DEPARTMENT OF INSTRUMENTATION ENGINEERING
ANNA UNIVERSITY, CHENNAI

VISION OF THE DEPARTMENT

The Department of Instrumentation Engineering perseveres in becoming a Centre for Excellence in Electronics, Instrumentation and Control Engineering for Higher level learning, Research and Consultancy. The Department aims at imparting high quality education to students and professionals leading them to global competence. Its endeavors is to become a preferred partner to the industry and community for providing Engineering solutions.

MISSION OF THE DEPARTMENT

- Provide the students with strong foundation in Electronics, Instrumentation and Control Engineering.
- Enhance the core competency of the students to cater to the needs of the industries and research organizations.
- Update the curriculum periodically and to upgrade the laboratories with state-of-art equipment.
- Encourage faculty members to keep abreast of current trends through continuing educational programs.
- Carry out interdisciplinary research and consultancy in the cutting-edge technology.
PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):
Bachelor of Electronics and Instrumentation Engineering curriculum is designed to prepare the graduates to acquire knowledge, skills and attitudes in order to:

1. Be successful in their technical, professional careers & in their chosen fields such as Electronics, Instrumentation, Process Control & Information Technology.
2. Engross in the life long process of learning to keep themselves abreast of new developments in the emerging areas of Electronics, Instrumentation, Process Control & Information Technology.
3. Start their own company or nurture innovative ideas and creativity in their work place.
4. Uphold the highest integrity and social responsibility in all their endeavors.
5. Exhibit leadership and interpersonal skills.

PROGRAMME OUTCOMES (POs):
The graduates will have the ability to

1. Apply the Mathematical knowledge and the basics of Science and Engineering to solve the problems pertaining to Electronics and Instrumentation Engineering.
2. Identify and formulate Instrumentation Engineering problems from research literature and be able to analyze the problem using first principles of Mathematics and Engineering Sciences.
3. Come out with solutions for the complex problems and to design system components or process that fulfill the particular needs taking into account public health and safety and the social, cultural and environmental issues.
4. Draw well-founded conclusions applying the knowledge acquired from research and research methods including design of experiments, analysis and interpretation of data and synthesis of information and to arrive at significant conclusion.
5. Form, select and apply relevant techniques, resources and Engineering and IT tools for Engineering activities like electronic prototyping, modeling and control of systems/processes and also being conscious of the limitations.
6. Understand the role and responsibility of the Professional Instrumentation Engineer and to assess societal, health, safety issues based on the reasoning received from the contextual knowledge.
7. Be aware of the impact of professional Engineering solutions in societal and environmental contexts and exhibit the knowledge and the need for sustainable Development.
8. Apply the principles of Professional Ethics to adhere to the norms of the engineering practice and to discharge ethical responsibilities.
9. Function actively and efficiently as an individual or a member/leader of different teams and multidisciplinary projects.
10. Communicate efficiently the engineering facts with a wide range of engineering community and others, to understand and prepare reports and design documents; to make effective presentations and to frame and follow instructions.
11. Demonstrate the knowledge and understanding of Engineering and Management principles and to apply these to one’s own work as a member / leader in a team to manage Electronics / Instrumentation / Control and Automation projects.

12. Recognize the need for self and life-long learning, keeping pace with technological challenges in the broadest sense.

PROGRAM SPECIFIC OUTCOMES (PSOs):

After completion of Electronics and Instrumentation Engineering program, students will gain core competency skills in domains such as Electronics, Instrumentation and Process control and

1. Be able to Select, install, calibrate and maintain instruments used for measurement and analysis and interpret the data obtained to arrive at a significant conclusion.

2. Be able to analyze, design and develop signal conditioning circuits for sensors, actuators and select a suitable Embedded System for realizing various control schemes and smart instruments.

3. Be able to design, develop and implement control schemes for various industrial processes and gain hands on experience in configuring Industrial Automation System such as PLC and DCS.

PEO/PO Mapping:

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# Mapping of Course Outcome and Programme Outcome

<p>| SEM I | Course Name | PO01 | PO02 | PO03 | PO04 | PO05 | PO06 | PO07 | PO08 | PO09 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-------|-------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| THEORY | Technical English | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    |
|        | Engineering Mathematics I | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    |
|        | Engineering Physics | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    |
|        | Engineering Chemistry | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    |
|        | Engineering Graphics | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    |
| PRACTICALS | Basic Sciences Laboratory | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    |
|        | Workshop Practices Laboratory | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    |
| SEM II | THEORY | Engineering Mathematics II | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    |
|        | Physics for Electronic Sciences | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    |
|        | Engineering Mechanics | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    |
|        | Problem Solving and Python Programming | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    |
| PRACTICALS | Electronics for Analog Signal Processing- I | S    | M    | M    | M    | M    | M    | M    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    |
|        | Problem Solving and Python Programming | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    |</p>
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| ELECTIVES | Analytical Instrumentation | S | L | M | M | M | L | L | L | L | L | M | S | L | L |
| | Biomedical Instrumentation | S | L | M | L | L | L | L | M | M | M | M | M | M | M |
| | Fiber optics and laser Instrumentation | L | M | M | M | M | L | M | M | M | M | M | M | M | M |
| | Safety Instrumented System | M | S | S | S | M | M | M | M | M | M | M | M | M | M |
| | Instrumentation Standards | L | L | L | M | M | L | L | L | L | L | L | S | S | S | M |
| | Fundamentals of Nano science and MEMS | L | L | S | L | S | S | L | S | M | M | M | M | M | M | M |
| | Modern Control Theory | S | L | M | M | M | L | M | M | M | M | M | M | M | M | M |
| | Advanced topics in PID control | S | L | S | M | S | S | L | M | M | M | M | M | M | M | M | M |

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### Summary

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OBJECTIVES:

The first semester English course entitled ‘Technical English ’ aims to,

- Familiarize first year students of engineering and technology with the fundamental aspects of technical English.
- Develop all the four language skills by giving sufficient practice in the use of the skills in real life contexts.
- Enhance the linguistic and communicative competence of first year engineering and technology students.

UNIT I INTRODUCING ONESELF 12
Listening: Listening and filling a form, listening to speeches by specialists from various branches of engineering and completing activities such as answering questions, identifying the main ideas of the listening text, style of the speaker (tone and tenor) – Speaking: Introducing oneself – introducing friend/ family - Reading: Descriptive passages (from newspapers / magazines)- Writing: Writing a paragraph (native place, school life)- Grammar: Simple present, present continuous – Vocabulary Development: One word substitution

UNIT II DIALOGUE WRITING 12
Listening: Listening to conversations (asking for and giving directions) – Speaking: making conversation using (asking for directions, making an enquiry), Role plays-dialogues- Reading: Reading a print interview and answering comprehension questions-Writing: Writing a checklist, Dialogue writing- Grammar: Simple past – question formation (Wh- questions, Yes or No questions, Tag questions)- Vocabulary Development: Stress shift, lexical items related to the theme of the given unit.

UNIT III FORMAL LETTER WRITING 12
Listening: Listening to speeches by famous people and identifying the central message of the speech – answering multiple-choice questions)-Speaking: Giving short talks on a given topic-Reading: Reading motivational essays on famous engineers and technologists (answering open-ended and closed questions)- Writing: Writing formal letters/ emails (Complaint letters)-Grammar: Future Tense forms of verbs, subject and verb agreement-Vocabulary Development: Collocations – Fixed expressions

UNIT IV WRITING COMPLAINT LETTERS 12

UNIT V WRITING DEFINITIONS AND PRODUCT DESCRIPTION 12
Listening: Listening to a product description (labeling and gap filling) exercises- Speaking: Describing a product and comparing and contrasting it with other products- Reading: Reading graphical material for comparison (advertisements)-Writing: Writing Definitions (short and long) – compare and contrast paragraphs- Grammar: Adjectives – Degrees of comparison - compound nouns- Vocabulary Development: Use of discourse markers – suffixes (adjectival endings).
Learning Outcomes

At the end of the course the students will have gained,

- Exposure to basic aspects of technical English.
- The confidence to communicate effectively in various academic situations.
- Learnt the use of basic features of Technical English.

Textbook:


Assessment Pattern

- Assessments will assess all the four skills through both pen and paper and computer based tests.
- Assessments can be pen and paper based, quizzes.

MA5158

ENGINEERING MATHEMATICS I

(L & T 3 1 0 4
in I Semester)

OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

UNIT I MATRICES


UNIT II DIFFERENTIAL CALCULUS

UNIT III  FUNCTIONS OF SEVERAL VARIABLES  

UNIT IV INTEGRAL CALCULUS  
Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

UNIT V MULTIPLE INTEGRALS  

TOTAL :60 PERIODS

OUTCOMES:
At the end of the course the students will be able to
- Use the matrix algebra methods for solving practical problems.
- Apply differential calculus tools in solving various application problems.
- Able to use differential calculus ideas on several variable functions.
- Apply different methods of integration in solving practical problems.
- Apply multiple integral ideas in solving areas, volumes and other practical problems.

TEXTBOOKS:

REFERENCES:
PH5151 ENGINEERING PHYSICS (Common to all branches of B.E / B.Tech programmes) 3 0 0 3

OBJECTIVE
- To make the students in understanding the importance of mechanics.
- To equip the students on the knowledge of electromagnetic waves.
- To introduce the basics of oscillations, optics and lasers.
- To enable the students in understanding the importance of quantum physics.
- To elucidate the application of quantum mechanics towards the formation of energy bands in crystalline materials.

UNIT I MECHANICS

UNIT II ELECTROMAGNETIC WAVES
Gauss’s law – Faraday’s law - Ampere’s law - The Maxwell’s equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

UNIT III OSCILLATIONS, OPTICS AND LASERS

UNIT IV BASIC QUANTUM MECHANICS
Photons and light waves - Electrons and matter waves - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization - Particle in a infinite potential well - Normalization, probabilities and the correspondence principle.

UNIT V APPLIED QUANTUM MECHANICS
The harmonic oscillator - Barrier penetration and quantum tunneling - Tunneling microscope - Resonant diode - Finite potential wells - particle in a three dimensional box - Bloch’s theorem for particles in a periodic potential, Kronig-Penney model and origin of energy bands.

TOTAL: 45 PERIODS

OUTCOME
After completion of this course, the students should able to
- Understanding the importance of mechanics.
- Express the knowledge of electromagnetic waves.
- Know the basics of oscillations, optics and lasers.
- Understanding the importance of quantum physics.
- Apply quantum mechanical principles towards the formation of energy bands in crystalline materials.
TEXT BOOKS

REFERENCES

CY5151 ENGINEERING CHEMISTRY
(COMMON TO ALL BRANCHES)

OBJECTIVES:
- To introduce the basic concepts of polymers, their properties and some of the important applications.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To facilitate the understanding of the laws of photochemistry, photoprocesses and instrumentation & applications of spectroscopic techniques.
- To familiarize the operating principles and applications of energy conversion, its processes and storage devices.
- To inculcate sound understanding of water quality parameters and water treatment techniques.

UNIT I POLYMER CHEMISTRY

UNIT II NANO CHEMISTRY

UNIT III PHOTO CHEMISTRY AND SPECTROSCOPY
UNIT IV ENERGY CONVERSIONS AND STORAGE

Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant – fast breeder reactor. Solar energy conversion - solar cells. Wind energy. Batteries - types of batteries – primary battery (dry cell), secondary battery (lead acid, nickel-cadmium and lithium-ion-battery). Fuel cells – $\text{H}_2\text{-O}_2$ and microbial fuel cell. Explosives – classification, examples: TNT, RDX, Dynamite; Rocket fuels and propellants – definition and uses.

UNIT V WATER TECHNOLOGY


TOTAL: 45 PERIODS

OUTCOMES:

- To recognize and apply basic knowledge on different types of polymeric materials, their general preparation methods and applications to futuristic material fabrication needs.
- To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
- To identify and apply suitable spectroscopic technique for material analysis and study different forms of photochemical reactions.
- To recognize different forms of energy resources and apply them for suitable applications in energy sectors.
- To demonstrate the knowledge of water and their quality in using at different industries.

TEXT BOOKS:


REFERENCE BOOKS:

COURSE OBJECTIVES: The main learning objective of this course is to prepare the students for:
1. Drawing free hand sketches of basic geometrical shapes and multiple views of objects.
2. Drawing orthographic projections of lines and planes.
3. Drawing orthographic projections of solids.
4. Drawing development of the surfaces of objects.
5. Drawing isometric and perspective views of simple solids.

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION)
Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I  PLANE CURVES AND FREE HANDSKETCHING  14
Basic Geometrical constructions, Curves used in engineering practices-Conics – Construction of ellipse, parabola and hyperbola by different methods – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles – Representation of Three-Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects

UNIT II  PROJECTION OF POINTS, LINES AND PLANE SURFACES  15
Orthographic projection- principles-Principle planes-First angle projection-Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes- Determination of true lengths and true inclinations by rotating line method and trapezoidal method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III  PROJECTION OF SOLIDS  15
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to both the principal planes by rotating object method and auxiliary plane method.

UNIT IV  PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES  15
Sectioning of solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes.

UNIT V  ISOMETRIC AND PERSPECTIVE PROJECTIONS  12
Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids-Prisms pyramids and cylinders by visual ray method and vanishing point method.

COMPUTER AIDED DRAFTING (DEMONSTRATION ONLY)  3
Introduction to drafting packages and demonstration of their use

TOTAL (L: 15 + P: 60)=75 PERIODS

COURSE OUTCOMES: Upon completion of this course, the students will be able to:
1. Draw free hand sketching of basic geometrical shapes and multiple views of objects.
2. Draw orthographic projections of lines and planes
3. Draw orthographic projections of solids
4. Draw development of the surfaces of objects
5. Draw isometric and perspective views of simple solids.

**TEXT BOOKS:**

**REFERENCES:**

**Publication of Bureau of Indian Standards:**

**Special points applicable to University Examinations on Engineering Graphics:**
1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only.
4. The students will be permitted to use appropriate scale to fit solution within A3 size.
5. The examination will be conducted in appropriate sessions on the same day.

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PHYSICS LABORATORY: (Any Seven Experiments)

OBJECTIVE
• To inculcate experimental skills to test basic understanding of physics of materials including properties of matter, thermal and optical properties.
• To induce the students to familiarize with experimental determination of velocity of ultrasonic waves and band gap determination.

LIST OF EXPERIMENTS:
1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of disc
2. Non-uniform bending - Determination of Young’s modulus
3. Uniform bending – Determination of Young’s modulus
4. Lee’s disc Determination of thermal conductivity of a bad conductor
5. Potentiometer-Determination of thermo e.m.f of a thermocouple
6. Laser- Determination of the wave length of the laser using grating
7. Air wedge - Determination of thickness of a thin sheet/wire
8. a) Optical fibre - Determination of Numerical Aperture and acceptance angle
    b) Compact disc - Determination of width of the groove using laser.
10. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
11. Post office box - Determination of Band gap of a semiconductor.
13. Photoelectric effect
14. Michelson Interferometer.
16. Melde’s string experiment

TOTAL: 30 PERIODS

OUTCOME
Upon completion of the course, the students will be able
• To determine various moduli of elasticity and also various thermal and optical properties of materials.
• To determine the velocity of ultrasonic waves, band gap determination and viscosity of liquids.

CHEMISTRY LABORATORY: (Minimum of 8 experiments to be conducted)

OBJECTIVES:
• To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.
• To induce the students to familiarize with electro analytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
• To demonstrate the analysis of metals and polymers by spectroscopy and viscometry methods.
LIST OF EXPERIMENTS:

1. Estimation of HCl using Na\textsubscript{2}CO\textsubscript{3} as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenantroline / thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
12. Pseudo first order kinetics-ester hydrolysis.
14. Phase change in a solid.

TOTAL: 30 PERIODS

OUTCOMES:

- To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.
- To determine the amount of metal ions through volumetric and spectroscopic techniques
- To determine the molecular weight of polymers by viscometric method.
- To quantitatively analyse the impurities in solution by electroanalytical techniques
- To design and analyse the kinetics of reactions and corrosion of metals

TEXTBOOKS:

2. Vogel’s Textbook of Quantitative Chemical Analysis (8\textsuperscript{th} edition, 2014).

COURSE OBJECTIVES: The main learning objective of this course is to provide hands on training to the students in:

1. Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common household wood work.
2. Wiring various electrical joints in common household electrical wire work.
3. Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work.
4. Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.
GROUP – A (CIVIL & ELECTRICAL)

PART I

CIVIL ENGINEERING PRACTICES

PLUMBING WORK:

a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
b) Preparing plumbing line sketches.
c) Laying pipe connection to the suction side of a pump
d) Laying pipe connection to the delivery side of a pump.
e) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK:

a) Sawing,
b) Planning and
c) Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.

Wood Work Study:

a) Studying joints in door panels and wooden furniture
b) Studying common industrial trusses using models.

PART II

ELECTRICAL ENGINEERING PRACTICES

WIRING WORK:

a) Wiring Switches, Fuse, Indicator and Lamp etc. such as in basic household,
b) Wiring Stair case light.
c) Wiring tube – light.
d) Preparing wiring diagrams for a given situation.

Wiring Study:

a) Studying an Iron-Box wiring.
b) Studying a Fan Regulator wiring.
c) Studying an Emergency Lamp wiring.

GROUP – B (MECHANICAL AND ELECTRONICS)

PART III

MECHANICAL ENGINEERING PRACTICES

WELDING WORK:

a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
b) Practicing gas welding.

BASIC MACHINING WORK:

a) (simple)Turning.
b) (simple) Drilling.
c) (simple) Tapping.

ASSEMBLY WORK:

a) Assembling a centrifugal pump.
b) Assembling a household mixer.
c) Assembling an air conditioner.

SHEET METAL WORK:

a) Making of a square tray

FOUNDRY WORK:

a) Demonstrating basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES

SOLDERING WORK:

a) Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:

a) Assembling and testing electronic components on a small PCB.

ELECTRONIC EQUIPMENT STUDY:

a) Studying a FM radio.
b) Studying an electronic telephone.

TOTAL (P: 60) = 60 PERIODS

COURSE OUTCOMES: Upon completion of this course, the students will be able to:

1. Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.
2. Wire various electrical joints in common household electrical wire work.
3. Weld various electrical joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.
4. Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

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OBJECTIVES:

- To acquaint the students with the concepts of vector calculus which naturally arises in many engineering problems.
- To develop an understanding of the standard techniques of complex variable theory in particular analytic function and its mapping property.
- To familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals.
- To acquaint the students with Differential Equations which are significantly used in Engineering problems.
- To make the students appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT I VECTOR CALCULUS
12

UNIT II ANALYTIC FUNCTION
12
Analytic functions – Necessary and sufficient conditions for analyticity - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions - Bilinear transformation \( w = c + z, \ a z, \ \frac{1}{z}, \ z^2 \).

UNIT III COMPLEX INTEGRATION
12

UNIT IV DIFFERENTIAL EQUATIONS
12
Method of variation of parameters – Method of undetermined coefficients – Homogenous equations of Euler’s and Legendre’s type – System of simultaneous linear differential equations with constant coefficients.

UNIT V LAPLACE TRANSFORMS
12

TOTAL : 60 PERIODS

OUTCOMES:

Upon successful completion of the course, students will be able to:
- Calculate grad, div and curl and use Gauss, Stokes and Greens theorems to simplify calculations of integrals.
- Construct analytic functions and use their conformal mapping property in application
- Evaluate real and complex integrals using the Cauchy’s integral formula and residue theorem.
- Apply various methods of solving differential equation which arise in many application problems.
- Apply Laplace transform methods for solving linear differential equations.

**TEXTBOOKS:**


**REFERENCES:**


**PH5252 PHYSICS FOR ELECTRONIC SCIENCES**

(Common to EEE and EI Branches)

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**OBJECTIVE**

- To make the students to understand the basics of crystallography and its importance in studying materials properties.
- To understand the electrical properties of materials including free electron theory, applications of quantum mechanics and magnetic materials.
- To instill knowledge on physics of semiconductors, determination of charge carriers and device applications.
- To establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications.
- To inculcate an idea of significance of nano structures, quantum confinement and ensuing nano device applications.

**UNIT I CRYSTALLOGRAPHY**

Crystal structures - Bravais lattices – packing factor of SC, BCC, FCC, HCP and diamond structures – Close-packed crystal directions and planes – Surface crystallography – surface structure for BCC and close packed structures - surface to volume ratio: plane, cylinder, cube, sphere - Number of atoms and number of surface atoms in a structure: unit cell approach - imperfections and impurities.

**UNIT II ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS**


UNIT III SEMICONDUCTORS AND TRANSPORT PHYSICS

UNIT IV OPTICAL PROPERTIES OF MATERIALS
Classification of optical materials – Absorption emission and scattering of light in metals, insulators & Semiconductors - LED’s – Organic LED’s – Plasma light emitting devices – LCD’s – Laser diodes – Optical data storage techniques (including DVD, Blue -ray disc, Holographic data storage).

UNIT V NANO DEVICES

TOTAL: 45 PERIODS

OUTCOME
At the end of the course, the students will
• know basics of crystallography and its importance for materials properties
• come to have firm knowledge on the electrical and magnetic properties of materials and their applications
• acquire adequate understanding of semiconductor physics and functioning of semiconductor devices
• understand the optical properties of materials and working principles of various optical devices
• appreciate the importance of nanotechnology, physics of nanodevices, low-dimensional structures and their applications

REFERENCES
COURSE OBJECTIVES: The main learning objective of this course is to prepare the students for:

1. Applying the various methods to determine the resultant forces and its equilibrium acting on a particle in 2D and 3D.
2. Applying the concept of reaction forces (non-concurrent coplanar and noncoplanar forces) and moment of various support systems with rigid bodies in 2D and 3D in equilibrium. Reducing the force, moment, and couple to an equivalent force / couple system acting on rigid bodies in 2D and 3D.
3. Applying the concepts of locating centroids / center of gravity of various sections / volumes and to find out area moments of inertia for the sections and mass moment of inertia of solids.
4. Applying the concepts of frictional forces at the contact surfaces of various engineering systems.
5. Applying the various methods of evaluating kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

UNIT I   STATICs OF PARTICLES  (9+3)


UNIT II   EQUILIBRIUM OF RIGID BODIES  (9+3)


UNIT III   DISTRIBUTED FORCes  (9+3)

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration, Theorems of Pappus-Guldinus, Distributed Loads on Beams, Centre of Gravity of a Three-Dimensional Body, Centroid of a Volume, Composite Bodies, Determination of Centroids of Volumes by Integration.

Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration, Polar Moment of Inertia, Radius of Gyration of an Area, Parallel-Axis Theorem, Moments of Inertia of Composite Areas, Moments of Inertia of a Mass - Moments of Inertia of Thin Plates, Determination of the Moment of Inertia of a Three-Dimensional Body by Integration

UNIT IV   FRICtion  (9+3)


UNIT V    DYNAMICS OF PARTICLES  (9+3)


TOTAL (L: 45 + T: 15)=60 PERIODS

COURSE OUTCOMES: Upon completion of this course, the students will be able to:

1. Apply the various methods to determine the resultant forces and its equilibrium acting on a particle in 2D and 3D.
2. Apply the concept of reaction forces (non-concurrent coplanar and noncoplanar forces) and moment of various support systems with rigid bodies in 2D and 3D in equilibrium. Reducing the force, moment, and couple to an equivalent force - couple system acting on rigid bodies in 2D and 3D.
3. Apply the concepts of locating centroids / center of gravity of various sections / volumes and to find out area moments of inertia for the sections and mass moment of inertia of solids.
4. Apply the concepts of frictional forces at the contact surfaces of various engineering systems.
5. Apply the various methods of evaluating kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

TEXT BOOKS:


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OBJECTIVES:
- To know the basics of algorithmic problem solving.
- To develop Python programs with conditionals and loops.
- To define Python functions and use function calls.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

UNIT I INTRODUCTION TO COMPUTING AND PROBLEM SOLVING 9

Suggested Activities:
- Developing Pseudocodes and flowcharts for real life activities such as railway ticket booking using IRCTC, admission process to undergraduate course, academic schedules during a semester etc.
- Developing algorithms for basic mathematical expressions using arithmetic operations.
- Installing Python.
- Simple programs on print statements, arithmetic operations.

Suggested Evaluation Methods:
- Assignments on pseudocodes and flowcharts.
- Tutorials on Python programs.

UNIT II CONDITIONALS AND FUNCTIONS 9

Suggested Activities:
- Simple Python program implementation using Operators, Conditionals, Iterative Constructs and Functions.
- Implementation of a simple calculator.
- Developing simple applications like calendar, phone directory, to-do lists etc.
- Flow charts for GCD, Exponent Functions, Fibonacci Series using conditionals and iterative statements.
- External learning - Recursion vs. Iteration.

Suggested Evaluation Methods:
- Tutorials on the above activities.
- Group Discussion on external learning.

UNIT III SIMPLE DATA STRUCTURES IN PYTHON 10
Deleting Elements in a Tuple, Tuple Assignment, Tuple as Return Value, Nested Tuples, Basic Tuple Operations – Sets.

Suggested Activities:
- Implementing python program using lists, tuples, sets for the following scenario:
  Simple sorting techniques
  Student Examination Report
  Billing Scheme during shopping.
- External learning - List vs. Tuple vs. Set – Implementing any application using all the three data structures.

Suggested Evaluation Methods:
- Tutorials on the above activities.
- Group Discussion on external learning component.

UNIT IV    STRINGS, DICTIONARIES, MODULES  10

Suggested Activities:
- Implementing Python program by importing Time module, Math package etc.
- Creation of any package (student’s choice) and importing into the application.

Suggested Evaluation Methods:
- Tutorials on the above activities.

UNIT V    FILE HANDLING AND EXCEPTION HANDLING  7
Introduction to Files – File Path – Opening and Closing Files – Reading and Writing Files – File Position – Exception: Errors and Exceptions, Exception Handling, Multiple Exceptions.

Suggested Activities:
- Developing modules using Python to handle files and apply various operations on files.
- Usage of exceptions, multiple except blocks - for applications that use delimiters like age, range of numerals etc.
- Implementing Python program to open a non-existent file using exceptions.

Suggested Evaluation Methods:
- Tutorials on the above activities.
- Case Studies.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, students will be able to:
CO1 Develop algorithmic solutions to simple computational problems.
CO2 Develop and execute simple Python programs.
CO3 Write simple Python programs for solving problems.
CO4 Decompose a Python program into functions.
CO5 Represent compound data using Python lists, tuples, dictionaries etc.
CO6 Read and write data from/to files in Python programs.
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EI5201 ELECTRONICS FOR ANALOG SIGNAL PROCESSING - I

COURSE OBJECTIVES
- To introduce the students to the construction, operation, characteristics and applications of various semiconductor diodes and transistors.
- To impart knowledge on different types of configurations and biasing circuits for BJT and FET.
- To impart knowledge on single & multi-stage amplifiers, power amplifiers and oscillators.
- To enable the students to analyze a given BJT / FET amplifier circuit for voltage gain, current gain, input impedance, output impedance and bandwidth.
- To enable the students to design transistor amplifiers and oscillators for a given set of specifications.

UNIT I SEMICONDUCTOR DEVICES
PN junction diode: Forward and reverse characteristics, Applications in Rectifier, Switching, Clipper, Clamper and Protection circuits - Zener diode: Forward and reverse characteristics, Application as voltage regulator, Introduction to special diodes: Schottky diode, Varactor diode, Laser diode, Photodiode – UJT characteristics and application as relaxation oscillator.

UNIT II BJT AMPLIFIERS AND POWER DEVICES
BJT: NPN and PNP transistors, Characteristics of CE, CB and CC amplifier configurations, Biasing circuits, Small Signal analysis of BJT amplifier, Frequency response of BJT amplifier, Gain-Bandwidth product – Transistor switching circuits - Thyristors: Characteristics and
applications of SCR, DIAC and TRIAC.

UNIT III  FET AMPLIFIERS
FET: JFET and MOSFET, Characteristics of CS, CG and CD amplifier configurations – Biasing circuits– Small signal analysis of FET amplifier, Frequency response of FET amplifiers - CMOS inverter circuits, IGBT and IGFET.

UNIT IV  MULTISTAGE AND FEEDBACK AMPLIFIERS

UNIT V  OSCILLATORS AND POWER AMPLIFIERS

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)
1. Ability to understand the behavior of semiconductor devices.
2. Ability to identify an appropriate semiconductor devices for a specific application
3. Ability to solve electronic devices and systems using mathematical concepts
4. Ability to analyze a given transistor amplifier and evaluate its performance with respect to gain, impedance and bandwidth.
5. Ability to develop design proficiency in the area of feedback amplifiers.
6. Ability to describe the design of single stage / multistage amplifiers, oscillators and power amplifiers using BJT.

TEXT BOOKS:

REFERENCE BOOKS:
5. NPTEL video lectures on “Electronics for Analog Signal Processing I” by Prof. K.R.K. Rao, IITM.
# GE5161 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY

## OBJECTIVES:
- To understand the problem solving approaches.
- To learn the basic programming constructs in Python.
- To articulate where computing strategies support in providing Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

## EXPERIMENTS:
1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same.
2. Python programming using simple statements and expressions.
3. Scientific problems using Conditionals and Iterative loops.
4. Implementing real-time/technical applications using Lists, Tuples.
5. Implementing real-time/technical applications using Sets, Dictionaries.
6. Implementing programs using Functions.
7. Implementing programs using Strings.
9. Implementing real-time/technical applications using File handling.
10. Implementing real-time/technical applications using Exception handling.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL: 60 PERIODS
OUTCOMES:
On completion of the course, students will be able to:
CO1 Develop algorithmic solutions to simple computational problems
CO2 Develop and execute simple Python programs.
CO3 Structure simple Python programs for solving problems.
CO4 Decompose a Python program into functions.
CO5 Represent compound data using Python data structures.
CO6 Apply Python features in developing software applications.

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EI5211    ANALOG SIGNAL PROCESSING LABORATORY    L T P C
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COURSE OBJECTIVES
• To facilitate the students to study the characteristics of various semiconductor devices.
• To provide practical knowledge on the analysis of rectifiers, regulators, amplifiers and oscillators.
• To enable the students to design rectifiers, regulators, amplifiers and oscillators for a given set of specifications.
• To impart hands-on training to the students on e-CAD tools used for designing electronic circuits.

LIST OF EXPERIMENTS
1. Study of CRO, DSO, Function Generator, Power Supply and Multi-meter
2. PN junction diode characteristics and application as a rectifier.
3. Determination of characteristics of BJT amplifier in CE configuration and determination of h-parameters.
4. Determination of characteristics of JFET amplifier in CS configuration and determination of amplification factor.
5. Determination of characteristics of UJT and application as a relaxation oscillator.
6. Determination of characteristics of SCR and application as a controlled rectifier.
7. Design and verification of Voltage divider bias for BJT and FET circuits for a given operating point.

9. Design and verification of cascaded CE amplifier.

10. Design and verification of Wien Bridge oscillator and Colpitts oscillator circuits.

11. Design and verification of series and shunt voltage regulators.

12. Simulation of at least four of the above experiments using e-CAD tools.

TOTAL : 60 PERIODS

COURSE OUTCOMES (COs)

1. Ability to identify with the physical construction, working and operational characteristics of Semiconductor devices like Diode, BJT, FET, SCR and UJT.

2. An ability to design for various application circuits with basic semiconductor devices, measuring instruments and power supplies.

3. An ability to construct, analyze and troubleshoot the designed circuits.

4. Ability to interpret the results of analysis and depict the significant conclusions.

5. Ability to Design and test the various application circuits by using appropriate software tools.

6. Ability to present the results in written and oral forms.

7. Ability to work as a member in a group.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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OBJECTIVES:
- Teach definition and classification of values.
- Explain Purusartha.
- Describe Sarvodaya idea.
- Summarize sustenance of life.
- Conclude views of hierarchy of values.

UNIT I  DEFINITION AND CLASSIFICATION OF VALUES  9
Extrinsic values- Universal and Situational values- Physical- Environmental-Sensuous- Economic- Social-Aesthetic-Moral and Religious values

UNIT II  CONCEPTS RELATED TO VALUES  9
Purusartha-Virtue- Right- duty- justice- Equality- Love and Good

UNIT III  IDEOLOGY OF SARVODAYA  9
Egoism- Altruism and universalism- The Ideal of Sarvodaya and Vasudhaiva Kutumbakam

UNIT IV  SUSTENANCE OF LIFE  9
The Problem of Sustenance of value in the process of Social, Political and Technological Changes

UNIT V  VIEWS ON HIERARCHY OF VALUES  9
The Problem of hierarchy of values and their choice, The views of Pt. Madan Mohan Malviya and Mahatma Gandhi

TOTAL: 45 PERIODS

OUTCOMES:
- CO1: Able to understand definition and classification of values.
- CO2: Able to understand purusartha.
- CO3: Able to understand sarvodaya idea.
- CO4: Able to understand sustenance of life.
- CO5: Able to understand views of hierarchy of values.
TEXTBOOKS:

2. Little, William, : An Introduction of Ethics (Allied Publisher, Indian Reprint 1955)

MA5356  LINEAR ALGEBRA AND NUMERICAL METHODS  L T P C
3 1 0 4

OBJECTIVES:
The basic concepts and tools of the subject covered are:

- Vector spaces and subspaces; linear independence and span of a set of vectors, basis and dimension; the standard bases for common vector spaces;
- Linear maps between vector spaces, their matrix representations, null-space and Range spaces, the Rank- Nullity Theorem;
- Inner product spaces: Cauchy-Schwarz inequality, orthonormal bases, the Gramm-Schmidt procedure, orthogonal complement of a subspace, orthogonal projection;
- Eigenvalues and eigenvectors, diagonalizability of a real symmetric matrix, canonical forms;
- Mathematical foundations of numerical techniques for solving linear systems, eigenvalue problems and generalized inverses.

UNIT I     VECTOR SPACES
Vector spaces – Subspaces – Linear combinations - Linear Span – Linear dependence - Linear independence – Bases and Dimensions

UNIT II    LINEAR TRANSFORMATIONS

UNIT III   INNER PRODUCT SPACES
Inner Products and norms - Inner Product Spaces - Orthogonal vectors – Gram Schmidt orthogonalization process – Orthogonal complement – Least square Approximations

UNIT IV    NUMERICAL SOLUTION OF LINEAR SYSTEM OF EQUATIONS

UNIT V     NUMERICAL SOLUTION OF EIGENVALUE PROBLEMS AND GENERALISED INVERSES
OUTCOMES:

- The students will be able to solve system of linear equations, to use matrix operations and vector spaces using algebraic methods.
- Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions.
- Apply numerical methods to obtain approximate solutions to mathematical problems.
- Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
- Analyze and evaluate the accuracy of common numerical methods.

TEXT BOOKS:

REFERENCES:

PR5301 THERMODYNAMICS AND FLUID MECHANICS

COURSE OBJECTIVES
1. To make students understand the basic laws of thermodynamics.
2. To make the students to familiarize with the concepts, laws and methodologies for the analysis of gas turbines and compressors.
3. To introduce the basic concepts of fluid mechanics.
4. To make students understand the working principle of different types of pumps and Hydraulic turbines.

UNIT I BASIC CONCEPTS AND LAWS OF THERMODYNAMICS
Thermodynamic system and surroundings – properties of system – STATE AND EQUILIBRIUM – Forms of energy – Quasi static process – Zeroth law of thermodynamics – Work and heat transfer – Path and point functions – First law of thermodynamics applied to open systems – SFEE equation and its applications. Second law of thermodynamics applied to Heat engines, Refrigerators& Heat pumps. Carnot’s theorem and clausius inequality – Concept of entropy applied to reversible and
irreversible processes – Third law of thermodynamics.

UNIT II INTRODUCTION TO APPLICATIONS OF THERMODYNAMICS

UNIT III BASIC CONCEPT OF FLUID MECHANICS & FLOW OF FLUIDS
Fluid: Properties and types.


UNIT IV DIMENSIONAL AND MODEL ANALYSIS
Dimension – need for dimensional analysis, Rayleigh’s and Buckingham’s method applied to flow problems, limitation of dimensional analysis. Model analysis – similitude, dimensionless numbers and their significance, similarity laws, model studies, limitation of scale models.

UNIT V HYDRAULIC MACHINES

Turbines: classification, working principle of a Pelton wheel turbine.

TOTAL : 45PERIODS

COURSE OUTCOMES (COs)
1. Ability to understand and apply the basic laws of thermodynamics and fluid mechanics for different applications.
2. Ability to use the basic concepts and methodologies for the analysis of gas turbine and compressors.
3. Ability to understand the need of dimensional and model analysis.
4. Ability to understand the working principle of different types of pumps and hydraulic turbines.

TEXT BOOKS:

REFERENCE BOOKS:
## MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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ANALYSIS OF ELECTRIC CIRCUITS

COURSE OBJECTIVES

- To introduce basic concepts of AC and DC circuits and to explore the basics of R, L, C circuits.
- To introduce various network theorems.
- To introduce the concept of transient analysis of first and second order linear circuits.
- To make the students understand the concept of resonance in Series and Parallel circuits.
- To introduce the concept of two port networks and the analysis of three-phase balanced and unbalanced circuits.

UNIT I  D.C and A.C CIRCUIT FUNDAMENTALS

UNIT II  STEADY STATE ANALYSIS OF NETWORKS

UNIT III  TRANSIENT ANALYSIS OF FIRST AND SECOND ORDER LINEAR CIRCUITS

UNIT IV  RESONANCE AND COUPLED CIRCUITS

UNIT V  THREE PHASE CIRCUITS AND TWO PORT NETWORKS

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to systematically obtain the equations that characterize the performance of an electric circuit as well as solving both single phase and three-phase circuits.
2. Ability to reduce complex network into simplified network.
3. Ability to determine the time & frequency responses of RL, RC and RLC circuits.
4. Ability to obtain the circuit parameters, current, voltage and power of a network.
5. Ability to use the software tools such as Pspice, Matlab, Circuit Wizard, etc. for solving large scale networks.
6. Ability to identify, formulate, and solve engineering problems in the area circuits and systems.
**TEXT BOOKS:**

**REFERENCE BOOKS:**

**MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES**

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**EI5302 ELECTRICAL MACHINES**

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**COURSE OBJECTIVES**
- To impart basic knowledge on different AC& DC Machines.
- To introduce the concept of special machines to motivate the students to solve complex problems related to machines.
- To impart knowledge on testing and controlling of different machines.
- Make the students familiar with the testing and controlling of different machines.

**UNIT I DC MACHINES**

**UNIT II TRANSFORMERS**

**UNIT III THREE-PHASE INDUCTION MOTOR**
UNIT IV  SYNCHRONOUS MACHINES

UNIT V  SPECIAL MACHINES

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)
1. Ability to understand the terms associated with electrical machines
2. Ability to understand basic concepts and working principle of electrical machines
3. Ability to understand the performance characteristics of machines
4. Ability to identify suitable machines for carrying out interdisciplinary projects.
5. Ability to apply the knowledge on various machines to choose appropriate machines for specific application useful for society.
6. Ability to understand the working principle of new machines and to learn their concepts.

TEXT BOOKS:

REFERENCE BOOKS:
3. Lecture series on “Electrical Machines I” and “Electrical Machines II” by Dr.Krishna Vasudevan, IIT Madras.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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COURSE OBJECTIVES

- To introduce the representation and classification of continuous-time and discrete-time signals.
- To impart knowledge on the methods and impact of analog to digital conversion and digital to analog conversion.
- To teach the analysis of Continuous Time and Discrete Time systems through various transform techniques such as Laplace transform, Fourier transform and Z-transform.
- To familiarize the concept of random signals and their statistical properties.

UNIT I  INTRODUCTION TO CONTINUOUS TIME AND DISCRETE TIME SIGNALS AND SYSTEMS

Definition of Continuous Time(CT) and Discrete Time(DT) signals, Representation of signals: – Impulse, Pulse, Step, Ramp, Exponential, Sinusoidal. Classification of signals: – periodic and a-periodic, power and energy, deterministic and random signals. Definition of system: Classification and characterization with examples: – Static & dynamic, causal & non causal, linear & non linear, time variant & time invariant, stable & unstable, FIR & IIR.

UNIT II  DISCRETIZATION AND SIGNAL RECONSTRUCTION

Discretization of signals: Sampling theorem, Types of sampling, Aliasing effects, Anti-aliasing filter, Quantization errors due to truncation and rounding in fixed and floating point representations, signal reconstruction:-Interpolation using zero-order hold & first order hold.

UNIT III  ANALYSIS OF CONTINUOUS TIME AND DISCRETE TIME SIGNALS AND SYSTEMS IN TIME DOMAIN


UNIT IV  TRANSFORM DOMAIN ANALYSIS OF CONTINUOUS TIME SYSTEMS


UNIT V  TRANSFORM DOMAIN ANALYSIS OF DT SIGNALS AND SYSTEMS


TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course, the student will be able to:

1. Ability to Infer the different types of CT and DT signals from their mathematical / graphical representations and classify them into various categories
2. Ability to characterize random signals using their statistical properties
3. Ability to analyze the CT and DT signals in time domain and frequency domain to infer their characteristics
4. Ability to apply the acquired knowledge to classify CT and DT systems into various categories
5. Ability to determine the response of a system for a given input using time domain and frequency domain techniques 
6. Ability to select the appropriate transform technique for the analysis of a given CT or DT system

**TEXT BOOKS:**

**REFERENCE BOOKS:**

**MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES**

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**EI5311 CIRCUIT SIMULATION LABORATORY**

**COURSE OBJECTIVES**
- To learn and practice generation of continuous and discrete time signals
- To analyze time and frequency response of continuous time and discrete time systems
- To study the effect of discretization of continuous time signal
- To simulate various network theorems using simulation software.
- To get introduced to self and mutual inductances
- To introduce power measurement in three phase circuits, z, y and h parameters of a two port network

**LIST OF EXPERIMENTS**
1. Generation of Continuous Time (CT) and Discrete Time (DT) signals using Simulation software
2. Determine the time response and frequency response of CT system
3. Determine the time response and frequency response of DT system
4. Study the effects of Sampling and quantization on the response of the system
5. Analyze the statistical parameters of random signals
6. Verification of Kirchhoff’s laws, Thevenin’s and Norton’s theorems.
7. Verification of Superposition, Maximum Power transfer and Reciprocity theorems.
9. Analyze and interpret the frequency response of Series and Parallel resonance circuits.
10. Determination of self, mutual inductances and coupling coefficient of coupled coils.
11. Power and power factor measurements in three phase circuits by two wattmeter method.
12. Determination of \( z \), \( y \) and \( h \) parameters of a two-port network.

TOTAL : 60 PERIODS

COURSE OUTCOMES (COs)

1. Ability to apply the first principle mathematical models to generate and characterize continuous and discrete time signals and systems
2. Ability to analyze the characteristics of random signals.
3. Ability to familiarize simulation software to verify the network theorems and analyze electrical network
4. Ability to design coupled circuit based on input and output signals
5. Ability to identify the type of load using two-wattmeter method
6. Ability to develop \( z \), \( y \) and \( h \) parameter model for two port network.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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EI5312 ELECTRICAL MACHINES LABORATORY LT P C 0 0 4 2

COURSE OBJECTIVES

- To impart the concept of load test and no load test on Electrical Machines.
- To obtain the performance characteristics of Electrical Machines.
- To introduce interfacing of Electrical Machines with LabVIEW software for data acquisition.
- To impart the knowledge to differentiate electrical and mechanical load.
- To introduce the concept of different methods used for speed control of Electrical Machines.
LIST OF EXPERIMENTS
1. Determination of open circuit and load characteristics of self excited DC generator.
2. Determination of open circuit and load characteristics of separately excited DC generator.
3. Speed control of DC shunt motor by manipulating field and armature parameters.
4. Determining the load characteristics of DC shunt motor using PC based data acquisition system.
5. Determination of load characteristics of DC series motors.
6. Comparison of loading effect on three-phase alternator using DC / AC motors.
7. PC based monitoring and regulation of three-phase alternator.
9. Load test on single phase transformer.
10. Analysis of loading effect on three phase induction motor using three phase alternator.
11. Load test on single phase induction motor.
12. V curves of synchronous motor for different load conditions.
13. Speed control of DC shunt motor using integrated DC and AC drives.

TOTAL : 60 PERIODS

COURSE OUTCOMES (COs)
The students will be able to:
1. Ability to understand the concept of no load and full load tests on static and Dynamic electrical machines.
2. Ability to realize the concept of mechanical load and electrical load.
3. Ability to obtain the characteristics of any electrical machines.
4. Ability to interface the machines with Lab view software to monitor the electrical parameters.
5. Ability to understand the concept of using electrical machines as the load.
6. Ability to communicate efficiently the engineering facts and function actively and efficiently as an individual or in a team.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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COURSE DESCRIPTION
This course offers an introduction to language and communication. The primary goal of this course is to familiarize students with key ideas related to communication using language as well as non-verbal means. Ideas related to the use of language and the underlying power structures are also examined. The course also examines the role of media in communication and in the dissemination of ideas as well as opinions.

Objectives
- To familiarize students with the concept of communication using linguistic and non-linguistic resources.
- To help students ask critical questions regarding facts and opinions.
- To provide students with the material to discuss issues such as language and power structures.
- To help students think critically about false propaganda and fake news.

Learning Outcomes
- Students will be able to use linguistic and non-linguistic resources of language in an integrated manner for communication.
- Students will be able to analyse communication in terms of facts and opinions.
- Students will be able to discuss, analyse and argue about issues related to language and power.

UNIT I  LINGUISTIC AND NON-LINGUISTIC RESOURCE OF COMMUNICATION:  9
a) Writing and Speech
b) Distinction between language structure and language use, form and function, acceptability and grammaticality
c) Gestures and Body language, pictures and symbols, cultural appropriacy
d) Communicative Competency, context and situation, combination of linguistic and non-linguistic elements of communication

UNIT II  STRUCTURE OF WRITING/CONVERSATION:  9
a) Language skills and the communication cycle; speaking and listening, writing and reading
b) Initiating and closing conversations, intervention, turn taking
c) Writing for target reader, rhetorical devices and strategies
d) Coherence and Cohesion in speech and writing

UNIT III  POWER STRUCTURE AND LANGUAGE USE:  9
a) Gender and language use
b) Politeness expressions and their use
c) Ethical dimensions of language use
d) Language rights as part of human rights

UNIT IV  MEDIA COMMUNICATION:  9
a) Print media, electronic media, social media
b) Power of media
c) Manufacturing of opinion, fake news and hidden agendas

UNIT V  PERSUASIVE COMMUNICATION AND MISCOMMUNICATION:  9
a) Fundamentals of persuasive communication
b) Persuasive strategies
c) Communication barriers

TOTAL : 45 PERIODS

TEXT BOOKS:

GE5251 ENVIRONMENTAL SCIENCES

OBJECTIVES:
- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and non-renewable resources, causes of their degradation and measures to preserve them.
- To familiarize the influence of societal use of resources on the environment and introduce the legal provisions, National and International laws and conventions for environmental protection.
- To inculcate the effect of population dynamics on human and environmental health and inform about human right, value education and role of technology in monitoring human and environmental issues.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY
Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – bio geographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – 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 – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION
Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – soil waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES
Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity,
case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land 47 degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT

UNIT V HUMAN POPULATION AND THE ENVIRONMENT

TOTAL: 45 PERIODS

OUTCOMES:
- To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
- To identify the causes, effects and environmental pollution and natural disasters and contribute to the preventive measures in the immediate society.
- To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.
- To recognize different forms of energy and apply them for suitable applications in for technological advancement and societal development.
- To demonstrate the knowledge of societal activity on the long and short term environmental issues and abide by the legal provisions, National and International laws and conventions in professional and personal activities and to identify and analyse effect of population dynamics on human value education, consumerism and role of technology in environmental issues.

TEXT BOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES

- To introduce the basics of operational amplifiers, their characteristics and their configurations.
- To impart knowledge about the concepts and applications of timer, PLL, ADC and DAC.
- To enable the students to analyze the given integrated circuit and evaluate the output.
- To enable the students to design signal conditioning circuits using operational amplifiers.
- To enable the students to design multi-vibrator circuits using OPAMP / Timer for switching applications.

UNIT I OPERATIONAL AMPLIFIERS


UNIT II APPLICATIONS OF OPERATIONAL AMPLIFIER

Summing and Difference amplifiers, Differentiator and Integrator: ideal and practical circuits, V to I and I to V converters - Clipper and Clamper – Log and Antilog amplifiers, Precision Rectifier, Instrumentation amplifier circuit analysis, Instrumentation amplifier IC – Active Filters: Low pass, High pass, Band pass and Band reject filters – Comparator, Schmitttrigger, Multi-vibrators, Triangular wave generator, Sine wave generator,

UNIT III TIMER AND PHASE LOCKED LOOP


UNIT IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS


UNIT V SPECIAL FUNCTION IC’S


TOTAL : 45 PERIODS

COURSE OUTCOMES

1. Ability to interpret the data sheets of Analog ICs.
2. Ability to realize analog circuits using first principle mathematical model.
3. Ability to design oscillators, modulators and demodulators.
4. Ability to understand different ADCs and DACs techniques.
5. Ability to design signal conditioning circuits for various applications.
6. Ability to familiarize analog ICs.
TEXT BOOKS:

REFERENCE BOOKS:
3. NPTEL video lectures on “Electronics for Analog Signal Processing II” by Prof. K.R.K. Rao, IITM.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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EI5402 DIGITAL SYSTEM DESIGN

COURSE OBJECTIVES
- To study various number systems, Boolean expressions and simplifications.
- To study, analyze and design of the combinational logic circuits for arithmetic operations.
- To study, analyze and design of sequential circuits, registers and counters.
- To study, analyze and design asynchronous sequential circuits and to know the functions of ASM charts.
- To learn memory components, PLA, PAL and the basic of HDL.

UNIT I BOOLEAN ALGEBRA AND LOGIC GATES
Review of number systems – Arithmetic operations in binary number system – Binary codes – Boolean algebra and rules – Boolean functions: Simplifications: standard / canonical form of SOP and POS, Simplification using Karnaugh Map and Tabulation methods – Basic logic gates – Universal gates. Logic Families & their characteristics - DTL, TTL, CMOS, FAN-IN, FAN-OUT.
UNIT II COMBINATIONAL LOGIC

UNIT III SYNCHRONOUS SEQUENTIAL LOGIC

UNIT IV ASYNCHRONOUS SEQUENTIAL LOGIC
Analysis and design of asynchronous sequential circuits – Reduction of state and flow tables – Race-free state assignment – Arithmetic State Machines: Introduction, components, features, examples.

UNIT V MEMORY AND PROGRAMMABLE LOGIC DEVICES

TOTAL : 45 PERIODS

LIST OF EXPERIMENTS
1. Verification of logic gates and realization of Boolean expressions using gates.
2. Implementation of Combinational logic circuits using MUX and Decoder ICs.
3. Design of code converters, Encoder and Decoder using logic gates
4. Verification of flip-flops and design of Asynchronous Counters, Synchronous Counters and Universal shift registers using flip-flop.
5. Simulation of combinational/sequential logic circuits using HDL and porting the program into FPGA/CPLD.
6. Design of combinational / sequential logic circuit for instrumentation application such as Alarm / Interlock.

TOTAL :30 PERIODS
TOTAL:45+30=75 PERIODS

COURSE OUTCOMES(COs)
1. Ability to apply mathematical knowledge of number systems, Boolean expressions / functions to simplify and realize logical expression, understand and contrast different logic families
2. Ability to analyze and design combinational logic circuits.
3. Ability to analyze and design of sequential logic circuits.
4. Ability to analyze and design synchronous and asynchronous logic circuits
5. Ability to understand memory types and get exposed to building blocks of different Programmable Logic devices.
6. Ability to solve engineering problems in the area of digital logic circuit.
7. Ability to use appropriate software such as VHDL/Verilog for necessary in engineering practice.
8. Ability to design and implementation of sequential and combinational logic circuits for instrumentation applications.

TEXT BOOKS:
REFERENCE BOOKS:

3. NPTEL video lectures on “Digital systems Design”, Prof. D. Roychoudhury IIT Kharagpur

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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EI5403 INSTRUMENT TRANSDUCERS

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COURSE OBJECTIVES
1. Get to know the methods of measurement, classification of transducers and to analyze error.
2. To understand the behavior of transducers under static and dynamic conditions and hence to model the transducer.
3. Get exposed to different types of resistive transducers and their application areas.
4. To acquire knowledge on capacitive and inductive transducers.
5. To gain knowledge on variety of transducers and get introduced to MEMS and Smart transducers.

UNIT I CHARACTERISTICS OF TRANSDUCERS

UNIT II SCIENCE OF MEASUREMENTS AND CLASSIFICATION OF TRANSDUCERS
UNIT III  VARIABLE RESISTANCE TRANSDUCERS  9

Principle of operation, construction details, characteristics and applications of potentiometer, strain gauge, resistance thermometer, Thermistor, hot-wire anemometer, piezo-resistive sensor and humidity sensor.

UNIT IV  VARIABLE INDUCTANCE AND VARIABLE CAPACITANCE TRANSDUCERS  9

Capacitive transducers: Principle of operation, construction details and characteristics – Different types & Signal Conditioning – Applications: Capacitor microphone, Capacitive pressure sensor, Proximity sensor.

UNIT V  OTHER TRANSDUCERS  9


TOTAL : 45 PERIODS

COURSE OUTCOMES (COS)
1. Ability to apply the Mathematical knowledge, basics of Science and Engineering fundamentals to solve the problems pertaining to measurement applications and to perform error analysis and uncertainty analysis.
2. Ability to infer the static and dynamic characteristics of various transducers.
3. Ability to utilize software like Lab VIEW, MATLAB to analyze the characteristics of the behavior of transducers.
4. Ability to understand transduction principles.
5. Ability to suggest a suitable transducer for a given specific application.
6. Ability to design signal conditioning circuits for resistive, inductive and capacitive transducers.

TEXT BOOKS:

REFERENCE BOOKS:
EI5404  ELECTRICAL AND ELECTRONIC MEASUREMENTS  L T P C
3 0 0 3

COURSE OBJECTIVES

- To provide knowledge in the specific area of electrical measuring instruments. Emphasis is laid on the meters used to measure current, voltage, resistance measuring methods, inductance and capacitance.
- To have an adequate knowledge in the measurement techniques for power and energy.
- Elaborate discussion about potentiometer and to impart knowledge on various instrument transformers and to understand the calibration of various meters.
- In-depth understanding and idea of analog and digital instruments.
- Detailed study of display and recording devices.

UNIT I  MEASUREMENT OF ELECTRICAL PARAMETERS
9

UNIT II  POWER AND ENERGY MEASUREMENTS
9

UNIT III  POTENTIOMETERS AND INSTRUMENT TRANSFORMERS
9
UNIT IV  ANALOG AND DIGITAL INSTRUMENTS

Wave analyzers, Logic analyser, spectrum analyser – Signal and function generators – Distortion factor meter – Q meter – Digital voltmeter and multi-meter – Microprocessor based DMM with auto ranging and self diagnostic features – Frequency & time period measurement, digital LCR meter

UNIT V  DISPLAY AND RECORDING DEVICES


TOTAL : 45 PERIODS

COURSE OUTCOMES
1. Ability to compare the working principles, merits, demerits and errors of different types of electrical instruments and can understand about different instruments that are used for measurement purpose.
2. Ability to compare different bridge networks and to design bridge balances for finding out values of resistance, capacitance and inductance.
3. An ability to apply concepts of electronic instrumentation for measurement of electrical quantities.
4. Ability to apply the principles and practices for instrument design and development to real world problems.
5. Ability to suggest the kind of instrument appropriate for typical measurements.
6. Ability to analyze and store the signals using various display and recording devices.

TEXT BOOKS:

REFERENCE BOOKS:

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES
COURSE OBJECTIVES

- To make the students aware of basic concepts of measurement and operation of different types of transducers.
- To make the students conscious about static and dynamic characteristics of different types of transducer.
- To make the students study on the design of signal conditioning circuit for different transducers.

LIST OF EXPERIMENTS

1. Determination of Static and Dynamic characteristics of Thermocouple (J,K,E) with and without thermo-well.
2. Determination of Static and Dynamic characteristics of RTD and Thermistor.
5. Determination of Characteristic study of load cell and pressure cell.
6. Sensitivity analysis of strain gauge bridges (quarter, half and full).
7. a. Determination of Static characteristic of flapper-nozzle system
   b. Loading effect on resistive potentiometer.
8. Determination of Characteristic of seismic type accelerometer.
9. Measurement of inductance (Anderson), capacitance (Schering) and resistance (Kelvin double) using bridges.
10. Design of signal conditioning circuits for resistive & capacitive sensors
11. Design of signal conditioning circuits for inductive sensors
12. Design of cold junction compensation for Thermocouples and lead wire compensation schemes for RTD.

TOTAL : 60 PERIODS

COURSE OUTCOMES

1. Ability to perform error analysis and uncertainty analysis.
2. Ability to evaluate the static and dynamic characteristics of measuring instruments.
3. Ability to design and construct measurement systems using different types of resistance, capacitance and inductance transducers.
4. Ability to apply special transducers for measurement applications.
5. Ability to interface and analyze different signal conditioning units.
6. Ability to present the results in oral form as well as in written form as a report and graph.
7. Ability to interpret the results of analysis and draw meaningful conclusions.
COURSE OBJECTIVES

- To outline the need for project management.
- To outline the importance of finance and accounting.
- To demonstrate knowledge and understanding of the engineering and management principles.
- To function effectively as an individual, and as a member or leader in diverse teams.

UNIT I  PROJECT MANAGEMENT, PROJECT SELECTION AND PROJECT


UNIT II  PROJECT IMPLEMENTATION, MONITORING AND CONTROL


UNIT III  PROJECT EVALUATION, AUDITING AND OTHER RELATED TOPICS IN PROJECT MANAGEMENT

Project Evaluation – Project auditing – Phase of project audit – Project closure reports, computers, e-markets in Project Management.

UNIT IV  FINANCE AND ACCOUNTING

UNIT V WORKING CAPITAL MANAGEMENT AND CAPITAL BUDGETING

Current assets management – Estimation of working capital requirements – Capital budgeting – Capital budgeting methods – Pack back method – Present value method – Accounting rate of return methods

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to prepare project feasibility report, Project preparation Implementation.
2. Ability to understand the role and responsibility of the Professional Engineer.
3. Be able to assess social, health, safety issues based on the reasoning received from the contextual knowledge.

TEXT BOOKS:


REFERENCE BOOKS:


EI5501 DISCRETE TIME SIGNAL PROCESSING

COURSE OBJECTIVES

To introduce the basic concepts of Digital Signal processing

- To make the students familiarize various mathematical tools for analyzing Discrete Time Systems.
- To make the students design Digital Filters based on the Filter specifications.
- To provide the exposure to the architectures of DSP processors.
- To implement various algorithms in DSP for solving Real-time problem.

UNIT I DFT AND FFT


UNIT II DIGITAL IIR FILTERS

Introduction, design procedures for digital IIR filters, frequency transformation techniques – Butterworth filter design using impulse invariant and bilinear transformation – Realization of IIR filters.

UNIT III DIGITAL FIR FILTERS


UNIT IV RANDOM PROCESS

Introduction to Statistical signal processing – Random process and random variables – Autocorrelation, Cross correlation, Stationary / Wide-sense stationary / Ergodic random processes,

UNIT V ADAPTIVE DIGITAL SIGNAL PROCESSING

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course, the student will be able to:
1. Ability to various mathematical tools for analyzing discrete time system using the fundamental knowledge of Signals and Systems
2. Ability to select the required sampling rate and required DFT points to avoid aliasing in time / frequency.
3. Ability to design digital filter from a given set of specifications and realize the filter in any required Digital Filter Structure
4. Ability to infer the characteristics of a random process from its statistical parameters and design suitable adaptive filters for the same
5. Ability to utilize the multirate signal processing techniques for analyzing random signals
6. Ability to come out with solutions for solving complex problems in filter design

TEXT BOOKS:

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MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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COURSE OBJECTIVES

- To make the students understand the various measuring techniques for force, torque, speed, acceleration, vibration, density, level, temperature and pressure.
- To make the students understand the construction, working principle, application and selection of various transducers used for the measurement of force, torque and speed.
- To give the students knowledge about various methods of acceleration, vibration and density measurement practiced in industries.
- To provide knowledge on different level measurement techniques practiced in industries and able to select appropriate sensor.
- To provide knowledge on different temperature measurement techniques and its selection.
- To provide knowledge on different pressure transmitters and its selection.

UNIT I MEASUREMENT OF FORCE, TORQUE AND SPEED

- Different types of load cells: Hydraulic, Pneumatic, Strain gauge, Magneto-elastic and Piezoelectric load cells
- Different methods of torque measurement: Strain gauge, Relative angular twist
- Speed measurement: Capacitive tacho, Drag cup type tacho, D.C and A.C tacho generators
- Stroboscope

UNIT II MEASUREMENT OF ACCELERATION, VIBRATION AND DENSITY

- Accelerometers: LVDT, Piezoelectric, Strain gauge and Variable reluctance type accelerometers
- Mechanical type vibration instruments
- Seismic instruments as accelerometer
- Vibration sensor
- Calibration of vibration pickups
- Units of density and specific gravity
- Baume scale and API scale
- Densitometers: Pressure type densitometers, Float type densitometers, Ultrasonic densitometer and gas densitometer

UNIT III LEVEL MEASUREMENT

- Level measurement: Float gauges, Displacer type, Bubbler system, Load cell, Conductivity sensors, Capacitive sensors, D/P methods, Nucleonic gauge, Ultrasonic gauge, DIP ultrasonic sensors
- Boiler drum level measurement: Differential pressure transmitter and Hydra step methods

UNIT IV TEMPERATURE MEASUREMENT

- Definitions and standards
- Primary and secondary fixed points
- Different types of filled in system thermometers
- Sources of errors in filled in systems and their compensation
- Bimetallic thermometers
- IC sensors
- Thermocouples: Laws of thermocouple, Fabrication of industrial thermocouples, Reference junctions compensation, Signal conditioning for thermocouple, Commercial circuits for cold junction compensation, Response of thermocouple, Special techniques for measuring high temperature using thermocouple
- Radiation fundamentals
- Radiation methods of temperature measurement
- Total radiation pyrometers
- Optical pyrometers
- Two color radiation pyrometers
- Fiber optic sensor for temperature measurement
- Thermograph, Temperature switches and thermostats
- Temperature sensor selection, Installation and Calibration

UNIT V PRESSURE MEASUREMENT

- Units of pressure
- Manometers: Different types, Elastic type pressure gauges: Bourdon tube, Bellows, Diaphragms and Capsules
- Electrical methods: Elastic elements with LVDT and strain gauges
- Capacitive type pressure gauge
- Piezo resistive pressure sensor
- Measurement of vacuum: McLeod gauge, Thermal conductivity gauge
- Cold cathode type and hot cathode type
- Pressure gauge selection, installation and calibration using dead weight tester
- Pressure Transmitter: Conventional and Smart transmitter
- Level Measurement using DPT:

TOTAL : 45PERIODS
COURSE OUTCOMES (COs)
1. Ability to compare instruments used for measurement of force, torque, speed, acceleration, vibration, density, level, pressure and temperature.
2. Ability to select instruments according to the application.
3. Ability to calibrate measuring instruments.
4. Ability to design compensation techniques for measuring instruments.
5. Ability to design signal conditioning circuits for various transducers.
6. Ability to design and develop a field transmitter with special features.

TEXT BOOKS:

REFERENCE BOOKS:

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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EI5503 CONTROL SYSTEM ANALYSIS AND DESIGN LT P C 3 0 0 3

COURSE OBJECTIVES
- To make the students familiarize various representations of systems.
- To introduce the formulation of linear models like state variable model and Transfer function model.
- To make the students analyze the stability of linear systems in time domain and frequency domain.
- To make the students design compensator based on the time and frequency domain specifications.
UNIT I Modeling of Linear Time Invariant System (LTIV)

Control system: Open loop and Closed loop – Feedback control system characteristics – First principle modeling: Mechanical, Electrical and Hydraulic systems – Transfer function representations: Block diagram and Signal flow graph.

UNIT II State Space Model of LTIV and LTV Systems


UNIT III Time Domain and Stability Analysis


UNIT IV Frequency Domain Analysis


UNIT V Design of Feed Back Control System

Design specifications – Lead, Lag and Lag-lead compensators using Root locus and Bode plot technique.

TOTAL :45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to understand the technical terms associated with control system.
2. Acquire the skill to develop various representations of system based on the first principles approach.
3. Ability to determine time and frequency responses and infer the time domain and frequency domain specifications from the response.
4. Ability to construct and interpret root locus, Bode plot, polar plot and Nyquist plot.
5. Ability to analyze higher order systems using appropriate software tools.
6. Ability to come out with the solution to analyze and infer the stability of systems in time and frequency domain.
7. Ability to design and implement lag, lead, lag-lead compensators to meet the time and frequency domain specifications.

TEXT BOOKS:


REFERENCE BOOKS:

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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EI5511 EMBEDDED SYSTEM DESIGN LABORATORY

LIST OF EXPERIMENTS

**Practical Module–1 Introduction to Embedded Hardware**

**Objective(s)**
- To introduce embedded system and its fundamental building blocks
- To make the students familiar with the architectural features and instruction set of microcontrollers/microprocessors

**Demonstration**
- Overview of on-board peripherals of the embedded trainer kit

**Experiment(s)**
1. Implementing specific tasks on microcontrollers/microprocessors through assembly language.
2. Constructing simple control applications on microcontrollers/microprocessors through assembly language.

**Assignment(s)**
1. Sorting an array and code conversion.
2. Development of mathematical operations.

**Practical Module–2 Introduction to Embedded C programming**

**Objective(s)**
- To introduce Embedded C programming and its fundamental building blocks
- To make the students effectively utilize the versatile features of Embedded C programming for embedded applications

**Demonstration**
- Building the source code for the required application on an Integrated Development Environment and loading the same onto the chosen microcontroller through In System Programming.

**Experiment(s)**
1. Implementing conditional and loop control operations using Embedded C.
2. Implementing specific tasks using functions.

**Assignment(s)**
1. Building a simple calculator.
2. Development of simple applications using recursion.

### Practical Module–3 Interfacing of input devices (Switches and keypad)

**Objective(s)**
- To introduce Programmable Peripheral Interface and built-in I/O Ports of microcontrollers
- To provide an insight over interfacing different kinds of input devices such as switches and keypad with microcontrollers/microprocessors

**Demonstration**
- Interfacing 8255 with microprocessor

**Experiment(s)**
1. Interfacing Push buttons with microcontroller.
2. Interfacing Limit switches with microcontroller.

**Assignment(s)**
1. Design of simple calculator using 4x4 keypad and display it using LCD module.
2. Simple control applications using level limit switches.

### Practical Module–4 Interfacing of output devices (Actuators and Display Devices)

**Objective(s)**
- To interface various output devices such as actuators and display devices and their applications
- To sensitize the students about voltage level converters needed for voltage compatibility

**Demonstration**
- Interfacing LED with microcontroller

**Experiment(s)**
1. LCD/Seven segment display interface.
2. Switching ON/OFF the pump using microcontroller.

**Assignment(s)**
- Simple DC/Stepper motor direction control using suitable driver module
- Interfacing heating element and solenoid valve with microcontroller using electromechanical relays

### Practical Module–5 Timers / Counters

**Objective(s)**
- To make the students understand the concept of on-chip Timers / Counters and programmable interval timer
- To enable the students to configure the Timer / Counter and familiarize with the scaling concepts

**Demonstration**
- Interfacing 8253 with microprocessor

**Experiment(s)**
1. Making LEDs ON/OFF for predefined time using Timer (with and without scaling).
2. Counting the occurrence of events using IR proximity sensor.

**Assignment(s)**
1. Design of a Programmable Timer .
2. Frequency measurement using Timer / Counter.

### Practical Module–6 Interrupts

**Objective(s)**
- To make the students understand the concept of interrupts and their classifications.
- To facilitate the students to realize the potential of interrupts in the given embedded architecture
<table>
<thead>
<tr>
<th>Demonstration</th>
<th>• Interfacing 8259 with microprocessor</th>
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</table>
| **Experiment(s)** | 1. Interfacing switch using hardware interrupt.  
2. Acknowledging the transmission and reception of information using interrupt. |
| **Assignment(s)** | 1. Design of real-time clock using software interrupt.  
2. Generation of interrupt using timer to activate/deactivate field devices. |

**Practical Module-7  ADC/DAC**

| Objective | • To make the students understand the operational features of various types of ADCs / DACs.  
• To provide an insight over data acquisition to carry out signal processing. |
| Demonstration | • Interfacing ADC/DAC with microcontroller using Proteus Design Suite.  
• Acquisition of a continuous signal and reconstruction of its sampled version. |
| **Experiment** | 1. Interfacing analog transmitter with microcontroller.  
2. Interfacing final control element with microcontroller. |
| **Assignment** | 1. Design of a multichannel data acquisition system.  
2. Design of a smart transmitter. |

**Practical Module–8  Memory Interfacing**

| Objective | • To effectively utilize the available built-in memory in a given architecture and realize the need for external memory storage  
• To interface external data and program memories |
| Demonstration | • Illustrating different operating modes of microcontroller through various memory configurations |
| **Experiment** | 1. Storing a block of data in external RAM and fetching the same.  
2. Interfacing external flash memory with microcontroller. |
| **Assignment** | 1. Switching program execution between internal and external memories.  
2. Reprogramming the specified block of flash memory. |

**Practical Module–9  Communication Modules**

| Objective | • To make the students familiar with synchronous(I²C & SPI) and asynchronous(UART) communication protocols  
• To impart knowledge on establishing communication between microcontrollers and peripherals using appropriate serial communication protocols |
| Demonstration | • Remote data transmission using both synchronous and asynchronous communication protocols. |
| Experiment | 1. I²C based DAC interface and SPI based ADC interface.  
2. Remote transmission of field transmitter data to PC. |
|-----------|----------------------------------------------------------|
| Assignment | 1. Interfacing RTC with microcontroller using I²C interface.  
2. Interfacing EEPROM with microcontroller using SPI interface. |

### Practical Module–10 Wireless Communication Modules

| Objective | • To introduce various wireless communication protocols  
• To facilitate the students to acquire field parameters through wireless communication Protocols |
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<tr>
<td>Demonstration</td>
<td>• Establishing communication between microcontroller and PC using Zigbee module.</td>
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<tr>
<td>Experiment</td>
<td>Remote transmission of sensor data using Zigbee protocol.</td>
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<td>Assignment</td>
<td>Remote monitoring of process using Zigbee protocol.</td>
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### Practical Module–11 RTOS Concepts

| Objective | • To facilitate the students to realize the power of RTOS and its operational characteristics  
• To enable the students to perform task scheduling and establish inter-task communication |
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<td>Demonstration</td>
<td>• Implementing multitasks on an RTOS enabled embedded system</td>
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<tr>
<td>Experiment</td>
<td>Design of a multichannel data acquisition system with time, interrupt, task and memory management features.</td>
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<td>Assignment</td>
<td>Implementation of a real-time control application (Inverted pendulum or dc motor etc.) using RTOS.</td>
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### Practical Module–12 IoT Enabled Embedded Systems

| Objective | • To impart knowledge on the inherent features of IoT for embedded applications  
• To enable the students to carry out IoT enabled data acquisition |
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<td>Demonstration</td>
<td>• Building an IoT application using Python</td>
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<td>Experiment</td>
<td>• IoT enabled field sensing.</td>
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<td>Assignment</td>
<td>• Development of IoT enabled transmitter.</td>
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<td>Mini Project</td>
<td>• μP/μC based PID Control Strategy for Temperature/Level Process.</td>
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**OUTCOMES**

1. Ability to infer the concept of embedded system and its architectural features
2. Ability to familiarize with the basic concept of Embedded C programming and its significant features
3. Ability to integrate/interface the real world input devices with microcontrollers/microprocessors
4. Ability to integrate/interface the real world displays and actuators with microcontrollers using relays

**TOTAL : 90 PERIODS**
5. Ability to configure and utilize the services of timer for a given application
6. Ability to understand the Interrupt structure of an architecture and utilize it for interfacing switches and serial I/Os.
7. Ability to acquisition of real world signals using suitable data converters for control applications
8. Ability to identify the need for external memory and explore memory interfacing.
9. Ability to interface peripherals using respective communication protocols
10. Ability to compare and justify the use of specific wireless communication protocol for process automation
11. Ability to utilize RTOS for an real time embedded system design
12. Explore remote data acquisition using IoT
13. Ability to apply the acquired technical skills in embedded programming and use it to develop microcontroller based closed loop control system for a typical process.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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EI5512  CONTROL AND INSTRUMENTATION LABORATORY  LT P C
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COURSE OBJECTIVES
- To make the students understand the concepts of control.
- To make them use modern tools to simulate and understand the dynamic behavior of physical systems.
- To make them familiar with conducting experiments on real time set up.
- To make the students understand the working and operation of different types of measuring instruments.
- To make the students understand the compensation techniques
- To make students gain knowledge on calibration and uncertainty estimation of measuring instruments.
- To provide practical knowledge in interfacing transmitters with PC.
LIST OF EXPERIMENTS

CONTROL:

1. Determination of time and frequency responses of a LTI system. (Mechanical, Electrical, Electromechanical and Hydraulic system)
2. Design, Analysis and implementation of lag and lead compensators using Bode and Root locus for a physical system.
3. Design, Analysis and implementation of lag-lead compensator using Bode and Root locus for a physical system.
4. Design and implementation of feedback control scheme for an open loop stable system.
5. Design and implementation of controller for an open loop unstable system.
6. Design and implementation of state feedback control scheme for a MIMO system.

INSTRUMENTATION:

2. i. Measurement of temperature using IR thermometer.  
   ii. Calibration of IR thermometer.  
   iii. Study of thermal image camera.
5. i. Testing of pressure gauge using dead-weight tester  
   ii. Configuration and calibration of Pressure Transmitter
6. i. Level measurement using differential pressure transmitter including elevation considerations  
   ii. PC interface with level transmitter

TOTAL : 60 PERIODS

COURSE OUTCOMES

1. Ability to determine the time response and frequency response of given systems such as mechanical, electrical, hydraulic systems using suitable tools.
2. Ability to design, realize and validate lag / lead / lag-lead compensators for a given single input and single output system.
3. Ability to analyze and design control scheme for an open loop unstable system and MIMO system.
4. Ability to determine the static and dynamic characteristics of torque, speed, density and level measuring instruments.
5. Ability to quantify uncertainty associated with measuring instruments.
6. Ability to interface field instruments with PC using DAQ cards.
7. Ability to configure smart transmitters using HART communicator.
8. Ability to communicate efficiently the engineering facts and function actively and efficiently as an individual or a member/leader of different teams and multidisciplinary projects.
## MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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### EI5601  POWER ELECTRONICS, DRIVES AND CONTROL  LT P C  

#### COURSE OBJECTIVES
- Comprehensive introduction to various power electronic devices, their structure, operating principle and characteristics
- Give exposure to Various topologies, working principle and analysis of controlled rectifiers and ac controllers
- Detailed knowledge on Classifications, structure, operating principle of dc choppers
- Introduction to different types of Inverters, their principle of operation and waveform control
- Overview on dc and ac drives and their control using power electronic circuits.

#### UNIT I  POWER SEMICONDUCTOR DEVICES AND CHARACTERISTICS  

#### UNIT II  CONTROLLED RECTIFIERS AND AC CONTROLLERS  

#### UNIT III  DC TO DC CONVERTERS  
Step up and Step down Chopper – Chopper classification - quadrant of operation – Switching mode Regulators – Buck, Boost, Buck-Boost, and Cuk Regulators.
UNIT IV INVERTERS

UNIT V DRIVES AND CONTROL
Static and Dynamic equations of dc and ac machines – Electrical breaking – Rectifier and chopper control of DC drives – Principles of v/f control of AC drives – Open loop and Closed loop schemes for DC and AC drives(Block diagram approach only) – Introduction to vector control of AC drives.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)
1. Ability to explain various devices and their structure, operating characteristics in the field of electronics.
2. Ability to classify, analyze and design, Controlled rectifier and AC Controllers.
3. Ability to comprehensive knowledge on design and analyze of DC to DC and DC to AC converters.
4. Ability to apply power electronic circuits for the control of popular applications.
5. Ability to exposure to design and analyze power electronic circuits using simulation software.
6. Ability to introductionary knowledge in drives and its control.

TEXT BOOKS:

REFERENCE BOOKS:
5. NPTEL Lecture Series on “Power Electronics” by Dr.B.G.Fernandes, IIT Bombay.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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COURSE OBJECTIVES

- To make the students acquainted with knowledge on variable head flow measurement techniques and its application considerations.
- To provide knowledge on different area and mass flow meters and its selection.
- To educate students in selection and calibration of various transducers used for measuring flow, viscosity, humidity and moisture.
- To enable the students get acquainted with various electrical type flow meters.
- To make students understand the construction, working principle for various measuring techniques of flow, viscosity, humidity and moisture.
- To provide knowledge on different safety zone followed in industries.

UNIT I VARIABLE HEAD TYPE FLOWMETERS


UNIT II QUANTITY METERS, AREA FLOW METERS AND MASS FLOW METERS


UNIT III ELECTRICAL TYPE FLOW METERS


UNIT IV MEASUREMENT OF VISCOSITY, HUMIDITY AND MOISTURE


UNIT V SAFETY ZONE CLASSIFICATION

Hazardous area classification - Electrical and other physical hazards – Chemical reaction hazards – Explosion hazards – Flammability classification – Hazard control: Reliability and risk analysis – Active protective systems and instrumentation – Overpressure relief – Instrumentation for control and safety - Intrinsic Safe Transmitter.

TOTAL : 45 PERIODS

COURSE OUTCOMES

1. Ability to understand the working principle of measuring instruments for flow, viscosity, humidity and moisture.
2. Ability to calibrate measuring instruments.
3. Ability to develop a field transmitter for sensing different parameter in industrial environment.
4. Ability to select the appropriate instrument for a given process measurement problem.
5. Ability to identify the appropriate use of instruments in process industries according to the safety practices.
6. Ability to carry out comparison and market survey of different types of flow meters.

TEXT BOOKS:

REFERENCE BOOKS:

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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COURSE OBJECTIVES

- To introduce technical terms and nomenclature associated with Process control domain.
- To introduce the fundamentals of mathematical modeling of processes.
- To familiarize the students with characteristics, selection and sizing of control valves.
- To provide an overview of the features associated with Industrial type PID controller.
- To make the students understand the various PID tuning methods.
- To elaborate different types of control schemes such as cascade control, feed-forward control and Model Based control schemes.

UNIT I PROCESS DYNAMICS
9

UNIT II CONTROL VALVE
9
Actuators: Pneumatic and electric actuators – I/P converter – Control Valve Terminology - Characteristic of Control Valves: Inherent and Installed characteristics - Valve Positioner – Modeling of a Pneumatically Actuated Control Valve – Valve body: Commercial valve bodies – Control Valve Sizing: ISA S 75.01 standard flow equations for sizing Control Valves – Cavitation and flashing– Control Valve selection.

UNIT III CONTROL ACTIONS
9

UNIT IV PID CONTROLLER TUNING – SINGLE LOOP REGULATORY CONTROL & ENHANCEMENT TO SINGLE LOOP REGULATORY CONTROL
9

UNIT V MODEL BASED CONTROL SCHEMES & INTRODUCTION TO MULTI-LOOP REGULATORY CONTROL & CASE STUDIES
9

TOTAL : 45 PERIODS

COURSE OUTCOMES (COS)
1. Ability to understand technical terms associated with Process control domain.
2. Ability to develop models using first principles approach for processes such as level, flow, temperature and pressure as well as analyze models.
3. Ability to recommend the right type of control valve along with its characteristics for a given application.
4. Ability to size a control valve following the procedure outlined in the ISA S 75.01 standard.
5. Ability to design & implement a suitable control scheme for a given process and validate through simulations.
6. Ability to analyze various control schemes and recommend the right control strategy for a given application.
7. Ability to use appropriate software tools (Example: MATLAB/SCiLAB) for analysis, design and implementation of Process Control System.

TEXT BOOKS:

REFERENCE BOOKS:

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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EI5611  PROCESS CONTROL AND INSTRUMENTATION LABORATORY  LT P C 0 0 4 2

COURSE OBJECTIVES
To impart theoretical and practical skills in
- Process Identification
- Tuning of PID controller and PID Enhancements.
- Design and Implementation of Cascade, Feed-forward Control Schemes and advanced Control schemes using the facilities available in the Process Control lab.
PROCESS CONTROL:

1. i. Study of a Process Control Training plant.
    ii. Determination of characteristics of a Pneumatically Actuated Control valve (with and without Positioner).
2. i. Design and implementation of ON-OFF controller for the Temperature Process.
    ii. Design and Implementation of split range control for a level process.
3. i. Design and Implementation of Practical Forms of PID Controller on the simulated model of a Typical Industrial Process.
    ii. Design and Implementation of Feed forward and Cascade control schemes on the simulated model of a Typical Industrial Process
4. i. Analysis of MIMO system.
    ii. Design and implementation of Multi-loop PID schemes on the simulated model of a Typical Industrial Process.
    iii. Interpretation of P & ID (ISA S5.1)
5. i. Cascade Control of Level and flow process using industrial type PID controller.
    ii. PC based control of level process.
    iii. On-line monitoring and control of a pilot plant using an industrial type distributed control system.
6. Design and implementation of advanced control scheme (adaptive controller or model predictive Control scheme) on the skid mounted pilot plant.

INSTRUMENTATION

1. Estimation of discharge coefficient of an Orifice plate( With and without U bend in the pipeline)
2. i. Interfacing different types of flow meters with PC.
    ii. Configuration of flow Transmitter.
3. i. Measurement of humidity and viscosity
    ii. Design and testing of Electromagnetic flow meters.
4. Determining the stoichiometric ratio of air fuel mixture in the combustion chamber.
5. i. Measurement of Absorbance and Transmittance of Test solutions using UV-Visible Spectrometer.
    ii. Measurement of Conductivity and pH of Test solutions
6. i. Monitoring Physiological Parameters using Vital signs monitor.
    ii. Assessment of electrical safety of devices using electrical safety analyzer.

COURSE OUTCOMES(COs)

1. Ability to work and measure parameter of flow/ level / temperature / pressure from SKID mounted pilot plant.
2. Ability to analyze, design suitable control schemes for industrial type process.
3. Ability to design ON-OFF, feed forward, cascade and multiloop PID controllers for the typical industrial process.
4. Ability to use appropriate software tools for design, analysis and implementation of control scheme.
5. Ability to experimentally measure industrial process parameters (such as flow, viscosity and humidity) and physiological parameters of the human body.
6. Ability to configure and interface different field devices with PC.
7. Ability to select, design, install and operate field devices for measurement of flow, temperature and pressure through a typical industrial case study(combustion process).
8. Ability to experimentally verify electrical safety of an instrument.
9. Ability to communicate efficiently the engineering facts and function actively and efficiently as an individual or a member/leader of different teams and multidisciplinary projects.

TOTAL : 60 PERIODS
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### EI5612  INDUSTRIAL AUTOMATION SYSTEMS LABORATORY  LT P C  0 0 6 3

#### COURSE OBJECTIVES
- To impart knowledge on architecture of PLC and DCS.
- To introduce students on how to program using all five IEC-61131-3 programming languages.
- To introduce students on how to interface Field devices (Conventional/Smart) with PLC and DCS.
- To make the students configure the IoT gateway

#### LIST OF EXPERIMENTS

**Practical Module – 1: Study of PLC architecture and Field Device Interface Modules (AI, AO, DI, DO Modules).**

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<td>Impart knowledge on PLC architecture including CPU, I/O module, connecting I/O modules (DI/DO/AI/AO modules) to CPU, Power supply module and Communication module &amp; Hot swapping, Industrial certifications.</td>
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<td>1. Study of DI/DO/AI/AO modules of all PLCs.</td>
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<td>2. Installation &amp; Configuration of I/O modules</td>
<td>3. Understanding one of the PLC Control panels wiring diagram and creating a control panel layout</td>
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<td>Practical Module – 3: Realization of Discrete control sequences using Functional Block Diagram (FBD) Programming</td>
<td>Introduce students to FBD programming and make them to realize Discrete control sequences using Function blocks</td>
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<td>Practical Module – 4: Realization of Discrete control sequences using ST, IL and SFC Programming methods.</td>
<td>Introduce students to ST, IL and SFC Programming methods and make them to realize Discrete control sequences using ST, IL and SFC.</td>
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| Assignment(s) | 1. Exercises covering all instruction set of IL, ST and SFC.  
| | 2. Reversal of direction of rotation of DC motor using ST, IL and SFC programming methods. |

**Practical Module – 5 Interfacing Analog/Digital Input/output Devices with Industrial Type PLC.**

| Objective(s) | To introduce students on how to Interface transmitters, limit switches, final control elements with PLC. |
| Demonstration | How to Interface field devices to a PLC – Case Study: How to interface field devices available in the filling and draining of liquid in a single tank experimental test setup to a PLC |
| Experiment(s) | 1. Interfacing Level Transmitter and Control valve with PLC.  
| | 2. Interfacing Limit switches and a Pump with PLC. |
| Assignment(s) | 1. Interfacing Temperature Transmitter and Heater with PLC.  
| | 2. Interfacing Flow Transmitter and Variable-speed pump with PLC. |

**Practical Module – 6 Closed loop control of a typical process using PLC.**

| Objective(s) | To introduce students on how to configure PID control block to achieve closed loop control. |
| Demonstration | Configuration of PID Function Block |
| Experiment | On-line Monitoring and Control of Level Process using PLC |
| Assignment(s) | On-line Monitoring and Control of Processes such as Flow, Temperature and Pressure, using PLC. |

**Practical Module – 7 HMI/SCADA Programming**

| Objective(s) | SCADA/HMI development, configuration of face plates, creation of logs, Transmitter data trend displays, linking of tags with graphics |
| Demonstration | HMI/SCADA development for the Pressure Control Station. |
| Experiment(s) | HMI/SCADA development for the Process Control Training Plant (Level/Flow Process) |
| Assignment(s) | HMI/SCADA development for a Typical Industrial Processes |

**Practical Module-8 Architecture of DCS**
| **Objective(s)** | Impart knowledge on DCS architecture including CPU, I/O module, connecting I/O modules (DI/DO/AI/AO modules) to CPU, Power supply module and Communication module & Hot swapping, Industrial certification |
| **Demonstration** | Configuration of DCS. |
| **Experiment(s)** | 1. Study of AI, AO, DI, DO, H1-interface modules of all DCSs.  
2. Installation & Configuration of I/O modules.  
3. Understanding any one of the DCS Control panels wiring diagram and creating a control panel layout. |
| **Assignment(s)** | Market survey of the recent DCSs and comparison of their features with the DCSs available in the lab. |

**Practical Module-9 Interfacing of field devices with DCS.**

| **Objectives** | To introduce students on how to Interface transmitters, limit switches, final control elements with DCS |
| **Demonstration** | 1. How to Interface Level transmitter and Flow Transmitter in the Process Control Training Plant to a DCS.  
2. How to interface Limit Switches, Pumps and Control valves in the Process Control Training Plant to a DCS. |
| **Experiment(s)** | 1. Interfacing Temperature Transmitter and Variable Speed Pump to a DCS  
2. Configuration of face plates, creation of logs and trend displays |
| **Assignment(s)** | Interfacing Temperature Transmitter and Heater and Variable Speed Pump with Pump Controller to a DCS. |

**Practical Module-10. Realization of control schemes for typical processes using DCS.**

| **Objective** | To introduce students on how to configure PID control block to achieve closed loop control |
| **Demonstration** | Configuration of PID Function Block and PID Faceplate |
| **Experiment** | On-line Monitoring and Control of Level Process using Distributed Control System. |
| **Assignment(s)** | On-line Monitoring and Control of Process such as Flow, Temperature and Pressure, using Distributed Control System. |

**Practical Module-11 Interfacing smart field devices with DCS.**

<p>| <strong>Objective</strong> | To introduce students on how to Interface smart field devices (HART/Foundation Field bus) with DCS. |
| <strong>Demonstration</strong> | Demonstration of ‘PID control’ in field devices. |
| <strong>Experiment(s)</strong> | Design and Implementation of Feedback control scheme (FF-PID) for the level process using DCS. |</p>
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<th>Assignment(s)</th>
<th>Market survey: Industrial Data Networks</th>
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**Practical Module-12 IoT based monitoring of Level/Flow process.**

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<td>Demonstration</td>
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| Experiment(s) | 1. Interfacing transmitters to DCS through IoT gateway.  
2. Cloud based Monitoring of level/flow process. |
| Assignment(s) | Cloud based Monitoring of temperature process. |

**TOTAL : 90 PERIODS**

**COURSE OUTCOMES**
1. Ability to understand all the important components such as PLC, SCADA, DCS, I/O modules and field devices of an industrial automation system.
2. Ability to develop PLC program in different languages for industrial applications.
3. Gain hands on experience in interfacing transmitters and final control elements with PLC and DCS.
4. Be able to Configure and develop Feedback Control Schemes using PLC and DCS.
5. Able to select and use most appropriate automation technologies for a given application.
6. Able to configure IoT gateway for any industrial process using DCS.

**MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES**

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COURSE OBJECTIVES

- To give an overview of the Industrial data communications systems.
- To provide a fundamental understanding of common principles, various standards, protocols.
- To provide insight into some of the new principles those are evolving for future industrial data networks.

UNIT I DATA NETWORK FUNDAMENTALS

UNIT II MODBUS AND HART
Evolution of industrial data communication standards - MODBUS:- Protocol structure, Function codes - HART communication protocol, Communication modes, HART Networks, HART commands, HART applications & Troubleshooting

UNIT III PROFIBUS AND FF

UNIT IV AS – INTERFACE (AS-i), DEVICENET AND INDUSTRIAL ETHERNET

UNIT V WIRELESS COMMUNICATION

TOTAL : 45 PERIODS

COURSE OUTCOMES(COs)

After completing the course, the students will gain ability to
1. Ability to differentiate various types of industrial data network standards and the associated protocols based on their specifications and applications.
2. Ability to analyze the various characteristics of each layer of the protocol stack pertaining to different Industrial data network standards
3. Ability to compare the performance of the standards and infer the advantages and drawbacks of each for a given industrial application
4. Ability to select and use the most appropriate networking technologies and standards for a given application.
5. Ability to identify procedures for fault-free operations in the data communications links
6. Ability to infer the requirements of an industry and select a wired or wireless solution for installing Industrial data network.

TEXT BOOKS:

REFERENCE BOOKS:

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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EI5702 INTRODUCTION TO PROCESS DATA ANALYTICS

COURSE OBJECTIVES
To introduce students the basic concepts of
- Experimental Design
- Linear Regression Analysis
- Linear Model Selection and Regularization
- Classification
- Process Identification, Performance Monitoring and Soft Sensor Design.

UNIT I INTRODUCTION

UNIT II REGRESSION
Linear Regression:- Simple Linear Regression, Multiple Linear Regression-K-nearest neighbors regression – Practical Consideration in the Regression Model - Validation methods to assess model quality:- The validation set approach, Leave-One-Out Cross Validation, k-Fold
Cross Validation – Bias-variance Trade-off for k-Fold Cross Validation

UNIT III LINEAR MODEL SELECTION & REGULARIZATION

UNIT IV SUPERVISED LEARNING WITH REGRESSION AND CLASSIFICATION TECHNIQUES
Logistic regression– Linear Discriminant Analysis - Quadratic Discriminant Analysis – Regression & Classification Trees – Support Vector Machines - Random forests, Bagging and boosting - Neural Networks – Deep Learning

UNIT V APPLICATIONS
Process data analysis for system identification (under open and closed loops) - Controller Performance Monitoring - Principal components analysis (PCA) for Process Monitoring and Partial Least Squares (PLS) for soft-sensor design - Data-based causality analysis for identification of process topology.

COURSE OUTCOMES (COs)
1. Ability to understand the statistical terms related to data analytics.
2. Ability to select the right regression method for a given application.
3. Ability to analyze and compare the performance of various model selection and regularization methods.
4. Ability to suggest and develop right classifier for a given application.
5. Ability to recommend appropriate data analysis tool for soft sensor development and controller performance monitoring.
6. Ability to use appropriate software tools for data driven analysis.

TEXT BOOKS:

REFERENCE BOOKS:

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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EI5703  INTRODUCTION TO INDUSTRIAL PROCESSES, MEASUREMENT AND CONTROL  L T P C
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OBJECTIVES
- To introduce common unit operations carried out in process industries.
- To impact knowledge about the important unit operations taking place in process industries.
- To prepare them to take up a case study on selected process industries like petrochemical industry, power plant industry and paper & pulp industry to make the students understand the different measurement and control techniques for important processes.
- Facilitate the students to apply knowledge to select appropriate measurement technique and control strategy for a given process.

UNITI  COMMON UNIT OPERATIONS IN PROCESS INDUSTRIES -I  9
Unit Operation, Measurement and Control :-Transport of solid, liquid and gases - Evaporators – Crystallizers-Dryers.

UNITII  COMMON UNIT OPERATIONS IN PROCESS INDUSTRIES -II  9
Unit Operation, Measurement and Control :- Distillation – Refrigeration processes – Chemical reactors.

UNITIII  PROCESS MEASUREMENT AND CONTROL IN PETROCHEMICAL INDUSTRY  9

UNITIV  PROCESS MEASUREMENT AND CONTROL IN THERMAL POWERPLANT INDUSTRY  9
Process flow diagram of Coal fired thermal Power Plant– Coal pulverizer - Deaerator – Boiler drum - Superheater – Turbines.

UNIT V  PROCESS MEASUREMENT AND CONTROL IN PAPER &PULP INDUSTRY  9
Process flow diagram of paper and pulp industry – Batch digestor – Continuous sulphate digestor – Control problems on the paper machine.

OUTCOMES
1. Ability to understand common unit operations in process industries
2. Ability to understand the dynamics of important unit operations in petro chemical industry
3. Ability to develop understanding of important processes taking place selected case studies namely petrochemical industry, power plant industry and paper & pulp industry
4. Ability to select appropriate measurement techniques for selective processes.
5. Ability to select controller structure based on the process knowledge.
6. Ability to understand the operation and challenges in integrated industrial processes.

TOTAL : 45 PERIODS
TEXT BOOKS:

REFERENCES:

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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EI5711 INSTRUMENTATION SYSTEM DESIGN LABORATORY LT P C 0 0 4 2

COURSE OBJECTIVES
- To impart knowledge on the design of signal conditioning circuits for the measurement of Level, temperature, pressure and flow.
- To develop the skills needed to design, fabricate and test Analog/ Digital PID controller, Data Loggers and Alarm Annunciator.
- To develop various modules for final year project as per industrial standards and practices.
- To make the student familiarize with the design of orifice and control valve sizing.
- To impart knowledge on the industrial documentation preparation.

LIST OF EXPERIMENTS
2. Design and Testing of 2-wire Smart Transmitter.
10. Design and Implementation of IoT Enabled Transmitter
11. (a) Preparation of documentation of Instrumentation Project.
   (b) Preparation of Project Scheduling, Installation Procedure and Safety Regulations

TOTAL : 60 PERIODS

COURSE OUTCOMES(COs)
1. Ability to competence to design and fabricate conventional, smart and IoT enabled
   transmitters for key process variables such as flow, level pressure and temperature.
2. Ability to realize On/Off controller, PID controller and PLC.
3. Ability to design data loggers and alarm circuits for an industrial application requirement.
4. Ability to develop software programs for sizing control valve and orifice.
5. Ability to prepare documentation for Instrumentation projects.
6. Ability to exposure to simulation tools such as MATLAB/Proteus
7. Ability to deliver the results in oral form as well as in written form as a report and graph.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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EI5001 ANALYTICAL INSTRUMENTATION

COURSE OBJECTIVES
- To understand the theory and operational principles of instrumental methods for identification
  and quantitative analysis of chemical substances by different types of spectroscopy.
- To impart fundamental knowledge on gas chromatography and liquid chromatography.
- To integrate a fundamental understanding of the underlining principles of physics as they
  relate to specific instrumentation used for gas analyzers and pollution monitoring.
instruments.
• To impart knowledge on the important measurement in many chemical processes and laboratories handling liquids or solutions.
• To understand the working principle, types and applications of NMR and Mass spectroscopy

UNIT I  SPECTROPHOTOMETRY


UNIT II  CHROMATOGRAPHY


UNIT III  INDUSTRIAL GAS ANALYZERS AND POLLUTION MONITORING INSTRUMENTS

Gas analyzers – Oxygen, NO₂ and H₂S types, IR analyzers, thermal conductivity detectors, analysis based on ionization of gases.
Air pollution due to carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide estimation - Dust and smoke measurements.

UNIT IV  pH METERS AND DISSOLVED COMPONENT ANALYZERS


UNIT V  NUCLEAR MAGNETIC RESONANCE AND MASS SPECTROMETRY


TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to understand the basic concept of qualitative and quantitative analysis of a given sample.
2. Ability to possess working knowledge of analytical instrumentation typically employed in chemical/biochemical research and industry laboratories
3. Ability to apply the fundamental principles of selective analytical instruments for separation, identification and quantitative analysis of chemical substances.
4. Describe and differentiate between online and offline process and identify suitable instruments for analysis.
5. Ability to appreciate the relative strengths and limitations of different instrumental based analysis methods.
6. Ability to assess and suggest a suitable analytical method for a specific application.

TEXT BOOKS:

REFERENCE BOOKS:

4. NPTEL lecture notes on, “Modern Instrumental methods of Analysis” by Dr.J.R. Mudakavi, IISC, Bangalore.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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EI5002          BIOMEDICAL INSTRUMENTATION          3 0 0 3

COURSE OBJECTIVES

- To provide an overview about various physiological signal measurements.
- To provide an overview about electrical parameter acquisition and recording.
- To provide knowledge on electrical safety.
- To make students understand various biomedical Instruments used for non-electrical parameter measurement.
- To make students familiarized with various medical imaging systems.
- To provide knowledge on the fundamental concept of life assisting and therapeutic devices.

UNIT I      BASIC CONCEPTS OF MEDICAL INSTRUMENTATION


UNIT II       BIOMEDICAL SIGNAL ACQUISITION AND ANALYSIS

Current, shock hazards – leakage current.

UNIT III MEASUREMENT OF NON ELECTRICAL PARAMETERS


UNIT IV MEDICAL IMAGING SYSTEMS


UNIT V THERAPEUTIC DEVICES AND TELEMETRY


TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to compare and analyze the operation of different medical devices.
2. Ability to measure, detect and analyze the bio-signals.
3. Ability to select and apply the appropriate medical instruments for measurement.
4. Ability to design medical devices for diagnosis and therapeutic applications.
5. Ability to analyze simple bio-sensing and transduction problems.
6. Ability to apply safety standards and select disposal method and procedures for electrical diagnostic equipment.

TEXT BOOKS:


REFERENCE BOOKS:


MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES
EI5003       FIBRE OPTICS AND LASER INSTRUMENTATION       LT P C
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COURSE OBJECTIVES
1. To provide knowledge on the theory behind light propagation in optical fibers, types of optical fibers, dispersion characteristics, and losses associated with optical fibers.
2. To provide an overview of recent advances in fiber optic sensor technology.
3. To provide knowledge on principles of laser generation, laser systems and its types.
4. To emphasize how lasers have been used for industrial applications.
5. To provide knowledge on the fundamentals of holography and medical applications of lasers.

UNIT I OPTICAL FIBER AND THEIR PROPERTIES 9

UNIT II FIBER OPTIC SENSORS 9
Fiber optic sensors – Fiber optic instrumentation system for measurement of fiber characteristics – Different types of modulators – Interferometric method for measurement of length – Measurement of pressure, temperature, electric field, liquid level and strain.

UNIT III LASER FUNDAMENTALS 9

UNIT IV INDUSTRIAL APPLICATION OF LASERS 9
Applications of Low Power Lasers:- Measurement of distance, length, velocity and acceleration using lasers, & Environmental monitoring using lasers.

UNIT V HOLOGRAPHY AND MEDICAL APPLICATIONS OF LASERS 9

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)
1. Ability to utilize the principles of light transmission, characteristics and losses in optical
fibers for measurement applications.
2. Ability to apply the concepts of optical fibers for its use in sensor development as well as important applications in production, manufacturing and industrial applications.
3. Ability to compare the lasing theory of various laser generation systems.
4. Ability to design laser systems for measurement of physical quantities and for industrial applications.
5. Ability to select lasers for a specific Industrial and medical application.
6. Ability to apply the principles of lasers for creating new sensors and measurement systems.

TEXT BOOKS:

REFERENCE BOOKS:

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EI5004 SAFETY INSTRUMENTED SYSTEM

COURSE OBJECTIVES
- To make the students aware of basic concepts of safety instrumented system, standards and risk analysis techniques.
- To make the students understand different layers of protection.
- To make student conscious about safety instrumentation applications.
- To make the students aware of potential events and impact of failures.
- To make students aware of design, installation and maintenance procedures.
UNIT I  INTRODUCTION


UNIT II  PROTECTION LAYERS AND SAFETY REQUIREMENT SPECIFICATIONS


UNIT III  SAFETY INTEGRITY LEVEL (SIL)

Evaluating Risk, Safety Integrity Levels, SIL Determination Method : As Low As Reasonably Practical ( ALARP ), Risk matrix, Risk Graph, Layers Of Protection Analysis (LOPA) -- Issues related to system size and complexity --Issues related to field device safety – Functional Testing.

UNIT IV  SYSTEM EVALUATION


UNIT V  CASE STUDY


TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to analyse the role of safety instrumented system in the industry.
2. Ability to Identify and analyse the hazards.
3. Ability to determine the safety integrity level for an application.
4. Ability to characterize the safety environment in industry.
5. Ability to analyse the failure modes, failure rates and MTBF using various reliability engineering tools.
6. Ability to apply the design, installation and maintenance procedures for SIS applied to industrial processes.
7. Ability to present the results in written and oral forms.
TEXT BOOKS:


REFERENCE BOOKS:


MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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EI5005 INSTRUMENTATION STANDARDS L T P C 3 0 0 3

COURSE OBJECTIVES
- To impart basic knowledge on Instrumentation standards, principles and its behavior.
- To make the students understand the general requirements for electrical equipment in hazardous location.
- To impart basic knowledge on control valve standards.
- To impart basic knowledge on fossil power plant and nuclear power plant standards.
- To impart basic knowledge on temperature sensor standards.
UNIT I  STANDARDS ORGANIZATION

Standards: Introduction International and National Standards organization: IEC, ISO, NIST, IEEE, ISA, API, BIS, DIN, JISC and ANSI.


UNIT II  ISA STANDARDS


UNIT II  ISA STANDARDS - CONTROL VALVE AND ACTUATOR

Control Valve Standards (ISA75): 75.01, 75.04, 75.05, 75.7, 75.11, 75.13, 75.14, 75.23, 75.24, 75.26. Valve Actuator (ISA 96): 96.01, 96.02, 96.03, 96.04.

UNIT IV  ISA STANDARDS - FOSSIL AND NUCLEAR POWER PLANTS

Fossil Power Plant Standards (ISA 77): 77.14, 77.22, 77.30, 77.41, 77.42, 77.44, 77.60, 77.70. Nuclear Power Plant Standards (ISA67): 67.01, 67.02, 67.03, 67.04, 67.06.

UNIT V  BS, ISO, IEC, & ANSI


TOTAL : 45 PERIODS

COURSE OUTCOMES (COS)

1. Ability to understand the role of standards organization.
2. Ability to implement different standards related to installation and control system, programming, documentation, equipment in hazardous area and instrument specification forms.
3. Ability to utilize the different standards related to control valve and actuators.
4. Ability to implement standards related to power plant and nuclear power plant.
5. Ability to select different standards related to orifice sizing, RTD and thermocouples.
6. Ability to compare and select standards related to Process industries.

TEXT BOOKS:

3. ISA standard 5, “Documentation of Measurement and Control Instruments and Systems”, ISA, North Carolina, USA.
4. ISA standard 12, “Electrical Equipment for Hazardous Locations”, ISA, North Carolina, USA.
5. ISA standard 20, “Instrument Specification Forms”, ISA, North Carolina, USA.
6. ISA standard 37, “Measurement Transducers”, ISA, North Carolina, USA.
7. ISA standard 75, “Control Valve Standards”, ISA, North Carolina, USA.
8. ISA standard 96, “Valve Actuator”, ISA, North Carolina, USA.
10. ISA standard 67, “Nuclear Power Plant Standards”, ISA, North Carolina, USA.

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E15006 FUNDAMENTALS OF NANO SCIENCE AND MEMS

COURSE OBJECTIVES
1. To provide wide information on nanomaterials, its properties and its applications.
2. To understand the various methods for synthesis of nano materials.
3. To understand the methods involved in preparation of nano scale devices.
4. To analyze the toxic effects of nanomaterials along with nano safety.
5. To understand and apply the various instrumentation techniques for characterization of nano materials

UNIT I INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOGY

UNIT II SYNTHESIS TECHNIQUES
UNIT III  PATTERNING AND LITHOGRAPHY FOR NANOSCALE DEVICES  

UNIT IV  NANOSAFETY AND CLEAN ROOM PRINCIPLES  
Nanotoxicology – Nano safety – Environmental effects - Clean rooms specifications – Clean Room Contaminants – Clean room principles:- Laminar flow and turbulent flow clean rooms – Clean Room Construction and Design:- Bay Chase Clean Room, Ball Room Clean Room & Micro Environment Clean Room.

UNIT V  INSTRUMENTS FOR CHARACTERIZATION OF NANOMATERIALS  

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)
1. Ability to utilize the principles of nano science along with the properties of nano materials for the design of novel systems.
2. Ability to select and apply the various techniques for synthesis of nano materials for specified application.
3. Ability to select and apply the various patterning techniques for development of micro and nano scale devices.
4. Ability to analyze the toxic effects of nano materials along with the safety measures for nano technological research.
5. Ability to apply and utilize the instrumentation systems for characterization of nano materials.
6. Will be in a position to learn and keep in pace with recent nanotechnological advancements.

TEXT BOOKS:

REFERENCE BOOKS:
MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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EI5007 MODERN CONTROL THEORY LT P C 3 0 0 3

COURSE OBJECTIVES
- To understand the nature of non-linear systems and to analyze the stability of such systems
- To develop suitable models of non-linear systems and to develop suitable controllers for such systems
- To understand the chaotic and bifurcation behavior of non-linear systems
- To linearize the non-linear systems.

UNIT I NON-LINEAR SYSTEMS

UNIT II STABILITY OF NON-LINEAR SYSTEMS

UNIT III MODELLING AND CONTROL OF NON-LINEAR SYSTEMS
UNIT IV  CHAOS AND BIFURCATION BEHAVIOR


UNIT V  LINEARIZATION


TOTAL : 45 PERIODS

COURSE OUTCOMES(COs)
1. Ability to find numerical solution for non-linear differential equations.
2. Ability to analyze and interpret the stability of the nonlinear systems.
3. Ability to apply mathematical knowledge and basics of science and engineering to develop model for non-linear systems.
4. Ability to understand the bifurcation behavior of non-linear systems.
5. Ability to linearize non-linear systems for developing linear control.
6. Ability to use appropriate software tools for analysis of non-linear systems.

TEXT BOOKS:

REFERENCE BOOKS:
7. NPTEL Lecture on “Non-linear system Analysis” by Prof. Laxmidhar Behera, IIT Kanpur.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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COURSE OBJECTIVES

- To provide an overview of the features associated with Industrial type PID controller.
- To make the students understand the various PID Controller Design methods and about PID stabilization for Linear Time-invariant models.
- To develop the skills needed to design adaptive and non-linear PID control schemes.
- To provide basic knowledge about Fractional-order systems and Fractional-order controller and to lay the foundation for the systematic approach to Design controller for fractional order systems.

UNIT I   INTRODUCTION

UNIT II  PID CONTROLLER DESIGN

UNIT III  PID STABILIZATION

UNIT IV  ADAPTIVE/NON-LINEAR PID CONTROL SCHEMES
Gain Scheduled PID Controller - Self-tuning PI/PID Controller – PID Types Fuzzy Logic Controller – Predictive PID Control.

UNIT V   INTRODUCTION TO FRACTIONAL ORDER SYSTEM AND FRACTIONAL ORDER PID CONTROLLER

COURSE OUTCOMES(COs)
1. Ability to determine the advanced features supported by the Industrial Type PID Controller.
2. Ability to design & implement a P/PI/PID Controllers for a given process and validate through simulations.
3. Ability to design and implement optimal/ robust PID controller for a given process and validate through simulations.
4. Ability to design and implement adaptive PID controllers and PID types Fuzzy Logic Controller for a given process and validate through simulations.
5. Ability to analyze fractional-order systems, fractional-order- controller and design a suitablefractional order P/PI/PID controller for fractional order and Integer order systems.
6. Ability to analyze various PID control schemes and recommend the right control strategy for a given application in accordance with the industrial requirement.
7. Ability to present the results in written and oral forms.

TEXT BOOKS:

REFERENCE BOOKS:

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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EI5009 MODEL PREDICTIVE CONTROL

COURSE OBJECTIVES

- To teach the students the general principles of model predictive control scheme.
- To provide a comprehensive description of model predictive control schemes namely as dynamic matrix control, generalized predictive control scheme and State space based model predictive control scheme.
- To highlight the key features of MPC for its Industrial Success.
- To introduce the skills required to formulate both unconstrained and constrained optimal control schemes.
- To develop the skills needed to design Model Predictive Control schemes to achieve the desired performance.

UNIT I MODEL PREDICTIVE CONTROL SCHEMES

Introduction to Model Predictive Control - Model Predictive Control Elements - Model Predictive Control Schemes: Dynamic Matrix Control and Model Algorithmic Control – Case Studies

UNIT II GENERALIZED PREDICTIVE CONTROL SCHEME

Generalized Predictive Control Scheme – Simple Implementation of Generalized Predictive Control Scheme for Industrial Processes – Multivariable Generalized Predictive Control Scheme – Case Studies

UNIT III STATE SPACE BASED MODEL PREDICTIVE CONTROL SCHEME

State Space Model Based Predictive Control Scheme - Review of Kalman Update based filters – State Observer Based Model Predictive Control Schemes – Case Studies

UNIT IV CONSTRAINED MODEL PREDICTIVE CONTROL SCHEME

Constraints Handling: Amplitude Constraints and Rate Constraints – Constraints and Optimization – Constrained Model Predictive Control Scheme – Case Studies.

UNIT V ADVANCED TOPICS IN MPC

Robust Model Predictive Control Scheme – Adaptive Model Predictive Control Scheme – Multiple-Model based Model Predictive Control Scheme - Fast Methods for Implementing Nonlinear Model Predictive Control Scheme – Case Studies
COURSE OUTCOMES (COs)
1. Ability to describe the advantages and disadvantages of various MPC schemes.
2. Ability to formulate and solve unconstrained/constrained model predictive control schemes for a given process.
3. Ability to implement Model Predictive Control algorithms in MATLAB/SCILAB and validate through simulations.
4. Ability to design and implement robust, adaptive MPC schemes on the simulated model of benchmark processes.
5. Ability to identify, formulate and solve problems in the field of Process Control domain using MPC.
6. Ability to present the results in written and oral forms.

TEXT BOOKS:

REFERENCE BOOKS:

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COURSE OBJECTIVES

- To give an overview of different Fault Detection and Diagnosis methods.
- To present an overview of various types of fault detection schemes using Limit Checking, Parameter estimation methods, Principle Component Analysis.
- To impart knowledge and skills needed to design and detect sensor and actuators faults using structured residual approach as well as directional structured residual approach.
- To impart knowledge and skills needed design and detect faults in sensor and actuators using GLR and MLR based Approaches.
- To impart knowledge and skills needed to detect and quantify and compensate stiction in Control valves.

UNIT I INTRODUCTION & ANALYTICAL REDUNDANCY CONCEPTS


UNIT II FAULT DETECTION AND DIAGNOSIS USING LIMIT CHECKING AND PROCESS IDENTIFICATION METHODS


UNIT III FAULT DETECTION AND DIAGNOSIS USING PARITY EQUATIONS


UNIT IV FAULT DIAGNOSIS USING STATE ESTIMATORS


UNIT V CASE STUDIES


TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to describe the different approaches to Fault Detection and Diagnosis.
3. Ability to detect sensors and actuators faults using structured residual approach as well as directional structured residual approach.
4. Ability to detect and isolate faults in sensor and actuators using Generalized Likelihood Ratio and Marginalized Likelihood Ratio based Approaches.
5. Ability to detect, quantify and compensate stiction in control valves.
6. Ability to present the results in written and oral forms
TEXT BOOKS

REFERENCE BOOKS

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EI5011 CYBER SECURITY FOR INDUSTRIAL AUTOMATION LT P C 3 0 0 3

COURSE OBJECTIVES
- To understand the Industrial security environment and cyberattacks
- To analyze and assess risks in the industrial environment
- To access, design and implement cybersecurity
- To test and troubleshoot the industrial network security system

UNIT I INTRODUCTION
Industrial security environment-Industrial automation and control system(IACS) culture Vs IT Paradigms-Cyberattacks: Threat sources and steps to successful cyberattacks

UNIT II RISK ANALYSIS
Risk identification, classification and assessment, Addressing risk: Cybersecurity Management System(CSMS), organizational security, physical and environmental security, network segmentation, access control, risk management and implementation.
UNIT III        ACCESSING THE CYBERSECURITY OF IACS  9
Identifying the scope of the IACS- generation of cybersecurity information-identification of vulnerabilities- risk assessment-evaluation of realistic threat scenarios- Gap assessment-capturing Ethernet traffic-documentation of assessment results

UNIT IV        CYBERSECURITY DESIGN AND IMPLEMENTATION  9
Cybersecurity lifecycle- conceptual design process- detailed design process- firewall design-remote access design- intrusion detection design

UNIT V        TESTING AND MAINTENANCE  9
Developing test plans- cybersecurity factory acceptance testing- site acceptance testing- network and application diagnostics and troubleshooting- cybersecurity audit procedure- IACS incident response

TOTAL : 45PERIODS

COURSE OUTCOMES (COs)
1. Ability to apply basis of science and engineering to understand Industrial security environment and cyberattacks.
2. Ability to analyze and assess risks in the industrial environment
3. Ability to access the cybersecurity of IACS
4. Ability to design and implement cyber security
5. Ability to test and troubleshoot the industrial network security system.
6. Ability to understand, investigate and explore feasible solution for a moderate industrial problem.

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COURSE OBJECTIVES

- To understand the nature of continuous and discrete systems
- To develop synchronous and asynchronous model of processes
- To specify both safety and liveness requirements in temporal logic and to debug the correctness of the protocol using model checking
- To develop and analyse model of timed and hybrid systems

UNIT I INTRODUCTION

Introduction-key features of cyber physical systems- Continuous dynamics: Newtonian mechanics-actor models-properties of systems-feedback control-Discrete dynamics: Discrete systems- Finite state machines

UNIT II SYNCHRONOUS AND ASYNCHRONOUS MODEL

Synchronous model: Reactive components-properties of components-composing components-synchronous design, Asynchronous model- asynchronous processes- asynchronous design primitives- coordination protocols.

UNIT III SAFETY AND LIVENESS REQUIREMENT

Safety specifications- verifying invariants- Enumerative search- Temporal logic- Model checking-reachability analysis- proving liveness

UNIT IV TIMED MODEL AND REAL-TIME SCHEDULING


UNIT V HYBRID SYSTEMS

Classes of Hybrid systems-Hybrid dynamic models:Hybrid Processes-Process Composition-Zeno Behaviors-Stability- designing hybrid systems- linear hybrid automata

TOTAL : 45PERIODS

COURSE OUTCOMES (COs)

1. Ability to understand knowledge, opportunities, challenges and Logical Foundations of Cyber Physical Systems.
2. Ability to develop model for synchronous, asynchronous, continuous and discrete systems.
3. Ability to identify safety specifications and critical properties of Cyber Physical Systems.
4. Ability to design and analyze the stability of hybrid systems.
5. Ability to apply automata for timed systems.

TEXT BOOKS:

REFERENCE BOOKS:

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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E15013 CONTROL VALVES LT P C 3 0 0 3

COURSE OBJECTIVES
- To understand the basic terminologies and types of control valves and actuators
- To understand the characteristics of control valves
- To select control valves and actuators based on the requirement
- To analyze various control valve problems and to test the quality of valves

UNIT I INTRODUCTION TO CONTROL VALVES 9
Basics Of Control Valves, Importance Of Control Valve In Process Industry, Basic Terminologies, Sliding Stem Control Valve, Rotatory Stem Control Valve Terminologies, Types Of Control Valves- Globe Valve, Sanitary Valves, Rotary Valves. ValveTrim Types.

UNIT II ACTUATORS AND CONTROL VALVE ACCESSORIES 9
UNIT III  VALVE CHARACTERISTICS, SIZING AND SELECTION  
Valve Performance And Characteristics For Different Types Of Valves, Dead Band – Causes , Effects, Performance Test, Valve Response Time- Importance Of Supply Pressure, Dead Time And Solutions To Minimize Dead Time. Valve Sizing, Actuator Sizing, Valve Selection, Actuator Selection.

UNIT IV  COMMON CONTROL VALVE PROBLEMS  

UNIT V  QUALITY TESTS AND STANDARDS  

COURSE OUTCOMES
1. Ability to understand terminologies associated with control valves.
2. Ability to determine the characteristic features of different types of control valves.
3. Ability to compare the merits and limitations of different types of actuators.
4. Ability to analyse and recommend appropriate control valves characteristics for a given application.
5. Ability to carry out design calculations for control valves.
6. Ability to evaluate the common problems associated with control valves outline.
7. Ability to comment on different quality testing methods for control valves.
8. Ability to interpret the industry popular standards for control valves diagnostics and testing procedure.

TEXT BOOKS:
1  Control system components, M.D.Desai, PHI Learning.
2  ISA Handbook for control valves, James W Hutchison ,ISA

REFERENCE BOOKS:

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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COURSE OBJECTIVES

- To give an introduction on several fundamental concepts and methods for machine learning.
- To familiarize with some basic learning algorithms and techniques and their applications.
- To provide the knowledge related to processing, analyzing and handling data sets.
- To illustrate the typical applications of various clustering based learning algorithms

UNIT I INTRODUCTION TO MACHINE LEARNING

Objectives of machine learning – Human learning/ Machine learning – Types of Machine learning:

UNIT II DATA PREPROCESSING

Data quality – Data preprocessing: - Data Cleaning:– Handling missing data and noisy data – Data integration:– Redundancy and correlation analysis – Continuous and Categorical Variables – Data Reduction:– Dimensionality reduction (Linear Discriminant Analysis – Principal Components Analysis – Factor Analysis – Independent Components Analysis)

UNIT III SUPERVISED LEARNING


UNIT IV CLUSTERING AND UNSUPERVISED LEARNING

Introduction – Clustering:– Partitioning Methods:– K-means algorithm – Mean Shift Clustering – Hierarchical clustering – Clustering using Gaussian Mixture Models – Clustering High-Dimensional Data:– Problems – Challenges

UNIT V NEURAL NETWORKS


TOTAL : 45 PERIODS

COURSE OUTCOMES

1. Ability to understand the basic theory underlying machine learning.
2. Ability to understand a range of machine learning algorithms along with their strengths and weaknesses.
3. Ability to formulate machine learning problems corresponding to different applications.
4. Ability to apply machine learning algorithms to solve problems of moderate complexity.
5. Ability to read current research papers and understand the issues raised by current research.

TEXT BOOKS:

REFERENCE BOOKS:
1. Jiawei Han, Micheline Kamber, Jian Pei, Data Mining: Concepts and Techniques: Concepts and Techniques, Elsevier, 2011.
2. Stephen Marsland, Machine Learning: An Algorithmic Perspective

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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COURSE OBJECTIVES

• To introduce the concept of microcontroller based system development
• To familiarize the Clocking and Memory Circuits
• To provide the Knowledge of Communication Modules
• To impart knowledge on RTOS based system Design
• To introduce the concept of Embedded Systems for IOT

UNIT I EMBEDDED HARDWARE DESIGN 9
Power supply - reset circuit - programming interface - GPIO options (slew rate, hysteresis, source, sink capability)- Digital input interfacing and protection - High side and low side drivers - unused pins - Internal ADC options - Brown out reset - optimizing power consumption.

UNIT II CLOCKING AND MEMORY 9
Internal vs External clock - PLL - Clocking tree - System clock/Peripheral clock - Frequency modulated clock - Progressive clock switch - Flash memory - Memory Management unit - Crossbar switch - Caching modes (write through, write back, inhibit) - Flushing vs Invalidating cache - Accessing External Memories - EEPROM cycles - Organization of C variables in memory.

UNIT III COMMUNICATION MODULES 9
Circuit design, clock and driver algorithm, Inter-Integrated Circuits (I2C) - Serial Communication Using SPI - Differences between SPI and I2C.- UART - Controller Area Network (CAN) - OSI Architecture - PHY (Ethernet - Wifi).

UNIT IV RTOS BASED SYSTEM DESIGN 9

UNIT V EMBEDDED SYSTEMS FOR IOT IN LINUX 9
Raspberry Pi - Introduction to Linux - Process - Thread Safety - Ethernet TCP/IP Stack - Socket programming - Security Introduction - Demo project on IoT using Embedded systems.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to determine the constitutional components of a microcomputer system and their significance.
2. Ability to select suitable communication protocols in accordance with the application in hand.
3. Ability to analyze the functioning of various memory modules.
4. Ability to differentiate the operational characteristics of Non-RTOS and RTOS based systems and use them efficiently in design environments.
5. Ability to infer the concept of IoT and demonstrate its power in real world applications.
6. Ability to formulate design strategies for embedded applications.

TEXT BOOKS:

REFERENCE BOOKS:
2. Datasheet of Microcontroller based on ARM CORTEX M4, NXP Semiconductors, Rev. 7, 05/2017
3. AVR Microcontroller Hardware Design Considerations, Microchip Technology Inc. 2017

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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EI5016 INTRODUCTION TO IMAGE AND VIDEO PROCESSING

COURSE OBJECTIVES

- To study the formation of an image and its acquisition
- To introduce the application of transforms in image processing
- To study techniques for improving quality of information in images
- To get familiarized with image and video processing techniques
- To apply image and video processing in industrial applications

UNIT I DIGITAL IMAGE FUNDAMENTALS

UNIT II IMAGE PREPROCESSING AND ENHANCEMENT
Point processing methods:- Contrast stretching – Gray level slicing- Histograms, Histogram equalization and specification techniques, Spatial filtering, Directional Smoothing, Median, Geometric mean, and Harmonic mean filters - Color image enhancement.
UNIT III     IMAGE SEGMENTATION AND ANALYSIS
Detection of Discontinuities, Edge linking, Boundary detection, Thresholding – Region oriented segmentation-Watershed segmentation – Object detection - Pattern Recognition – Classification.

UNIT IV     DIGITAL VIDEO PROCESSING
Video acquisition - Inter-frame processing, Motion Estimation and Compensation – Filtering – Video segmentation – Tracking by detection – Tracking multiple objects.

UNIT V     APPLICATIONS OF IMAGE AND VIDEO PROCESSING
Applications in measurements, manufacturing, medicine, agriculture and food industry – Case studies.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)
1. Ability to understand the technical terms associated with image and video processing.
2. Ability to select the appropriate preprocessing techniques for manipulation of images
3. Ability to utilize the different approaches of image enhancement, segmentation and analysis techniques
4. Ability to use appropriate software tools(Example: Matlab, Open CV and Python) for image and video processing
5. Ability to apply different digital video processing methods
6. Ability to design automated techniques for image based applications

TEXT BOOKS:

REFERENCE BOOKS:

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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COURSE OBJECTIVES

1. To introduce the students to the principles of analog and digital communication.
2. To impart knowledge on the waveform encoding techniques.
3. To facilitate the students in analyzing the performance of transmitters and receivers.
4. To familiarize the students with the principles of multi-user communication systems.

UNIT I  ANALOG MODULATION SCHEMES  9

UNIT II  WAVEFORM ENCODING TECHNIQUES  9
Sampling theorem, Types of Sampling, Quantization – Principles of PAM, PPM, PWM – Pulse code Modulation, DPCM, Quantization noise in PCM – Delta Modulation, ADM.

UNIT III  LINE CODING TECHNIQUES AND ERROR CORRECTION  9
Properties of line codes, UniPolar / Bipolar, RZ/NRZ and Manchester – Time domain representation - M-ary schemes, Error detection and correction:- Hamming code and Linear block codes - Matched filter and Correlator.

UNIT IV  PASSBAND DIGITAL MODULATION  9
BASK, BFSK, BPSK, QPSK and QAM – Signal space representation – Probability of error for ASK, FSK, PSK – Comparison of the schemes – Coherent/Non-Coherent reception.

UNIT V  MULTIPLEXING AND MULTIPLE ACCESS SCHEMES  9
Concept of multiplexing: FDM and TDM. Multiple Access: FDMA, TDMA and CDMA – Application to Mobile communication and Satellite communication.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to gain knowledge about the principles of communication techniques.
2. Ability to understand the importance of each type of modulation system for specific applications
3. Ability to capable of configuring Source coding schemes
4. Ability to analyze various Band pass signaling schemes and compare their performance
5. Ability to gain knowledge on multiple access schemes.
6. Get acquainted with the principle and operation of mobile and satellite communication systems.

TEXT BOOKS:

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EI5018  INDUSTRIAL INTERNET of THINGS  L T P C
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COURSE OBJECTIVES

- To give an overview of the Interconnection and Integration of the Physical World with Cyber Space.
- To provide an insight into Design and Development of IOT application.

UNIT I  INTERNET PRINCIPLES  9
Definition and Characteristics - IoT enabling technologies – Levels of deployment – Domain specific IoTs - SDN and NFV for IoT – ISO/OSI model – MAC address and IP address -Overview of TCP/IP and UDP -Basics of DNS - Classes of IP addresses - Static and dynamic addressing – Salient features of IPV4 – Specifications of IPV6 and 6LoPAN.

UNIT II  PHYSICAL AND LOGICAL DESIGN METHODOLOGIES  9
UNIT III PROTOCOLS AND CLOUDS FOR IOT
Application layer protocols for IoT – MQTT and –Introduction to cloud storage models and communication APIs – Web application framework – Designing a web API – Web services - IoT device management

UNIT IV INDUSTRIAL IOT AND SECURITY

UNIT V PROCESS DATA ANALYTICS

TOTAL : 45 PERIODS

COURSE OUTCOMES:
1. Ability to apply the knowledge of Internet principles and protocols to understand the architecture and specifications of a given network
2. Ability to design simple IoT applications using prototyping boards
3. Ability to select the appropriate protocol for a specific network implementation
4. Ability to identify the security level needed for a particular industrial IOT application
5. Ability to analyze the process data using cloud based process data management tools
6. Ability to acquire insight regarding the technological challenges and opportunities in Industrial IOT design and implementation

TEXT BOOKS:
1 Arshdeep Bahga and Vijay Madisetti, “Internet of Things A Hands-on Approach”, Universities Press (India), 2015

REFERENCE BOOKS:
1 Adrian McEwen and Hakim Cassimally, “Designing the Internet of Things”, John Wiley & Sons, 2014

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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OBJECTIVES:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To learn the fundamentals of VLSI design
- To understand the IC Manufacturing Process
- To familiarize with VLSI combinational logic circuits design
- To familiarize with VLSI sequential logic circuits design
- To learn the various arithmetic circuits and testing methodologies
- To familiarize with the different FPGA architectures

UNIT I  MOS TRANSISTOR PRINCIPLES  9
MOS Technology and VLSI, Pass transistors, NMOS, CMOS Fabrication process and Electrical properties of CMOS circuits and Device modelling. Characteristics of CMOS inverter, Scaling principles and fundamental limits. Propagation Delays, CMOS inverter scaling, Stick diagram, Layout diagrams, Elmore’s constant, Logical Effort. Case study: Study of technology development in MOS.

UNIT II  COMBINATIONAL LOGIC CIRCUITS  9
Static CMOS logic Design, Design techniques to improve the speed, power dissipation of CMOS logic, low power circuit techniques, Ratioed logic, Pass transistor Logic, Transmission CPL, DCVSL, Dynamic CMOS logic, Domino logic, Dual Rail logic, NP CMOS logic and NORA logic

UNIT III  SEQUENTIAL LOGIC CIRCUITS  9
Static and Dynamic Latches and Registers, Timing Issues, Pipelines, Clocking strategies, Memory Architectures, and Memory control circuits.

UNIT IV  DESIGNING ARITHMETIC BUILDING BLOCKS & TESTING  9
Data path circuits, Architectures for Adders, Accumulators, Multipliers, Barrel Shifters, Need for testing- Manufacturing test principles- Design for testability. Case study: Analysis of area, power and delay for 16 bit adder and 8 bit multiplier.

UNIT V  IMPLEMENTATION STRATEGIES  9
Full Custom and Semicustom Design, Standard Cell design and cell libraries, FPGA building block architectures, FPGA interconnect routing procedures. Demo: Complete ASIC flow using Backend tool and fabrication flow Overall case study: Development of IC in commercial aspects (design, testing and fab cost)

COURSE OUTCOMES:
CO1: Ability to analyze inverter characteristics and realize modeling of MOS transistors.
CO2: Ability to design combinational logic using various logic styles, satisfying static and dynamic requirements.
CO3: Ability to analyze timing issues of sequential logic and design memories.
CO4: Ability to design data path elements.
CO5: Ability to compare and analyze FPGA architecture and interconnect methodology.

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EC5075 MIXED SIGNAL IC DESIGN

OBJECTIVES:
- To introduce various functional modules of Mixed Signal ICs
- To introduce the design issues of analog and digital circuit interoperability
- To introduce power management modules in Mixed Signal ICs

UNIT I REFERENCE CIRCUITS
Performance Metrics, Current Mirrors, Self Biased Current Reference, startup circuits, VBE based Current Reference, VT Based Current Reference, Band Gap Reference, Supply Independent Biasing, Temperature Independent Biasing, PTAT and CTAT Current Generation, Constant Gm Biasing

UNIT II LOW DROP OUT REGULATORS

UNIT III FREQUENCY SYNTHESIZERS
Integer-N Phase Lock Loop(PLL), Fractional-N Phase Lock Loop, Delay-Lock Loop (DLL), multiplying-DLL, Injection-locked PLLs, and Sub-sampled PLLs.

UNIT IV ACTIVE FILTER DESIGN
Butterworth Filter approximations, Chebyshev Filter approximations, Frequency Transformations, Continuous time filters- Biquad and Ladder based designs, Active RC and Gm-C Filters, Switch Capacitor Filters, Integrator realization and nonidealities

UNIT V CLOCK AND DATA RECOVERY CIRCUITS
Channel characteristics-intersymbol interference, eye diagrams, Linear equalization at the transmitter and receiver; CDR Architectures, Trans Impedance Amplifiers, Linear Half Rate CDR Circuits, Wide capture Range CDR Circuits.
COURSE OUTCOMES:
The student who undergoes this course will be able to
CO1: Design Band gap reference circuits and Low Drop Out regulator for a given specification.
CO2: Design Frequency synthesizers meeting a given specification.
CO3: Choose active filter topology and design for a given specification.
CO4: Design clock generation circuits in the context of high speed I/Os, High speed Broad Band Communication circuits and Data Conversion Circuits.

TEXT BOOKS:

REFERENCES:
3. Deliyannis, Sun, and Fidler, "Continuous-Time Active Filter Design", CRC Press 1998,

EC5073 ELECTRO MAGNETIC INTERFERENCE AND COMPATIBILITY LT P C 3 0 0 3

OBJECTIVES:
• To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
• To tutor the basics of EMI, EMC
• To instill knowledge on the EMI coupling mechanism and its mitigation techniques
• To impart comprehensive insight about the current EMC standards and about various measurement techniques

UNIT I BASIC CONCEPTS 7
Definition of EMI and EMC; Intra and Inter system EMI; Sources and victims of EMI, Conducted and Radiated EMI emission and susceptibility; Transient & ESD; Case Histories; Radiation Hazards to humans.

UNIT II COUPLING MECHANISM 9
Common made coupling; Differential mode coupling; Common impedance coupling; Ground loop coupling; Field to cable coupling; Cable to cable coupling; Power mains and Power supply coupling.

UNIT III EMI MITIGATION TECHNIQUES 10
Shielding – principle, choice of materials for H, E and free space fields, and thickness; EMI gaskets; Bonding; Grounding – circuits, system and cable grounding; Filtering; Transient EMI control devices and applications; PCB Zoning, Component selection, mounting, trace routing.
UNIT IV STANDARDS AND REGULATION
Units of EMI; National and International EMI Standardizing Organizations – IEC, ANSI, FCC, CISPR, BIS, CENELEC; FCC standards; EN Emission and Susceptibility standards and specifications; MIL461E Standards.

UNIT V TEST METHODS AND INSTRUMENTATION
EMI test sites - Open area site; TEM cell; Shielded chamber; Shielded Anechoic chamber; EMI test receivers; Spectrum Analyzer; Transient EMI Test wave Simulators; EMI coupling Networks - Line impedance Stabilization Networks; Feed through capacitors; Antennas and factors; Current probes and calibration factor; MIL-STD test methods; Civilian STD Test methods, Government policies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Ability to comprehend and appreciate the significance and role of this course in the present contemporary world Upon Completion of the course, the students will be able to:
CO1: To design a EMI free system.
CO2: To reduce system level crosstalk.
CO3: To design high speed Printed Circuit board with minimum interference.
CO4: To make our world free from unwanted electromagnetic environment.

TEXT BOOKS:

REFERENCES:

ME5552 METROLOGY AND MEASUREMENTS

COURSE OBJECTIVES: The main learning objective of this course is to prepare the students for:
1. Explaining the importance of measurements in engineering and the factors affecting measurements and to estimate measurement uncertainty.
2. Applying the working principle and applications of various linear and angular measuring instruments and basic concepts of measurement of assembly and transmission elements.
3. Interpreting the various tolerance symbols given in engineering drawings to choose the appropriate manufacturing process.
4. Applying the principles and methods of form and surface metrology.
5. Applying the advances in measurements for quality control in manufacturing Industries

UNIT I BASICS OF METROLOGY
UNIT II MEASUREMENT OF LINEAR, ANGULAR DIMENSIONS AND ASSEMBLY AND TRANSMISSION ELEMENTS


UNIT III TOLERANCE ANALYSIS

Tolerancing – Interchangeability, Selective assembly, Tolerance representation, Terminology, Limits and Fits, Problems (using tables); Design of Limit gauges, Problems. Tolerance analysis in manufacturing, Process capability, tolerance stackup, tolerance charting.

UNIT IV METROLOGY OF SURFACES

Fundamentals of GD & T- Conventional vs Geometric tolerance, Datums, Inspection of geometric deviations like straightness, flatness, roundness deviations, etc. Simple problems – Measurement of Surface finish – Functionality of surfaces, Parameters, Comparative, Stylus based and Optical Measurement techniques, Filters, Introduction to 3D surface metrology- Parameters.

UNIT V ADVANCES IN METROLOGY


Total (L: 45) = 45 Periods

COURSE OUTCOMES: Upon completion of this course, the students will be able to:

1. Explain the importance of measurements in engineering and the factors affecting measurements and to estimate measurement uncertainty.
2. Apply the working principle and applications of various linear and angular measuring instruments and basic concepts of measurement of assembly and transmission elements.
3. Interpret the various tolerance symbols given in engineering drawings to choose the appropriate manufacturing process.
4. Apply the principles and methods of form and surface metrology.
5. Apply the advances in measurements for quality control in manufacturing Industries.

TEXTBOOKS:


REFERENCES:

AU5551 AUTOMOTIVE ELECTRICAL AND ELECTRONICS SYSTEMS L T P C

OBJECTIVES:

i. To define the glossary related to vehicle electrical and electronic system.

ii. To understand the need for starter batteries, starter motor and alternator in the vehicle.

iii. To differentiate the conventional and modern vehicle architecture and the data transfer amongst the different electronic control unit using different communication protocols.

iv. To list common types of sensor and actuators used in vehicles.

v. To understand networking in vehicles.

UNIT I INTRODUCTION AND AUTOMOTIVE BATTERIES
Introduction - Overview of vehicle electrical systems - Electrical circuits - Electrical power supply in conventional vehicle - Dimensioning of wires - Circuit diagrams and symbols - Electromagnetic Compatibility and interference suppression. Batteries – Battery design – Method of operation – Lead acid battery construction – Battery ratings and testing - Maintenance -free batteries – Battery – Substitute, versions, special cases.

UNIT II STARTING AND CHARGING SYSTEM

UNIT III IGNITION, LIGHTING AND AUXILIARY SYSTEM

UNIT IV AUTOMOTIVE ELECTRONICS AND SENSORS AND ACTUATORS
UNIT V: VEHICLE NETWORKING

Data transfer between automotive Electronics systems - Basic principles of networking- Network topology - Network organization- OSI reference model - Control mechanisms - communication protocols in embedded systems - Vehicle Communication Protocols – Cross-system functions - Requirements for bus systems - Classification of bus systems - Applications in the vehicle - Coupling of networks - Examples of networked Vehicles - Bus system- CAN, LIN, Flexray – MOST etc.

TOTAL PERIODS: 45

OUTCOMES:

i. Define the glossary related to vehicle electrical and electronic system
ii. Understand the need for starter batteries, starter motor and alternator in the vehicle.
iii. Differentiate the conventional and modern vehicle architecture and the data transfer among the different electronic control unit using different communication protocols
iv. List common types of sensor and actuators used in vehicles.
v. Understand networking in vehicles.

TEXT BOOKS:


REFERENCES:


AU5072 VEHICLE CONTROL SYSTEMS

OBJECTIVES:

i. To understand the basics of control system used in automobiles
ii. To recognize the electronically controlled system used in driving mechanics.
iii. To understand the working principle of driver modelling and power train control systems.
iv. To identify the control system used in hybrid and electrical vehicles.
v. To illustrate the need of automated transport systems.

UNIT I: INTRODUCTION TO VEHICLE CONTROL SYSTEM

Trends, overview and examples of vehicle control system - Sensors, actuators and controller modules-Vehicle communication Network-System Engineering V-diagram- Algorithm Development - Steps in vehicle control system design- Degree of freedom for vehicle control- selection of controlled, manipulated, measured disturbance variables- classification of the variables in various automotive systems like engines, suspension, braking, air conditioning – General types of vehicle controller configurations- Feedback, Inferential, Feed-Forward, Ratio control.

UNIT II: CONTROL SCHEMES, CRUISE AND HEADWAY CONTROL

Feed - Forward control - Cascade control- Design considerations for cascade control, Time delay compensation, Inferential control- Nonlinear control- Adaptive control etc. Cruise control design- Autonomous cruise control- Anti locking brakes- Traction control system- Vehicle stability control

UNIT III  DRIVER MODELING AND POWERTRAIN CONTROL SYSTEMS  9

UNIT IV  CONTROL OF HYBRID AND FUEL CELL VEHICLES  9
Series-Parallel- Split Hybrid Configurations- Hybrid Vehicle Control Hierarchy- Control Concepts of Series Hybrids- Equivalent Consumption minimization strategy- control concepts for split hybrid modelling of fuel cell systems- fuel stack model- control of fuel cell system.

UNIT V  HUMAN FACTORS AND INTELLIGENT TRANSPORT SYSTEM  9
Human factors in vehicle automation- cross over model principle- Risk- Homeostatic Theory- Driving simulators- percentage of road departure Advanced traffic management system- Advanced traveller information system- commercial vehicle operation- Advanced vehicle control system- Preventing collisions- Longitudinal motion control and platoons- Site specific information- comparison of longitudinal control approaches- String stability- Automated steering and lateral control – Lane sensing- automated lane change and follow control.

TOTAL: 45 PERIODS

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

i. Understand the basics of control system used in automobiles
ii. Recognize the electronically controlled system used in driving mechanics.
iii. Understand the working principle of driver modelling and power train control systems.
iv. Identify the control system used in hybrid and electrical vehicles.
v. Illustrate the need of automated transport systems.

TEXT BOOKS:

REFERENCES:
OBJECTIVES:
The course should enable the students to:
  i. General aspects of Electric and Hybrid Vehicles (EHV), including architectures, modeling, sizing, subsystem design and hybrid vehicle control.
  ii. Understand about vehicle dynamics,
  iii. Design the required energy storage devices,
  iv. Select the suitable electric propulsion systems and
  v. Understand of hybrid electric vehicles.

UNIT I       NEED FOR ALTERNATIVE SYSTEM 10
Need for hybrid and electric vehicles – main components and working principles of a hybrid and electric vehicles. Different configurations of hybrid and electric vehicles. Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and Limitations of hybrid and electric Vehicles. Case study on specification of electric and hybrid vehicles.

UNIT II   DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES 9

UNIT III  ENERGY SOURCES 9

UNIT IV    MOTORS AND CONTROLLERS 9
Types of Motors, Characteristic of DC motors, AC single phase and 3-phase motor, PM motors, Switched reluctance motors, Motor Drives and speed controllers, Torque Vectoring, Regenerative Braking. Rectifiers, Inverters, DC/DC converters.

UNIT V     SUBSYSTEMS OF HYBRID AND ELECTRIC VEHICLES 8

OUTCOMES:
The students able to understand
  i. Electric and hybrid vehicle operation and architectures
  ii. Design of hybrid and electric vehicles.
  iii. Energy requirement for vehicles.
  iv. Vehicle characteristics, operating modes, and performance parameters of the vehicle
  v. Different subsystems of hybrid and electric vehicles

TEXT BOOKS:

REFERENCES:
OBJECTIVES:

i. To provide theoretical and applicative knowledge in automobile test instrumentation.

ii. To identify the various instruments for measuring force, torque, pressure, temperature, fluid flow, velocity and rotational speed.

iii. To enhance the knowledge of students regarding the experimental methods followed in industries.

iv. To familiarize the students on standard test codes.

v. To impart skills on the testing procedure followed for evaluating brake, engine and vehicle.

UNIT I MECHANICAL MEASUREMENT

Introduction to measurements – Construction, principle, working of Instruments for measuring force, torque, pressure, temperature, fluid flow, velocity, rotational speed.

UNIT II VIBRATION AND BODY TEST

Vibration measurement instrument – accelerometer and signal conditioning. Dynamic simulation sled testing, methodology, vehicle acceleration measurement and documentation. Dolly roll over test, dolly role over fixture, photographic / video coverage. Vehicle roof strength test – Door system crush test – wind tunnel tests.

UNIT III CRASH AND BRAKE TEST

Crash tests – standards – road hazard impact test for wheel and tyre assemblies, test procedures, failure and performance criteria. Bumpers - types of tests, pendulum test, fixed collision barrier test, procedure, performance criteria. Air and hydraulic brake test, air brake actuator, valves test, performance requirements.

UNIT IV ENGINE EXPERIMENTAL TECHNIQUES

I.S Code for Engine testing – Instruments for performance testing of engine, Instrumentation for measuring noise, vibration in cylinder, different types of engine tests are performed within the industry.

UNIT V VEHICLE EXPERIMENTAL TECHNIQUES

Laboratory tests- test tracks - Endurance Tests - Dynamic cornering fatigue, dynamic radial fatigue tests – procedure, bending moment and radial load calculations.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

i. Demonstrate the understanding of engine testing procedures.

ii. Develop a measurement strategy for temperature, pressure, mass flow, velocity.

iii. Understand sensors and instrumentation, and to analyse and interpret test data.

iv. Develop new system that would help in keeping the environment sustainable.

v. Demonstrate the understanding of brake testing procedures

TEXT BOOKS:


REFERENCES:

AE5071 AIRCRAFT SYSTEMS ENGINEERING L T P C
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OBJECTIVES: Of this course are
01. To introduce basic concepts of systems engineering and their application to aircraft systems.
02. To acquaint students with design, build, test, operate and disposal phases of aircraft systems and aircraft operating environment system.
03. To impart knowledge on evolution of avionics architecture and arrangements of systems integration of aircraft.
04. To familiarise students with varying system configurations and their compatibility and system evolution considerations.
05. To impart knowledge on fault and failure analysis of aircraft systems and components and types of maintenance procedures

UNIT I INTRODUCTION TO SYSTEMS ENGINEERING

UNIT II DESIGN AND DEVELOPMENT PROCESS
Product Life Cycle –Concept Phase-Definition Phase-Design Phase-Build, Test, Operate and Disposal Phase-Whole Life Cycle Tasks-Systems Analysis- Design Drivers in the Project, Product, Operating Environment-Interfaces with the Subsystems.

UNIT III SYSTEM ARCHITECTURES AND INTEGRATION

UNIT IV PRACTICAL CONSIDERATIONS AND CONFIGURATION CONTROL

UNIT V SYSTEMS RELIABILITY AND MAINTAINABILITY
Systems and Components-Analysis-Influence, Economics, Design for Reliability-Fault and Failure Analysis-Case Study-Maintenance Types-Program-Planning and Design.

TOTAL: 45 PERIODS

OUTCOMES: Upon completion of this course, Students will be able to
CO1: Acquire knowledge on the basic working principle of hydraulic and pneumatic systems and their components.
CO2: Identify the types of control systems namely conventional and modern systems and the need to choose them for specific aircraft application.
CO3: Acquire knowledge on the different types of fuel system used for piston engine and jet engines.
CO4: Identify the different configurations of aircrafts and compatibility of various systems.
CO5: Acquire knowledge on the fault and failure analysis of aircraft systems.

#### OBJECTIVES:
- 01. To introduce the basic of avionics and its need for civil and military aircrafts.
- 02. To impart knowledge about the avionic architecture and various avionics data buses.
- 03. To gain more knowledge on various avionics subsystems.
- 04. To impart knowledge on feedback systems.
- 05. To gain knowledge in field of navigation systems.

#### UNIT I
**INTRODUCTION TO AVIONICS**
Need for avionics in civil and military aircraft and space systems – Integrated avionics and weapon systems – Typical avionics subsystems, design, technologies – Introduction to Digital Computer and memories.

#### UNIT II
**DIGITAL AVIONICS ARCHITECTURE**

#### UNIT III
**FLIGHT DECKS AND COCKPITS**
Control and display technologies: CRT, LED, LCD, EL and plasma panel – Touch screen – Direct voice input (DVI) – Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS.

#### UNIT IV
**INTRODUCTION TO NAVIGATION SYSTEMS**

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**TEXT BOOKS:**

**REFERENCES:**
UNIT V  AIR DATA SYSTEMS AND AUTO PILOT

Air data quantities – Altitude, Air speed, Vertical speed, Mach number, Auto pilot – Basic principles, Longitudinal and lateral auto pilot.

TOTAL: 45 PERIODS

OUTCOMES: Upon completion of this course, Students will be able to

CO1: Apply the basics of avionics subsystems architecture.
CO2: Distinguish between the needs of civil and military avionics systems.
CO3: Acquire knowledge on display technologies.
CO4: Build Digital avionics architecture.
CO5: Design navigation system and ability to design and perform analysis on air data system.

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PR5073  ROBOTIC TECHNOLOGY  L T P C

OBJECTIVES:

- To study the kinematics, drive systems and programming of robots.
- To study the basics of robot laws and transmission systems.
- To familiarize students with the concepts and techniques of robot manipulator, its kinematics.
- To familiarize students with the various Programming and Machine Vison application in robots.
To build confidence among students to evaluate, choose and incorporate robots in engineering systems.

UNIT I  FUNDAMENTALS OF ROBOT  9

UNIT II  ROBOT KINEMATICS  9
Forward kinematics, inverse kinematics and the difference: forward kinematics and inverse Kinematics of Manipulators with two, three degrees of freedom (in 2 dimensional), four degrees of freedom (in 3 dimensional) – derivations and problems. Homogeneous transformation matrices, translation and rotation matrices Denvavit and Hartenberg transformation.

UNIT III  ROBOT DRIVE SYSTEMS AND END EFFECTORS  9

UNIT IV  SENSORS IN ROBOTICS  9
Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors, safety considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and compliance mechanism. Machine vision system - camera, frame grabber, sensing and digitizing image data – signal conversion, image storage, lighting techniques, image processing and analysis – data reduction, segmentation, feature extraction, object recognition, other algorithms, applications – Inspection, identification, visual serving and navigation.

UNIT V  PROGRAMMING AND APPLICATIONS OF ROBOT  9
Teach pendant programming, lead through programming, robot programming languages – VAL programming – Motion Commands, Sensors commands, End-Effector Commands, and simple programs - Role of robots in inspection, assembly, material handling, underwater, space and medical fields.

TOTAL: 45 PERIODS

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

CO1: Interpret the features of robots and technology involved in the control.
CO2: Apply the basic engineering knowledge and laws for the design of robotics.
CO3: Explain the basic concepts like various configurations, classification and parts of end effectors compare various end effectors and grippers and tools and sensors used in robots.
CO4: Explain the concept of kinematics, degeneracy, dexterity and trajectory planning.
CO5: Demonstrate the image processing and image analysis techniques by machine vision system.

TEXT BOOKS:

REFERENCES:
OBJECTIVES:
- To learn the fundamentals of data models, conceptualize and depict a database system using ER diagram.
- To study the principles to be followed to create an effective relational database and write SQL queries to store/retrieve data to/from database systems.
- To know the fundamental concepts of transaction processing, concurrency control techniques and recovery procedure.
- To learn about the internal storage structures using different file and indexing techniques and the basics of query processing and optimization.
- To study the basics of distributed databases, semi-structured and un-structured data models.

UNIT I RELATIONAL DATABASES

Suggested Activities:
- Creating tables with key constraints, adding and removing constraints with referential integrity using DDL commands.
- Flipped classroom on relational algebra operations (selection, projection, joins etc.).
- Write SQL queries for demonstrating CRUD operations, aggregate functions and various join operations using DML commands.
- Create stored procedures for executing complex SQL transactions.
- Create triggers for alerting user/system while manipulating data.

Suggested Evaluation Methods:
- Tutorials on DDL, DML and DCL queries.
- Quizzes on relational algebra operations.
- Demonstration of created stored procedures and triggers.

UNIT II DATABASE DESIGN

Suggested Activities:
- Simple database application design using ER diagram.
- Practical - ER modeling using open source tools and realizing database.
• Study of various anomalies and normalizing table (1NF, 2NF, 3NF, BCNF).
• Flipped classroom on topics of database design and normalization.

Suggested Evaluation Methods:
• Tutorials on application specific ER Diagram.
• Tutorials on normalization and database design.

UNIT III TRANSACTION MANAGEMENT 9

Suggested Activities:
• Checking serializability among transactions.
• Flipped classroom on concurrency control protocols.
• Study of crash recovery algorithm (ARIES).

Suggested Evaluation Methods:
• Tutorials on serializability and crash recovery algorithm
• Quizzes on concurrency control protocols.

UNIT IV IMPLEMENTATION TECHNIQUES 9

Suggested Student Activities:
• Study of different RAID levels and its uses in different applications.
• Practical - Creation of B+ tree with insertion and deletion operations.
• Assignments on cost estimation of different types of queries.

Suggested Evaluation Methods:
• Report on applications of RAID levels.
• Tutorials on B+ Tree manipulation.
• Quizzes on hashing mechanisms.
• Exercise on cost estimation for various SQL queries.
• Evaluation of the practical assignments.

UNIT V ADVANCED TOPICS 9

Suggested Student Activities:
• Design of distributed database using fragmentation.
• Creation of XML document based on XML schema.
• Creation of document and column oriented databases and simple manipulation.

Suggested Evaluation Methods:
• Tutorials on fragmenting database tables and writing simple SQL queries.
• Assignments on creation of XML schema and validating XML documents.
• Demonstration of created document and column-oriented databases.

TOTAL: 45 PERIODS
OUTCOMES:
On completion of the course, the student will be able to:
CO1: Model an application’s data requirements using conceptual modeling and design
database schemas based on the conceptual model.
CO2: Formulate solutions to a broad range of query problems using relational algebra/SQL.
CO3: Demonstrate an understanding of normalization theory and apply such knowledge to
the normalization of a database.
CO4: Run transactions and estimate the procedures for controlling the consequences of
concurrent data access.
CO5: Explain basic database storage structures, access techniques and query processing.
CO6: Describe distributed, semi-structured and unstructured database systems.

TEXT BOOKS:

REFERENCES:
1. C. J. Date, A. Kannan, S. Swamynathan, “An Introduction to Database Systems”, Eighth

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OBJECTIVES:
- To understand the concept of layering in networks.
- To know the functions of protocols of each layer of TCP/IP protocol suite.
- To visualize the end-to-end flow of information.
- To understand the components required to build different types of networks.
- To learn concepts related to network addressing and routing.

UNIT I INTRODUCTION AND APPLICATION LAYER


Suggested Activities:
- In-class activity - Solving problems on performance metrics.
- In-class activity - HTTP problems.
- Accessing HTTP and SMTP server through Telnet.
- External learning - HTTP/DNS format using a tool like Wireshark.
- External learning - POP3 and IMAP protocols of email application.

Suggested Evaluation Methods:
- Quiz on Wireshark.
- Quiz on POP3 and IMAP.
- Assignment problems different protocols.

UNIT II TRANSPORT LAYER


Suggested Activities:
- Flipped Classroom on UDP Applications.
- External learning - Wireshark for UDP, TCP packet formats.
- External learning - Transport for Real Time Applications.
- External learning - Understanding RFCs.
- Assignments on flow control analysis in class.

Suggested Evaluation Methods:
- Quiz on UDP applications.
- Quiz on real time transport protocols.
- Discussion/assignment on RFC.
- Interpreting Wireshark output.

UNIT III NETWORK LAYER


Suggested Activities:
- In-class activity - IP addressing.
- External learning - IPV4 Packet Format using Wireshark.
- In-class activity - Subnetting for different scenarios.
- Flipped classroom on CIDR.
• External learning - Ping and trace-route commands.
• Mini-project on the implementation of a protocol based on an RFC.

Suggested Evaluation Methods:
• Quiz on CIDR.
• Check ability to use commands.

UNIT IV    ROUTING

Suggested Activities:
• In-class activity - Distance Vector Routing, Link State Routing.
• External learning - RIP, OSPF packet formats.
• Assignment on Link state routing for different network graphs.
• In-class activity - Error Detection and Correction.
• Flipped classroom on IPV6.
• External learning - Study on global IP address assignment.

Suggested Evaluation Methods:
• Quizzes on RIP, OSPF packet format.
• Quiz on IPv6.

UNIT V    DATA LINK AND PHYSICAL LAYERS

Suggested Activities:
• In-class activity - Problems on encoding techniques.
• External learning - Virtual LAN , Wireless LAN (802.11) formats.
• Flipped Classroom on recent developments in transmission media.
• Design a protocol for some application.
• Trace the end-to-end flow of packets through the network.

Suggested Evaluation Methods:
• Quizzes on VLAN and 802.11 formats.
• Presentation/Implementation of design.
• Demonstration of RFC implementation project.

TOTAL : 45 PERIODS

OUTCOMES:
On the completion of the course, the student will be able to:
1. Highlight the significance of the functions of each layer in the network.
2. Identify the devices and protocols to design a network and implement it.
3. Build network applications using the right set of protocols and estimate their performances.
4. Trace packet flows and interpret packet formats.
5. Apply addressing principles such as subnetting and VLSM for efficient routing.
6. Explain media access and communication techniques.

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IT5451 COMPUTER ARCHITECTURE

OBJECTIVES:
- To identify the functional units in a digital computer system.
- To distinguish between the various ISA styles.
- To trace the execution sequence of an instruction through the processor.
- To evaluate different computer systems based on performance metrics.
- To understand the fundamentals of memory and I/O systems and their interface with the processor.

UNIT I FUNDAMENTALS OF COMPUTER SYSTEMS

Suggested Activities:
- In-class activity on performance evaluation.
- Flipped classroom – Evolution and types of computer systems, identification of benchmarks.
- Use a Simulator for RISC and CISC. Analyze the ISA supported by the architectural simulator by running simple programs on the simulator.
- Mapping and correlating a C code with its machine code.
- Practical – Opening up a computer system and studying the components.

Suggested Evaluation Methods:
- Mock test on problems for computer performance.
- Group discussion on activity four with assembly instruction, identifying the instruction type and encoding used in machine code.
- Quizzes on ISA.
UNIT II  ARITHMETIC FOR COMPUTERS

Suggested Activities:
- Flipped classroom – Unsigned binary operations(+,-,*,/).
- Simulation of the floating point operations.
- External learning – Arithmetic algorithms for faster multiplication and division.
- Tutorials on multiplication and division (Booths algorithm, restoring and non-restoring).

Suggested Evaluation Methods:
- Mock test on multiplication and division.
- Quizzes on floating point single precision and double precision representation.

UNIT III  PROCESSOR

Suggested Activities:
- Flipped Classroom for analyzing data path in Intel and ARM core.
- Practical – Analyzing the data path on the standard simulator.
- Practical – Study of the pipelined implementation and analysis of various hazards on a standard simulator.

Suggested Evaluation Methods:
- Assignment on data path design.
- Group discussion on pipeline depth and stages.
- Quiz on class or automatic quizzes on the flipped classroom content.

UNIT IV  MEMORY AND I/O

Suggested Activities:
- Flipped classroom on memory hierarchy in Intel i7 and ARM Cortex.
- Practical – Implement a simple functional model for memory mapping in cache using C/C++.
- Study hit/miss rates for various access patterns. Experiment with different replacement policies.

Suggested Evaluation Methods:
- Mock test for problems on memory mapping.
- Quizzes on memory management in ARM and Intel processor.

UNIT V  PARALLEL PROCESSING

Suggested Activities:
- Flipped classroom on evolution of GPU.
- External learning – Speculative dynamic scheduling.
- Survey on multicore and draw a mind map on trends of multicore processors.
Suggested Evaluation Methods:
- Quizzes on dynamic scheduling.
- Group discussion on how to reduce CPI to less than one clock cycle.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the students will be able to:
- Interpret assembly language instructions.
- Design and analyze ALU circuits.
- Implement a control unit as per the functional specification.
- Design and analyze memory, I/O devices and cache structures for processor.
- Evaluate the performance of computer systems.
- Point out the hazards present in a pipeline and suggest remedies.

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OBJECTIVES:
- To introduce the basics of C programming language.
- To learn the concepts of advanced features of C.
- To understand the concepts of ADTs and linear data structures.
- To know the concepts of non-linear data structure and hashing.
- To familiarize the concepts of sorting and searching techniques.

UNIT I  C PROGRAMMING FUNDAMENTALS

Suggested Activities:
- Implementing programs using data types, arithmetic operators and basic input/output operations.
- Developing programs using if-else, do-while, while, for, switch, break, continue, enum.
- Write an application to perform operations like finding the maximum, minimum, average values using single dimensional integer and float arrays.
- Develop an application to perform matrix operations using multi-dimensional arrays.
- Create an application that performs operations like concatenation, finding a substring from a given string, etc. using character arrays.
- Develop any application (student’s choice) using User-defined functions and Recursive functions.

Suggested Evaluation Methods:
- Tutorials on conditionals and loops.
- Evaluation of the programs implemented.

UNIT II  C PROGRAMMING - ADVANCED FEATURES

Suggested Activities:
- Implementing applications using Structures, Unions, Enumerations.
- Demonstration of C programs using pointers to variables, arrays, functions and using address arithmetic.
- Demonstration of programs using dynamic memory.
- Demonstration of real world applications using file operations.

Suggested Evaluation Methods:
- Tutorials on file handling.
- Checking output of programs implemented.

UNIT III  LINEAR DATA STRUCTURES

Suggested Activities:
- Converting an algorithm from recursive to non-recursive using stack.
- Demonstrating stack for Towers of Hanoi application.
- Developing any application (student’s choice) using all the linear data structures.

Suggested Evaluation Methods:
- Tutorials on applications of linear data structures.
- Checking output of programs implemented.
UNIT IV  NON-LINEAR DATA STRUCTURES

Suggested Activities:
• Implementing binary tree and tree traversals.
• Solving expressions using expression trees by determining infix, prefix and postfix expressions.
• Implementation of phone directory using hash tables.
• Developing any application using trees.

Suggested Evaluation Methods:
• Tutorials on hashing.
• Check output of programs implemented.
• Quiz on various topics of the unit.

UNIT V  SORTING AND SEARCHING TECHNIQUES
Insertion Sort – Quick Sort – Heap Sort – Merge Sort – Linear Search – Binary Search.

Suggested Activities:
• External learning - External sorting implementation.
• Implementation of all sorting techniques in C language.
• Demonstration of searching techniques under best and worst case inputs.

Suggested Evaluation Methods:
• Tutorials on external sorting.
• Checking output of programs implemented.

OUTCOMES:
On completion of the course, the students will be able to:
CO1: Develop C programs for any real world/technical application.
CO2: Apply advanced features of C in solving problems.
CO3: Write functions to implement linear and non–linear data structure operations.
CO4: Suggest and use appropriate linear/non–linear data structure operations for solving a given problem.
CO5: Appropriately use sort and search algorithms for a given application.
CO6: Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval.

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**AUDIT COURSES**

AD5091 CONSTITUTION OF INDIA

**OBJECTIVES:**
- Teach history and philosophy of Indian Constitution.
- Describe the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Summarize powers and functions of Indian government.
- Explain emergency rule.
- Explain structure and functions of local administration.

**UNIT I INTRODUCTION**
History of Making of the Indian Constitution-Drafting Committee- (Composition & Working) - Philosophy of the Indian Constitution-Preamble-Salient Features

**UNIT II CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES**

**UNIT III ORGANS OF GOVERNANCE**
Parliament-Composition-Qualifications and Disqualifications-Powers and Functions-Executive President-Governor-Council of Ministers-Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions

**UNIT IV EMERGENCY PROVISIONS**
UNIT V LOCAL ADMINISTRATION
District’s Administration head- Role and Importance-Municipalities- Introduction- Mayor and role of Elected Representative-CEO of Municipal Corporation-Pachayati raj- Introduction- PRI- Zila Panchayat-Elected officials and their roles- CEO ZilaPanchayat- Position and role-Block level- Organizational Hierarchy (Different departments)-Village level- Role of Elected and Appointed officials-Importance of grass root democracy

OUTCOMES:
CO1: Able to understand history and philosophy of Indian Constitution.
CO2: Able to understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
CO3: Able to understand powers and functions of Indian government.
CO4: Able to understand emergency rule.
CO5: Able to understand structure and functions of local administration.

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TEXTBOOKS:
4. The Constitution of India (Bare Act), Government Publication, 1950

AD5092 VALUE EDUCATION

OBJECTIVES:
- Develop knowledge of self-development
- Explain the importance of Human values
- Develop the overall personality through value education
- Overcome the self destructive habits with value education
- Interpret social empowerment with value education

UNIT I INTRODUCTION TO VALUE EDUCATION
Values and self-development -Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non-moral valuation, Standards and principles, Value judgements
UNIT II    IMPORTANCE OF VALUES
Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness. Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline

UNIT III   INFLUENCE OF VALUE EDUCATION
Personality and Behaviour development - Soul and Scientific attitude. Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendshipHappiness Vs suffering, love for truth.

UNIT IV    REINCARNATION THROUGH VALUE EDUCATION

UNIT V     VALUE EDUCATION IN SOCIAL EMPOWERMENT
Equality, Non violence, Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively

TOTAL: 45 PERIODS

OUTCOMES:

CO1 – Gain knowledge of self-development
CO2 – Learn the importance of Human values
CO3 – Develop the overall personality through value education
CO4 – Overcome the self destructive habits with value education
CO5 – Interpret social empowerment with value education

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REFERENCES:
OBJECTIVES:

- Understand the methodology of pedagogy.
- Compare pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Infer how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Illustrate the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

UNIT I  INTRODUCTION AND METHODOLOGY:  9
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT II  THEMATIC OVERVIEW  9
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III  EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES  9
Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers’ attitudes and beliefs and Pedagogic strategies.

UNIT IV  PROFESSIONAL DEVELOPMENT  9
Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes.

UNIT V  RESEARCH GAPS AND FUTURE DIRECTIONS  9
Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 45 PERIODS

OUTCOMES:

- Understand the methodology of pedagogy.
- Understand Pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Find how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Know the factors necessary for professional development.
- Identify the Research gaps in pedagogy.
REFERENCES:


AD5094 STRESS MANAGEMENT BY YOGA L T P C

OBJECTIVES:

• Develop healthy mind in a healthy body thus improving social health also improve efficiency
• Invent Do’s and Don’t’s in life through Yam
• Categorize Do’s and Don’t’s in life through Niyam
• Develop a healthy mind and body through YogAsans
• Invent breathing techniques through Pranayam

UNIT I INTRODUCTION TO YOGA
Definitions of Eight parts of yog. (Ashtanga)

UNIT II YAM
Do’s and Don’t’s in life.
Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT III NIYAM
Do’s and Don’t’s in life.
Ahinsa, satya, astheya, bramhacharya and aparigraha

UNIT IV ASAN
Various yog poses and their benefits for mind & body

UNIT V PRANAYAM
Regularization of breathing techniques and its effects - Types of pranayam
OUTCOMES:

CO1 – Develop healthy mind in a healthy body thus improving social health also improve efficiency
CO2 – Learn Do’s and Don’ts in life through Yam
CO3 – Learn Do’s and Don’ts in life through Niyam
CO4 – Develop a healthy mind and body through YogAsans
CO5 – Learn breathing techniques through Pranayam

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1. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata
2. “Yogic Asanas for Group Training-Part-I” : Janardan Swami Yogabhyasi Mandal, Nagpur

AD5095 PERSONALITY DEVELOPMENT THROUGH LIFE LT P C
ENLIGHTENMENT SKILLS 3 0 0 0

OBJECTIVES:

- Develop basic personality skills holistically
- Develop deep personality skills holistically to achieve happy goals
- Rewrite the responsibilities
- Reframe a person with stable mind, pleasing personality and determination
- Discover wisdom in students

UNIT I NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - I 9
Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue)

UNIT II NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - II 9
Verses- 52,53,59 (don’ts) - Verses- 71,73,75,78 (do’s)

UNIT III APPROACH TO DAY TO DAY WORK AND DUTIES 9
Shrimad BhagwadGeeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48

UNIT IV STATEMENTS OF BASIC KNOWLEDGE – I 9
Statements of basic knowledge - Shrimad BhagwadGeeta: Chapter 2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18
OUTCOMES:

CO1: To develop basic personality skills holistically
CO2: To develop deep personality skills holistically to achieve happy goals
CO3: To rewrite the responsibilities
CO4: To reframe a person with stable mind, pleasing personality and determination
CO5: To awaken wisdom in students

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1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari’s Three Satakam, Niti-sringar-vairagya, New Delhi, 2010