiley India, First Edition, 2110
2. **MEMS & Microsystems: Design and Manufacture-** Tai-Ran Tsu, Tata Mc-Graw-Hill.

**E-Books:**

1.https://www.crcpress.com/Bio-MEMS-Technologies-and-Applications/Wang Soper/p/book/9780849335327

2. https://www.amazon.in/Bio-MEMS-Technologies-Applications-Wanjun-Wang-ebook/dp/B009AI34IS

**MOOCs :**

1. https://www.extension.harvard.edu/academics/courses/introduction-mems-biomems/14876
2. https://onlinecourses.nptel.ac.in/noc15_me01/preview

| Course Title: | EMBEDDED SYSTEM DESIGN | | | L | T | P | C |
|---|---|---|---|---|---|---|---|
| Course Code: | 21EI653 | | | 3 | 0 | 0 | 3 |
| Hours / week: 3 | CIE: 50 Marks | SEE: 50 | Exam hours: 3 | | | | Total hours: 40 |

**MODULE-1**

**Introduction:** Embedded system overview, design challenges, common design metrics, processor technology, IC technology, design technology, trade-offs, design productivity gap.

**General Purpose and application Specific Instruction Set Processors:** Introduction, Basic architecture, operation, Programmer's view, development environment- example, DSP, Less-general ASIP environment, selecting a microcontroller, general purpose processor design.

**10 Hours**

**MODULE-2**

**Standard single purpose processor:** Introduction, timers, counters and watch dog timers, UART, Pulse width modulation, LCD controller, key pad controller, stepper motor controller, analog to digital converters, real time clocks.

**Memory:** Introduction, memory write ability and storage performance, common memory types, composing memory, memory hierarchy and cache, advanced RAM

**10 Hours**

**MODULE-3**

**Interfacing:** Introduction, communication basics, arbitration, multilevel bus architectures, advanced communication principles, serial protocols, parallel protocols, wireless protocols.

**Application of embedded system:** Digital camera-Introduction, Introduction to a simple digital camera, requirement specification-non functional requirements, informal functional, refined functional specification, design-implementation 1-microcontoller alone, Implementation 2: microcontroller and CCDPP.

**10 Hours**

**MODULE-4**

**Firmware for embedded system:** Firmware and boot loader, ARM firmware suits, red hat redboot, example: sandstone-standstone directory, layout and code structure.

**Embedded operating system:** fundamental components, example-simple little operating system (SLOS)-SLOS directory layout, initialization, memory model, interrupts and exceptions handling, scheduler, context switch, device driver frame work.

**10 Hours**

**Text books:**

1. Embedded system design: A unified hardware/software, Introduction-Frank Vahid, Tony Givargis, John Wiley and Sons, Inc.2102.
2. ARM System Developer's Guide, Andrew N. Sloss, DomonicSymes and chirs Wright, Elsevier, Morgan Kaufmann Publishers, 2108.

**Reference Books:**

1. Embedded Systems: Architecture and programming, Raj Kamal,TMH,2108.
2. ARM Processor Manual, ISM, Bangalore,2105.

**E-books**

1. https://en.wikibooks.org/wiki/Embedded_Systems
2. https://read.pudn.com/

**MOOCs**

1. http://nptel.ac.in/courses/108102145
2. https://www.coursera.org

| Course Title: | COMPUTER ORGANISATION | | | L | T | P | C |
|---|---|---|---|---|---|---|---|
| Course Code: | 21EI654 | | | 3 | 0 | 0 | 3 |
| Hours / week: 3 | CIE: 50 Marks | SEE: 50 | Exam hours: 3 | Total hours: 40 | | | |

**MODULE-1**

**Basic Structures of Computers:** Computer types : Functional units : Input unit, Memory unit, Arithmetic &logic

unit, Output unit, Control unit; Basic Operational Concepts : Bus Structures : Performance : Processor clock, Basic Performance equation, Pipelining & Superscalar operation, Clock rate, Performance measurement; Multiprocessor &Multicomputers:

**05 Hours**

**Machine Instructions &Programs:** Numbers, Arithmetic operations and characters, Memory Locations & Addresses : Byte addressability, Big-endian & Little-endian assignments, Word Alignment, Accessing Numbers, Memory Operation : Instruction & Instruction Execution & Straight-line sequencing, Branching, Condition Codes, Generating Memory Addresses.

**05 Hours**

**MODULE-2**

**Assembly Language** : Assembler Directives, Number Notation; Basic Input/output Operations : Stacks & Queues : Subroutines : Subroutine Nesting & Processor Stack, Parameter Passing, The Stack Frame; Additional Instructions : Logic Instruction, Shift & Rotate Instructions, Multiplication & Division; General features of CISC & RISC.

**05 Hours**

**Input/output Organization:** Accessing I/O devices : Interrupts : Interrupt Hardware, Enabling & Disabling Interrupt, Handling Multiple devices, Controlling Device Requests, Exceptions; Direct Memory Access : Bus Arbitration; Buses : Synchronous Bus, Asynchronous Bus; Interface Circuits : Parallel Port, Serial Port**.05 Hours**

**MODULE-3**

**The Memory System:** Some Basic Concepts: Semiconductor RAM Memories: Internal Organization of Memory Chips, Static Memories, Asynchronous DRAMs, Synchronous DRAMs, Memory System Considerations, Rambus memory.

**05 Hours**

**The Memory System:** Read-only Memories: ROM, PROM, EPROM, EEPROM, Flash memory; Speed, Size &Cost : Cache Memories : Mapping functions; Performance considerations : Interleaving, Hit Rate & Miss Penalty; Virtual memories : Address Translation.

**05 Hours**

**MODULE-4**

**Arithmetic Unit:** Addition& Subtraction of Signed Numbers. Addition/Subtraction Logic Unit; Signed-Operand Multiplication: Booth Algorithm; Fast Multiplication: Bit-pair Receding of Multipliers; Integer

division: Floating-Point Numbers & Operations: IEEE Standard for Floating-Point Numbers, Arithmetic Operations on Floating-Point Numbers.

**05 Hours**

**Basic Processing Unit:** Some Fundamental Concepts: Register Transfers, Performing an Arithmetic or Logic operation, Fetching a Word from Memory, Storing a Word in Memory; Execution of a Complete Instruction: Branch instruction; Multiple-Bus Organization: Hardwired Control: A Complete Processor**.**

**05Hours**

**Text Book**:

**1. Computer Organization**, Carl Hamacher, Z Vranesic& S Zaky ,TMH, 5th Edition., , 2102

**Reference Books:**

1. **Computer System Architecture**, Morris Mano, 2nd Edition, PHI,1986.
2. **Computer system Design & Architecture**, V Heuring& H Jordan,Addison-Wesley, 1st Edition., 1999.

| Course tittle: | INTERNET OF THINGS | L | T | P | C |
|---|---|---|---|---|---|
| Course Code: | 21EI655 | 3 | 0 | 0 | 3 |
| Hours / week: 3 | CIE: 50 Marks SEE: 50 Marks Exam hours: 3 Total hours: 40 | | | | |

**Course Outcomes (COs):**

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

1. Explain the basic concepts of IoT and about its domain specific.
2. Illustrate IoT system management and design methodologies.
3. Evaluate the data types, data structures and logical design using python.
4. Explain the concepts of Iot devices and its interfaces.

**Module 1**

**Introduction & Concepts**- Definition & Characteristics of IoT; Physical Design of IoT; Logical Design of IoT. IoT Enabling Technologies**:** WSN, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems, Domain Specific IoTs- Introduction, Home Automation; Cities; Environment; Energy; Retail;

**10 Hours**

**Module 2**

Logistics; Agriculture; Industry; Health & Lifestyle, IoT and M2M-Introduction; M2M; Difference between IoT and M2M.Need for IoT Systems management; SNMP; Network Operator Requirements; IoT Systems management with NETCONF-YANF; NETOPEER

**10 Hours**

**Module 3**

**Developing IoT**- IoT Design Methodology: Purpose & Requirements Specification, Process Specification, Domain Model Specification, Information Model Specification, Service Specification IOT Level Specification, Functional View Specification, Operational View Specification, Device & Component Integration & Application Development.Case Study on IOT System for weather Monitoring**,** Logical Design using Python- Introduction; Installing Python; Python Data Types & Data structures;

**10 Hours**

**Module 4**

Control Flow; Functions; Modules; Packages; File Handling; Date/Time Operations;**IoT Physical Devices and Endpoints**- What is an IoT device; Exemplary Device- Raspberry Pi; Linux on Raspberry Pi; Raspberry Pi Interfaces;

**10 Hours**

**Text Book:**

1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands on Approach)", 1stEdition, VPT, 2114

**Reference Books:**

1. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2113
2. Cuno Pfister, Getting Started with the Internet of Things, O"Reilly Media, 2111

**EBooks:**

1.http://www.internet-of-things-research.eu/pdf/IoT-From%21Research%21and%21Innovation%21to%21Market%21Deployment_IERC_Cluster_eBook_978-87-93102-95-8_P.pdf
2. http://support.ptc.com/WCMS/files/160474/en/PTC_eBook_Impact_of_the_IoT_on_Manufacturers.pdf

**MOOCs:**
1. https://www.coursera.org/specializations/internet-of-things
2. http://web.mit.edu/professional/digital-programs/courses/IoT/
3. https://www.mooc-list.com/tags/iot

| Course Title: | PROCESS CONTROL | L | T | P | C |
|---|---|---|---|---|---|
| Course Code: | 21EI656 | 3 | 0 | 0 | 3 |
| Hours / week: 4 | CIE: 50 MarksSEE: 50 Marks Exam hours: 3 Total hours: 40 | | | | |

**Prerequisites**: Logic design, Analog signal conditioning Circuits, Control system, Data Converter
**Course Outcomes**: Upon completion of this course, student should be able to:
CO1: Explain the elements of a process control loop, different standards and symbols used in process control industry.
CO2: Distinguish different process control principles and valve selection procedures for a given application.
CO3: Design various controllers using analog and digital devices
CO4: Illustrate various types of controllers for process compensation
CO5:Evaluate stability and process loop tuning

**Module-1**

**Introduction to Process Control:** Process controls block diagram, control system evaluation, units, standards and definitions (Except1.6.4 of C D Johnson). Converters: Frequency based converters, Data Acquisition Systems: DAS Hardware, DAS software. **Final control:** Introduction to final control operation, signal conversions, actuators, valve actuators, valve positioner..
**Self study:** open loop comparators, comparators with hysteresis

**10 Hours**

**Module-2**

**Control Valves:** Capacity of control valve, valve sizing, determining pressure drop across valve, cavitation and flashing, valve range ability, selection factors, sequencing control valves, viscosity corrections. **Controller principles:** Introduction, process characteristics, control system parameters, discontinuous control modes, continuous control modes, and composite control modes.
**Self study:** various types of control valves depending on their construction.

**10 Hours**

**Module-3**

**Analog controllers**: Introduction, general features, electronic controllers, pneumatic controllers, designs considerations. **Digital controllers**: Digital electronic methods, computers in process control, process control networks, characteristics of digital data.
**Self study**: study of various computer networking methods.

**10 Hours**

**Module-4**

**Combination control systems:** Ratio controller, Cascade controller, saturation in cascade loops, feed forward control, advantages, technique. **Control-loop characteristics**: Introduction, control system configuration, control system quality, stability, and process loop tuning.
**Self study:** Control drawings: P & ID symbols and diagrams: flow sheet symbols, inter logic symbols, graphic symbols, alarms and annotators.

**10 Hours**

**Text Books:**
1. **Process Control Instrumentation Technology**, C D Johnson PHI,8th Edition, 2104
2. **Instrumentation for Process Measurement and control**, Norman.A.Anderson, CRC Press, Third Edition

**Reference Books:**

1. **Instrument Engineers Handbook** (Vol 1 & 2),B G Liptak ,Chilton Book Company, 3rdEdition
2. **Process Control**, K Krishnaswamy, New age International India, 1st Edition, 2106.
3. **Computer based Industrial Control**, Krishna Kant, PHI.

**E Books:**

1. http://www.learnerstv.com/Free-engineering-Video-lectures-ltv689-Page1.htm
2. http://nptel.ac.in/courses/103105064/

**MOOCs:**

1. https://www.mooc-list.com/tags/process-management
2. http://freevideolectures.com/Course/2345/Industrial-Automation-and-Control/3

| Course Title: | ROBOTICS | L | T | P | C |
|---|---|---|---|---|---|
| Course Code: | 21EI657 | 3 | 0 | 0 | 3 |
| Hours / week: 3 | CIE: 50 Marks SEE: 50 Exam hours: 3Total hours: 40 | | | | |

**MODULE-1**

1. **Introduction and Robotic technology:** Automation and robots, brief history, the technology of robots, economic and social issues, present and future applications.Robot Arm Kinematics**:** Introduction, The direct Kinematics Problem, Rotation matrices, Composite Rotation matrix, Rotation matrix about an arbitrary axis, Kinematic equations for manipulators.

**5 Hours**

2. **Robot classification:** classification, arm geometry, degrees of freedom, power sources, types of motion, path control, and intelligence level.

**5 Hours**

**MODULE-2**

3. **Robot system analysis:** robot operation, hierarchical control structure, line tracking, dynamic properties of robots, modular robot components.

**5 Hours**

4. **Robot and effectors:** types of end effectors, mechanical grippers, gripper force analysis, other types of grippers, special purpose grippers, gripper selection and design, process tooling, compliance.

**5 Hours**

**MODULE-3**

5. **Low level Vision:** Image acquisition, illumination Techniques, Imaging geometry, some basic transformations, perspective transformations. Camera model, camera calibration stereo imaging, some basic relationships between pixels, Preprocessing, Smoothing, Edge detection**.**

**5 Hours**

6. **High-Level Vision:** Segmentation, Edge linking and Boundary detection, Thresholding.Safety: robot safety, safety standards, system reliability, human factor issues, safety sensors and monitoring, safeguarding, training, safety guidelines.

**5 Hours**

**MODULE-4**

7. **Industrial applications:** automation in manufacturing, robot applications, material-handling applications, processing operations, assembly operations, inspection operations, evaluating the potential of a robot application.

**5 Hours**

8. **Sensors:** Robot sensors, inductive sensors, Hall effect sensors, sensor classification, micro switches, solid state switches, proximity sensors, photoelectric sensors, rotary position sensors, usage and selection of sensors.

**5 Hours**

**Text Books:**

1. **Robot Technology Fundamentals -** James G. Keramas, Cengage learning
2. **Robotics control sensing Vision and Intelligence-** KS Fu, RC Gonzalez, CSG Lee, McGraw Hill, 1987.

**Reference Books:**

1. **Applied Robotics (An Introduction Book 1&2)-** Edwin Wise, Cengage learning
2. **Introduction to Robotics Mechanics and control-** John J Craig, 2nd Edition, Pearson Education, 2103.

| Course Title: | COMPUTER NETWORKS | L | T | P | C |
|---|---|---|---|---|---|
| Course Code: | 21 EI661 | 3 | 0 | 0 | 3 |
| Hours / week: 3 | CIE: 50 Marks SEE: 50 Exam hours: 3 Total hours: 40 | | | | |

**Course Outcomes:** Upon completion of this course, student should be able to:
CO1: Explain basic concepts of computer networks
CO2: Illustrate various issues of direct link networks
CO3: Analyze various packet switching mechanisms
CO4: Interpret different aspects of network layer,transport layer protocols and routing algorithms
CO5: Summarize congestion control, avoidance mechanisms and applications of computer Network

**MODULE 1**

**1. Review of Basic Concepts:** Network Architecture- Layering and Protocols, OSI Architecture, Internet Architecture; Performance- Bandwidth and Latency. **Direct link networks**: Internet checksum Algorithm, cyclic Redundancy Check; Reliable Transmission- Stop-and-Wait, Sliding Window: Algorithm and Finite Sequence numbers, Rings (802.5, FDDI) –Token Ring Media Access Control, Token Ring Maintenance.
**Self Study**: - Connectivity, Common Services; Cost-Effective Resource Sharing, Support for Common Services, Hardware Building Blocks-nodes, links; Error Detection- Two-Dimensional Parity

**10 Hours**

**MODULE 2**

**2. Packet Switching:** Switching and forwarding – Data grams, Virtual Circuit Switching, Source Routing; Bridges and LAN Switches – Learning Bridges(excluding implementation), Spanning Tree Algorithm,
**Internetworking-1:** Simple internetworking (IP) –Internetwork, IPv4, Service Model, Global Address, Datagram Forwarding in IP, Address Translation(ARP),
**Self Study**: Broadcast and Multicast, Limitations of Bridges, Host Configuration(DHCP),Error Reporting(ICMP).
**10Hours**

**MODULE 3**

**3. Internetworking-2:** Routing – Network as a Graph, Distance Vector(excluding implementation), Global Internet – Subnetting, Classless Routing(CIDR), **End –to-End Protocols:** Simple demultiplexer (UDP); Reliable byte stream (TCP) – **End-to-End Issues**, Segment Format, Connection Establishment and Termination, Sliding Window, Triggering Transmission
**Self Study**: Inter-domain Routing(BGP), Routing Areas, IP Version 6(IPv6) packet Header, , Adaptive Retransmission, Alternative Design Choices.

**10 Hours**

**MODULE 4**

**4. Congestion Control and Resource Allocation:** Issues in resource allocation – Network Model, Queuing discipline – FIFO, Fair Queuing; TCP Congestion Control – Additive Increase/Multiplicative Decrease, Congestion-Avoidance mechanisms – DECbit,
**Applications:** Traditional applications – Electronic Mail (SMTP, MIME, IMAP), World Wide Web (HTTP), Name Service (DNS),
**Self Study**: Slow Start, Fast Retransmit and Fast Recovery; Random Early Detection (RED), Network management (SNMP); Web services – Custom APPLICATION Protocols (WSDL, SOAP).
**10 Hours**

**Text Book:**
**1. Computer Networks – A Systems Approach**, Larry L. Peterson and Bruce S. David,4th Edition, Elsevier,2107.

**Reference Books:**
**1.Data Communications and Networking**, Behrouz A. Forouzan, 4th Edition, Tata McGraw Hill, 2106.
**2.Computer Networks**, Andrews S.Tanenbaum, Pearson Education, 4th Edition, 2104

**E Books:**

1. Communication Networks by Anish Arkatkar, et al, wikibooks2112
2. Digital Switching System – K.Chandrashekar, first edition 2108, Technical Publications Pune.

**MOOCs:**

1. http://nptel.ac.in/video.php?subjectId=106105081
2. http://freevideolectures.com/Course/2278/Data-Communication
3. https://www.itu.int/en/Pages/default.aspx
4. http://www.youtube.com/watch?v=xGkp-AnWV (NPTEL Video lecture 3)

| Course Title: | DIGITAL IMAGE PROCESSING | | | L | T | P | C |
|---|---|---|---|---|---|---|---|
| Course Code: | 21 EI662 | | | 3 | 0 | 0 | 3 |
| Hours / week: 3 | CIE: 50 Marks | SEE: 50 | Exam hours: 3 | Total hours: 40 | | | |

**Module-1**

**Fundamentals:** Introduction, Fundamental steps in digital image processing (DIP), components of DIP system, A simple image formation model, Image sampling and quantization, Basic relationship between pixels.

**05Hours**

**Image Transforms:** Mathematical preliminaries-Vector algebra, Linear operations, Fourier transforms, Discrete sine and cosine transforms, Hartley transform, Walsh-Hadamard transform, Harr transform, Slant transform, K-L transform.

**05Hours**

**Module-2**

**Image Enhancement in Spatial Domain-1**: Background, Point processing – Image negatives, Log transformations, Power law transformations, Contrast stretching, Gray level slicing, Bit plane slicing, Histogram processing – Histogram equalization, Histogram matching (specification) and Local enhancement.

**05Hours**

**Image Enhancement in Spatial Domain-2**: Arithmetic/Logic operations – Image subtraction, Image averaging, Basics of spatial filtering, Smoothing spatial filters – Smoothing linear filters, ordered statistics filters, Sharpening spatial filters – Foundation, Laplacian and gradient.

**05Hours**

**Module-3**

**Image Enhancement in Frequency Domain**: Background, Basic properties of the frequency domain, Basic filtering in the frequency domain, Basic filters and their properties, Smoothing frequency domain filters – Ideal low-pass filters, Butterworth low-pass filters, Gaussian low-pass filters, Sharpening frequency domain filters – Ideal high-pass filters, Butterworth high-pass filters, Gaussian high-pass filters, Homomorphic filtering.

**05Hours**

**Image Restoration**: Image degradation and restoration models, noise models, restoration using spatial filtering – mean filter, geometric mean filter, harmonic mean filter, median filter, max & min filters, midpoint filter.

**05Hours**

**Module-4**

**Noise filtering by frequency domain** filtering – band reject filter, band pass filter, notch filter, inverse filtering, minimum mean square error (Wiener) filtering.

**05Hours**

**Detection of discontinuities**- Point line edge detection, Gradient operators, Laplacian, edge linking and boundary detection- local processing. Global processing through Hough transform, Thresholding-

Foundation, Illumination role, Basic global thresholding, Region based separation- Region growing, Region splitting and merging.

**05 Hours**

**Text Books:**

1. **Digital Image Processing**, Rafael C. Gonzalez & Richard E. Woods,. Pearson Education Inc.,2nd Edition, 2104 ( units 1,3,4,5 and 6)
2. **Digital Image Processing and Analysis**, B.Chanda, D.DuttaMajumder, PHI, 6th reprint, 2105

**Reference Books**:

1. **Fundamentals of Digital Image Processing**, A.K.Jain, PHI, 2nd Edition, 2107
2. **Image Processing, analysis and Machine Vision**, Milan Sonka, Vaclar H lavac and Roger boyle, Thomson, 2nd Edition ,2103

**E Book:**

1. https://www.cs.nmt.edu/~ip/lectures.html

**MOOC:**

1. http://nptel.ac.in/courses/117105079/

| Course Title: | Safety Instrumentation | | | | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| Course Code: | 21EI663 | | | | 3 | 0 | 0 | 3 |
| Hours / week: 3 | CIE: 50 Marks | SEE: 50 | Exam hours: 3 | Total hours: 40 | | | | |

**Course Outcomes: After completing the course, the students will be able to**

- **CO1:** Represent the operation of safety systems and their applications.
- **CO2:** Apply the principle of industrial safety during process design
- **CO3:** Analyze the standards of various safety mechanisms
- **CO4:** Conceptualize and design industrial system safety.

**Module-1**

**Introduction to Safety Instrumented Systems:** Scope-Safety Technology in Process Automation-Factory Automation-Machine Automation-Robotics—Fire Triangle-, Fire& Gas Detection.

**05Hours**

Learning From Major Accidents-Basic Process control & Safety Instrumented Systems -Definitions – Acronyms- Overview of Standards and Regulations

**05 Hours**

**Module-2**

**Introduction to Reliability engineering:** Equipment failure, Failure rate, time dependent failure rate, confidence factor, mean time between failure, Mean time to restore, relationship between MTBF, MTTR and failure rate. Relationship between reliability and unreliability, Probability of failure on demand.

**05 Hours**

**System Reliability engineering:** Reliability block diagram, series and parallel configuration, fault tree analysis, Markov modeling, Markov solution technique.

**05 Hours**

**Module-3**

**The concept of Safety integrity:** HAZOP (Hazard and operability study), Layer of protection (LOPA), As low as reasonably practical (ALARP), Different levels of Safety integrity level and the target requirements.

05 Hours

**System Architectures**: MooN architecture, redundancy and voting logic, Common Mode failure, importance of redundancy and diversity, Hardware design principles for functional safety (Meeting IEC 61508 Standard Part 2) fault tolerance, Safety PLCs, Safety requirements, Failure mode effect analysis, identification of safe faults, and dangerous faults.

**05 Hours**

**Module-4**

**Software design principles for functional safety** (Meeting IEC 61508 Standard Part 3): Software requirements for SIS, Introduction to Safe failure fraction, software verification requirements. Reduction

of systematic faults using quality management.**Root Finding-2**: Mullers Method/ Newton's Method/ polynomial roots/ Nonlinear systems of equations.

**05 Hours**

**Application in a gas detection industry:** Typical SIF solutions for SIL1 and SIL2, Calculation of PFD Avg for SIL1 architecture, Application in oil and gas production facilities, Individual well controls, high pressure SIF, SIF PFD Avg calculation.

**05 Hours**

**Text Book:**


1 Safety Instrumented Systems Verification: Practical Probabilistic Calculations, Harry Cheddie, W.M. Goble, 2104, ISA Publication,ISBN: 155617909X. (Chapters 1, 2, 3,4,5,12,13**,** Appendix E & F).


**Reference Books:**


1 The Safety Critical Systems Handbook, A Straightforward Guide to Functional Safety: IEC 61508, IEC 61511 and Related Guidance, David Smith, 4th Edition, ISBN: 9780081008973. (Chapter 3.1 to 3.6, 4.1 to 4.6.)

2 Safety Integrity Level Selection,Edward M. Marsza, 2102, ISA Publication, ISBN: 1556177771.


| Course Title: | CONCEPTS OF OPERATING SYSTEMS | L | T | P | C |
|---|---|---|---|---|---|
| Course Code: | 21EI664 | 3 | 0 | 0 | 3 |
| Hours / week: 3 | CIE: 50 Marks SEE: 50 Exam hours: 3 Total hours: 40 | | | | |

**Prerequisites**: Higher Level Programming Language

**Module – 1**

**Introduction:** Abstract views of OS, Goals and operation of an OS, OS and the computer system, Interrupt action and processing of interrupts and system calls

**5Hours**

**Classes of OS:** Batch processing OS, Multiprogramming OS, Time sharing OS, RTOS, Distributed OS.

**5Hours**

**Module – 2**

**Processes and Threads:** Processes and programs, OS view of processes, Threads: User and kernel level threads, Hybrid thread model.

**5Hours**

**Scheduling:** Concepts and terminologies, Non-preemptive scheduling-FCFS and SRN policies, Preemptive scheduling- RR, LCN and STG policies, Scheduling in practice: long, medium and short term scheduling.

**Hours**

**Module – 3**

**Memory Management:** Static and Dynamic Memory allocation, Memory allocation to a process, Reuse of memory – Performing fresh allocations using a free list, Memory fragmentation, Merging free areas, Memory compaction, contiguous Memory allocation-Handling memory fragmentation, Memory compaction, Reuse of memory areas, non-contiguous allocation.

**5Hours**

**Virtual Memory:** VM Basics, Demand paging-Overview of paging, demand paging preliminaries, page replacement, optimal page size, Page replacement policies-FIFO, LRU and optimal.

**5Hours**

**Module - 4**

**Structure of OS:** Operation of OS, Structure of an OS, OS with monolithic structure, Layered design of OS, Kernel based OS, Microkernel based OS, Architecture of UNIX and Windows.

**5Hours**

**Distributed Operating System:** Features and nodes of Distributed systems, Network OS, Distributed OS, reliable inter-process communication, Distributed computation paradigms-client server computing, remote procedure calls and remote evaluation**.**

**5Hours**

**Text Book**:
**1. Operating Systems: A Concept Based Approach** – D.M Dhamdhere, 2nd Edition, Tata McGraw- Hill, 2102.

**Reference Books:**
**1**. **Operating System Principles –** Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, 7th edition, Wiley-India, 2106
**2.Operating Systems** – P.C.P. Bhatt, 2nd Edition, PHI, 2106.
**3. Operating Systems** – Harvey M Deital, 3rd Edition, Addison Wesley, 1990.

**E Book:**
1. http://www.satishkashyap.com/2113/02/video-lectures-on-operating-systems-by.html

**MOOC:**
1. http://nptel.ac.in/courses/106108101/

| Course Title: | Foundation of Innovations | L | T | P | C |
|---|---|---|---|---|---|
| Course Code: | 21 EI665 | 3 | 0 | 0 | 3 |
| Hours / week: 3 | CIE: 50 Marks SEE: 50 Marks Exam hours: 3 Total hours: 40 | | | | |

**Course Outcomes:** Upon completion of this course, student should be able to:
CO1: Explain concepts and types of innovation.
CO2: Identify challenges and corresponding innovation activities.
CO3: Build innovation sand box, margin of safety and innovative leadership.
CO4: Illustrate different types of innovation

MODULE 1

1. Introduction: Understanding the Concept of Innovation and its Importance, Types of Innovation, Innovation in Organization,
Lay the Foundation and Create a Challenge Book: Step one: Lay the Foundation, Create a Challenge Book, Let's Discuss Step One and Two, The Innovation Activity.

**10Hours**

MODULE 2

2. Build Participation and Experiment with Low-cost at High –speed: Choosing the Right "Role Model", Ways to Motivate Innovation Activity in Organization, Role of Catalyst in Building Participation in Innovation Process, How to Overcome Velocity Problem?, Failure Fallacy, Encouraging Experimentation, Prototyping
Go Fast from Prototyping to Incubation and Iterate on The Business Model: Being a Champion, Iterating on Business Model, Design of a Pitch, Business Model Metaphors

**10Hours**

MODULE 3

3. Build an Innovation Sandbox and Create a Margin of Safety: Ways to Enhance the Batting Average Problem, Sand box, Platform and Open Source Approach, Intellectual Property Protection, Risk Management, Big Bets Risks, Where Do We Stand?
Innovative Leadership in Growing Companies. The Path to Entrepreneurship: Seven Rules for Business Success, Plan to Succeed

**10Hours**

MODULE 4

4. The Evolution of an Innovative Business Unit, Disruptive Innovation, Mission Driven Innovation,
Extraordinary Measures, Leveraging Collaboration for Innovation, Building Innovative Partnerships to Heal the World.

**10Hours**

Text Books:

1. **8 STEPS TO INNOVATION Going from Jugaad to Excellence** Vinay Dabholkar Rishikesha T. Krishnan, HarperCollins Publishers, First Edition, 2113.
2. **Entrepreneurship and Innovation**, James C. Barood, Rothman Institute of Entrepreneurship, 2110.

**Reference Books**:

1. Lateral Thinking, De Bano , Penguin UK, 2116
2. Innovation and Entrepreneurship, Peter F. Drucker, Butterworth-Heinemann,2112

MOOCs:

1. https://swayam.gov.in/nd2_imb19_mg05

Mode of evaluation for 10 marks component of continuous internal evaluation:

1. Student has to present a Seminar on Cutting edge developments in selected domain - 5 marks
2. Student batch has to do case study and submit a report on selected topics -5 marks

| Course Title: | Programming with Python | | | L | T | P | C |
|---|---|---|---|---|---|---|---|
| Course Code: | 21 EI666 | | | 3 | 0 | 0 | 3 |
| Hours / week: 3 | CIE: 50 Marks | SEE: 50 | Exam hours: 3 | Total hours: 40 | | | |

**Module 1**

**Introduction to Python:** The basic elements of python, Branching Programs, Control Structures, Strings and Input, and Iteration.

**5Hours**

**Functions, Scoping and Abstraction**: Functions and scoping, Specifications, Recursion, Global variables, Modules, Files, System Functions and Parameters.

**5Hours**

**Module 2**

**Structured Types, Mutability and Higher-Order Functions:** Strings, Tuples, Lists and Dictionaries, Lists and Mutability, Functions as Objects.

**5Hours**

**Testing, Debugging, Exceptions and Assertions:** Types of testing, Black-box and Glass-box, Debugging, Handling Exceptions and assertions.

**5Hours**

**Module 3**

**Classes and Objects:** Oriented Programming, Abstract Data Types and Classes, Inheritance, Encapsulation and Information Hiding.

**5Hours**

**Simple Algorithms and Data structures:** Search Algorithms, Sorting Algorithms and Hash Tables. **5 Hrs.**

**Module 4**

**Advanced Topics I:** Regular Expressions(RE), **Sequence Characters in RE, Quantifiers in RE, Special Characters in RE and Using RE on files**. Plotting using PyLab.

**5Hours**

**Advanced Topics II:Networking in Python: Protocol, Sockets, Reading the source code of a web page, TCP/IP server, TCP/IP client, UDP server, UDP client, File server and File client** .

**5Hours**

**Text Books:**

1. John V Guttag. "Introduction to Computation and Programming Using Python", Second Edition, Prentice Hall of India.

**2. R. Nageswara Rao, "Core Python Programming", Second Edition, Dreamtech Press.**
**Reference Books:**
1. Wesley J. Chun. "Core Python Programming", Second Edition, Prentice Hall.
2. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, "Data Structures and Algorithms in Pyhon", Wiley India.

**EBooks**
1. https://www.cs.uky.edu/~keen/115/Haltermanpythonbook.pdf
2. http://slav0nic.org.ua/static/books/python/OReilly%21-%21Core%21Python%21Programming.pdf

**MOOCs**
1. https://www.coursera.org/learn/python
2. https://www.udacity.com/course/programming-foundations-with-python--ud036
3. https://www.edx.org/course/introduction-computer-science-mitx-6-00-1x-10
4. https://www.edx.org/course/programming-python-data-science-microsoft-dat210x-4

| Course Title: | E-Waste Management | L | T | P | C |
|---|---|---|---|---|---|
| Course Code: | 21EI667 | 3 | 0 | 0 | 3 |
| Hours / week: 3 | CIE: 50 Marks SEE: 50 Marks Exam hours: 3 | Total hours: 40 | | | |

**Course Outcomes (COs)**At the end of the course the student will be able to:

| COs | Statement | POs |
|---|---|---|
| 1. | Understand Multidisciplinary nature of environmental studies and Investigate how and why things happen, and make their own decisions about complex environmental issues by developing and enhancing critical and creative thinking skills. | 6,7,12 |
| 2. | Understand how their decisions and actions affect the environment, builds knowledge and skills necessary to address complex environmental issues | 6,7,12 |
| 3. | To develop the sense of awareness among the students about the environment and its various problems. | 6,7,9,12 |
| 4. | Acquiring the basic knowledge about environment and the social norms that provides unity with environmental characteristics and create positive attitude about the environment. | 6,7,12 |

**Course Contents:**

| Module -1 | Teaching Hours |
|---|---|
| Multidisciplinary nature of environmental studies- Definition, scope and importance. Need for public awareness. Natural Resources-Renewable and non-renewable resources: Natural resources and associated problems. a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer, pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources, Case studies. f) Land resources: Land as a resource, land degradation, man induced and slides, soil erosion and desertification Role of individual in conservation of natural resources. Equitable use of resources for sustainable life styles. | 10 Hours |
| **Module -2** | |
| Biodiversity and its conservation-Introduction Biogeographical classification of India, Value of biodiversity: consumptive, productive, social, ethical, aesthetic and option values. India as a mega-diversity nation Hot-spots of biodiversity Threats to biodiversity: habitat loss, poaching of wildlife, man wildlife conflicts Endangered and endemic species of India. | 10 Hours |

| | |
|---|---|
| Environmental Pollution-Definition Causes, effects and control measures of Air pollution Water pollution Soil pollution Marine pollution Noise pollution Thermal pollution nuclear hazards. Solid waste Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution case studies Disaster management: floods, earthquake, cyclone and landslides. | |
| **Module -3** | |
| E-waste growth- An overview, hazards of E-waste, what is E-waste, digital dump yard, how to minimize E-waste, Hazardous substances waste Electrical and Electronic Equipment, characteristics of pollutants, batteries, electrical and electronic components, plastic and flame retardants, circuit boards, pollutants in waste electrical and electronic equipment. | 10 Hours |
| **Module -4** | |
| E-Waste Recycling Technologies for recovery of resources from electronic waste, resource recovery potential of e-waste, steps in recycling and recovery of materials-mechanical processing, technologies for recovery of materials. | 10 Hours |

**TEXT BOOK:**


1. **Bharucha Erach**, Text Book of Environmental Studies for undergraduate Courses. University Press, IInd Edition 2013
2. E-Waste Managing the Digital Dump Yard, Edited by **Vishakha Munshi**, ICFAI University Press (Chapter 1)
3. E-waste: Implications, Regulations and Management in India and Current Global Best Practices, Edited by **Rakesh Johri**, The Energy and Resources Institute, New Delhi (Chapter 1, 5)


## Open Elective Courses

| **Course Title:** | **INDUSTRIAL INSTRUMENTATION** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| **Course Code:** | **21OEEI61** | **3** | **0** | **0** | **3** |
| **Hours / week: 3** | **CIE: 50 Marks SEE: 50 Marks Exam hours: 3 Total hours: 40** | | | | |

**Course Outcomes:**Upon the completion of this course student will be able to:
CO1: Distinguish functional elements of a system and classify the transducer.
CO2: Define the static characteristics of instruments.
CO3: Explain resistive, capacitive and inductive transducer based on their working principle.
CO4: Illustrate various techniques for temperature, low and medium pressure measurement
CO5: Employ specified flow and level meters for industrial applications based on their classification.

### MODULE-1

**Introduction:** Functional elements of an instrument: analog & digital modes of operation, I/O configuration of measuring instruments & instrument system- methods of correction for interfering & modifying inputs Definition of a transducer, Active and Passive Transducers, Primary and Secondary Transducers, Advantages of Electrical Transducers and Selection of Transducers. **Static Characteristics of Instruments:** Definition, Static Calibration, Static Error & correction, accuracy & Precision, linearity, Resolution & Threshold, Sensitivity, Reproducibility, Repeatability, Range, Span and Bias, Drift, Dead time & Dead zone, Hysteresis, Stability.

**Self-study component:** Study of various types of errors, Relationship with various static characteristics.

**10 Hours**

### MODULE-2

**Displacement and Force Transducers:** Potentiometers: Characteristics, loading effect, Linearity & sensitivity, advantages & disadvantages of Resistive potentiometers, Strain gauge: theory,. Linear variable differential Transformer (LVDT): Principles, characteristics, advantages, disadvantages, applications
Capacitive Transducers using change in area of plates, distance between plates, & change of dielectric constants, advantages and disadvantages of Capacitive Transducers

**Self-study component:** RVDT, Variable Inductance and Reluctance pickups.

**10 Hours**

### MODULE-3

**Temperature Measurement:** Thermistors, RTD,Thermoelectric sensor – laws and effects of thermocouples, reference junction consideration, Black body-tipped fiber optic radiation thermometer.
**Pressure Measurement:** Introduction, manometers, Bourdon Pressure Gauge, Low pressure measurement-thermocouple vacuum gauge, pirani thermal conductivity gauge, ionization gauge, Knudsen gauge.
**Self-study component:** McLeod gage.

**10 Hours**

**MODULE-4**

**Flow Measurement:** Bernoulli's principle, orifice meters, rotameter, target flow meter, turbine flow meter, , Electromagnetic flow meters.
**Level Measurement:** Direct Liquid Level measurements: Dip-stick method, sight glass method, hook gauge, float gauge indirect Liquid Level measurements: hydrostatic pressure level measurement device, capacitance level gauge, ultrasonic level gauge, nucleonic gauge.
**Self-Learning Component:** venture meters, flow nozzle and ultrasonic flow meters.

**Text Books:**

1. **Electrical & Electronic Measurements &Instrumentation**, A.K. Sawhney, 17th edition.
2. **Instrumentation Measurement and analysis**, B.C.Nakra and K.K.Chaudhry, TMH,2102.

**Reference Books:**

1. **Measurement Techniques**, E.O.Doeblin, 6th edition, McGraw Hill publications
2. **Transducers and Instrumentation**, D.V.S Murthy, PHI.

**E Books:**

1. http://nptel.ac.in/courses/112103174/pdf/mod2.pdf
2. http://nptel.iitg.ernet.in/courses/Elec_Engg/IIT%21Bombay/Electrical%21and%21Electronic%21 Measurements.html
3. http://www.nptelvideos.in/2112/11/industrial-instrumentation.html
4. http://onlinevideolecture.com/?course_id=385&lecture_no=32
5. http://nptel.iitg.ernet.in/courses/Elec_Engg/IIT%21Bombay/Electrical%21and%21Electronic%21 Measurements.htm
6. http://www.nptelvideos.in/2112/11/industrial-instrumentation.html

**MOOCs:**

1. http://nptel.ac.in/courses/112103174/3
2. http://nptel.ac.in/courses/112103174/3

| **Course Title:** | **Medical Electronics** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| **Course Code:** | **21OEEI62** | **3** | **0** | **0** | **1** |
| **Hours / week: 4** | **CIE: 50 Marks SEE: 50 Marks Exam hours: 3** | **Total hours:40** | | | |

**Course outcomes:** Upon the completion of this course student will be able to:
CO1: Explain fundamentals of nature, behavior and acquisition of biomedical signals
CO2: Measure cardiac parameters using ECG
CO3: Apprehend working of EEG and its computerized analysis
CO4: Explain functioning of various instruments in patient monitoring systems
CO5: Use of various life saving biomedical instruments on humans
CO6: Adopt safety aspects and testing of biomedical equipments

**MODULE 1**

**Fundamentals:** Sources of biomedical signals, basic medical instrumentation system, general constraints in design of biomedical instrumentation systems. electrodes for ECG, EEG, EMG.
**Electrocardiograph:** Electrical activity of heart, block diagram of electrocardiograph, ECG Leads system, effects of artifacts on ECG recordings. Electroencephalograph: Typical EEG signal waveform, block diagram of Electroencephalograph.

**Self study:** Bioelectric signals and electrodes: Origin of bioelectric signals, recording electrodes, Electrode-tissue interface, polarization, Computerized EEG analysis

**10Hours**

**MODULE 2**

**Patient monitoring system:** Bedside patient monitoring system, , heart rate measurement-, instantaneous heart rate meter, measurement of pulse rate.

**Blood pressure and respiration rate measurement:** Direct method of BP measurement (fluid filled system), indirect methods-Korotkoff method, Rheographic method, and Ultrasonic Doppler shift method. Measurement of respiration rate, CO2 method.

**Self study:** central monitors, average heart rate meter, Oscillometric method, Impedance pneumography.

**10Hours**

**MODULE 3**

**Blood flow meters:** Ultrasonic Doppler shift blood flow meter, NMR blood flow meter, Laser Doppler blood flow meter.

**Cardiac pacemakers:** Need for cardiac pacemakers, External pacemakers, Types of implantable pacemakers, Ventricular synchronous demand pacemakers.

**Self study:** Square wave Electromagnetic blood flow meter, , programmable pacemaker, , rate responsive pacemakers

**10Hours**

**MODULE 4**

**Cardiac Arrhythmia:** Arrhythmia monitor, ST/AR Arrhythmia algorithm, , detection of ventricular fibrillation, exercise stress testing.

**Patient safety:** Electric shock hazards, Gross shock, effects of electric currents on human body, micro current shock, types of leakage currents, precautions to minimize electric shock hazards,

**Self study:** data compression and processing of ECG by AZTEC, , electro physiology of ventricular fibrillation, testing of biomedical equipment.

**10Hours**

**Text Book**:

1.**Handbook of Biomedical Instrumentation**, -R.S.Khandpur- Tata Mc-grawhill Co.2103 2nd Edition

**Reference Books:**

1. **Introduction to biomedical equipment technology**-Joseph.J.Corr and John.M.Brown,, Pearson education., 4th Edition, 2101
2. **Principles of applied biomedical Instruments**-Leslie Cromwell and John M Brown,Pearson education, 4th Edition, 2104

**E-Books:**

1.http://www.ebook3000.com/Introduction-to-Biomedical-Instrumentation--The-Technology-of-Patient-Care_51854.html

2. Barbara Christe, Introduction to Biomedical Instrumentation: The Technology of Patient Care, Cambridge University Press | 2109 | ISBN: 0521515122

**MOOCs:**

1. Ma, Hongshen. 2.996 Biomedical Devices Design Laboratory, Fall 2107. (MIT OpenCourseWare: Massachusetts Institute of Technology), http://ocw.mit.edu/courses/mechanical-engineering/2-996-biomedical-devices-design-laboratory-fall-2107 (Accessed 27 Jul,2114). License: Creative Commons BY-NC-SA

2. Lauffenburger, Douglas, Paul Matsudaira, Biological Engineering Faculty, and Angela Belcher. 21.010J Introduction to Bioengineering (BE.010J), Spring 2106. (MIT OpenCourseWare: Massachusetts Institute of Technology), http://ocw.mit.edu/courses/biological-engineering/21-010j-introduction-to-bioengineering-be-010j-spring-2106 (Accessed 26 Jul,2114). License: Creative Commons BY-NC-SA

| **Course Title:** | **Analog Signal Conditioning** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| **Course Code:** | **21OEEI63** | **3** | **0** | **0** | **3** |
| **Hours / week: 3** | **CIE: 50 Marks SEE: 50 MarksExam hours: 3 Total hours: 40** | | | | |

**Prerequisites:** Basic Electronics

**Course outcomes:** Upon the completion of this course student will be able to**:**

CO1: Explain fundamentals of Opamp and its behavior in open loop configuration

CO2: Design of Opamp circuits with positive and negative feedback and their applications.

CO3: Measure basic performance parameters of Opamp.

CO4: Use of Opamp with diodes and capacitors for special applications.

CO5: Design circuits to generate basic signals using Opamp and timer.

CO6: Design SCC for specified instrumentation applications.

## MODULE 1

**Introduction to OPAMPs:** Basic internal circuit of OPAMP (Differential Amplifier), Block diagram representation of a typical OPAMP, OPAMP terminals and its ideal characteristics /Specifications; OPAMP in Open loop configuration: Open loop voltage gain, Zero Crossing detector: Inverting & Non Inverting ZCDs; Positive and Negative voltage level detectors, LM 339-Quad Comparator, Generation of PWM using LM339. **OPAMPs with negative feedback and its applications:** Inverting and Non Inverting amplifier: Closed loop voltage gain, Input impedance, Output impedance, Bandwidth with feedback, Applications: Adder (Multichannel amplifier), Inverting averaging amplifier, Non Inverting Adder, Voltage follower, Difference amplifier: Subtractor and design problems.

**Self -study component: Ideal voltage source**

10 Hours

## MODULE 2

**OPAMPs with positive feedback and its applications:** Effect of noise on comparator circuits, Design aspects of ZCD with Hysteresis (Schmitt trigger),(Design aspects of Voltage level detectors with Hysteresis (both Inverting and Non Inverting), Applications: independently adjustable set point controller. **DC performance and AC performance of OPAMPs:** Measurement and effect of OPAMP Parameters: Input bias current, Input offset current, Input offset voltage, Frequency response of OPAMP: Open loop and Closed loop configurations.

**Self -study component: Slew rate and output voltage.**

10 Hours

## MODULE 3

**Special Applications of OPAMPs:** V-I ( both floating load and grounded load) converter and their Applications: Diode match finder, design of high input impedance DC/AC voltmeter using ammeter, I-V converter and its applications; design of I-V circuit for Photo based sensor, Precision rectifiers: Half wave and Full wave;, Frequency response of Integrator, Differentiator and their Design. **Waveform Generators:** Multivibrators using OPAMPs: Free running (square wave generator) and oneshotmultivibrators, Triangular wave generator, Design problems, 555 Timer: Introduction, Astablemultivibrators and Mon stable multivibrators: applications and their applications**.**

**Self- study component: Zener diode tester, Phase shift oscillator**

10 Hours

## MODULE 4

**Active Filters:** Introduction to Filters: Design aspects of Low pass Butterworth filter; first order and Second order filters, Design aspects of High pass Butterworth filter; first order and Second order filters, Higher order filters, Design aspects of Band pass filter and Band rejection filter. **Signal conditioning circuits:** Basic differential Amplifiers, differential versus single input amplifiers, Instrumentation amplifier, Basic Bridge Amplifiers, Balancing and linearization techniques for the bridges**.**

**Self-study component Design of Signal conditioning circuits for Strain gauge, Thermistor**

10 Hours

**Text Books:**

1. **Operational Amplifiers and Linear Integrated Circuits**, Robert. F. Coughlin &Fred.F. Driscoll, , PHI/Pearson, 2106
2. **Operational Amplifiers and Linear Integrated Circuits**, Ramakant A. Gayakwad, , 4th edition, PHI

**Reference Book:**

**1. Linear Integrated Circuits,** D. Roy Choudhury and Shail B. Jain, , 2nd edition, Reprint 2106, New Age International

**E Books:**

1. http://freevideolectures.com/Course/2321/Electronics-for-Analog-Signal-Processing-I
2. http://freevideolectures.com/Course/2322/Electronics-for-Analog-Signal-Processing-I

**MOOCs:**
1. http://ocw.tudelft.nl/courses/microelectronics/analog-integrated-circuitdesign/course-home/
2. Introductory Analog Electronics Laboratory (Spring 2107) by MIT Open Courseware |Reviews and Ratings
3. http://www.pannam.com/blog/free-resources-to-learn-electrical-engineering/

| Course Title: | INTRODUCTION TO VHDL PROGRAMMING | L | T | P | C |
|---|---|---|---|---|---|
| Course Code: | 21OEEI64 | 3 | 0 | 0 | 3 |
| Hours / week: 3 | CIE: 50 Marks SEE: 50 MarksExam hours: 3 | Total hours: 40 | | | |

**Prerequisites:** Logic Design

**Course outcomes:** Upon the completion of this course student will be able to**:**
CO1: Distinguish various identifiers, data objects, operators and data types
CO2: Design a flow model for given digital circuit
CO3: Identify suitable model for given application
CO4: Construct digital circuits using packages and library functions.

**MODULE-1**

**Introduction:** Fundamentals of VHDL, A Brief History of VHDL, Capabilities, Basic Terminology, Entity Declaration, Architecture Body, Identifiers, Data objects, Operators and Data types.**Data –Flow Modeling:** Concurrent Signal Assignment statement, Concurrent V/S Sequential Signal Assignment, Conditional signal Assignment Statement, Selected Signal Assignment Statement.
**Self-study component:** The Unaffected Value and Block Statement.

**10 Hours**

**MODULE-2**

**Behavioral Modeling:** Entity Declaration, Architecture Body, Process Statement, Variable Assignment Statement, Signal assignment statement, Wait, If, Case, Null Statements, Loop Next, Exit statement. **Structural Modeling and state Machines:** Component declaration, Component Instantiation and State machines.
**Self-study component:**Assertion, Report Statements Inertial delay model and Transport delay model, Multiple Processes.

**10 Hours**

**MODULE-3**

**Generics and Configurations & Advance Features:** Generics, Why Configurations, Configuration Specification, configuration Declaration, Default Rules, Generate statements. **Sub Programs &Advanced HDL Descriptions:** Functions, Procedures, Subprogram overloading, Operator Overloading, Functions File Processing.
**Self-study component:**Type Conversions, Attributes, examples of File Processing.

**10 Hours**

**MODULE-4**

**Packages and Libraries:** Package Declaration, Package Body, design File, design Libraries, Implicit Visibility, and Explicit Visibility. **Synthesis Basics:** Highlights of Synthesis, Synthesis information from Entity and Module, Mapping Process in the Hardware Domain.

**10 Hours**

**Text Books:**
1. **A VHDL Primer**- J.Bhaskar – PHI Publications
2. **Introduction to HDL Programming** - NazeihM.Botros- Dreamtech Press (Available through John Wiley – India and Thomson Learning).

**Reference Books:**

1. **Circuit design with VHDL**, VolneiA.Pedroni, PHI
2. **VHDL Programming by Examples** -Douglas perry-Tata McGraw-Hill.

**EBooks:**

1. http://access.ee.ntu.edu.tw/course/dsd_99second/2011_lecture/W2_HDL_ Fundamentals_2011-03-02.pdf
2. http://www.ics.uci.edu/~alexv/154/VHDL-Cookbook.pdf
3. http://ece.niu.edu.tw/~chu/download/fpga/verilog.pdf

**MOOCs:**

1. Electronic Design Automation http://nptel.ac.in/courses/106105083/
2. Digital system design with PLDs and FPGAs http://nptel.ac.in/courses/117108040/
3. Fundamentals of HDL (Lecture #008)
   https://www.youtube.com/watch?v=rdAPXzxeaxs&index=8&list=PLE3BC3EBC9CE15FB0

| Course title: | NETWORK ANALYSIS | L | T | P | C |
|---|---|---|---|---|---|
| Course Code: | 21OEEI65 | 2 | 2 | 0 | 3 |
| Hours / week: 4 | CIE: 50 Marks SEE: 50 Marks Exam hours: 3 Total hours: 52 | | | | |

**Prerequisites**: Basic Electrical Engineering

**Course Outcomes:** Upon the completion of this course student will be able to:

CO1: Explain different types of electrical energy sources and linear electrical circuits using basic principles and theorems

CO2:Design series and parallel resonance circuits

CO3:Evaluate initial conditions to find out the complete response.

CO4: Determine Laplace transform for various signals and circuits

CO5: Evaluate two port network parameters

**MODULE-1**

**Basic Concepts:** Practical sources, Source transformations, Loop and node analysis with linearly dependent and independent sources for DC and AC networks, Concepts of super node and super mesh. **Network Topology:** Graph of a network, Concept of tree and co-tree, incidence matrix, tie -set, tie-set and cut-set schedules, Principle of duality.

**Self-study component:** Star-Delta configuration for impedance and admittance circuits, Formulation of equilibrium equations in matrix form, Solution of resistive networks,

**10 Hours**

**MODULE-2**

**Network Theorems:**Superposition, Reciprocity and Millman's theorems (Numerical only on independent sources) Thevinin's and Norton's theorems; Maximum Power transfer theorem (Numerical only on independent sources)

**Self-study component:** Numerical with dependent sources.

**10 Hours**

**MODULE-3**

**Resonant Circuits:** Series and parallel resonance, frequency response of series and Parallel circuits, Q – factor, Bandwidth. Relevant derivations and numerical.**Transient behavior and initial conditions:** Behavior of circuit elements under switching condition and their Representation, evaluation of initial and final conditions in RL, RC and RLC circuits for DC excitations. Relevant derivations and numerical.

**Self-study component:** Deriving conditions for frequencies corresponding to $V_L$ Max and $V_c$Max. Evaluation of initial and final conditions in RL, RC and RLC circuits for AC excitations.

**10 Hours**

**MODULE-4**

**Applications of Laplace Transformation:** Step, Ramp and Impulse responses, waveform Synthesis, Solution of networks using Laplace transforms, Initial and final value theorem and numerical. **Two port**

**network parameters:** Definition of z, y, h parameters and modelling with these parameters and relationship between parameters sets. Relevant derivations and numericals.
**Self-study component:** Transmission parameters, Interconnection of two port networks.

**10 Hours**

**Text Book:**
**1. Network Analysis,** M. E. Van Valkenburg, PHI / Pearson Education, 3rd Edition.
**Reference Book:**
**1. Networks and systems** Roy Choudhury, 2nd edition, 2006 Re-print, New Age International Publications
**E-Books:**
1. nptel.ac.in/courses/108105065- Networks signals and systems by Prof T.K. Basu, IIT Kharagpur
2. nptel.ac.in/courses/108102042- Circuit Theory by Prof Dutta Roy S.C, IIT Delhi
3. www.electrodiction.com/circuit-theory

**MOOCs:**
1. http://elearning.vtu.ac.in/06ES34.html
2. https://www.coursera.org/course/circuits

| **Course Title:** | **E-Waste Management** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| **Course Code:** | **21OEEI66** | **3** | **0** | **0** | **3** |
| **Hours / week: 3** | **CIE: 50 Marks SEE: 50 Marks Exam hours: 3** | **Total hours: 40** | | | |

**Course Outcomes (COs)**At the end of the course the student will be able to:

| **COs** | **Statement** | **POs** |
|---|---|---|
| 5. | Understand Multidisciplinary nature of environmental studies and Investigate how and why things happen, and make their own decisions about complex environmental issues by developing and enhancing critical and creative thinking skills. | 6,7,12 |
| 6. | Understand how their decisions and actions affect the environment, builds knowledge and skills necessary to address complex environmental issues | 6,7,12 |
| 7. | To develop the sense of awareness among the students about the environment and its various problems. | 6,7,9,12 |
| 8. | Acquiring the basic knowledge about environment and the social norms that provides unity with environmental characteristics and create positive attitude about the environment. | 6,7,12 |

**Course Contents:**

| **Module -1** | **Teaching Hours** |
|---|---|
| Multidisciplinary nature of environmental studies- Definition, scope and importance. Need for public awareness. Natural Resources-Renewable and non-renewable resources: Natural resources and associated problems. a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer, pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources, Case studies. f) Land resources: Land as a resource, land degradation, man induced and slides, soil erosion and desertification Role of individual in conservation of natural resources. Equitable use of resources for sustainable life styles. | 10 Hours |
| **Module -2** | |
| Biodiversity and its conservation-Introduction Biogeographical classification of India, Value of biodiversity: consumptive, productive, social, ethical, aesthetic and option values. India as a mega-diversity nation Hot-spots of biodiversity Threats to biodiversity: habitat | 10 Hours |

| | |
|---|---|
| loss, poaching of wildlife, man wildlife conflicts Endangered and endemic species of India. Environmental Pollution-Definition Causes, effects and control measures of Air pollution Water pollution Soil pollution Marine pollution Noise pollution Thermal pollution nuclear hazards. Solid waste Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution case studies Disaster management: floods, earthquake, cyclone and landslides. | |
| **Module -3** | |
| E-waste growth- An overview, hazards of E-waste, what is E-waste, digital dump yard, how to minimize E-waste, Hazardous substances waste Electrical and Electronic Equipment, characteristics of pollutants, batteries, electrical and electronic components, plastic and flame retardants, circuit boards, pollutants in waste electrical and electronic equipment. | 10 Hours |
| **Module -4** | |
| E-Waste Recycling Technologies for recovery of resources from electronic waste, resource recovery potential of e-waste, steps in recycling and recovery of materials-mechanical processing, technologies for recovery of materials. | 10 Hours |

**TEXT BOOK:**


1. **Bharucha Erach**, Text Book of Environmental Studies for undergraduate Courses. University Press, IInd Edition 2013
4. E-Waste Managing the Digital Dump Yard, Edited by **Vishakha Munshi**, ICFAI University Press (Chapter 1)
5. E-waste: Implications, Regulations and Management in India and Current Global Best Practices, Edited by **Rakesh Johri**, The Energy and Resources Institute, New Delhi (Chapter 1, 5)


| **Course Title:** | **MICRO SENSORS AND MICRO ACTUATORS** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| **Course Code:** | **21OEEI67** | **3** | **0** | **0** | **3** |
| **Hours / week: 3** | **CIE: 50 Marks SEE: 50 MarksExam hours: 3 Total hours: 40** | | | | |

**Course Objective**

Students shall be able to realize the importance of Micro systems in domestic as well as industrial applications with the knowledge of technologies involved in the fabrication and packaging of micro sensors and micro actuators along with the suitable Signal conditioning Circuits.

**Prerequisites**: Transducer and Instrumentation, Linear Integrated Circuits, Physics and Chemistry

**Course Outcomes**

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

The student should be able to:

CO1. Have the knowledge of the basics of micro devices and their applications

CO2. Have the knowledge of different technique involved in the process of fabrication of MEMS devices

CO3. Have the knowledge of necessary integrated circuits of MEMS devices

CO4. Know the various techniques involved in the integration and packaging methods for MEMS

**MODULE-1**

**Introduction to MEMS / Micro systems:** Overview ofMEMS/Micro systems. Principle components of Micro Systems, Need ofMiniaturizationand Micro systems, Comparison of Micro systems and Microelectronics. Role of Multi-disciplinary aspects, Applications areas: Automobile area with micro sensors and micro actuators.

**5 Hours**

**Micromachining Process Techniques -I:**Substrates and wafers, Silicon as a material for micro machining, Single crystal Siliconby cZokarlski method, Crystal structure of Silicon, Crystallography of silicon using Miller indices, Material modification:Ion Implantation, Diffusion and Oxidation.

**5 Hours**

**MODULE-2**

**Micromachining Process Techniques -II:**Thin-film deposition (Additive process): Physical Vapour depositiontechniques, Chemical vapour depositiontechniques, Patterning: Photo Lithography and Lift off techniques,Etching (subtractive process):Wet etching and dry etching techniques

**5 Hours**

**Micromachining Technologies:** Silicon micromachining Technologies**:** Bulk micromachining and Surface micromachining,Realization of a cantilever beam using – A Case study, Non Silicon micro machining technologies: LIGA Process.

**5 Hours**

**MODULE-3**

**Micro Sensors, Actuators, Smart Materials and Systems-1:**Pressure Sensors: Piezoresistive type, capacitive type and Vibrating beam type pressure sensors, Concept of accelerometer, Analysis of physical model of accelerometer and Silicon capacitive accelerometer, Chemical sensors: Various techniques employed and Conductometric gas sensor, Portable blood analyzer and Electrostatic comb-drive.

**5 Hours**

**Micro Sensors, Actuators, Smart Materials and Systems-2:** Principle means for micro actuation, micro grippers, Piezo-electric based inkjet print-head, Silicon micro-mirror arrays. Smart Materials and systems.

**5 Hours**

**MODULE-4**

**Signal Conditioning Circuits for Micro Sensors:**Semiconductor Devices: Operational amplifiers, Basic Op-Amp circuits, Difference amplifier, Instrumentation amplifier as a differential voltage amplifier, Wheat stone bridge for measurement of change in resistance.

**5 Hours**

**Integration and Packaging of Micro Electro- Mechanical Systems:** Integration of microelectronics, Special issues in Microsystems packaging, Types of Microsystems Packaging: Packaging technologies: Wire Bonding, Flip-Chip Assembly, ball-Grid Array, Embedded Overlay, Wafer-Level Packaging.

**5 Hours**

**Text Books:**


3. **Micro and Smart Systems,** G K Ananthasuresh et al., John-Wiley India, First Edition, 2010
4. **MEMS & Microsystems: Design and Manufacture-** Tai-Ran Tsu, Tata Mc-Graw-Hill.


**E-Books:**

1. https://www.crcpress.com/Bio-MEMS-Technologies-and-Applications/Wang-Soper/p/book/ 9780849335327
2. https://www.amazon.in/Bio-MEMS-Technologies-Applications-Wanjun-Wang-ebook/dp/ B009AI34IS

**MOOCs :**

1. https://www.extension.harvard.edu/academics/courses/introduction-mems-biomems/14876
2. https://onlinecourses.nptel.ac.in/noc15_me01/preview

## 21ARD-Aptitude Reasoning Development (0-1-0) 0

**CIE: 100 Marks** **Hours/Week: 3** **Total Hours: 45**

**Course Outcomes:** At the end of course, student will be able to:

| # | Course Outcomes | Mapping to POs | Mapping to PSOs |
|---|---|---|---|
| 1. | Apply Logical reasoning and deductions for given | 1 | - |

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Introduction and concepts of Logical reasoning, Illustrative examples, Logical analysis. Technical aptitude on C and C++. Language fundamental. Illustrative programs. MCQs on coding constructs, error detection, finding the output of code segments.

**Scheme of Evaluation:**

**CIE**- 5 quizzes each for 10 marks.

| **Course Title:** | **CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS (Audit Course)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| **Course Code:** | **21CIP** | **2** | **0** | **0** | **0** |
| **Hours / week: 2** | **CIE: N/A SEE: N/A Exam hours: N/A Total hours: 26** | | | | |

**Course Outcomes:** Upon completion of this course, student should be able to:

CO1: Explain the significance of the preamble of the constitution, the fundamental rights and duties

CO2: Appreciate and emulate the principles of Freedom of thought and expression as a professional

CO3: Critically analyze and interpret the current scenario of the nation verses the constitutional provisions

CO4: Gain professional and ethical responsibility as engineers and acquire application competence

**Constitution of India**

1. Preamble to the constitution of India - Evolution of constitutional Law Scope and extent of fundamental rights under part III - Details of Exercise of rights, Limitations and Important Cases.

**4 Hours**

2. Relevance of Directive Principles of State Policy under Part IV, Significance of Fundamental Duties under Part IV

**3 Hours**

3. Union Executive President, Vice-President, Prime Minister, Council of Ministers, Parliament and Supreme Court of India.

**3 Hours**

4. State Executive, Governor, Chief Minister, Council of Ministers, Legislature and High Courts.

**3 Hours**

5. Constitutional provisions for scheduled castes and tribes, women and children and backward classes, Emergency provisions

**4 Hours**

6. Electoral process, amendment procedure, $42^{nd}$, $44^{th}$, $74^{th}$, $76^{th}$, $86^{th}$ and $91^{st}$ constitutional amendments.

**3 Hours**

**Professional Ethics**

7. Scope and aims of engineering ethics, responsibility of engineers, impediments to responsibility.

**3 Hours**

8. Honesty, integrity and reliability, risks, safety and liability in engineering.

**3 Hours**

**Text Books:**

1. DurgaDasBasu : Introduction to the Constitution of India (Students Edn.), PH - EEE, $19^{th}$ / $21^{th}$ Edition., 2101.
2. Charles E Haries, Michael S Pritchard and Michael J Robins, Engineering Ethics, Thompson Asia, 2103-08-05.

**Reference Books:**

1. M V Pylee : An Introduction to Constitution of India, Vikas Publishing.
2. M Govindarajan, S Natarajan, V S Senthilkumar : Engineering Ethics, Prentice - Hall of India, New Delhi, 2104.

| **Course Title:** | **SWAYAM Course I (Mandatory Audit Course)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| **Course Code:** | **21SW01** | **-** | **-** | **-** | **0** |

Students have to register for the SWAYAM courses offered by NPTEL, MHRD. Before registering for the course, consult the faculty advisor/mentor and get the approval from the HoD. The activities conducted by the SWAYAM course are to be completed by obtaining the minimum prescribed marks. Students must appear for the course end proctored examination and obtain the minimum qualifying marks. The certificate obtained from SWAYAM is to be submitted to get the qualifying grade(Y/N).