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 endeavor 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:

PEO1: Be successful in their technical, professional careers & in their chosen fields such as Electronics, Instrumentation, Process Control & Information Technology.
PEO2: 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.
PEO3: Start their own company or nurture innovative ideas and creativity in their work place.
PEO4: Uphold the highest integrity and social responsibility in all their endeavors.
PEO5: Exhibit leadership and inter-personal skills.

PROGRAMME OUTCOMES (POs):
Engineering Graduates will be able to:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of their formation to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
**PO11: Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**PO12: Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

**PROGRAM SPECIFIC OUTCOMES (PSOs):**

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

**PSO1**: 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.

**PSO2**: 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.

**PSO3**: 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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TOTAL 18 0 10 28 20

*Audit Course is optional

# SEMESTER VI

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## Audit Courses (AC)

Registration for any of these courses is optional to students.

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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

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

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

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


UNIT V WRITING DEFINITIONS AND PRODUCT DESCRIPTION

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

COURSE OUTCOMES:
After completion the above subject, students will be able to understand
CO1: Exposure to basic aspects of technical English.
CO2: The confidence to communicate effectively I various academic situations.
CO3: Learnt the use of basic features of Technical English.
CO4: Small group discussions and note making
CO5: Listening to a product description, reading and writing

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.

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MA5158 ENGINEERING MATHEMATICS – I

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  
Limit of function – One sided limit – Limit Laws – Continuity – left and right continuity – 
types of discontinuities – Intermediate Value Theorem – Derivatives of a function 
Differentiation rules – Chain rule – Implicit differentiation – logarithmic differentiation – 
Maxima and minima – Mean value theorem – (Optional: Polar coordinate system – 
Differentiation in polar coordinates).

UNIT III  FUNCTIONS OF SEVERAL VARIABLES  
Partial derivatives – Homogeneous functions and Euler’s theorem – Total derivative – 
Differentiation of implicit functions – Change of variables – Jacobians – Partial differentiation of 
implicit functions – Taylor’s series for functions of two variables – Errors and approximations – 
Maxima and minima of functions of two variables – Lagrange’s method of undetermined multipliers.

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

UNIT V  MULTIPLE INTEGRALS  
Double integrals – Change of order of integration – Double integrals in polar coordinates – Area 
enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double 
and triple integrals.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand
CO1: Use the matrix algebra methods for solving practical problems.
CO2: Apply differential calculus tools in solving various application problems.
CO3: Able to use differential calculus ideas on several variable functions.
CO4: Apply different methods of integration in solving practical problems.
CO5: Apply multiple integral ideas in solving areas, volumes and other practical problems.

TEXTBOOKS:
   2017.
   New Delhi, 2013.
   New Delhi, 2018.

REFERENCES:
   Delhi, 2015.
   Reprint, Delhi, 2009.
PH5151 ENGINEERING PHYSICS
(Common to all branches of B.E / B.Tech programmes)

OBJECTIVE
• To make the students understand 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

COURSE OUTCOMES:
After completion the above subject, students will be able to understand
CO1: Understanding the importance of mechanics.
CO2: Express the knowledge of electromagnetic waves.
CO3: Know the basics of oscillations, optics and lasers.
CO4: Understanding the importance of quantum physics.
CO5: Apply quantum mechanical principles towards the formation of energy bands in crystalline materials.

TEXT BOOKS

REFERENCES

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

| PO,PSO /CO | PO01 | PO02 | PO03 | PO04 | PO05 | PO06 | PO07 | PO08 | PO09 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
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| CO103.2   | 3    | 3    | 3    | 2    | 2    |      |      |      |      |      |      |      |      |      |
| CO103.3   | 3    | 3    | 3    | 2    | 2    |      |      |      |      |      |      |      |      |      |
| CO103.4   | 3    | 3    | 3    | 2    | 2    |      |      |      |      |      |      |      |      |      |
| CO103.5   | 3    | 3    | 3    | 2    | 2    |      |      |      |      |      |      |      |      |      |
| CO103     | 3    | 3    | 3    | 2    | 2    |      |      |      |      |      |      |      |      |      |

CY5151  ENGINEERING CHEMISTRY
(COMMON TO ALL BRANCHES) | L | T | P | C
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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, photo processes 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 NANOCHEMISTRY

UNIT III PHOTOCHEMISTRY 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 – H₂-O₂ and microbial fuel cell. Explosives – classification, examples: TNT, RDX, Dynamite; Rocket fuels and propellants – definition and uses.

UNIT V WATER TECHNOLOGY

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completion the above subject, students will be able to understand
CO1: To recognize and apply basic knowledge on different types of polymeric materials, their general preparation methods and applications to futuristic material fabrication needs.
CO2: To identify and apply basic concepts of nano science and nanotechnology in designing the synthesis of nano materials for engineering and technology applications.

26
CO3: To identify and apply suitable spectroscopic technique for material analysis and study different forms of photochemical reactions.

CO4: To recognize different forms of energy resources and apply them for suitable applications in energy sectors.

CO5: To demonstrate the knowledge of water and their quality in using at different industries.

TEXT BOOKS:

REFERENCE BOOKS:

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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GE5151 ENGINEERING GRAPHICS

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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
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 Protection 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)
Introduction to drafting packages and demonstration of their use

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

COURSE OUTCOMES:
After completion the above subject, students will be able to understand
CO1: Draw free hand sketching of basic geometrical shapes and multiple views of objects.
CO2: Draw orthographic projections of lines and planes
CO3: Draw orthographic projections of solids
CO4: Draw development of the surfaces of objects.
CO5: 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.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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BS5161 BASIC SCIENCES LABORATORY
(Common to all branches of B.E. / B.Tech Programmes)

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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
COURSE OUTCOMES:
After completion the above subject, students will be able to understand
CO1: To determine various moduli of elasticity.
CO2: To determine the velocity of ultrasonic waves, band gap determination
CO3: To determine various thermal and optical properties of materials.
CO4: To determine the viscosity of liquids
CO5: To determine the estimation of laser parameters

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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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, pHmetry, 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 Na2CO3 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 argent metric 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-Phenanthroline / 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 analyze 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 analyze the impurities in solution by electro analytical techniques
- To design and analyze the kinetics of reactions and corrosion of metals

TEXTBOOKS:

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) Completion joints in door panels and wooden furniture
b) Completion 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)  Completion an Iron-Box wiring.
b)  Completion a Fan Regulator wiring.
c)  Completion 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)  Completion a FM radio.
b)  Completion an electronic telephone.

TOTAL (P: 60) = 60 PERIODS
COURSE OUTCOMES:
After completion the above subject, students will be able to understand:

CO1: 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.

CO2: Wire various electrical joints in common household electrical wire work.

CO3: Weld various 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 equipment; Make a tray out of metal sheet using sheet metal work.

CO4: Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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SEMESTER II

MA5252   ENGINEERING MATHEMATICS – II
(Common to all Branches of B.E. / B.Tech. Programmes)

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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

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

UNIT III COMPLEX INTEGRATION
Line integral Cauchy’s integral theorem – Cauchy’s integral formula – Taylor’s and Laurent’s series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of
real integrals – Use of circular contour and semicircular contour with no pole on real axis

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

COURSE OUTCOMES:
After completion the above subject, students will be able to understand
CO1: Calculate grad, div and curl and use Gauss, Stokes and Greens theorems to simplify calculations of integrals.
CO2: Construct analytic functions and use their conformal mapping property in application problems.
CO3: Evaluate real and complex integrals using the Cauchy’s integral formula and residue theorem.
CO4: Apply various methods of solving differential equation which arise in many application problems.
CO5: Apply Laplace transform methods for solving linear differential equations.

TEXTBOOKS:

REFERENCES:

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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OBJECTIVE

- To make the students to understand the basics of crystallography and its importance in completion 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

COURSE OUTCOMES:
After completion the above subject, students will be able to understand
CO1: Know basics of crystallography and its importance for materials properties
CO2: Come to have firm knowledge on the electrical and magnetic properties of materials and their
CO3: Acquire adequate understanding of semiconductor physics and functioning of semiconductor devices

CO4: Understand the optical properties of materials and working principles of various optical devices

CO5: Appreciate the importance of nanotechnology, physics of nano devices, low-dimensional structures and their applications

REFERENCES

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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GE5152 ENGINEERING MECHANICS

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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 non coplanar 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
Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions,Statics of Particles - Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force, Unit Vectors. Equilibrium of a Particle- Newton’s First Law of
Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space.

UNIT II EQUILIBRIUM OF RIGID BODIES


UNIT III DISTRIBUTED FORCES

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

The Laws of Dry Friction, Coefficients of Friction, Angles of Friction, Wedges, Wheel Friction, Rolling Resistance, Ladder friction.

UNIT V DYNAMICS OF PARTICLES


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

COURSE OUTCOMES:
After completion of the above subject, students will be able to understand

CO1: Apply the various methods to determine the resultant forces and its equilibrium acting on a particle in 2D and 3D.

CO2: 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.

CO3: 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.

CO4: Apply the concepts of frictional forces at the contact surfaces of various engineering systems.

CO5: Apply the various methods of evaluating kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

TEXT BOOKS:

REFERENCES:

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GE5153 PROBLEM SOLVING AND PYTHON PROGRAMMING

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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

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
– Function Call and Returning Values – Parameter Passing – Local and Global Scope – Recursive Functions.

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


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


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

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.

**COURSE OUTCOMES:**
After completion the above subject, students will be able to understand
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.

**TEXT BOOK:**

**REFERENCES:**

**MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES**

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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 9
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 9
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 9
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 9

UNIT V OSCILLATORS AND POWER AMPLIFIERS 9

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)
1. Be able to gain knowledge on the operation and characteristics of different semi-conductor devices.
2. Ability to design an application of semi-conductor devices under various conditions.
3. To develop competence in frequency response analysis and biasing techniques to operate BJT and FET in different configurations.
4. Be able to develop analytical capability to examine feedback in amplifiers.
5. Develop the design competence in the area of multistage amplifiers.
6. To make the students understand the concept of various power amplifiers and tuned amplifiers.
7. Be able to design transistor amplifiers and oscillators for a given conditions.

Attested

[Signature]
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025
TEXT BOOKS:

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

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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GE5161 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY

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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

COURSE OUTCOMES:
After completion the above subject, students will be able to understand
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.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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EI5211 ANALOG SIGNAL PROCESSING LABORATORY

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. To make the students understand the concept of various instruments and meters for measurement of electrical quantities.
2. Ability to identify the operational characteristics of semiconductor devices like Diode, BJT, FET, SCR and UJT through experimentation.
3. Ability to demonstrate different applications of diode, UJT and SCR with measuring instruments and power supplies.
4. Ability to design and experiment with various voltage regulation circuits, multistage amplifier and oscillators
5. Ability to use appropriate software tools for design, analysis and implementation of various application circuits.
6. Ability to construct, analyze and troubleshoot the designed circuits.
7. Ability to interpret the results of analysis and depict the significant conclusions.
8. Ability to work as a member of a team while carrying out experiments.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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MA5356 LINEAR ALGEBRA AND NUMERICAL METHODS

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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

TOTAL: 60 PERIODS

OUTCOMES:
1. The students will be able to solve system of linear equations, to use matrix operations and vector spaces using algebraic methods.
2. Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions.
3. Apply numerical methods to obtain approximate solutions to mathematical problems.
4. 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.
5. Analyze and evaluate the accuracy of common numerical methods.

TEXT BOOKS:

REFERENCES:
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PR5301 THERMODYNAMICS AND FLUID MECHANICS

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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

UNIT II INTRODUCTION TO APPLICATIONS OF THERMODYNAMICS

UNIT III BASIC CONCEPT OF FLUID MECHANICS & FLOW OF FLUIDS

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

TOTAL : 45 PERIODS
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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EI5301 ANALYSIS OF ELECTRIC CIRCUITS

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<td>To introduce various network theorems.</td>
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<td>To introduce the concept of transient analysis of first and second order linear circuits.</td>
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<td>To make the students understand the concept of resonance in Series and Parallel circuits.</td>
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<td>To introduce the concept of two port networks and the analysis of three-phase balanced and unbalanced circuits.</td>
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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)
At the end of the course, the students will
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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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


COURSE OUTCOMES (COs)

1. Ability to Remember and understand Terms, basic concepts and working principle of electrical machines.
2. Apply the Knowledge of Basic Concepts and Working Principles to carry out Test on Electrical Machines.
3. Ability to understand and Interpret 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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EI5303  SIGNALS AND SYSTEMS  

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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, Antialiasing 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 understand the characteristics and classifications of CT and DT signals and Systems
2. Ability to understand the sampling and reconstruction of signals
3. Ability to apply the mathematical tools for characterizing various CT and DT signals and Systems in time domain
4. Ability to analyze the given CT signal or system in transform domain
5. Ability to analyze the given DT signal or system in transform domain
6. Ability to solve complex problems in the analysis of CT and DT signals and Systems

TEXT BOOKS:

REFERENCE BOOKS:

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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EI5311  CIRCUIT SIMULATION LABORATORY  L  T  P  C
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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

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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 Lab VIEW 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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GE5251  ENVIRONMENTAL SCIENCES

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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 nonrenewable 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 – biogeographical 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

COURSE OUTCOMES:
1. To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
2. To identify the causes, effects and environmental pollution and natural disasters and contribute to the preventive measures in the immediate society.
3. To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.

4. To recognize different forms of energy and apply them for suitable applications in for technological advancement and societal development.

5. 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 analyze effect of population dynamics on human value education, consumerism and role of technology in environmental issues.

TEXT BOOKS:

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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, Schmitt trigger, 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. Be able to gain knowledge on the fundamentals of operational amplifiers and their characteristics.
2. Ability to develop competence in linear and nonlinear operational amplifiers circuit analysis.
3. Ability to design competence on signal filtering and signal conversion.
4. Be able to design and develop signal conditioning circuits for a specific application.
5. Ability to acquire knowledge about the concept and applications of 555 timer IC and PLL.
6. Ability to suggest the appropriate A/D and D/A converters for signal processing applications.
7. Be able to understand the concept of power amplifiers, voltage regulators and analog multipliers.

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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EIS402 DIGITAL SYSTEM DESIGN

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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 sequential logic circuits.
4. Ability to analyze and design synchronous and asynchronous logic circuits
5. Ability to understand memory types and gain knowledge on 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 electronic prototyping and modeling of digital system.
8. Ability to design, implement and demonstrate sequential and combinational logic circuits for instrumentation applications

TEXT BOOKS:

REFERENCE BOOKS:

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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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
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
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

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:

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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EI5404 ELECTRICAL AND ELECTRONICS MEASUREMENTS

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


UNIT II POWER AND ENERGY MEASUREMENTS


UNIT III POTENTIOMETERS AND INSTRUMENT TRANSFORMERS


UNIT IV ANALOG AND DIGITAL INSTRUMENTS

Wave analyzers, Logic analyzer, spectrum analyzer – 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 analyze and store the signals using various display and recording devices.
6. Ability to suggest the kind of instrument appropriate for typical measurements.

TEXT BOOKS:

REFERENCE BOOKS:

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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EI5411     | SENSORS AND SIGNAL CONDITIONING CIRCUITS LABORATORY | L | T | P | C |
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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 understand the concept of Data Acquisition in real-time environment using LabVIEW.
2. Ability to perform the measurement of error, uncertainty and sensitivity analysis.
3. Ability to evaluate the static and dynamic characteristics of measuring instruments.
4. Ability to design and construct measurement systems using resistive, inductive and capacitive sensors.
5. Acquire knowledge of importance in calibration for special transducers.
6. Ability to interface and analysis of different signal conditioning units.
7. Ability to design and experimentation on various measuring instruments.
8. Ability to work as a member of a team while carrying out experiments.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025
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.
4. Apply the organizing principle to ensure a management’s smooth operation.
5. Determine the effects of each leadership style by evaluation process.
6. Determine the best management strategies to use and implement them when managing a firm.

TEXT BOOKS:


REFERENCE BOOKS:


MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES
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 problems.

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

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 apply the mathematical tools such as DFT and FFT algorithms for discrete time signal processing
2. Ability to understand the various types of digital IIR/FIR filters and their design procedures
3. Ability to design digital IIR/FIR filters for a given set of specifications
4. Ability to characterize and classify random processes
5. Ability to model random processes and the fundamentals of multirate signal processing
6. Ability to solve complex problems in Digital Filter Design and systems for Discrete Time Signal Processing

TEXT BOOKS:
REFERENCE BOOKS:

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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EI5502     INDUSTRIAL INSTRUMENTATION - I

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
9
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
9
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
9
UNIT IV TEMPERATURE MEASUREMENT

UNIT V PRESSURE MEASUREMENT

TOTAL : 45 PERIODS

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

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## 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)
9
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
9

### UNIT III TIME DOMAIN AND STABILITY ANALYSIS
9

### UNIT IV FREQUENCY DOMAIN ANALYSIS
9

### UNIT V DESIGN OF FEED BACK CONTROL SYSTEM
9
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:
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MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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EI5511 EMBEDDED SYSTEM DESIGN LABORATORY

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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) Implementing specific tasks on microcontrollers/microprocessors through assembly language.
Constructing simple control applications on microcontrollers/microprocessors through assembly language.

Assignment(s) Sorting an array and code conversion.
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) | Implementing conditional and loop control operations using Embedded C.  
Implementing specific tasks using functions. |
| Assignment(s) | Building a simple calculator.  
Development of simple applications using recursion. |

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

| Objective(s) | To introduce Programmable Peripheral Iinterface and built-in I/O Ports of  
microcontrollers |
| Demonstration | |
| Experiment(s) | |
| Assignment(s) | |

**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) | LCD/Seven segment display interface.  
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  
andprogrammable interval timer  
To enable the students to configure the Timer / Counter and familiarize with the  
scaling concepts |
| Demonstration | Interfacing 8253 with microprocessor |
| Experiment(s) | Making LEDs ON/OFF for predefined time using Timer (with and  
withoutscaling).  
Counting the occurrence of events using IR proximity sensor. |
| Assignment(s) | Design of a Programmable Timer.  
Frequency measurement using Timer / Counter. |
### Practical Module–6 Intercepts

| 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 |
| Demonstration | Interfacing 8259 with microprocessor |
| Experiment(s) | Interfacing switch using hardware interrupt. Acknowledging the transmission and reception of information using interrupt. |
| Assignment(s) | Design of real-time clock using software interrupt. 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 | Interfacing analog transmitter with microcontroller.  
Interfacing final control element with microcontroller. |
| Assignment | Design of a multichannel data acquisition system.  
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 | Storing a block of data in external RAM and fetching the same.  
Interfacing external flash memory with microcontroller. |
| Assignment | Switching program execution between internal and external memories.  
Reprogramming the specified block of flash memory. |

### Practical Module–9 Communication Modules

| Objective | To make the students familiar with synchronous(I^2C&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 | I^2C based DAC interface and SPI based ADC interface.  
Remote transmission of field transmitter data to PC. |
| Assignment | Interfacing RTC with microcontroller using I^2C interface.  
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 |
### 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 |
| Demonstration | Implementing multitasks on an RTOS enabled embedded system |
| Experiment | Design of a multichannel data acquisition system with time, interrupt, task and memory management features. |
| Assignment | Implementation of a real-time control application (Inverted pendulum or dc motor etc.) using RTOS. |

### 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 |
| Demonstration | Building an IoT application using Python |
| Experiment | IoT enabled field sensing. |
| Assignment | Development of IoT enabled transmitter. |
| Mini Project | P/C based PID Control Strategy for Temperature/Level Process. |

### COURSE 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.
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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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, Electro mehanical 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

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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  9

UNIT II  CONTROLLED RECTIFIERS AND AC CONTROLLERS  9

73
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
Voltage source Inverters – Half bridge – Full bridge – Three Phase Bridge Inverters – Voltage control –
PWM Techniques – Current Source Inverters: Capacitor Commutated Inverter- Resonant inverters :Series,
Parallel, ZVS, ZCS – Introduction to multilevel 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 analyze and design of DC to DC and DC to AC converters.
4. Ability to apply power electronic circuits for the control of electric drive applications.
5. Ability to exposure to design and analyze power electronic circuits using simulation software.

TEXT BOOKS:
2006.

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 - Intrinsice Safe Transmitter.

TOTAL : 45 PERIODS

COURSE OUTCOMES
1. Ability to understand the working principle of measuring instruments for flow, viscosity, humidity and moisture.
2. Potential to identify and select the appropriate instrument for a given process measurement problem.
3. Select and use appropriate concepts and methods to solve problems effectively.
4. Competent to demonstrate the installation procedure for different measuring instruments.
5. Ability to calibrate measuring instruments.
6. Expertise to choose appropriate field transmitter for sensing different parameter in industrial environment.
7. Capable to identify the appropriate use of instruments in process industries according to the safety practices.

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


UNIT II CONTROL VALVE

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

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

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

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:

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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 UVVisible
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.

TOTAL : 60 PERIODS
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.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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EI5612 INDUSTRIAL AUTOMATION SYSTEMS LABORATORY

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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).

<table>
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<tr>
<th>Objective(s)</th>
<th>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.</th>
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<tr>
<td>Demonstration</td>
<td>Configuration of a PLC.</td>
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</table>
| **Experiment(s)** | 1. Study of DI/DO/AI/AO modules of all PLCs.  
2. Installation & Configuration of I/O modules  
3. Understanding one of the PLC Control panels wiring diagram and creating a control panel layout |
| **Assignment(s)** | 1. Comparison of all PLCs in the lab.  
2. Market survey of the recent PLCs and comparison of their features with the PLCs available in the lab. |

### Practical Module – 2: Realization of discrete control sequence using Ladder Logic Programming

| **Objective(s)** | 1. Introduce students to Programming PLC using (IEC 61131-3). Programming languages  
To make students familiarize and realize discrete control sequences using Ladder Logic Instruction set. |
| **Demonstration** | Procedure for filling and draining of liquid in a single tank setup using Ladder Logic instruction set. |
| **Experiment(s)** | 1. Implementation of Alarm annunciator sequence (ISA 18.1 Standard) using Ladder logic programming. |
| **Assignment(s)** | 1. Exercises covering all instruction set.  
2. Implementation of Traffic light control sequence using Ladder Logic programming.  
3. Assignment on drawing shapes using Three axis control of Robotic Pen using Ladder Logic programming. |

### Practical Module – 3: Realization of Discrete control sequences using Functional Block Diagram (FBD) Programming

| **Objective(s)** | Introduce students to FBD programming and make them to realize Discrete control sequences using Function blocks |
| **Demonstration** | Demonstration of filling and draining of liquid in a single tank experimental setup using Function blocks. |
| **Experiment(s)** | 1. Implementation of Alarm annunciator sequence (ISA 18.1 Standard) using FBD.  
Implementation of Reversal of direction of rotation of DC motor using FBD. |
| **Assignment(s)** | 1. Exercises covering all function blocks.  
Implementation of Traffic light control sequence using FBD. |

### Practical Module – 4: Realization of Discrete control sequences using ST, IL and SFC Programming methods

| **Objective(s)** | Introduce students to ST, IL and SFC Programming methods and make them to realize Discrete control sequences using ST, IL and SFC. |
| **Demonstration** | Demonstration of Traffic light control sequences using ST, IL and SFC programming methods. |
| **Experiment(s)** | Implementation of Alarm annunciator sequence (ISA 18.1 Standard) using ST, IL and SFC programming methods. |
| **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.

<p>| <strong>Objective(s)</strong> | To introduce students on how to Interface transmitters, limit switches, final control elements with PLC. |
| <strong>Demonstration</strong> | 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 setup using PLC. |</p>
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<tr>
<th>Practical Module – 6 Closed loop control of a typical process using PLC.</th>
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<td><strong>Objective(s)</strong></td>
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<th>Practical Module – 8 Architecture of DCS</th>
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<td><strong>Objective(s)</strong></td>
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<td><strong>Demonstration</strong></td>
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| **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. |

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<tr>
<th>Practical Module – 9 Interfacing of field devices with DCS.</th>
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<td><strong>Objectives</strong></td>
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| **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. |

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<th>Practical Module – 10. Realization of control schemes for typical processes using DCS</th>
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Practical Module-11 Interfacing smart field devices with DCS.

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

| Objective(s) | Introduction to IoT based monitoring. |
| Demonstration | Configuration of IoT gateway. |
| 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.
7. Able to interface smart field devices (HART/FF enabled field devices) with DCS and gain knowledge on the recent developments in industrial data networks.
8. Able to configure IoT gateway for any industrial process using DCS.
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.

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 gain knowledge on 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 apply the gained knowledge on networking to choose a protocol and 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:
4 NPTEL Lecture notes on,” Computer Networks” by Department of Electrical Engg, IIT Kharagpur.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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E15702 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.

TOTAL: 45 PERIODS

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

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

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

UNIT III  PROCESS MEASUREMENT AND CONTROL INPETROCHEMICAL INDUSTRY
Process flow diagram of Petro Chemical Industry - Gas oil separation in production platform – wet gas
processing – Fractionization Column – Catalytic Cracking unit – Catalytic reforming unit.

UNIT IV  PROCESS MEASUREMENT AND CONTROL IN THERMAL POWER PLANT
INDUSTRY
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
Process flow diagram of paper and pulp industry – Batch digestor – Continous sulphate digestor – Control
problems on the paper machine.

TOTAL : 45 PERIODS

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.

TEXT BOOKS:

REFERENCES:

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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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

COURSE OUTCOMES(COs)

1. Competence to design and fabricate conventional, smart and IoT enabled transmitters for key process variables such as flow, level, pressure and temperature.
2. Potential to realize On/Off controller, PID controller and PLC.
3. Ability to design data loggers and alarm circuits for an industrial application requirement.
4. Able to develop software programs for sizing control valve and orifice.
5. Capable of preparing 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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COURSE OBJECTIVES
The student should be made to:
1. To use the knowledge acquired in various subjects of Electronics and Instrumentation Engineering and carry out Mini Project. This will motivate students to come up with new designs, Fabrication, developing algorithms and software programs expressing their ideas in a novel way.
2. Learn methodology to select a good project and able to work in a team leading to development of hardware/software product.
3. Prepare a good technical report.
4. Gain Motivation to present the ideas behind the project with clarity.
5. Get exposure to work in an industrial environment.

SUMMER INTERNSHIP SUMMER PROJECT (MINIMUM 4 WEEKS)
The student should undergo Internship for a minimum period of 4 weeks/maximum 6 weeks in industry/Research organization/academic institution. The student earns 2 credits by undergoing the Internship. Internship needs to be undergone continuously in one organization only. The student is allowed to undergo a maximum of 6 weeks Internship at the end of sixth semester during the summer vacation.

The Internship shall carry 100 marks. The review committee may be constituted by the Head of the Department. At the end of Internship, the student shall submit a brief report on the training undergone and a certificate from the organization concerned. The evaluation will be made based on this report and a viva-voce Examination, conducted internally by a three member Departmental Committee constituted by the Head of the Department.

COURSE OUTCOMES (COs)
At the end of the course, the student should be able to:
1. Select a good project and able to work in a team leading to development of hardware/software product.
2. Prepare a good technical report and able to present the ideas with clarity.
3. Gain Knowledge on various terminologies related to industrial environment.
4. Able to work efficiently as a member of different teams related to multidisciplinary projects.
5. Acquire skills to communicate efficiently and gain management skills related to industry/research organizations.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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COURSE OBJECTIVES

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2. Learn methodology to select a good project and able to work in a team leading to development of hardware/software product.
3. Prepare a good technical report.
4. Gain Motivation to present the ideas behind the project with clarity.
5. Get exposure to work in an industrial environment.

A Project topic must be selected either from research literature or the students themselves may propose suitable topics in consultation with their guides. The aim of the project work is to deepen Comprehension of principles by applying them to a new problem which may be the design/fabrication of Sensor/Activator/Controller, a research investigation, a computer or management project or a design problem.

The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department.

A project report is required at the end of the semester. The project work is evaluated jointly by external and internal examiners constituted by the Head of the Department based on oral presentation and the project report.

TOTAL: 90 PERIODS

COURSE OUTCOMES (COs)

1. Ability to find solution for complex engineering problems applying the engineering knowledge.
2. Ability to formulate and analyze complex engineering problem.
3. Select and apply software tools required to solve the formulated problem.
4. Ability to identify and find solution to societal issues.
5. Ability to work as a member in a team.
6. Ability to find solutions to the formulated problem using multidisciplinary engineering knowledge.
7. Ability to communicate the engineering activity and to do effective documentation of the work carried out.
8. Ability to use the knowledge obtained from project to engage in lifelong learning.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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COURSE OBJECTIVES

1. To use the knowledge acquired in various subjects of Electronics and Instrumentation Engineering and carry out Mini Project. This will motivate students to come up with new designs, Fabrication, developing algorithms and software programs expressing their ideas in a novel way.

2. Learn methodology to select a good project and able to work in a team leading to development of hardware/software product.

3. Prepare a good technical report.

4. Gain Motivation to present the ideas behind the project with clarity.

5. Get exposure to work in an industrial environment.

A Project topic must be selected either from research literature or the students themselves may propose suitable topics in consultation with their guides. The aim of the project work is to deepen Comprehension of principles by applying them to a new problem which may be the design/fabrication of Sensor/Activator/Controller, a research investigation, a computer or management project or a design problem.

The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department.

A project report is required at the end of the semester. The project work is evaluated jointly by external and internal examiners constituted by the Head of the Department based on oral presentation and the project report.

TOTAL : 240 PERIODS

COURSE OUTCOMES (COs)

1. Ability to find solution for complex engineering problems applying the engineering knowledge.

2. Ability to formulate and analyze complex engineering problem.

3. Select and apply software tools required to solve the formulated problem.

4. Ability to identify and find solution to societal issues.

5. Ability to work as a member in a team.

6. Ability to find solutions to the formulated problem using multidisciplinary engineering knowledge.

7. Ability to communicate the engineering activity and to do effective documentation of the work carried out.

8. Ability to use the knowledge obtained from project to engage in life-long learning.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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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 underlying 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 spectrometry.

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 | L | T | P | C | 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 9

UNIT II  BIOMEDICAL SIGNAL ACQUISITION AND ANALYSIS 9

UNIT III  MEASUREMENT OF NON ELECTRICAL PARAMETERS 9
Measurement of blood pressure – Cardiac output – Blood flow – Heart rate – Heart sound – Pulmonary function measurements – Spirometer – Photo Plethysmography, Body

UNIT IV  MEDICAL IMAGING SYSTEMS  9  

UNIT V  THERAPEUTIC DEVICES AND TELEMETRY  9  

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

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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 High Power Lasers: Material processing — Laser heating, welding, melting and trimming of material, Material Removal & vaporization.

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:

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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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
Failure Modes, Safe/Dangerous Failures, Detected/Undetected Failures, Metrics: Failure Rate, MTBF, and Life, Degree of Modeling Accuracy, Modeling Methods: Reliability Block Diagrams, Fault Trees, Markov
Models - Consequence analysis: Characterization of potential events, dispersion, impacts, occupancy considerations, consequence analysis tools - Quantitative layer of protection analysis: multiple initiating events, estimating initiating event frequencies and IPL failure probabilities.

UNIT V - CASE STUDY

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)
1. Ability to analyze the role of safety instrumented system in the industry.
2. Ability to identify and analyze 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 analyze 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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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.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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E15006 FUNDAMENTALS OF NANO SCIENCE AND MEMS

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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 NANO TECHNOLOGY

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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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
9

UNIT II STABILITY OF NON-LINEAR SYSTEMS
9

UNIT III MODELLING AND CONTROL OF NON-LINEAR SYSTEMS
9

UNIT IV CHAOS AND BIFURCATION BEHAVIOR
9

UNIT V LINEARIZATION
9

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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EI5008 ADVANCED TOPICS IN PID CONTROL

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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

TOTAL : 45 PERIODS
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 suitable fractional 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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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

TOTAL : 45 PERIODS

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

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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EI5011 CYBER SECURITY FOR INDUSTRIAL AUTOMATION

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COURSE OBJECTIVES
- To understand the Industrial security environment and cyberattacks
- To analyze and assess risks in the industrial environment
- To access, design and implement cyber security
- 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
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
Cybersecurity lifecycle- conceptual design process- detailed design process- firewall design- remote access
UNIT V TESTING AND MAINTENANCE
Developing test plans- cybersecurity factory acceptance testing- site acceptance testing- network and application diagnostics and troubleshooting- cybersecurity audit procedure- IACS incident response.

TOTAL : 45 PERIODS

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.

TEXT BOOKS:

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EI5012 CYBER PHYSICAL SYSTEMS

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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 analyze model of timed and hybrid systems.
UNIT I INTRODUCTION
Introduction-key features of cyber physical systems- Continuous dynamics: Newtonian mechanicsactor 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 componentssynchronous design, Asynchronous model- asynchronous processes- asynchronous design primitives- coordination protocols.

UNIT III SAFETY AND LIVENESS REQUIREMENT

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 : 45 PERIODS

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:

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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
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. Valve Trim Types.

UNIT II ACTUATORS AND CONTROL VALVE ACCESSORIES

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 analyze 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 9

UNIT II DATA PREPROCESSING 9

UNIT III SUPERVISED LEARNING 9

UNIT IV CLUSTERING AND UNSUPERVISED LEARNING 9

UNIT V NEURAL NETWORKS 9

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.
6. Able to Explore the data by understanding the concepts of exploratory data analysis.

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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EI5015 MICRO CONTROLLER BASED SYSTEM DESIGN

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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
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
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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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 9

UNIT II IMAGE PREPROCESSING AND ENHANCEMENT 9
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 9
Detection of Discontinuities, Edge linking, Boundary detection, Thresholding – Region oriented segmentation-Watershed segmentation – Object detection - Pattern Recognition – Classification.

UNIT IV DIGITAL VIDEO PROCESSING 9
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 9
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

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MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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EI5017 PRINCIPLES OF COMMUNICATION ENGINEERING

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COURSE OBJECTIVES

- To introduce the students to the principles of analog and digital communication.
- To impart knowledge on the waveform encoding techniques.
- To facilitate the students in analyzing the performance of transmitters and receivers.
- 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.

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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
UNIT II PHYSICAL AND LOGICAL DESIGN METHODOLOGIES

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 understand the concept of IoT and acquire adequate knowledge over computer networking and communication protocols.
2. Ability to design and develop IoT enabled embedded applications employing wireless sensor networks.
3. Ability to analyze the requirements of a given application and use appropriate protocols and recognize the role of cloud computing and the associated services for IoT based applications.
4. Ability to recognize the technological challenges and opportunities in Industrial IoT design and implementation.
5. Ability to apply the acquired knowledge towards the development of architectural design for IoT enabled Networked Control Systems.
6. Ability to analyze the process data using cloud-based process data management tools.

TEXT BOOKS:

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

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES
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)

TOTAL : 45 PERIODS

COURSE OUTCOMES:
1. Ability to analyze inverter characteristics and realize modeling of MOS transistors.
2. Ability to design combinational logic using various logic styles, satisfying static and dynamic requirements.
3. Ability to analyze timing issues of sequential logic and design memories.
4. Ability to design data path elements.
5. Ability to compare and analyze FPGA architecture and interconnect methodology.

TEXT BOOK:

REFERENCES

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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EC5075 MIXED SIGNAL IC DESIGN

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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.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
The student who undergoes this course will be able to
1. Design Band gap reference circuits and Low Drop Out regulator for a given specification.
2. Design Frequency synthesizers meeting a given specification.
3. Choose active filter topology and design for a given specification.
4. Design clock generation circuits in the context of high speed I/Os, High speed Broad
   Band Communication circuits and Data Conversion Circuits.

TEXT BOOKS:
1. Gabriel A. Rincon-Mora, "Voltage references from diode to precision higher order bandgap circuits”,

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

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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 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 7
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 12
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.
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:
1. To design a EMI free system.
2. To reduce system level crosstalk.
3. To design high speed Printed Circuit board with minimum interference. CO4: To make our world free from unwanted electromagnetic environment.

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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

COURSE OUTCOMES:
completion of this course, the students will be able to:
1. Describe the importance of measurements in engineering and the factors affecting measurements and to estimate measurement uncertainty.
2. Describe the working principle and applications of various linear and angular measuring instruments and basic concepts of measurement of assembly and transmission elements and select a measuring instrument for the given application.
3. Interpret the various tolerance symbols given in engineering drawings to choose the appropriate manufacturing process.
4. Describe the principles and methods of form and surface metrology and interpret surface metrology related information in Engineering drawings.
5. Describe the advances in measurements for quality control in manufacturing Industries.

TEXTBOOKS:

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MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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OBJECTIVES:
1. To define the glossary related to vehicle electrical and electronic system.
2. To understand the need for starter batteries, starter motor and alternator in the vehicle.
3. To differentiate the conventional and modern vehicle architecture and the data transfer among the different electronic control unit using different communication protocols.
4. To list common types of sensor and actuators used in vehicles.
5. 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
Alternators – Generation of electrical energy in vehicle physical principles Alternator and voltage regulations versions – power losses – characteristics curve- Alternator operation in the vehicle- Alternator circuitry. Starter Motors – Development and Starting requirements in the IC engines- starter motor design – Starter motor design variations – starter motor control and power circuits

UNIT III IGNITION, LIGHTING AND AUXILLARY 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.

COURSE OUTCOMES:
1. Define the glossary related to vehicle electrical and electronic system
2. Understand the need for starter batteries, starter motor and alternator in the vehicle.
3. Differentiate the conventional and modern vehicle architecture and the data transfer among the different electronic control unit using different communication protocols
4. List common types of sensor and actuators used in vehicles.
5. Understand networking in vehicles.

TEXT BOOKS:
OBJECTIVES:
1. To understand the basics of control system used in automobiles
2. To recognize the electronically controlled system used in driving mechanics.
3. To understand the working principle of driver modelling and power train control systems.
4. To identify the control system used in hybrid and electrical vehicles.
5. 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

UNIT III DRIVER MODELING AND POWERTRAIN CONTROL SYSTEMS

UNIT IV CONTROL OF HYBRID AND FUEL CELL VEHICLES
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
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.

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

1. Understand the basics of control system used in automobiles
2. Recognize the electronically controlled system used in driving mechanics.
3. Understand the working principle of driver modelling and power train control systems.
4. Identify the control system used in hybrid and electrical vehicles.
5. Illustrate the need of automated transport systems.

TEXT BOOKS:

REFERENCES:

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

UNIT 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
1. Electric and hybrid vehicle operation and architectures
3. Vehicle characteristics, operating modes, and performance parameters of the vehicle
4. Different subsystems of hybrid and electric vehicles

TEXT BOOKS:

REFERENCES:

OBJECTIVES:
1. To provide theoretical and applicative knowledge in automobile test instrumentation.
2. To identify the various instruments for measuring force, torque, pressure, temperature, fluid flow, velocity and rotational speed.
3. To enhance the knowledge of students regarding the experimental methods followed in industries.
4. To familiarize the students on standard test codes.
5. To impart skills on the testing procedure followed for evaluating brake, engine and vehicle.

UNIT I MECHANICAL MEASUREMENT 9
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 9
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 9
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 9
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 9
Laboratory tests- test tracks - Endurance Tests - Dynamic cornering fatigue, dynamic radial fatigue tests – procedure, bending moment and radial load calculations.

COURSE OUTCOMES:
The students will be able to
1. Demonstrate the understanding of engine testing procedures.
2. Develop a measurement strategy for temperature, pressure, mass flow, velocity.
3. Understand sensors and instrumentation, and to analyse and interpret test data.

TOTAL: 45 PERIODS
4. Develop new system that would help in keeping the environment sustainable.
5. Demonstrate the understanding of brake testing procedures

**TEXT BOOKS:**

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**OBJECTIVES:**
1. To introduce basic concepts of systems engineering and their application to aircraft systems.
2. To acquaint students with design, build, test, operate and disposal phases of aircraft systems and aircraft operating environment system.
3. To impart knowledge on evolution of avionics architecture and arrangements of systems integration of aircraft.
4. To familiarise students with varying system configurations and their compatibility and system evolution considerations.
5. 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**

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

TEXT BOOKS:

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AE5072       AVIONICS SYSTEMS

OBJECTIVES: Of this course are
1. To introduce the basic of avionics and its need for civil and military aircrafts.
2. To impart knowledge about the avionic architecture and various avionics data buses.
3. To gain more knowledge on various avionics subsystems.
4. To impart knowledge on feedback systems.
5. 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

UNIT V AIRDATA 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
COURSE OUTCOMES:
Upon completion of this course, Students will be able to
CO1: Develop a solid foundation in the theory, concepts and principles of fracture mechanics,
CO2: Be able to use these solutions to guide a corresponding design, manufacture, or failure analysis
CO3: Ability to investigate the life of a structure under dynamic loading conditions.
CO4: Knowledge of fracture mechanics approach applicable to homogeneous and heterogeneous materials
CO5: Knowledge of probabilistic approach and development of mathematical models for life prediction of structures and knowledge of safe life and fail safe design.

TEXT BOOKS:

REFERENCES:

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PR5073 ROBOTIC TECHNOLOGY

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 Vision application in robots.
• To build confidence among students to evaluate, choose and incorporate robots in engineering systems.

UNIT I  FUNDAMENTALS OF ROBOT

UNIT II  ROBOT KINEMATICS
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 Dennavit and Hartenberg transformation.

UNIT III  ROBOT DRIVE SYSTEMS AND END EFFECTORS
Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors,
Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of All These Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic grippers, vacuum grippers, two fingered and three fingered grippers, internal grippers and external grippers, selection and design considerations of a gripper - gripper force calculation and analysis.

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.

COURSE OUTCOMES:
At the end of the course, students will be able to:
1. Interpret the features of robots and technology involved in the control.
2. Apply the basic engineering knowledge and laws for the design of robotics.
3. 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.
4. Explain the concept of kinematics, degeneracy, dexterity and trajectory planning.
5. Demonstrate the image processing and image analysis techniques by machine vision system.

TEXT BOOKS:

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IT5351 DATABASE MANAGEMENT SYSTEMS

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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


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

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

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

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

TEXT BOOKS:

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IT5551 COMPUTER NETWORKS

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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
Subnetting – Classless Inter Domain Routing (CIDR) – Variable Length Subnet Mask (VLSM) – DHCP –
ARP – Network Address Translation (NAT) – ICMP – Concept of SDN.

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
Introduction to Quality of Service (QoS).

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
Data Link Layer – Framing – Flow control – Error control – Media Access Control – Ethernet Basics –
CSMA/CD – Virtual LAN – Wireless LAN (802.11) – Physical layer – Signals – Bandwidth and Data

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.

TEXT BOOKS:

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IT5451 | COMPUTER ARCHITECTURE  
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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
• 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.

**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.

**TEXT BOOKS:**

**REFERENCES:**

**MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES**

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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
9

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
9

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
9

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
9
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.

TOTAL: 45 PERIODS
OUTCOMES:
On completion of the course, the students will be able to:
1. Develop C programs for any real world/technical application.
2. Apply advanced features of C in solving problems.
3. Write functions to implement linear and non-linear data structure operations.
4. Suggest and use appropriate linear/non-linear data structure operations for solving a given problem.
5. Appropriately use sort and search algorithms for a given application.
6. Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval.

TEXT BOOKS:

REFERENCES:

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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AUDIT COURSES

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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
Policy-Fundamental Duties

UNIT III ORGANS OF GOVERNANCE 9
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 9

UNIT V LOCAL ADMINISTRATION 9
District’s Administration head- Role and Importance-Municipalities- Introduction- Mayor and role of Elected Representative-CEO of Municipal Corporation-Pachayati raj- Introduction- PRI- Zila Pachayat-Elected officials and their roles- CEO ZilaPachayat- Position and role-Block levelOrganizational Hierarchy (Different departments)-Village level- Role of Elected and Appointed officials-Importance of grass root democracy

TOTAL: 45 PERIODS

COURSE OUTCOMES:
1. Able to understand history and philosophy of Indian Constitution.
2. Able to understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
3. Able to understand powers and functions of Indian government.
4. Able to understand emergency rule.
5. Able to understand structure and functions of local administration.

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

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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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 9
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 friendship Happiness Vs suffering, love for truth.

UNIT IV REINCARNATION THROUGH VALUE EDUCATION

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
1. Gain knowledge of self-development
2. Learn the importance of Human values
3. Develop the overall personality through value education
4. Overcome the self destructive habits with value education
5. Interpret social empowerment with value education

REFERENCES:

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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AD5093 PEDAGOGY STUDIES

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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.
UNIT I  INTRODUCTION AND METHODOLOGY:
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
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
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
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
Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 45 PERIODS

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

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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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
1. Develop healthy mind in a healthy body thus improving social health also improve efficiency
2. Learn Do’s and Don’t’s in life through Yam
3. Learn Do’s and Don’t’s in life through Niyam
4. Develop a healthy mind and body through YogAsans
5. Learn breathing techniques through Pranayam

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

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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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: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18

UNIT V PERSONALITY OF ROLE MODEL - SHRIMAD BHAGWADGEETA 9
Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 45 PERIODS

OUTCOMES:
1. To develop basic personality skills holistically
2. To develop deep personality skills holistically to achieve happy goals
3. To rewrite the responsibilities
4. To reframe a person with stable mind, pleasing personality and determination
5. To awaken wisdom in students

REFERENCES:
1. Gopinath,Rashtriya Sanskrit Sansthanam P, Bhartrihari’sThreeSatakam , Niti-sringarvairagya, New Delhi,2010

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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COURSE OBJECTIVES
The course will introduce the students to
• get a knowledge about Indian Culture
• Know Indian Languages and Literature religion and philosophy and the fine arts in India
• Explore the Science and Scientists of Ancient, Medieval and Modern India
 Understand education systems in India

UNIT I INTRODUCTION TO CULTURE
Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India.

UNIT II INDIAN LANGUAGES AND LITERATURE
Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languages and Literature – II: Northern Indian Languages & Literature

UNIT III RELIGION AND PHILOSOPHY
Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only)

UNIT IV FINE ARTS IN INDIA (ART, TECHNOLOGY & ENGINEERING)
Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India

UNIT V EDUCATION SYSTEM IN INDIA
Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India

TOTAL: 45 PERIODS

COURSE OUTCOMES
After successful completion of the course the students will be able to
1. Distinguish the Indian languages and literature.
2. Distinguish the Indian languages and literature.
3. Learn the philosophy of ancient, medieval and modern India.
4. Acquire the information about the fine arts in India.
5. Know the contribution of scientists of different eras.
6. Understand education systems in India

REFERENCES:
5. Satya Prakash, “Founders of Sciences in Ancient India”, Vijay Kumar Publisher, 1989

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES
Course Objectives:
The main learning objective of this course is to make the students an appreciation for:
- Introduction to Sanga Tamil Literature.
- ‘Agathinai’ and ‘Purathinai’ in Sanga Tamil Literature.
- ‘Attruppadai’ in Sanga Tamil Literature.
- ‘Puranaanuru’ in Sanga Tamil Literature.
- ‘Pathitrupaththu’ in Sanga Tamil Literature.

UNIT I SANGA TAMIL LITERATURE AN INTRODUCTION
Introduction to Tamil Sangam–History of Tamil Three Sangams–Introduction to Tamil Sangam Literature–Special Branches in Tamil Sangam Literature– Tamil Sangam Literature’s Grammar- Tamil Sangam Literature’s parables.

UNIT II ‘AGATHINAI’ AND ‘PURATHINAI’

UNIT III ‘ATTRUPPADAI’.

UNIT IV ‘PURANAANURU’
Puranaanuru on Good Administration,Ruler and Subjects – Emotion & its Effect in Puranaanuru.

UNIT V ‘PATHITRUPATHTHU’
Pathitrupaththu in Ettuthogai–Pathitrupaththu’s Parables– Tamil dynasty: Valor, Administration, Charity in Pathitrupaththu- Message to Society from Pathitrupaththu.

Total (L:45) = 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Appreciate and apply the messages in Sanga Tamil Literature in their life.
2. Differentiate ‘Agathinai’ and ‘Purathinai’ in their personal and societal life.
3. Appreciate and apply the messages in ‘Attruppadai’ in their personal and societal life.
4. Appreciate and apply the messages in ‘Puranaanuru’ in their personal and societal life.
5. Appreciate and apply the messages in ‘Pathitrupaththu’ in their personal and societal life.
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MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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HSMC – ELECTIVES – HUMANITIES I (ODD SEMESTER)

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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:

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
Extrinsic values- Universal and Situational values- Physical- Environmental-Sensuous- Economic-Social-Aesthetic-Moral and Religious values

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

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

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

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

TOTAL: 45 PERIODS

OUTCOMES:
1. Able to understand definition and classification of values.
2. Able to understand purusartha.
3. Able to understand sarvodaya idea.
4. Able to understand sustenance of life.
5. Able to understand views of hierarchy of values.

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

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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OBJECTIVES:
- Illustrate human relations at work its relationship with self.
- Explain the importance of interacting with people at work to develop teamwork.
- Infer the importance of physical health in maintaining human relations at work.
- Describe the importance of staying psychologically healthy.
- Identify the essential qualities for progressing in career.

UNIT I UNDERSTANDING AND MANAGING YOURSELF
Human Relations and You: Self-Esteem and Self-Confidence; Self-Motivation and Goal Setting; Emotional Intelligence, Attitudes, and Happiness; Values and Ethics and Problem Solving and Creativity.

UNIT II DEALING EFFECTIVELY WITH PEOPLE
Communication in the Workplace; Specialized Tactics for Getting Along with Others in the Workplace; Managing Conflict; Becoming an Effective Leader; Motivating Others and Developing Teamwork; Diversity and Cross-Cultural Competence.

UNIT III STAYING PHYSICALLY HEALTHY
Yoga, Pranayam and Exercise: Aerobic and anaerobic.

UNIT IV STAYING PSYCHOLOGICALLY HEALTHY
Managing Stress and Personal Problems, Meditation.

UNIT V DEVELOPING CAREER THRUST

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Students will be able to
1. Understand the importance of self-management.
2. Know how to deal with people to develop teamwork.
3. Know the importance of staying healthy.
4. Know how to manage stress and personal problems.
5. Develop the personal qualities essential for career growth.

TEXT BOOK:

REFERENCES:

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES
COURSE DESCRIPTION
Psychological Processes course is designed for students to be aware of the basic principles of psychology for the better understanding of people’s psyche and behaviour around them. This course enables learners to use the optimal use of different forms of thinking skills and thereby results in effective communication in diverse situations. Every unit of the syllabus highlights the psychological process of people, the most powerful and constructive use of perceptions.

OBJECTIVES
The major objectives of this course is

- To develop students’ awareness – on psychology, learning behavior and usage of perception effectively.
- To learn to use the various kinds of thinking in a formal context.
- To critically evaluate content and comprehend the message on the bases of perception, personality and intelligence.

UNIT 1: INTRODUCTION

UNIT 2: SENSORY & PERCEPTUAL PROCESSES
Some general properties of Senses: Visual system – the eye, colour vision – Auditory system – Hearing, listening, Sounds - Other senses - Selective attention; physiological correlates of attention; Internal influences on perception learning – set - motivation & emotion - cognitive styles; External influences on perception figure and ground separation – movement – organization – illusion; Internal- external interactions: Constancy - Depth Perception- Binocular & Monocular Perception; Perceptual defense & Perceptual vigilance; Sensory deprivation -Sensory bombardment; ESP - Social Perception.

UNIT 3: COGNITION & AFFECT

UNIT 4: THINKING, PROBLEM-SOLVING & DECISION MAKING

UNIT 5: PERSONALITY & INTELLIGENCE
Psychological phenomena & Attributes of humans - cognition, motivation, and behavior - thoughts, feelings, perceptions, and actions – personality dimensions, traits, patterns - Specialized knowledge, performance accomplishments, automaticity or ease of functioning, skilled performance under challenge - generative flexibility, and speed of learning or behavior change.

TOTAL:45 PERIODS
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HU5175 EDUCATION, TECHNOLOGY AND SOCIETY

COURSE DESCRIPTION
This course introduces students to multidisciplinary studies in Education, Technology and Society. Students will get an understanding of the relationship between education, technology and society. They will also learn about the long lasting impact of good education in a technologically advanced society.

COURSE OBJECTIVES:
The course aims
- To help learners understand the basics of different types of technology utilised in the field of education
- To make them realize the impact of education in society
- To make them evolve as responsible citizen in a technologically advanced society

LEARNING OUTCOMES
By the end of the course, learners will be able to
1. Understand the various apps of technology apps and use them to access, generate and present information effectively.
2. Apply technology based resources and other media formats equitably, ethically and legally.
3. Integrate their technical education for betterment of society as well as their personal life.

UNIT I INDIAN EDUCATION SYSTEM
Gurukul to ICT education – Teacher as facilitator – Macaulay’s Minutes – English medium vs Regional medium – Importance of Education in Modern India - Challenges in Education

UNIT II LEARNING THEORIES
UNIT III TECHNOLOGICAL ADVANCEMENTS
Web tools – Social media in education – eLearning – MOOCs – Mobile assisted learning – Learning Apps – Blended learning - Self-directed learning

UNIT IV EDUCATIONAL TECHNOLOGY
Technological implications on Education – Teaching, Learning & Testing with Technology - Advantages and drawbacks – Critical analysis on the use of technology

UNIT V ETHICAL IMPLICATIONS
Plagiarism – Online Copyright issues – Ethical and value implications of education and technology on individual and society.

TOTAL: 45 PERIODS

TEACHING METHODS
Teaching modes include guest lectures, discussion groups, presentations, visual media, and a practicum style of learning.

EVALUATION
As this is a course not a content based course, it focuses more on the ethical use of technology in education and society, and so, evaluation can be based on assignments and discussions. So there is no need for an end semester examination. Internals marks can be taken for the total marks.

INTERNAL (100 % WEIGHTAGE)
(a) Written Test (40 marks)
(b) Assignment: Write a real time report of the technology use in any school / college (15 marks)
(c) Presentation: Students choose any one of the technological tools and present its relevance to education and society (15 marks)
(d) Group discussion: Students discuss in groups on case studies relating to various challenges in education and technology use in society (20 marks)
(e) Blog entry: Making weekly blog posts in Class Blog on the topics related to the course posted by the instructor and commenting on others’ posts. (10 marks)

REFERENCES
1) Education and Social order by Bertrand Russel
2) Theories of learning by Bower and Hilgard
3) Technology and Society by Jan L Harrington

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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TOTAL: 45 PERIODS
OBJECTIVES

- To create a new understanding by teaching philosophy through a comparison of Indian and Western traditions.
- To foster critical thinking and imagination by dealing with inter-related concepts in literature and science.
- To bridge the gap between the sciences and humanities through introspective analyses.
- To nurture an understanding of the self and elucidates ways to progress towards a higher understanding of one’s self and others.

UNIT I KNOWLEDGE


UNIT II ORIGIN


UNIT III WORD


UNIT IV KNOWLEDGE AS POWER/OPPRESSION


UNIT V SELF KNOWLEDGE/BRAHMAN


TOTAL : 45 PERIODS

COURSE OUTCOMES:
On completion of the course, the students will be able to:
1. Think sceptically, ask questions and to arrive at deductions.
2. Connect and relate different branches of thought.
3. Comprehends the relation between language, thought and action.
4. Arrive at a better understanding of self and others and forms a new outlook.

REFERENCES:
7. Bacon, Francis: Power as Knowledge
MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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HU5177 APPLICATIONS OF PSYCHOLOGY IN EVERYDAY LIFE

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UNIT I INTRODUCTION
Nature and fields.

UNIT II PSYCHOLOGY IN INDUSTRIES AND ORGANIZATIONS
Job analysis; fatigue and accidents; consumer behavior.

UNIT III PSYCHOLOGY AND MENTAL HEALTH
Abnormality, symptoms and causes psychological disorders

UNIT IV PSYCHOLOGY AND COUNSELING
Need of Counseling, Counselor and the Counselee, Counseling Process, Areas of Counseling.

UNIT V PSYCHOLOGY AND SOCIAL BEHAVIOUR
Group, group dynamics, teambuilding, Prejudice and stereotypes; Effective Communication, conflict and negotiation.

TOTAL: 45 PERIODS

TEXTBOOKS

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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COURSE DESCRIPTION
This course offers an introduction to Gender Studies that asks critical questions about the meanings of sex and gender in Indian society. The primary goal of this course is to familiarize students with key issues, questions and debates in Gender Studies, both historical and contemporary drawing from Indian literature and media studies, to examine cultural assumptions about sex, gender, and sexuality. This course integrates analysis of current events through student presentations, aiming to increase awareness of contemporary and historical experiences of women, and of the multiple ways that sex and gender interact with class, caste and other social identities. This course also seeks to build an understanding of the concepts of gender, gender based violence, sexuality, and rights and their impact on development through a number of discussions, exercises and reflective activities.

Objectives
1. To familiarize students with the concepts of sex and gender through literary and media texts.
2. To help students ask critical questions regarding gender roles in society.
3. To provide students with the material to discuss gender issues such as gender based discrimination, violence and development.
4. To help students think critically about gender based problems and solutions.
5. Learning Outcomes
6. Students will be able to critically read literary and media texts and understand the underlying gender perspectives in them.
7. Students will be able to analyse current social events in the light of gender perspectives.
8. Students will be able to discuss, analyse and argue about issues related to gender and their impact on society, culture and development.

UNIT I: Introduction to Gender
• Definition of Gender
• Basic Gender Concepts and Terminology
• Exploring Attitudes towards Gender
• Social Construction of Gender Texts:
  1. Sukhu and Dukhu (Amar Chitra Katha)
  2. The Cat who Became a Queen (Folk tale, J. Hinton Knowles, Folk-Tales of Kashmir. London: Kegan Paul, Trench, Trübner, and Company, 1893, pp. 8-10.)

UNIT II: Gender Roles and Relations
• Types of Gender Roles
• Gender Roles and Relationships Matrix
• Gender-based Division and Valuation of Labour Texts:
  1. Muniyakka (Short Story, Lakshmi Kannan, Nandanvan and Other Stories, Hyderabad: Orient Blackswan, 2011)

UNIT III: Gender Development Issues
• Identifying Gender Issues
• Gender Sensitive Language
• Gender, Governance and Sustainable Development
• Gender and Human Rights
• Gender and Mainstreaming Texts:
  2. Tell Us Marx (Poem, Mallika Sengupta, Translated by Sanjukta Dasgupta)
UNIT IV: Gender-based Violence

- The concept of violence
- Types of Gender-based violence
- The relationship between gender, development and violence
- Gender-based violence from a human rights perspective

Texts:
1. Lights Out (Play, Manjula Padmanabhan)
2. Lights Out (Video of play enacted)

UNIT V: Gender and Culture

- Gender and Film
- Gender, Media and Advertisement

Texts:
1. Mahanagar (Movie: Satyajit Ray)
2. Beti Bachao Beti Padhao Advertisements

READINGS: Relevant additional texts for readings will be announced in the class. Classes will consist of a combination of activities: dialogue-based lectures, discussions, collaborative learning activities, group work and in-class assignments.

ASSESSMENT AND GRADING:
Discussion & Classroom Participation: 20%
Project/Assignment: 30%
End Term Exam: 50%

COURSE OUTCOMES
After completion the above subject, students will be able to understand
CO1: Students will be able to critically read literary and media texts and understand the underlying gender perspectives in them.
CO2: Students will be able to analyse current social events in the light of gender perspectives.
CO3: Students will be able to discuss, analyse and argue about issues related to gender and their impact on society, culture and development.
CO4: Students will be able to know the concept of violence.
CO5: Students will be able to know the gender and culture.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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OBJECTIVES:
• To emphasize the meaning and nature of ethics, human values and holistic life for leading a good, successful and happy life through continuous examination of thoughts and conduct in day to day life.
• To understand the status and responsible role of individual in abatement of value crisis in contemporary world in order to develop a civilized and human society. Understanding the process of ethical decision making through critical assessment of incidents/cases of ethical dilemmas in personal, professional and social life.
• To view the place of Ethics and Human Values in the development of individual and society through identification and cross examination of life values and world view of his/her role models in society.

UNIT I HUMAN LIFE, ITS AIM AND SIGNIFICANCE
The concept of a successful life, happy life and a meaningful life, Ethical and decision making capability and its development: Meaning of Ethical dilemma, sharing real life experiences.

UNIT II CREATIVE AND LEADERSHIP ABILITY AND THEIR DEVELOPMENT
Intellectual, Emotional, Creative, Ethico - spiritual development, Aesthetic sense, Selfdependency, Activeness, Development of positive attitude.

UNIT III HARMONY IN PERSONAL AND SOCIAL LIFE:
Concept of personal and group Ethics; Balance between - rights and duties-welfare of self and welfare of all, Creating a value based work culture in hostel, classroom and other places in the campus and society.

UNIT IV CHARACTER, RIGHTEOUSNESS AND VIRTUES FOR A MEANINGFUL LIFE
Egolessness, Humility, Righteousness, Purity, Truthfulness, Integrity, Self-restraint, Self-control, Sense of responsibility, Empathy, Love, Compassion, Maitri / Comradeship, Cooperation, Tolerance.

UNIT V DILEMMA BETWEEN MATERIALISTIC DEVELOPMENT AND HUMAN WELFARE

OUTCOMES:
On completion of the course, the students will be able to:
1. Enable students to understand the concept of contemporary ethics at different levels: Individual, local and Global and enable them to cross examine the ethical and social consequences of the decisions of their life-view and world view.
2. Develop the ability of students to create a balance between their individual freedom and social responsibilities and enable them to identify the personal, professional and social values and integrate them in their personality after cross examination.
3. Enable students to cross examine their earlier decisions taken in life and understand the meaning of ethical dilemma to overcome the ethical dilemmas and engage in critical reflection.
4. Develop positive habits of thought and conduct and work cohesively with fellow beings who have variety of strengths, experiences, shortcomings and challenges, hence to enable them to handle diverse type of personalities.
5. Enable students to develop a method for making ethically sound decisions for themselves, within hostels, classrooms, university campus and society.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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UNIT I  THE LEGAL SYSTEM: SOURCES OF LAW AND THE COURT STRUCTURE  9
Enacted law - Acts of Parliament are of primary legislation, Common Law or Case law- Principles taken from decisions of judges constitute binding legal rules. The Court System in India and Foreign Courtiers. (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court) Arbitration: As an alternative to resolving disputes in the normal courts, parties who are in dispute can agree that this will instead be referred to arbitration.

UNIT II  LAWS  9
Basic principles of contract law, sale of goods law, laws relating to industrial pollution, accident, environmental protection, health and safety at work, patent law, constitutional law: the supreme law of the land, Information technology law and cyber crimes.

UNIT III  BUSINESS ORGANISATIONS  9
Sole traders (Business has no separate identity from you, all business property belongs to you). Partnerships: Types of Partnerships - Limited Liability Partnership, General Partnership, Limited Partnerships. Companies: The nature of companies, Classification of companies, Formation of companies, Features of a public company, Carrying on business, Directors– Their Powers and Responsibilities/Liabilities.

UNIT IV  LAW AND SOCIETY  9
Interdisciplinary nature of law, legal ideologies/philosophy/schools of jurisprudence.

UNIT V  CASE STUDIES  9
Important legal disputes and judicial litigations

TOTAL: 45 PERIODS

COURSE OUTCOMES
After completion the above subject, students will be able to understand
CO1: Know the structure of law system.
CO2: Understand the types of laws.
CO3: Know the different types of organizations.
CO4: Understand the development of law for the society.
CO5: Know the important issues in legal disputes.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

COURSE DESCRIPTION
This is an intensive course designed to promote comprehensive understanding and insights into the nature of cinema and other related forms and practices. Movies, though at times are used more as escapism, they are also a true art form and expressive tool used by writers, directors and actors. This course will explore the aesthetics of cinema, the concepts behind storytelling and various other elements of a film. It will also
explore the impact of movies in our society and in our lives. It also encourages students to use films as a medium to analyse visual texts and read underlying messages.

**OBJECTIVES:**
- To help learners understand the various movie genres and its types.
- To understand various elements that contributes to film making.
- To make them realize the impact of film in society.
- To analyse the visual media and interpret the underlying messages.

**UNIT I THE COMPONENTS OF FILMS**
Story, Screenplay & Script – Actors – Director – Crew Members – Mis En Scene – Structure of A Film – Narrative Elements – Linear & Non-Linear – Types of Movie Genres: Mysteries, Romantic Comedies, Horror Etc.

**UNIT II EVOLUTION OF FILM**

**UNIT III FILMS ACROSS THE WORLD**

**UNIT IV INDIAN FILMS**

**UNIT V INTERPRETING FILMS**
Film Criticism & Appreciation – Censorship in Movies – Cultural Representation in Movies – Television – New Media & Online Media – Films Beyond Entertainment.

**TOTAL: 45 PERIODS OUTCOMES**
On completion of the course, the students will be able to:
1. Recognize types of films, their impact on society and their roles in our lives.
2. Have an understanding of the concepts of storytelling, Mise en Scene, and other elements of film making.
3. Interpret the underlying messages in the movies.

**Teaching Methods**
- Each unit consists of reading materials, learning activities videos, websites. Students are expected to watch movies sometimes in class and at times at home and discuss in class.

**Evaluation**
- As this is course is critical appreciation course on films, there is no written end semester examination. The course is more on learning how to critically analyse a movie and appreciate its finer elements. Therefore evaluation can be based on assignments and discussions. Internals marks can be taken for the total marks.

Internal (100 % weightage)
- Assignment 1: Write a movie review with critical analysis (20 marks).
- Assignment2 : Write a script for a scene taken from a short story / novella (20 marks).
- Presentation: Students choose any one topic related to films and present it to the audience. (25 marks)
- Group discussion : Students discuss in groups on the various aspects of movies and its impact on society. (25 marks)
- Blog entry: Making weekly blog posts in Class Blog on the topics related to the course posted by the instructor and commenting on others’ posts. (10 marks)

**REFERENCES**
1. A Biographical Dictionary of Film by David Thomson, Secker & Warburg, 1975
2. Signs and Meaning in the Cinema by Peter Wollen, Secker & Warburg, 1969
3. The World Viewed by Stanley Cavell 1971
4. Film Style and Technology: History and Analysis by Barry Salt, Starword, 1983

**COURSE OUTCOMES**

After completion the above subject, students will be able to understand

- CO1: Recognize types of films, their impact on society and their roles in our lives.
- CO2: Have an understanding of the concepts of storytelling, Mise en Scene, and other elements of film making.
- CO3: Interpret the underlying messages in the movies.
- CO4: Know the principles in interpreting the films.
- CO5: Know the history of Indian cinema.

**MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES**

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**HU5275 FUNDAMENTALS OF LANGUAGE AND LINGUISTICS**

**OBJECTIVES**
- To broadly introduce students to the formal and theoretical aspects of linguistics.
- To enable learners to understand the various practical applications of language and recent findings in the field of applied linguistics.

**CONTENTS :**

**UNIT I LANGUAGE AND LINGUISTICS: AN OVERVIEW**

**UNIT II MORPHOLOGY - WORDS OF LANGUAGE**

**UNIT III SYNTAX- THE SENTENCE PATTERNS OF LANGUAGE AND SEMANTICS-THE MEANING OF LANGUAGE**

**UNIT IV PHONETICS – THE SOUNDS OF LANGUAGE**
Speech sounds- Introduction to branches of Phonetics- The Phonetic Alphabet – IPA – Consonants - Vowels - Diphthongs- Tone and Intonation.

**UNIT V APPLIED LINGUISTICS - THE PRACTICAL APPLICATIONS OF LANGUAGE**
Language learning and teaching (ELT)- lexicography-translation studies-computational linguistics-neurolinguistics (speech pathology and language disorders)- forensic linguistics sociolinguistics.
Teaching Methods: Lectures, discussion.

Evaluation Internal and External:
Internal: 2 written tests + assignments, seminars, project (50+15+15+20). External: A 3 hour written exam (50 marks)

REFERENCES:

COURSE OUTCOMES
After completion the above subject, students will be able to understand
CO1: Know the overview of language
CO2: Understand the words of language
CO3: Know the syntax of sentence pattern
CO4: Understand the sounds of language
CO5: Know the practical application of language.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

HU5276 UNDERSTANDING SOCIETY AND CULTURE THROUGH LITERATURE

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<td>To internalize the importance of language by understanding its role in the transformation of man.</td>
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<td>To look at language, literature and culture as locus of identity and change.</td>
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<td>To extract meaning from existing literatures and cultures.</td>
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<td>To identify meanings in modern life by reconnecting with lost cultures.</td>
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Unit 1 Introduction
Why study literature? Tracing the origin – pictures. Tokens as precursors of writing. Movement from three dimensions to two dimensions- Pictography. From visual to oral -Logography. Reading out literature to young children- Edmund J Farrell.

Unit 2. Reading Culture
Reading culture through language, signs and consumables- Roland Barthes. Culture through poems- Nissim Ezekiel’s ‘ The night of the Scorpion’ . ‘Nothing’s Changed’- Tatamkhulu Afrika- Apartheid. Ruskin Bond- ‘Night train at Deoli’- How real life is different from movies.

Unit 3. Identifying Meaning
Searching and locating meaning through literature. Looking for order in a chaotic world. The Myth of Sisyphus (Albert Camus) and Adi Shankar’s ‘Jagat Mithya’ - the world as an illusion. The Indian version as ‘meaningless meaning’.

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Unit 4. Post Modernism
‘If on a winter’s night a traveler’- Italo Calvino. The book about the reader- the experience of reading as reading. Metafiction. Selfie Culture. Visual Culture as purpose of modern life.

Unit 5. Returning to Pictures

Reading list
1. Bond, Ruskin: ‘Night train at Deoli’
2. Ezekiel, Nissim: ‘The Night of the Scorpion’
3. Afrika, Tatamkhulu: ‘Nothing’s Changed’
4. Barthes, Roland: Mythologies
5. Shankaracharya: Viveka Chudamani
6. Camus, Albert- The Myth of Sisyphus
7. Calvino, Italo: If on a winter’s night a traveler

COURSE OUTCOME
After completion the above subject, students will be able to understand
CO1: Identify the connections among language, literature and culture.
CO2: To relate between seemingly different aspects of life.
CO3: Understands the fractions in modern life and can assimilate meanings.
CO4: Know the different type of culture.
CO5: Understand the development in the visual world

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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