

BE INSTRUMENTATION AND CONTROL ENGINEERING

SEMESTER - 1

19U101 CALCULUS AND ITS APPLICATIONS

3 1 0 4

DIFFERENTIAL CALCULUS: Functions of two variables, limit, continuity, partial derivatives, differentiability, total differential, extreme values and saddle points, constrained maxima and minima, Lagrange multipliers with single constraint, Taylor's formula for two variables. (9 + 3)

MULTIPLE INTEGRALS I : Basic concepts, double integrals over rectangles, double integrals as volumes, Fubini's theorem, double integrals over general regions, area by double integration, reversing the order of integration. (9 + 3)

MULTIPLE INTEGRALS II: Double integrals in polar form, triple integrals in rectangular coordinates, spherical and cylindrical coordinates. (9 + 3)

SECOND ORDER LINEAR ORDINARY DIFFERENTIAL EQUATIONS: Homogeneous linear ODEs of second order, linearity principle, general solution, homogeneous linear ODEs with constant coefficients, Euler–Cauchy equations, solution by variation of parameters, modeling of electric circuits. (9 + 3)

VECTOR CALCULUS: Gradient of a scalar field, directional derivative, divergence of a vector field, curl of a vector field. Integration in vector field — line integrals, Green's, Gauss divergence and Stokes's theorems. (9 + 3)

Total L: 45 +T: 15 = 60

TEXT BOOKS:

1. Joel Hass, Christopher Heil, Maurice D.Weir ""Thomas' Calculus", Pearson Education., New Delhi, 2018
2. Erwin Kreyszig "Advanced Engineering Mathematics", Wiley India Pvt Ltd., New Delhi, 2015

REFERENCES:

1. J.E.Marsden, A.J.Tromba, A. Weinstein "Basic multivariable Calculus", Springer Verlag., New York, 2019
2. Howard Anton, Irl Bivens, Stephen Davis "Calculus", , John Wiley & Sons, INC., USA, 2016
3. Wylie C R and Barrett L C "Advanced Engineering Mathematics", Tata McGraw-Hill., New Delhi, 2019
4. James Stewart "Multivariable Calculus", Brooks Cole., USA, 2012

19U102 INTRODUCTION TO ELECTROMAGNETIC THEORY

3 0 0 3

ELECTRIC CHARGE, FORCE & FIELD: Electric charge, Coulomb's laws, Electric field, Fields of charge distributors, Matters in Electric field: Point charge, dipoles, Conductors, Insulators & dielectrics. Gauss law: Electric field lines, Electric flux and field, Gauss law, Fields of Arbitrary charge distribution, Field at a conductor surface. Applications: Microwave cooking, Liquid Crystals, Shielding and Lightning Safety. (9)

ELECTRIC POTENTIAL: Electric potential difference, curved paths and non uniform fields. Calculating potential difference: potential of a point charge, zero potential, finding potential differences using superposition. Potential difference and Electric field, charged conductors. Electrostatic Energy, Capacitors, Energy in the Electric field. Applications: Corona discharge, pollution control and xerography. (9)

MAGNETISM: Magnetic force and field, Charged particles in magnetic fields, Magnetic force on a current, Hall effect. Biot-Savart's law, Magnetic force between conductors. Magnetic dipoles, Gauss's law of magnetism, Torque on a magnetic dipole. Ampere's law, Magnetic field due to straight conductors, circular loop — Magnetic flux density(B), Magnetic potential. (9)

ELECTROMAGNETIC INDUCTION: Induced currents, Faraday's law, Induction and Energy, motional emf and Lenz's law, Electromagnetic braking and its applications. Eddy currents, closed and open circuits in magnetic field. Inductance: mutual and self inductance. Magnetic energy, Induced electric fields: conservative and non conservative electric fields. (9)

MAXWELL'S EQUATIONS AND ELECTROMAGNETIC WAVES: Ampere's law - modification. Maxwell's equations, electromagnetic waves, Properties of electromagnetic waves, Electromagnetic spectrum, Electromagnetic waves propagation through isotropic media. (9)

Total L: 45

TEXT BOOKS:

1. Richard Wolfson "Essential University Physics", Pearson., 2011
2. David J Griffiths "Introduction to Electrodynamics", Pearson., 2015

REFERENCES:

1. D Halliday and R Resnick "Fundamentals of Physics", John Wiley and Sons., 2015
2. Richard P Feynman, Robert B Leighton "The Feynman Lectures on Physics", Addison-Wesley., 2011
3. Gaur R K, Gupta S L "Engineering Physics", Dhanpat Rai publications., 2013
4. Raymond A. Serway, John W. Jewett "Physics for Scientist and Engineers", Cenagage Learning., 2010

19U103 CHEMISTRY OF ELECTRONIC MATERIALS**3 0 0 3**

CONDUCTING PROPERTIES OF MATERIALS: Molecular orbital treatment of bonding in metals, insulators, semiconductors — direct band and indirect band, elemental, p-doped, n-doped, stoichiometric compound semiconductors and chalcogen semiconductors. Crystal defects and their influence on properties of materials — intrinsic defects - schottky and frenkel, non-stoichiometric compounds, extrinsic defects - oxide ion conductors -applications. Nanoscale materials – Quantum dots-band gap – size dependant optical properties. (9)

POLYMERIC MATERIALS: Classification, degree of polymerization, average molecular weights, polydispersity. Polymerization reactions — chain and condensation. Thermal properties -glass transition temperature(Tg) — factors affecting Tg - determination by DSC. Mechanical properties — significance in fabrication of electronics. Electrical insulating properties - dielectric breakdown - aging of polymer insulations - discharges in voids, electrical treeing. Thermal and photochemical degradations. Additives - plasticisers, stabilisers, functional additives. (9)

FLEXIBLE ELECTRONIC MATERIALS: Conjugated polymers — electronic energy bands - mechanism of charge transport — intrachain and interchain - solitons, polarons and bipolarons. Factors influencing charge transport — structural features - defects, molecular weight, crystalline/amorphous nature, doping- oxidative and reductive. Synthesis, properties and applications of polyaniline, polythiophene and polypyrrole. Molecular electronics - graphene, fullerenes, carbon nanotubes – structure, synthesis, properties and applications. (9)

OPTOELECTRONIC MATERIALS: Electroluminescence- exciton, OLED materials– emitters- charge transfer complexes, metal chelates, polycyclic aromatic oligomers, conjugated polymers — polyphenylenes, polyfluorenes. Liquid crystalline polymers- classification of liquid crystals, chemical constitution, stability and applications. Organic and dye sensitized photovoltaics — working principle, materials, advantages and disadvantages. Preparation of ultrathin polymer films - Langmuir-Blodgett Films –self assembled monolayers. (9)

MATERIALS FOR ELECTRONICS PROCESSING: Semiconductor wafer fabrication -Overview and challenges –high purity chemicals, air filters for clean rooms, electronic grade water- quality parameters, water treatment stages for ultrapure water production — membranes and ion-exchange resins, electro dialysis. Photoresists for wafer fabrication — microlithography, resist requirements, material chemistry. Electronic packaging materials-adhesives, connectors, eutectic alloys, phase change materials-phase diagrams, applications. (9)

Total L: 45**TEXT BOOKS:**

1. Lesley E.Smart, Elaine A.Moore "Solid State Chemistry - an Introduction", CRC Press., London, 2005. , 4th edition
2. Cowie J.M.G, Valeria Arrighi "Polymers: Chemistry and Physics of modern materials", CRC Press., London, 2007. , 3rd edition

REFERENCES:

1. Sam-Shajing Sun, Larry R. Dalton "Introduction to Organic Electronic and Optoelectronic Materials and Devices", CRC press., London, 2017. , 2nd edition
2. Stergios Logothetidis "Handbook of Flexible Organic Electronics Materials - Manufacturing and Applications", WoodHead publishing., London, 2015. , 1st edition
3. Peter Van Zant "Microchip Fabrication: A Practical Guide to Semiconductor Processing", Mc Graw Hill.,, 2014. , 6th edition
4. Anthony R.West "Solid state chemistry and its applications", John Wiley., USA, 2014. , 2nd edition

19U104 PROBLEM SOLVING AND C PROGRAMMING**2 0 0 2**

INTRODUCTION TO PROBLEM SOLVING: Analyzing and Defining the Problem - Algorithm - Flow Chart — Program development steps -Types of programming language. C: The C character set - Identifiers and keywords – Data types — Constants - Variables -Declarations -input and output functions-preprocessor directives. (3)

OPERATORS AND EXPRESSIONS: Arithmetic operators - Unary operators - Relational operators - logical operators - Assignment operators - Conditional operators - comma operator - sizeof operator -precedence and associativity- Library

functions. Control statements: simple if, if..else, nested if .. else ,elseif ladder , switch case -while-do while -for-Nested loops - break—continue—goto statements. (9)

ARRAYS: Defining an array - Processing an array - Multi dimensional arrays -strings. (6)

FUNCTIONS: Function prototype - Defining a function — function call - Passing arguments to a function –nested function — recursive function- Storage classes - auto - static - extern and register variables (4)

STRUCTURES: Definitions - Processing a structure — Array and structures — Nested structures - Structures and functions. Pointers: Definition - Pointer Arithmetic — types of pointer - const pointer, pointer to a constant, void pointer, null pointer (8)

Total L: 30

TEXT BOOKS:

1. Deitel H. M. and Deitel P. J "C: How To Program", Prentice Hall of India., New Delhi, 2015
2. Ajay Mittal "Programming in C - A Practical approach", Pearson., New Delhi, 2010

REFERENCES:

3. Gottfried B "Programming with C", McGraw Hill Education., New Delhi, 2018
4. Herbert Schildt "C: The Complete Reference", McGraw Hill., New Delhi, 2017
5. Kernighan B. W. and Ritchie D. M "Programming Language (ANSI C)", Prentice Hall of India., New Delhi, 2013

19G105 ENGLISH LANGUAGE PROFICIENCY

2 1 0 3

LEARNING LANGUAGE THROUGH STANDARD LITERARY AND GENERAL TEXTS: Integrated Tasks focusing on Language Skills - Training based on Text based Vocabulary, tone, register and Syntax features (12 + 0)

GRAMMAR IN CONTEXT: Word Order - Subject Verb Concord - Style features - Tenses, Conditionals, Prepositions, Active and Passive Voice, Modals, Cloze and Spotting Errors exercise (10 + 0)

GUIDELINES FOR WRITTEN COMMUNICATION: Principles of Clear Writing - Paragraph Writing - Essay Writing - Emphasis Techniques - Summarizing and Paraphrasing - Analytical Writing (8 + 0)

FOCUS ON SPOKEN ENGLISH:Task — based activities with graded levels of difficulty and with focus on language functions - Level 1: Self — expression — Greetings in Conversation, Hobbies, Special interests, Daily routine - Level 2: General Awareness — Expression of Concepts, Opinions, Social Issues, Description of a process / picture/chart, news presentation / review - Level 3: Advanced Skills — Making Short Speeches and Participating in Role Plays (0 + 10)

LISTENING ACTIVITY: Task based Activities using Language Lab (0 + 5)

Total L: 30 +T: 15 = 45

TEXT BOOKS:

1. Faculty- Department of English "Course materials", PSG College of Technology., Coimbatore, 2019

REFERENCES:

1. Jill Singleton "Writers at Work: The Paragraph", Cambridge University Press., New York, 2012
2. Simon Haines, Mark Nettle and Martin Hewings "Advanced Grammar In Use", Cambridge University Press., New Delhi, 2008
3. Anne Laws "Writing Skills", Orient Black Swan., Hyderabad, 2011
4. Sinha DK "Specimens of English Prose", Orient Black Swan., Hyderabad, 2012

19U106 ELECTRIC CIRCUITS

3 1 0 4

BASIC DEFINITIONS AND LAWS : Overview of electrical circuits: currents, voltages, power and energy - Circuit elements: active and passive elements - Independent and dependent sources - Resistive circuits: Ohm's law and Kirchoff's laws - Series resistors and voltage division - Parallel resistors and current division - Series voltage source and parallel current source - Y-Δ transformations (9+3)

DC CIRCUIT ANALYSIS AND CIRCUIT THEOREMS : Node voltage analysis - Mesh current analysis - Circuit theorems: Source transformation - Superposition theorem - Thevenin's theorem - Norton's theorem – Maximum power transfer theorems. (9+3)

AC CIRCUIT ANALYSIS : Sinusoidal voltages and currents - Phasor representation - RMS value - Form factor - Energy storage elements: Capacitors and inductors - Phasor relationship for R, L and C - Impedance and admittance - Inductively coupled

circuits: Mutual inductance - Dot convention - Coefficient of coupling - Resonance in parallel and series circuits - Bandwidth and Q factor (9+3)

COMPLETE RESPONSE ANALYSIS : First order circuits - Source-Free RC Circuits - Source-Free RL Circuits - Step Response of RC Circuits - Step Response of RL Circuits - Second order circuits - Finding Initial and Final Values - Source-Free Series RLC Circuits - Source-Free Parallel RLC Circuits - Step Response of Series RLC Circuits - Step Response of Parallel RLC Circuits (9+3)

THREE PHASE CIRCUITS : Three phase voltages and currents - Y connected source and load - Δ connected source and load - Y to Δ circuit - Balanced three phase circuits - Power and power factor in three phase - Two-Wattmeter method of power measurement (9 + 3)

Total L: 45 +T: 15 = 60

TEXT BOOKS:

1. Charles K. Alexander, Mathew N. O. Sadiku . Fundamentals of Electric Circuits ,Fifth Edition , Tata McGraw Hill, 2016.
2. John Bird . Electrical Circuit Theory and Technology ,Fifth Edition , Newyork: Routledge, 2017.

REFERENCES:

1. Richard C. Dorf, James A Svoboda . Introduction to Electric Circuits ,Ninth Edition John Wiley and Sons Inc, 2017.
2. K.C.A.Smith, R.E. Alley . Electrical circuits an introduction , New Delhi: CAMBRIDGE University Press, 2017.
3. Allan H. Robbins, Wilhelm C. Miller . Circuit Analysis: Theory and Practice ,Fifth Edition , Cengage publishers, 2013.
4. Sudhakar A, Shyammoan S. Palli . Circuits and Network Analysis and Synthesis ,Fifth Edition , Tata McGraw Hill, 2017.

19U110 ENGINEERING GRAPHICS

0 0 4 2

INTRODUCTION:

1. Introduction to Engineering Drawing
2. BIS
3. Principles of dimensioning
4. Lettering Practice

(12)

ORTHOGRAPHIC PROJECTION:

1. Principles of orthographic projection-projection of points, straight lines, planes and solids.
2. Orthographic projection of simple engineering components – missing view exercises.
3. Drawing orthographic projections of computer components.

(12)

PICTORIAL PROJECTIONS:

1. Principles of pictorial views, isometric view of simple engineering components.
2. Isometric views from given two or three views.
3. Drawing isometric views of typical electronic components.

(12)

SECTION OF SOLIDS:

1. Section of regular solids, Need for Sectional views.
2. Sectional views of simple engineering components.
3. Drawing sectional views of assemblies like electric motor, mobile phone.

(12)

DEVELOPMENT OF SURFACES:

1. Development of lateral surfaces of regular solids and truncated solids.
2. Preparing parts like tray, funnel, CPU housing using cardboard material.

(12)

Total P: 60

TEXT BOOKS:

1. John K C "Engineering Graphics for degree", PHI Publishers., 2009
2. Venugopal K, Prabhu Raja V "Engineering Graphics", New Age International Publishers., 2007

REFERENCES:

1. Natarajan K V "Engineering Drawing and Graphics", M/s Dhanalakshmi Publishers., 2007
2. Luzadder, Duff "Fundamentals of Engineering Drawing", Prentice Hall of India Pvt. Ltd., 2009
3. Bureau of Indian Standards "Engineering Drawing Practices for Schools and Colleges SP 46-2003", BIS., 2004

19U111 PROBLEM SOLVING AND C PROGRAMMING LABORATORY

0 0 2 1

1. Working with RAPTOR Tool – Flowchart Interpreter
2. Operators
3. Decision making Statements
4. Loops : while , do..while, for
5. One dimensional array
6. Two dimensional array
7. Strings
8. Functions
9. Recursive functions
10. Structures
11. Structures and arrays
12. Nested Structures
13. Pointers

Total P: 30

REFERENCES:

1. Deitel H. M. and Deitel P "C: How To Program", Prentice Hall of India., New Delhi, 2015
2. Ajay Mittal "Programming in C - A Practical approach", Pearson., New Delhi, 2010
3. Gottfried B "Programming with C", McGraw Hill Education., New Delhi, 2018
4. Herbert Schildt "C: The Complete Reference", McGraw Hill., New Delhi, 2017

19IP15 INDUCTION PROGRAMME

0 0 0 0

As per AICTE guidelines

SEMESTER - 2

19U201 COMPLEX VARIABLES AND TRANSFORMS

3 1 0 4

COMPLEX DIFFERENTIATION: Complex differentiation - analytic function, Cauchy Riemann equations, harmonic functions, linear fractional transformations. (9 + 3)

COMPLEX INTEGRATION: Cauchy's integral theorem, Cauchy's integral formula, Laurent series, singularities and zeros, residue integration method (Residue integration of complex integrals only). (9 + 3)

LAPLACE TRANSFORMS: Laplace transform, inverse transform, linearity, s-shifting, transforms of derivatives and integrals, unit step function, t - shifting, Dirac's delta function, periodic functions, method of solving differential equations by using Laplace transform technique. (9 + 3)

FOURIER SERIES: Fourier series- convergence and sum of Fourier series, functions of any period 2L, even and odd functions, half range expansions. (9 + 3)

FOURIER TRANSFORMS: Fourier transform, Fourier cosine and sine transforms - Discrete Fourier transform —FastFourier transform—DITalgorithm. (9 + 3)

Total L: 45 +T: 15 = 60

TEXT BOOKS:

1. Erwin Kreyszig "Advanced Engineering Mathematics", John Wiley & Sons., New Delhi, 2015
2. Wylie C. R. and Barrett L. C "Advanced Engineering Mathematics", Tata McGraw-Hill., New Delhi, 2019

REFERENCES:

1. Mathews J. H. and Howell R. W "Complex Analysis for Mathematics and Engineering", Narosa Publishing House., New Delhi, 2012
2. Peter V.O Neil "Advanced Engineering Mathematics", Cengage., New Delhi, 2016
3. Dennis G Zill "Advanced Engineering Mathematics", Jones & Bartlett India P Ltd., New Delhi, 2017
4. Dean G Duffy "Advanced Engineering Mathematics with MATLAB", CRC., USA, 2017

19U202 MATERIALS SCIENCE

2002

QUANTUM MECHANICS : Wave particle duality, de Broglie waves- Heisenberg's uncertainty principle. Wave function-normalization. The wave equation. Schrodinger's equation of motion: Time dependent form, steady-state form. Particle in a box. Quantum Tunneling and applications to Scanning Tunneling Microscope and Tunnel diode. (8)

ELECTRICAL PROPERTIES : Conducting materials-quantum free electron theory -Fermi Dirac Statistics-Band theory of solids-the density of states. Dielectrics-types of polarization-measurement of dielectric permittivity-Loss factor-Dielectric loss mechanisms. Magnetostriction. Electron ballistics- materials for thermionic (7)

PHYSICS OF SEMICONDUCTORS : P type and N type semiconductors-the effective mass. Free electron and hole concentration in semiconductors. Band gap determination. Carrier concentration in n and p type semiconductor. P- N junction, rectifier equation -Hall effect-Quantum tunneling. Hetero junction-Quantum well, wire, dots- Optical properties of Semiconductors: LD, LED, Photo diode. Introduction to MEMS (8)

MAGNETIC PROPERTIES : Types of magnetic materials-domain theory-hysteresis- hard and soft magnetic materials-Applications-eddy current brakes, regenerative braking. Magnetic lenses. Superconductivity -Meissners effect- Josephson junction, SQUID magnetometer, applications. (7)

Total L: 30

TEXT BOOKS:

1. William D Callister Jr "Materials Science and Engineering - An Introduction", John Wiley and Sons Inc., New York, 2007, 6th Edition
2. Arthur Beiser "Concepts of Modern Physics", Tata McGraw Hill., India, 2002

REFERENCES:

1. James F Shackelford S "Introduction to Materials Science for Engineers", Macmillan Publishing Company., India, 1992, 3rd Edition
2. Van Vleck "Elements of Material Science and Engineering", Pearson Education., India, 2008
3. Sze S.M "Physics of Semiconductor Devices", John Wiley and Sons., USA, 2007
4. Donald R Askeland, Wendelin J Wright "Essentials of Materials Science and Engineering", Cengage Learning., USA, 2013, 3rd Edition

19U203 INDUSTRIAL ELECTROCHEMISTRY

2002

ELECTROCHEMISTRY: Conductance of strong and weak electrolytes, mobility of ions - transport number, applications of conductance measurement. Electrode potential — standard and reference electrodes, Nernst equation, emf series — applications. Galvanic and concentration cells. Applications of emf measurements — glass electrode - pH measurement, potentiometric redox titrations. (6)

CORROSION: Mechanisms - Galvanic and differential aeration corrosion. Corrosion rate — factors influencing corrosion - Galvanic series. Corrosion control - corrosion inhibitors, cathodic protection - sacrificial anode, current impression, conversion coatings — anodizing — determination of thickness of anodized film. Nature inspired coatings-super hydrophobic coatings, self healing coatings. Corrosion in electronic components — control by vapour phase inhibitor (6)

METAL FINISHING IN ELECTRONIC INDUSTRY: Electroplating — plating parameters- polarization and overvoltage, current and energy efficiency. Electroplating of Cu, Ni, and Cr. Electroless deposition of Ni and Cu. Production of plated through hole PCBs, electroforming - fabrication of CD stampers, electrochemical etching of Cu from PCBs, Electrophoretic painting, Electrochemical etching of semiconductors. (6)

ELECTROCHEMICAL POWER SOURCES: Batteries- types, characteristics. Fabrication and working of Leclanche cell, primary lithium cell, lead- acid battery, Ni-metal hydride and lithium ion batteries. Supercapacitors. Fuel cells - Classification, working principle, components, applications of proton exchange membrane, direct methanol and solid oxide fuel cells. Hydrogen as a fuel-production and storage. (6)

SENSORS: Components of electrochemical sensors, electrochemical transducers-potentiometric, amperometric and conductometric methods — ion-selective electrodes — solid-state electrode, liquid ion-exchange membrane electrodes. Gas sensors—CO₂, O₂ and NH₃ sensing. Sensors for healthcare—glucose and urea. (6)

Total L: 30

TEXT BOOKS:

1. Derek Pletcher and Frank C. Walsh "Industrial Electrochemistry", Chapman and Hall., London, 1993., 2nd edition
2. John O'M. Bockris and Amulya K. N. Reddy "Modern Electrochemistry 2B", Kluwer Academic/Plenum Publishers., New

York, 1998. , 2nd edition

REFERENCES:

1. Dell R. M. and Rand D. A. J "Understanding Batteries", Royal Society of Chemistry., UK, 2001. , 1st edition
2. Brian Eggins "Chemical Sensors and Biosensors", John Wiley & Sons., US, 2002. , 1st edition
3. Zaki Ahmad, Digby Macdonald "Principles of Corrosion Engineering and Corrosion Control", Butterworth- Heinemann., London, 2013. , 2nd edition

19U204 ELECTRONIC DEVICES AND CIRCUITS

3 0 0 3

DIODES : Semiconductor materials - N type and P type semiconductor - PN Junction - The Ideal diode - Diode operation - Voltage and current characteristics - Diode models - Diode datasheet - Diode testing - Zener diode - Zener diode applications - Varactor diode - LED - OLED and Quantum dots - Laser diode - Schottky diode - PIN diode - Step recovery diode - Tunnel Diode and Current regulated Diode - Diode applications - Rectifiers, Clippers and Clampers (9)

TRANSISTORS : Basic BJT operation - Characteristics and Parameter - Transistor as a switch, as an amplifier - Phototransistor - Transistor biasing circuits - DC Operating point - Voltage divider bias and other bias methods - Hybrid equivalent circuit of a transistor - General Black Box theory - JFET Characteristics, Parameters and Biasing - MOSFET Characteristics, Parameters and Biasing - MOSFET based digital switching - Characteristics and applications of UniJunction Transistor (9)

AMPLIFIERS : Amplifier concepts - Gain and attenuation - DC and AC analysis - Amplifier impedance - Output impedance - Input impedance - Impedance matching - Small signal amplifiers - BJT amplifier configurations - Introduction to differential amplifier - Gain impedance and phase - BJT parameters, AC emitter resistance - Power amplifiers - Class A, B, AB and Class C Power amplifiers - Push-Pull amplifiers (10)

OSCILLATORS : Elements of feedback oscillator - Conditions for oscillations - start up conditions - Oscillators with RC feedback circuits - Phase shift oscillator - Wein Bridge oscillator - Oscillators with LC feedback circuits - Colpitts oscillators - UJT relaxation oscillator - Crystal controlled oscillator (8)

VOLTAGE REGULATORS : Voltage regulation - Selection of voltage regulator - Basic linear series regulator - short circuit or overload protection - Foldback current limiting - Linear shunt regulator - Introduction to switching regulators - Integrated circuit voltage regulators (9)

Total L: 45

TEXT BOOKS:

1. Thomas L Floyd "Electronic Devices", Pearson., Prentice Hall India., 2019 , 9th edition
2. Robert T Paynter "Introductory Electronic Devices and Circuits", Pearson., New Delhi, 2012 , 7th edition

REFERENCES:

1. Bell D. A "Electronic Devices and Circuits", Oxford University Press., 2013 , 5th edition
2. Millman J. and Halkias C "Integrated Electronics", Tata McGraw-Hill., 2010
3. Nagrath I.J "Electronic Devices and Circuits", Prentice Hall India., 2007
4. Boylestad R. L. and Nashelsky "Electronic Devices and Circuit Theory", Pearson Education India., New Delhi, 2009.

19U210 CIRCUITS AND DEVICES LABORATORY

0 0 4 2

LIST OF EXPERIMENTS:

1. Characteristics of PN Junction Diode (Silicon diode –forward bias only)
2. Half wave and Full wave diode rectifiers
3. Diode Clipper and Clamper Circuits
4. Characteristics of Zener diode and Zener diode voltage regulator
5. Characteristics of Bipolar Junction Transistor (BJT)
6. Characteristics of Junction Field Effect Transistor (JFET)
7. Characteristics of Uni Junction Transistor (UJT)
8. Realization of Differential amplifier using Bipolar Junction Transistors (BJT)
9. Single stage RC coupled Common Emitter amplifier
10. RC phase shift oscillator using BJT
11. Relaxation oscillators using UJT
12. Series and Shunt voltage regulators using BJT

Total P: 60

REFERENCES:

1. Poornachandra Rao S. and Sasikala B "Handbook of experiments in Electronics and Communication Engineering", Vikas Publishing House Pvt. Ltd., New Delhi, 2010
2. Thomas L Floyd "Electronic Devices", Pearson, Prentice Hall India., 2019 , 9th edition
3. Laboratory manual prepared by the Department of Instrumentation and Control Systems Engineering 2019.

19U211 BASIC SCIENCES LABORATORY**0 0 4 2****PHYSICS LABORATORY (ANY EIGHT EXPERIMENTS):**

1. Determination of magnetic field along the axis of a coil
2. Determination of Hysteresis loss of a ferromagnetic material
3. Determination of resistivity of metal and alloy using Carey Foster bridge
4. Determination of Temperature Coefficient of Resistance of metallic wire using post office box
5. Determination of capacitance using LCR bridge
6. Study of reverse bias characteristics of Germanium diode and determination of its band gap
7. Study of I-V characteristics of solar cell and determination of its efficiency
8. Thermistor: Measurement of temperature and band gap
9. Determination of dielectric constant and Curie Temperature of Barium Titanate
10. Hall effect set up - Determination of Hall Coefficient

(30)

CHEMISTRY(ANY EIGHT EXPERIMENTS) :

1. Determination of hardness, TDS, pH and conductivity of a water sample.
2. Determination of molecular weight of polymers by Ostwald / Ubbelohde Viscometer.
3. Construction of phase diagram for eutectic system – for application in electronic cooling system.
4. Study of a galvanic cell.
5. Conductometric estimation of acid strength of a pickling bath.
6. Potentiometric estimation of ferrous ion in an effluent.
7. Anodizing of aluminium and determination of thickness of anodised film.
8. Preparation of chloride ion sensor by anodizing silver and calibration.
9. Electroplating of nickel & copper and determination of cathode efficiency.
10. Examination of different forms of corrosion using Ferroxy indicator and determination of corrosion rate by current measurement.

(30)

Total P: 60**REFERENCES:**

1. Department of Chemistry "Basic Science Laboratory Manual", 2019
2. Wilson J. D. and Hernandez C. A "Physics Laboratory Experiments", Cengage Learning., New York, 2014 , 8th edition
3. Department of Physics "Physics Practicals", PSG College of Technology., Coimbatore, 2019

19U212 COMPUTATIONAL TECHNIQUES**0 0 2 1****LIST OF EXPERIMENTS:**

1. Simple and complex numbers and their vector and polar forms
2. Elementary functions, their evaluations and series approximations
3. Polynomial interpolation schemes and curve fitting of data
4. Solutions of algebraic and transcendental equations
5. Matrix algebra and eigen values
6. Numerical differentiation and the finite difference methods
7. Approximate solutions of differential equations
8. Numerical integration
9. Arithmetic using graphical programming
10. Boolean operations using graphical programming

Total P: 30**REFERENCES:**

1. Syed Nasimul Alam, Sanjib Islam, Saroj Kumar Patel "Advanced Guide to Matlab: Practical Examples in Science and Engineering", I K International Publishing House Pvt. Ltd., New Delhi, 2015
2. Jovitha Jerome "Virtual Instrumentation using LabVIEW", PHI learning Pvt Ltd., New Delhi, 2010
3. John H Mathes, Kurtis D Fink "Numerical methods using MATLAB", PHI Learning Pvt. Ltd., New Delhi, 2014 , 4th Edition
4. Steven C Chapra "Applied Numerical Methods with MATLAB for Engineers and Scientists", McGraw-Hill., New Delhi,

- 2014 , 3rd Edition
5. Gary W Johnson, Richard Jennings "LabVIEW Graphical Programming", McGraw Hill., New Delhi, 2016 ,4th Edition

19U213 INTERNSHIP

0 0 0 2

MODULE - I INSTRUMENTATION AND CONTROL

1. Study of Sensors
2. Functioning of Measurement Systems - Demonstration
3. Functioning of Control Systems - Demonstration

MODULE - II MECHANICAL

1. Fitting - Tools, operations, exercises Make —L joint, types of joints.
2. Carpentry- Tools, carpentry process, carpentry exercises types of joints.
3. Sheet metal work - Tools, operations, exercises Make a Rectangular Tray in Galvanized Iron sheet

MODULE - III SEMINAR PRESENTATION AND TECHNICAL REPORT WRITING

1. Technical Presentation
2. Writing Technical Laboratory Report

REFERENCES:

1. Daniel G. Riordan "Technical Report Writing Today", Wadsworth Cengage Learning., USA, 2012 , 10th Edition

SEMESTER - 3

19U301 LINEAR ALGEBRA AND NUMERICAL ANALYSIS

3 1 0 4

VECTOR SPACE : General vector spaces, real vector spaces, Euclidean n-space, subspaces, linear independence, basis and dimension. (9 + 3)

SYSTEM OF LINEAR EQUATIONS, EIGENVALUES AND EIGENVECTORS : Errors - approximations and round-off errors — truncation errors, system of linear equations - Naive Gauss elimination method, Crout's method, Gauss – Seidel method, eigenvalues and eigenvectors using power method. (9 + 3)

INTERPOLATION, DIFFERENTIATION AND INTEGRATION : Newton's divided-difference interpolating polynomials, Lagrange interpolating polynomials, equally spaced data - Newton's forward and backward interpolating polynomials, numerical differentiation — evenly spaced data, numerical integration - Newton-cotes formulae, trapezoidal rule, Simpson's 1/3 rule. (9 + 3)

NUMERICAL SOLUTION TO ORDINARY DIFFERENTIAL EQUATIONS : Numerical methods for initial value problem, Taylor-series, Euler's method, modified Euler's method, Runge-Kutta method of 4th order, multi step methods - Milne method. (9 + 3)

NUMERICAL SOLUTION TO PARTIAL DIFFERENTIAL EQUATIONS : Finite difference: elliptic equations - the Laplace equation, Poisson equation — Liebmann method, parabolic equations — heat conduction equation — Crank Nicolson's method, hyperbolic equations – vibrating string. (9 + 3)

Total L: 45 +T: 15 = 60

TEXT BOOKS:

1. Howard Anton and Chris Rorres , "Elementary Linear Algebra", Wiley India, New Delhi, 2018.
2. Steven C Chapra and Raymond P Canale , "Numerical Methods for Engineers", Tata McGraw Hill, New Delhi, 2017.

REFERENCES:

1. David C Lay , "Linear Algebra and its Applications", Pearson, New Delhi, 2016.
2. Curtis F Gerald and Patrick O Wheatly , "Applied Numerical Analysis", Pearson, New Delhi, 2017.
3. Richard L Burden and Douglas J Faires , "Numerical Analysis", Thomas Learning, NewYork, 2017.
4. Ward Cheney and David Kincaid , "Numerical Mathematics and Computing", Cengage Learning, USA, 2018.

19U302 ELECTRICAL MACHINES

3 0 0 3

DC MACHINES : Principles of energy conversion - Construction and principle of operation of DC generator - EMF equation - Characteristics of DC generators - Principle of operation of DC motor - Torque equation- Characteristics of DC motors — Starting of DC motors - Speed control of DC motors - Losses and efficiency calculations- Braking - Applications of DC machines. (9)

TRANSFORMERS : Construction and principle of operation of single phase transformer- EMF equation- Equivalent circuit - Testing of transformer — Efficiency and voltage regulation - All day efficiency - Operation of auto transformers - Three phase transformer connections - Applications of single phase and three phase transformer. (9)

SYNCHRONOUS MACHINES : Construction and principle of operation of three phase alternators - EMF equation - Determination of regulation - Theory of operation of synchronous motor - Methods of starting- Operating characteristics: Constant excitation with variable load and constant load with variable excitation – Synchronous condenser—Applications (9)

INDUCTION MOTORS : Construction and principle of operation of three phase induction motor - Classification of induction motor - Torque production — Torque-Slip characteristics - Maximum torque - Starting and speed control - Principle of operation of single phase induction motor - Types of single phase induction motors and their applications. (9)

SPECIAL MACHINES : Stepper motor — Switched reluctance motor - Universal motor - Brushless DC motor - Permanent magnet synchronous motor - Servomotor - Linear induction motor. (9)

Total L: 45

TEXT BOOKS:

1. Kothari D P and Nagrath I J , "Electric Machines", 4th Edition, Tata McGraw Hill, 2014.
2. Bimbhra , "Electrical Machinery", 7th Edition, Khanna Publishers, 2011.

REFERENCES:

1. Theodore Wildi , "Electrical Machines, Drives and Power Systems", 6th Edition, Pearson Education, 2013.
2. Murugesh Kumar K , "DC Machines and Transformers", 2nd Edition, Vikas Publishing House, 2016.
3. Bhattacharya S.K , "Electrical Machines", 4th Edition, Tata McGraw Hill, 2015.
4. Bandyopadhyay. M.N , "Electrical Machines Theory and Practice", 4th Edition, PHI Learning Private Limited, New Delhi, 2014.

19U303 DIGITAL ELECTRONICS

3 1 0 4

NUMBER SYSTEMS AND BOOLEAN FUNCTIONS : Review of Number Systems, number complements, Binary arithmetic, Binary codes: weighted and non-weighted codes, alphanumeric codes, Error detection and correction codes, Switching functions, Canonical forms, Incompletely specified functions, Simplification of logic functions through Boolean Algebra, K — maps and Quine-McClusky method, Implementation of logic functions using basic logic gates and universal gates. (9 + 3)

COMBINATIONAL LOGIC DESIGN : Design of Arithmetic circuits-Adders / subtractors, Carry look-ahead adder, signed number addition and subtraction, BCD adders, IC adders, Magnitude comparator, Decoders, Encoders, Multiplexers and Demultiplexers. Implementation of combinational logic function using multiplexers and demultiplexers. (9 + 3)

SEQUENTIAL LOGIC DESIGN : General model of sequential circuits — Latch, Flip Flops, Design of synchronous sequential circuits — Up-down / Modulus counters, Shift register : Ring counter, Johnson counter, Timing diagram. Mealy/Moore models — Concept of state, State diagram, State table, Design of sequence detector, State reduction procedures using Partitioning and Implication chart. Introduction to Asynchronous Sequential Circuits — Fundamental mode and Pulse mode circuit(9 + 3)

PROGRAMMABLE LOGIC DEVICES : Semicustom design - Introduction to Programmable Logic Devices — Read Only Memory, Programmable Array Logic, Programmable Logic Array, Field Programmable Logic Array, Field Programmable Logic Sequencer, Architecture of Programmable Logic Devices , Implementation of digital functions. (9 + 3)

DIGITAL LOGIC FAMILIES : Characteristics of digital ICs — Voltage and current ratings, Noise margin, Propagation delay, Power dissipation, Fan-in, Fan-out. TTL logic family — Totem pole, Open collector and tristate outputs. MOS transistor switches –nMOS Inverter / Logic gates, CMOS Inverter / logic gates, ECL logic families, Comparison of performance of various logic families, Interfacing TTL and CMOS devices.. (9 + 3)

Total L: 45 +T: 15 = 60

TEXT BOOKS:

1. M. Morris Mano, Michael D. Cilette , "Digital Design", 5th Edition, Prentice Hall, 2011.
2. Donald P Leach, Albert Paul Malvino, Gautam Saha , "Digital Principles and Applications", 7th Edition, Tata McGraw Hill, 2011.

REFERENCES:

1. Tocci R J, Widmer.N S , "Digital Systems : Principles and Applications", 10th Edition, Pearson Education Pvt. Ltd, 2011.
2. Donald D Givone , "Digital Principles and Design", Tata Mc Graw-Hill, 2016.
3. Anand Kumar , "Fundamentals of Digital Circuits", 2nd Edition, Prentice Hall of India, Pvt Ltd, New Delhi, 2010.
4. Thomas L Floyd , "Digital Fundamentals", 10th Edition, Prentice Hall, 2009.

19U304 LINEAR ICS AND APPLICATIONS

3 0 0 3

OPERATIONAL AMPLIFIER CHARACTERISTICS : Functional Block Diagram - Symbol - Characteristics of an ideal operational amplifier - Circuit schematic of 741 op-amp - Open loop gain - CMRR - DC characteristics - Frequency response characteristics - stability - limitations - frequency compensation - slew rate (9)

LINEAR APPLICATIONS OF OPERATIONAL AMPLIFIERS : Inverting and Non-inverting amplifiers - Voltage follower - Summing amplifier - Differential amplifier - Instrumentation amplifier: Design and applications - Integrator and Differentiator - Voltage to Current and Current to Voltage converters - Active filters - Design of Butterworth filters - low pass, high pass, wide band pass, Band stop and notch filter (9)

NON-LINEAR APPLICATIONS OF OPERATIONAL AMPLIFIERS : Comparator - Regenerative comparator - Zero crossing detector - Window detector - Sample and Hold circuit - Precision diode - Half and Full wave rectifiers - Active peak detector - Clipper and Clamper - Logarithmic and Exponential amplifiers - Square and Triangular waveform generators (9)

VOLTAGE REGULATORS AND SPECIAL FUNCTION ICS : Block diagram of 723 general purpose voltage regulator - Circuit configurations, Fixed and adjustable three terminal regulators - 555 Timer - Functional block diagram and description - Monostable and Astable operation, Applications - Voltage Controlled Oscillator - PLL: Functional Block diagram - Principle of operation- Applications (9)

D/A AND A/D CONVERTERS : Digital to Analog Converters - Binary weighted and R-2R Ladder types - Analog to digital converters - Continuous, Counter ramp - Successive approximation, Single slope - Dual slope and Parallel types - Sigma-Delta type ADC -Performance characteristics (9)

Total L: 45

TEXT BOOKS:

1. Roy Choudhury, Shail Jain , "Linear Integrated Circuits", 5th Edition, New Age International Limited, 2018.
2. Coughlin F R, Driscoll F F , "Operational Amplifiers and Linear Integrated Circuits", 6th Edition, Pearson Education, Noida, 2016.

REFERENCES:

1. Gayakwad A R , "OP-amps and Linear Integrated circuits", 4th Edition, Pearson Education, Noida, 2016.
2. Sedra, Smith , "Microelectronic Circuits", 6th Edition, Oxford University Press, 2015.
3. David A Bell , "Operational Amplifiers and Linear ICs", 3rd Edition, Prentice Hall of India, 2013.
4. Sergio Franco , "Design with Operational Amplifiers and Analog Integrated Circuits", 3rd Edition, McGraw Hill, 2012.

19U305 THERMODYNAMICS AND FLUID MECHANICS

3 0 0 3

BASIC CONCEPTS OF THERMODYNAMICS : System, property, state and equilibrium, process and cycle, work, heat and other forms of energy. Zeroth law and application, first law - statement, applications to closed and open systems, statements - Heat engine, refrigerator and heat pump, reversibility and irreversibility, Carnot cycle and Carnot theorem, second law, entropy - Thermo Dynamic Cycles: Air standard cycles - Otto cycle, Diesel cycle, Dualcycle, Brayton cycle. Rankine cycle (12)

BASIC CONCEPT OF FLUID MECHANICS : Introduction — Classification — Types of fluids — Properties — Laws of pressure — Atmospheric, gauge, absolute pressure, pressure measurement — Manometers — Mechanical gauges - Flow of fluids: Introduction — Types of fluid flow — Velocity — Rate equation of continuity — Energy of a liquid in motion — Head of a liquid (9)

FLOW THROUGH CIRCULAR PIPES : Pipes in series and parallel. Reynolds number, Darcy-Weisbach equation, minor losses- Sudden expansion, sudden contraction and losses in pipe fittings (9)

HYDRAULIC TURBINES AND PUMPS : Impulse type, Pelton wheel, reaction type, Francis, Kaplan and Propeller — Principle of operation, performance of turbines, draft tube. Hydraulic pumps: Classification - Reciprocating and centrifugal pumps - Performance studies, fluid coupling and torque converter (9)

COMPRESSORS : Classification, reciprocating and centrifugal compressors, applications, characteristics, surging and stalling (6)

Total L: 45

TEXT BOOKS:

1. Nag P K , "Engineering Thermodynamics", Tata McGraw Hill Publishing Company, New Delhi, 2004.

2. Frank M White , "Fluid Mechanics", Tata McGraw Hill Education Pvt. Ltd, New Delhi, 2011.

REFERENCES:

1. Kothandaraman C P and Rudramoorthy R , "Basic Fluid Mechanics", New age International Publishers, Chennai, 1998.
2. Kumar D S , "Fluid Mechanics and Fluid Power Engineering", Kataria S K and Sons, New Delhi, 2010.
3. Holman J P , "Thermodynamics", McGraw Hill Book Company, 1988.
4. Yunus A Cengel and Michael A Boles , "Thermodynamics, An Engineering Approach", Tata McGraw Hill, 2006.

190306 ECONOMICS FOR ENGINEERS

3 0 0 3

INTRODUCTION : Definition — Nature and Scope — Central Problems of an Economy — Positive and Normative Economics— Micro Economics and Macro Economics, Significance of Economics, Economic Assumptions. (9)

THEORY OF CONSUMER BEHAVIOR : Utility — Indifference Curve Analysis - Properties, Consumer's Budget Line - Demand Analysis: Demand Function and Law of Demand, Elasticity of Demand. Demand forecasting using Econometric Techniques. Supply— Factors Affecting Supply, Market Equilibrium Price, Consumer Surplus. (9)

PRODUCTION, COST AND REVENUE : Production Function, Total Product, Average Product and Marginal Product, Returns to Scale. Costs, Nature of Costs, Short-run and Long-run Cost Curves, Revenue concepts. (9)

MARKET STRUCTURE : Types of Markets - Perfect Competition — Characteristics — Imperfect Competition: Monopoly — Monopolistic Competition — Oligopoly and Duopoly - Price Discrimination and Product Differentiation under Different Markets — Price and Output Determination in Short run and Long run and profit maximization. (9)

PERFORMANCE OF AN ECONOMY (MACRO ECONOMICS) : Demand and Supply of Money — Quantity Theory of Money, Banking — Functions of Commercial Banks and Central Bank — Inflation — Causes — Control Measures — National Income — Concepts — Methods of Calculating National Income — Problems in Calculating National Income. (9)

Total L: 45

TEXT BOOKS:

1. Varian H.R. , "Intermediate Microeconomics", East– West Press, New Delhi, 2014.
2. Dewett.K.K, Navalur. M.H. , "Modern Economic Theory", S. Chand, New Delhi, 2015.

REFERENCES:

1. William A, McEachern, Simrit Kaur , "Micro ECON", Cengage Learning, Noida, 2013.
2. William A, McEachern, Indira A. , "Macro ECON", Cengage Learning, Noida, 2014.
3. Deepashree , "Principles of Economics", Ane Books Pvt Ltd, New Delhi, 2010.
4. Dwivedi , "Essentials of Business Economics", Vikas Publishing House Pvt Ltd, New Delhi, 2010.

19U310 ELECTRICAL MACHINES LABORATORY

0 0 4 2

LIST OF EXPERIMENTS :

1. No-load and Load Characteristics of DC Shunt Generator
2. Load Characteristics of Compound Motor
3. Load Characteristics of DC Series Motor
4. Open Circuit and Short Circuit Tests on Single phase Transformer
5. Load Test on Single phase Transformer
6. Load Test on Three phase Alternator
7. Load Test on Three phase Induction Motor
8. Load Test on Single phase Induction Motor
9. Electrical Braking of DC shunt motor
10. Speed control of DC shunt motor

Total P: 60

REFERENCES:

1. Gupta B R, Vandana Singhal , "Fundamentals of Electrical Machines", 3rd Edition, New Age International Publishers, 2010.
2. Department of Instrumentation and Control Systems Engineering , "Laboratory manual", 2019.

19U311 LINEAR AND DIGITAL ICS LABORATORY

0 0 4 2

ANALOG ICS BASED EXPERIMENTS :

1. Implementation of linear applications of operational amplifier
2. Implementation of Non linear applications of operational amplifier
3. Design and implementation of active filters

4. Implementation of voltage regulators
 5. Realization of astable multivibrator using 555 timer
- (30)

DIGITAL ICS BASED EXPERIMENTS :

1. Realization of universal gates using basic logic gates
 2. Design and implementation of combinatorial circuits
 3. Design and implementation of flip flops using logic gates
 4. Design and implementation of counters and registers
 5. Design of synchronous sequential circuits
- (30)

Total P: 60

REFERENCES:

1. David A Bell , "Laboratory manual for operational amplifiers and Linear ICs", 2nd Edition, Prentice Hall of India, New Delhi, 2005.
2. Department of Instrumentation and Control Systems Engineering , "Laboratory manual", 2019.

19K312 ENVIRONMENTAL SCIENCE

2 0 0 0

INTRODUCTION TO ENVIRONMENT :Environment - Definition, scope and importance. Types and composition of atmosphere — particles, ions and radicals. Ozone layer- significance, formation and depletion. Ecosystems- Structure and functions, components, energy flow, food chains, food web, Biodiversity-levels, values and threats — India as a mega-diversity nation — hotspots of biodiversity — endangered and endemic species of India — conservation of biodiversity. (6)

ENERGY RESOURCES : Introduction — National and International status- exploitation - sustainable strategies- Fossil fuels- classification, composition, physico-chemical characteristics and energy content of coal, petroleum and natural gas; solar energy - introduction, harnessing strategies. Wind energy - availability, wind power plants, wind energy conversion systems, site characteristics, and types of wind turbines. Supporting renewable energy resources - tidal –geothermal -hydroelectric. (6)

ENVIRONMENTAL POLLUTION : Definition — Sources, causes, impacts 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 (h) RF hazards - Role of an individual in prevention of pollution. **DISASTER MANAGEMENT:** Floods, earthquake, cyclone and landslides — Case studies, consequences and rescue measures (6)

WASTE MANAGEMENT : Wastewater - Characteristics of domestic and industrial wastewater - COD and BOD — Various stages of treatment — primary, secondary, tertiary treatment- Biological and advanced oxidation processes. Solid waste management — Characteristics of municipal solid waste(MSW), biomedical, automobile and e-wastes and their management — landfills, incineration, pyrolysis, gasification and composting. (6)

SOCIAL ISSUES AND THE ENVIRONMENT : Environmentally Sustainable work practices- Rain water harvesting — Role of non-governmental organizations. Human ethics and rights- impact on environment and human health — role of information technology on environment and human kind. Green IT policies, Process of EIA - ISO 14000. Legislation- Environment protection act — Air (Prevention and Control of Pollution) act — Water (Prevention and control of Pollution) act — Wildlife protection act— Forest conservation act. (6)

Total L: 30

TEXT BOOKS:

1. Gilbert M.Masters , "Introduction to Environmental Engineering and Science", Pearson Education, New Delhi, 2004.
2. De A K , "Environmental Chemistry", New Age International P Ltd, New Delhi, 2006.

REFERENCES:

1. Benny Joseph , "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2006.
2. KoteswaraRao MVR, "Energy Resources: Conventional & Non-Conventional", BSP Publications, New Delhi, 2006.
3. Deswal S and Deswal A, "A Basic Course in Environmental Studies", Dhanpat Rai and Co, New Delhi, 2004.

SEMESTER - 4

19U401 PROBABILITY AND RANDOM PROCESSES

3 1 0 4

PROBABILITY : Probability axioms, some consequences of the axioms, conditional probability, law of total probability, Baye's theorem, independence, sequential experiments and tree diagrams, reliability problems. (9 + 3)

RANDOM VARIABLES : Discrete random variables — probability mass function, binomial, Poisson and geometric random variables, cumulative distribution function, expectations. Continuous random variables — probability density function,

uniform, exponential, Gaussian random variables, expectations. (9 + 3)

PAIRS OF RANDOM VARIABLES : Joint cumulative distribution function, joint probability mass function, marginal probability mass function, joint probability density function, marginal probability density function, expected values, independent random variables, covariance. (9 + 3)

STOCHASTIC PROCESSES : Types of stochastic processes — Poisson process, Brownian motion process, expected value and correlation, stationary processes, wide sense stationary stochastic process, cross-correlation (9 + 3)

RANDOM SIGNAL PROCESSING : Linear filtering of a continuous-time stochastic process, linear filtering of a random sequence, power spectral density of a random sequence. (9 + 3)

Total L: 45 +T: 15 = 60

TEXT BOOKS:

1. Roy D. Yates and David J Goodman, "Probability and Stochastic Processes — A friendly Introduction for Electrical and Computer Engineers", Wiley India, New Delhi, 2014.
2. Saeed Ghahramani, "Fundamentals of Probability with Stochastic Processes", CRC Press, Taylor & Francis Group, USA, 2018.

REFERENCES:

1. Kishore S. Trivedi, "Probability and Statistics with reliability, queueing and computer science applications", PHI Learning Pvt Ltd, New Delhi, 2016.
2. Sheldon M. Ross, "Stochastic Processes", Wiley India, New Delhi, 2016.
3. Athanasios Papoulis and Unnikrishna Pillai S, "Probability, Random Variables and Stochastic Processes", Tata McGraw Hill, New Delhi, 2011.
4. William Feller, "An Introduction to probability theory and its applications", Wiley India, New Delhi, 2013.

19U402 TRANSDUCER ENGINEERING

3 0 0 3

SCIENCE OF MEASUREMENT : Units and Standards –General concept and terminology of measurement systems– General input-output configuration - transducer classification –Static and Dynamic characteristics– Calibration techniques (analog and digital) – Statistical analysis of measurement data (9)

RESISTANCE TRANSDUCERS : Principles of operation, construction details, characteristics of resistance transducers, resistance potentiometers, metal and semiconductor strain gauges. Signal conditioning circuits. Applications of strain gauge for measurement of load and torque (9)

INDUCTIVE TRANSDUCERS : Induction potentiometer, variable reluctance transducers, LVDT, eddy current transducers, synchros and resolvers, magneto-strictive transducers, electromagnetic sensors — associated signal conditioning circuits for above transducers- Proximity sensor (9)

OTHER SENSORS : Piezo-electric transducer, Piezo resistive sensor, capacitive transducer, Hall effect transducer, tachogenerator, stroboscope, photoelectric transducers, thermocouples, gyroscope, seismic instruments and accelerometers, digital displacement transducers, fibre optic sensor, IC sensor, LIDAR (9)

MICRO AND SMART SENSORS : MEMS sensors and actuators, principle and application. Smart sensors: Introduction construction, advantages and application, flexible sensors, Gas sensors (9)

Total L: 45

TEXT BOOKS:

1. Doebelin E O, "Measurement Systems — Application and Design", 5th Edition, Tata McGraw-Hill, 2010.
2. John P. Bentley, "Principles of Measurement Systems", 3rd Edition, Pearson Education, 2009.

REFERENCES:

1. Murty D.V.S, "Transducers and Instrumentation", 2nd Edition, Prentice-Hall of India Private Limited, New Delhi, 2009.
2. Srinivasan A V, Michael D and McFarland, "Smart Structures: Analysis and Design", Cambridge University Press, 2001.
3. James W. Dally, William F. Riley and Kenneth G. McConnell, "Instrumentation for Engineering Measurements", 2nd Edition, Wiley Publishers, 2004.
4. Gondi Ananthasuresh, K. J. Vinoy, S. Gopalakrishnan, K. N. Bhat, V. Vasudev Aatre, "Micro and Smart Systems", Wiley Publishers, 2010.

19U403 ELECTRICAL AND ELECTRONIC MEASUREMENTS

3 0 0 3

ELECTRO MECHANICAL INSTRUMENTS : Classification of instruments, Operating forces and Control systems for electromechanical indicating instruments, D'Arsonval galvanometer- Permanent Magnet Moving Coil instrument, Moving iron instruments, Electro-dynamometer type instruments - Construction, Torque equation, Errors, Extension of instrument ranges, Use of Shunts, Multipliers and Instrument transformers. (9)

MEASUREMENT OF POWER AND ENERGY : Electro-dynamometer wattmeter, Torque expression, errors, Measurement of power using instrument transformers, Measurement of power in single and three phase circuits, Single phase induction type energy meter, Digital energy meter, Single phase Electro-dynamometer Power Factor meter. (9)

MEASUREMENT OF RESISTANCE : Classification of resistances, Measurement of resistances: Ammeter Voltmeter method, Substitution method, Wheatstone bridge, Kelvin's double bridge method, Meggar, Potentiometers . (9)

IMPEDANCE MEASUREMENTS : General equation for bridge balance — Maxwell's bridge — Wien's bridge — Hay's bridge — Schering bridge—Anderson bridge—Campbell bridge to measure mutual inductance. (9)

TEST AND MEASURING INSTRUMENTS : Evolution of measuring instruments, Digital voltmeter of Ramp and Integrating types, Digital multimeter, Digital Storage Oscilloscope, Mixed Signal Oscilloscope, Waveform analysers— Distortion meter - Spectrum Analyzer, Signal generators. (9)

Total L: 45

TEXT BOOKS:

1. Golding E W, Widdis F C , "Electrical Measurements and Measuring Instruments", Reem Publications, New Delhi, 2009.
2. David A Bell , "Electronic Instrumentation and Measurements", Oxford Publisher, 2017.

REFERENCES:

1. Kalsi H S . , "Electronic Instrumentation", Tata McGraw-Hill, New Delhi, 2013.
2. Sawhney A K , "A Course in Electrical and Electronic Measurement and Instrumentation", Dhanpat Rai and Sons, New Delhi, 2017.
3. Albert D, Helfrick, William D Cooper , "Modern Electronic Instrumentation and Measurement Techniques", Pearson Education, New Delhi, 2016.
4. Rangan C S, Sharma G R, Mani V S , "Instrumentation Devices and Systems", McGraw Hill Education, Chennai, 2017.

19U404 CONTROL SYSTEMS I

3 1 0 4

INTRODUCTION TO CONTROL SYSTEMS: History of control systems - Types of control systems: Open loop and closed loop - Mathematical modeling: Linearization, modeling of mechanical systems, electrical systems, liquid level systems, and thermal systems - Electrical analogy of physical systems - Reduction of multiple subsystems: block diagram, signal flow graphs. (9+3)

TRANSIENT AND STEADY STATE RESPONSE ANALYSIS: Introduction - Standard test signals - Time response of prototype first order and second order systems – Effects of adding poles and zeros to transfer functions - Higher order systems: dominant closed loop poles - Determination of open loop and closed loop transfer function from time response - Analysis of steady state error: static error constants, specifications and sensitivity - Characteristic equation – Concepts of stability: absolute and relative stability – Routh -Hurwitz criterion. (9+3)

CONTROL SYSTEMS ANALYSIS AND DESIGN BY ROOT-LOCUS METHOD: Introduction – Root locus plots – General rules for constructing root loci – Root locus approach to control system design - Lead, Lag, Lag-Lead compensator - Design of parallel compensator- Introduction to root contours. (9+3)

CONTROL SYSTEMS ANALYSIS AND DESIGN BY FREQUENCY RESPONSE METHOD: Introduction - Bode diagrams - Polar plots - Log magnitude versus phase plots - Nyquist stability criterion - Stability analysis - Relative stability analysis – Correlation between step transient response and frequency response in the prototype second order system - Constant M-N circles – Nichols chart - Experimental determination of transfer functions- Control system design by frequency response: Lead, lag, Lag-Lead compensators. (9+3)

INTRODUCTION TO INDUSTRIAL CONTROLLERS: Proportional, Integral and Derivative modes of control – PI, PD, PID controllers – Tuning rules for PID controllers - Modification of PID control schemes - Robust control systems and system sensitivity – Design of robust PID controlled system. (9+3)

TEXT BOOKS:

1. K Ogata, "Modern Control Engineering", Pearson, Fifth Edition, 2018

2. Farid Galnaraghi & Benjamin C. Kuo , "Automatic Control System", Ninth Edition, John Wiley & Sons, Inc, 2010

REFERENCES:

1. Richard C Dorf & Robert H Bishop, "Modern Control Systems", Global Edition, Pearson Education Limited, 2016
2. Norman S Nise, 'Control Systems Engineering', Sixth Edition, John Wiley & Sons, 2011.
3. M. Gopal, "Control Systems: Principles and Design", Fourth Edition, Tata McGraw Hill, New Delhi, 2012
4. Smarajit Ghosh, "Control Systems: Theory and Applications", Pearson Education India, Second Edition, 2012.

19U405 PRINCIPLES OF COMMUNICATION SYSTEMS

2 0 0 2

AMPLITUDE MODULATION : Electromagnetic Waves, Principles of Amplitude Modulation, AM Generation, AM Transmitter, AM Receiver, AM Detection. (6)

ANGLE MODULATION : Frequency Modulation, Direct and Indirect Method of FM Generation, FM Transmitter, FM Receiver, FM Detection, Phase Modulation. (6)

DIGITAL MODULATION : Introduction to Digital Communication, Digital Modulation Schemes: Amplitude Shift Keying, Frequency Shift Keying, Phase Shift Keying, Quadrature Phase Shift Keying and Differential Phase Shift Keying. (6)

DIGITAL TRANSMISSION : Pulse Modulation Techniques: Pulse Amplitude Modulation, Pulse Frequency Modulation, Pulse Position Modulation, Pulse Width Modulation, Pulse Code Modulation, Differential PCM and Delta Modulation, Multiplexing Techniques, Digital communication system. (6)

ADVANCED COMMUNICATION SYSTEMS : Fiber Optic Communication, Mobile Communication, Telemetry, Wireless Technologies: Wireless LAN, Bluetooth, 6LoWPAN Zigbee. (6)

Total L: 30

TEXT BOOKS:

1. Wayne Tomasi, "Electronic Communications Systems — Fundamentals Through Advanced", 5th Edition, Pearson Education Inc, New Delhi, 2013.
2. Louis E. Frenzel , "Principles of Electronic Communication Systems", 3rd Edition, McGraw-Hill Education (I) P Ltd, New Delhi, 2016.

REFERENCES:

1. George Kennedy, Bernard Davis, Prasanna S R M , "Electronic Communication System", 3rd Edition, McGraw- Hill Education (I) P Ltd, New Delhi, 2016.
2. Simon Haykin , "An Introduction to Analog and Digital Communications", Wiley India, New Delhi, 2010.
3. Lathi B.P, Zhi Ding , "Modern Digital and Analog Communication Systems", 4th Edition, Oxford University Press, 2017.
4. Bernard Sklar , "Digital Communications — Fundamentals and Applications", 2nd Edition, Pearson, Noida, 2018.

19U406 DATA STRUCTURES AND ALGORITHMS

3 0 0 3

ALGORITHM AND ANALYSIS : Data types — Abstract data types - Linear and Non-linear Data structures. Algorithms- Structure and properties — Design and development of algorithm- Recursive Algorithms-Tower of Hanoi puzzle-Analysis of Algorithms- Best case, Average case, Worst case — Asymptotic Notations. (9)

ARRAYS AND STACKS : Arrays- operations — Memory Representation- Row Major and Column Major — Multi Dimensional Arrays — Applications— Sparse Matrix-ordered lists. Stack :Array implementation — operations- Applications – Evaluation of expressions: Infix, prefix and postfix expressions. (9)

QUEUES : Array implementation – Operations-Circular Queue – Priority Queues. Linked List: Types-Singly Linked List – Circularly Linked List – Doubly Linked List – Operations. Linked Stacks and Linked Queues- Applications. (7)

NON-LINEAR DATA STRUCTURES : Trees- Definitions -Terminologies - Binary trees — Representations — Operations – Traversals- Inorder, Preorder and Postorder- Binary Search Trees – Insertion and deletion. – Graph - Definitions- Terminologies-Breadth First Search algorithm- Depth First Search Algorithm. (8)

SORTING AND SEARCHING : Bubble Sort — Insertion Sort- Selection sort- Radix Sort- Algorithms and Time Complexity. Linear Search — Binary Search — Hashing: Hash functions — Separate Chaining — Open Addressing — Linear Probing. (12)

Total L: 45

TEXT BOOKS:

1. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein , "Introduction to Algorithms", The MIT Press, 2014.
2. Aaron M Tanenbaum, Moshe J Augenstein, YedidyahLangsam , "Data structures using C and C++", PHI Learning, 2009.

REFERENCES:

1. Mark Allen Weiss , "Data Structures and Algorithm Analysis in C++", Pearson Education, 2012.
2. Ellis Horowitz, SartajSahni, Sanguthevar Rajasekaran , "Fundamentals of Computer Algorithms", 2nd Edition, Universities Press, 2011.
3. Sahni Sartaj , "Data Structures, Algorithms and Applications in C++", Silicon Press, 2009.
4. Reema Thareja , "Data Structures using C", 2nd Edition, Oxford Publication, 2014.

19U410 TRANSDUCER LABORATORY**0 0 4 2****LIST OF EXPERIMENTS :**

1. Measurement of strain using strain gauges
2. Measurement of linear displacement using LVDT
3. Characteristics of Hall effect sensor
4. Characteristics of temperature sensors
5. Measurement of vibration
6. Measurement of pressure
7. Measurement of distance using proximity sensors
8. Experimental study of loading effect of potentiometer
9. Implementation of opto-coupler using photoelectric transducers
- 10.Characteristics of capacitive measurement systems
- 11.Study of angular displacement measurement using digital transducer
- 12.Study of sound intensity measurement

Total P: 60**REFERENCES:**

1. John P Bentley , "Principles of Measurement Systems", 3rd Edition, Pearson Education, 2015.
2. Department of Instrumentation and Control Systems Engineering , "Laboratory Manual", 2019.

19U411 SYSTEMS AND MEASUREMENT LABORATORY**0 0 4 2****LIST OF EXPERIMENTS :**

1. Measurement of resistance using Wheatstone bridge and Kelvin's Double bridge
2. Measurement of capacitance and inductance using Schering Bridge and Anderson Bridge
3. Extension of instrument ranges
4. Calibration of energy meter using Phantom loading method.
5. Calibration of voltmeter and ammeter
6. Time response of first order systems for test inputs
7. Time response of second order system for test inputs
8. Frequency response analysis of systems
9. Study of effect of adding poles and zeros
- 10.Design of compensation networks

Total P: 60**REFERENCES:**

1. Golding E W, Widdis F C , "Electrical Measurements and Measuring Instruments", Reem Publications, New Delhi, 2009.
2. Department of Instrumentation and Control Systems Engineering , "Laboratory manual", 2019.

19O412 INDIAN CONSTITUTION**2 0 0 0****INTRODUCTION :** Evolution of Indian Constitution; Significance of Constitution; Composition; Preamble and its Philosophy. (4)

RIGHTS, DUTIES AND DIRECTIVE PRINCIPLES : Fundamental Rights- Writs and Duties, Directive Principles of State Policy (6)

COMPOSITION OF PARLIAMENT AND FEDERALISM : : Union Government, President and Vice President, Houses of the Parliament and their functions; Composition of State Legislature; Powers, Functions and Position of Governor, Function of Chief Ministers, Council of Ministers; The Indian Federal System, Administrative Relationship between Union and States. (8)

BILLS AND CONSTITUTION AMENDMENT PROCEDURE : Types of Bills, Stages of passing of Bill into an Act, Veto Power, Constitution Amendment Procedure, Various Amendments made and their significance for India. (6)

JUDICIARY : Supreme Court and High Court; Functions and powers, Judicial Review. (6)

Total L: 30

TEXT BOOKS:

1. Subash C. Kashyap , "Our Constitution", 5th Edition, NBT, India, New Delhi, 2015.
2. Basu D D , "Introduction to the Constitution of India", 20th Edition, Prentice Hall of India, New Delhi, 2011.

REFERENCES:

1. Brijji Kishore Sharma , "Introduction to the Constitution of India", 8th Edition, Prentice Hall of India, New Delhi, 2017.
2. Hoshiar Singh , "Indian Administration", 1st Edition, Pearson Education, New Delhi, 2011.
3. Jain M C , "The Consitution of India", 5th Edition, State Mutual Book & Periodical Service, Limited, New Delhi, 1988.
4. Shukla V N , "Consitution of India", 13th Edition, Eastern Book Company Limited, New Delhi, 2017.

19Q413 SOFT SKILLS DEVELOPMENT

0 0 2 1

SOFT SKILLS DEVELOPMENT :

1. Body Language and Professionalism
2. Interpersonal skills
3. Goal setting
4. Impression Management
5. Team Building
6. Time Management
7. Stress Management
8. Convincing Skills
9. Motivation
10. Change Management
11. Communication Confidence
12. Group discussion basics
13. Personal Interview basics
14. Resume writing

Total P: 30

REFERENCES:

1. Jeff Butterfield , "Soft Skills for Everyone", 6th Edition, Cengage Learning, Delhi, 2015.
2. Rao M S , "Soft Skills - Enhancing Empolyability", LK International Publishing House, New Delhi, 2011.

SEMESTER - 5

19U501 INDUSTRIAL INSTRUMENTATION I

3 0 0 3

PRESSURE MEASUREMENT : Terminologies - Units - Manometer types - Elastic elements: Bourdon tube-Bellows- Diaphragm. Electrical Methods: Elastic elements with LVDT and strain gauges-Capacitive type pressure gauge - Piezo resistive pressure sensors- I/P converter- Low pressure measurement: McLeod gauge-Thermal conductivity gauges-Ionization gauge-Cold cathode and hot cathode types - Testing and calibration of pressure gauges: Dead weight tester (9)

LEVEL MEASUREMENT : Units - Sight glass - Dip stick - Float type - Level measurement in open and closed head tanks - Bubbler method- Tuning fork and displacer methods -Differential pressure method- Mounting Issues - Purge system - Electrical methods of level measurement using resistance,capacitance, radar, nuclear radiation and ultrasonic sensors - Level switches

- Calibration of level sensors (9)

TEMPERATURE MEASUREMENT : Units - Filled-in systems: Different types - Sources of errors and their compensation - Bimetallic thermometer - Electrical methods of temperature measurement: RTD - Types of RTDs - 3 wire and 4 wire RTDs - Thermistor - Linearization - Diode type sensors - Integrated circuit sensors - Temperature switches and thermostats - Thermal Imaging - Calibrators - Calibration of temperature sensors (9)

THERMOCOUPLES AND RADIATION PYROMETERS : Thermocouple - Laws and types of thermocouple - Fabrication of industrial thermocouples - Signal conditioning - Cold junction compensation - Thermocouple burnout detection - Special techniques for measuring high temperature using thermocouples - Thermopile - Installation - Radiation fundamentals - Radiation methods of temperature measurement: Radiation pyrometers - Total radiation pyrometers - Optical radiation pyrometers - Ultrasonic thermometers - Fiber optic temperature measurement (9)

MEASUREMENT OF VISCOSITY, HUMIDITY, DENSITY AND MOISTURE : Units- Viscosity -Terminologies - Saybolt viscometer - Torsion Viscometer - Rotameter type viscometer. - Humidity terms - Dry and wet bulb psychrometers - Hotwire electrode type hygrometer-Dew cell - Electrolysis type hygrometer - Capacitive humidity sensor - Density measurement using weight, buoyancy, hydrostatic head and radiation methods - Moisture measurement - Electrical methods - Overview of weight measurement techniques (9)

Total L: 45

TEXT BOOKS:

1. Donald P Eckman , "Industrial Instrumentation", CBS Publisher, 2004.
2. Jones B.E. , "Instrument Technology", Butterworth-Heinemann, 2003.

REFERENCES:

1. Ernest O Doebelin , "Measurement systems Application and Design", Tata McGraw-Hill Book Company, 2010.
2. Nakra B C, Choudry K K , "Instrumentation Measurement and Analysis", Tata McGraw-Hill Publishing Company Ltd, 2010.
3. Liptak B.G , "Process Measurement and Analysis", 4th Edition, Chilton Book Company, 2003.
4. Gregory K, McMillan , Douglas M Considine , "Process/ Industrial Instruments and Controls Handbook", 5th Edition, Tata Mc-Graw Hill, 2009.

19U502 CONTROL SYSTEMS II

3 1 0 4

MATHEMATICAL MODELING IN STATE SPACE: State variable representation: State variable concepts, State variable modeling - Modeling of mechanical, Electrical, Fluid and Thermal systems – State diagrams – Transformation of state variables: Similarity Transformation, Invariance property, Conversion of transfer functions to canonical state variable models - Conversion of state variable model to transfer functions – Linearization of nonlinear models. (9+3)

ANALYSIS IN STATE SPACE: Characteristic equation, Eigen values and Eigen vectors - Matrix exponential - Solution of state equation – State transition matrix - Concepts of controllability and Observability - Controllability tests – Observability tests – Invariance property - Effect of Pole Zero cancellation on controllability and Observability – Equivalence between transfer function and state variable representations. (9+3)

DESIGN OF CONTROLLERS AND OBSERVERS: Introduction – Controllable and observable companion forms - Effects of state feedback on controllability and observability –Duality– Pole placement design – Stabilizability - State feedback with integral control – Design of state observers: Full order and reduced order observers – Design of regulated systems with observer - Design of control systems with observer. (9+3)

INTRODUCTION TO DIGITAL CONTROL SYSTEMS: Basic elements of discrete data control system – Advantages of discrete data control system – State equations of discrete data systems – Relationship between state equations and transfer functions - Relationship between state equations and higher order difference equations – Digital controllers: Physical realizability considerations, Realization of digital controller by digital programming, Digital PID controllers – Pole placement design with state feedback (SISO). (9+3)

LYAPUNOV STABILITY ANALYSIS: Introduction: Quadratic forms, Sign definiteness, Sylvester's criterion - Stability concepts in state space – Lyapunov stability analysis: Lyapunov first method, Jacobian linearization - Second method of Lyapunov – Lyapunov main stability theorem - Lyapunov stability analysis for linear time invariant systems. (9+3)

TEXT BOOKS:

1. M. Gopal, "Digital Control and State Variable Methods", Fourth Edition, McGraw Hill Education (India), 2012
2. Farid Galnaraghi & Benjamin C. Kuo , "Automatic Control System", Nineth Edition, John Wiley & Sons, Inc, 2010

REFERENCES:

1. K Ogata, "Modern Control Engineering", Pearson, Fifth Edition, 2018
2. Benjamin C. Kuo, "Digital Control Systems", Oxford University Press, Second Edition, 2007
3. Eronini Umez Eronini, "System Dynamics and Control", Thomson Asia Pvt. Ltd., First Edition, 1998
4. Norman S Nise, 'Control Systems Engineering', Sixth Edition, John Wiley & Sons, 2011.

19U503 MICROPROCESSORS AND MICROCONTROLLERS**3 0 0 3**

MICROPROCESSOR : Architecture of 8-bit microprocessor, bus configurations, Instruction classifications — Instruction, data format and storage - Overview of 8085 Instruction set — Programming exercise — Instruction execution time. (8)

MEMORY AND I/O INTERFACING : Interface requirements — Address space partitioning — Buffering of Buses — Memory control signals — Typical EPROM, RAM Interfacing. I/O interfacing: Memory mapped I/O scheme — I/O mapped I/O scheme — I/O ports - Programmable peripheral interface. (9)

MICROCONTROLLER : Microprocessor versus Microcontroller - 8051 Microcontroller Block diagram — Internal Data RAM — Special Function Registers — Internal register banks and stack — Addressing mode and Instruction set — 8051 Assembler and Intel Hex file format. (10)

ON-CHIP PERIPHERALS AND INTERFACING : Input / Output Ports structure - Counter and Timers, Serial Data Input / Output - Interrupts, LCD, LED and Keyboard Interfacing, ADC, DAC and Sensor interfacing, interfacing to external memory. (9)

APPLICATIONS AND PROGRAMMING IN C : Stepper and DC motor interfacing, 8051 programming in C: Data types, I/O programming, Logic operation, Accessing code ROM space. (9)

Total L: 45**TEXT BOOKS:**

1. Ramesh S Goankar, "Microprocessor Architecture, Programming and Applications with the 8085", 6th Edition, Penram International, 2013.
2. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D Mckinlay, "8051 microcontroller and embedded systems", 2nd Edition, Pearson Education, 2009.

REFERENCES:

1. Douglas V Hall, "Microprocessor and Interfacing : Programming and Hardware", 2nd Edition, McGraw Hill Inc, 2010.
2. Kenneth Ayala, "The 8051 Microcontroller", 3rd Edition, Thomson Delmar Learning, 2008.
3. Subrata Ghosal, "8051 Microcontroller: Internals, Instructions, Programming and Interfacing", Pearson Education India, 2010.
4. Krishna Kant, "Microprocessors and Microcontrollers: Architecture, Programming and System Design 8085, 8086, 8051, 8096", 2nd Edition, PHI Learning Pvt. Ltd., 2013.

19U504 DIGITAL SIGNAL PROCESSING**3 0 0 3**

DISCRETE TIME SIGNALS AND SYSTEMS : Motivation — Sampling and Quantization of signal-Discrete time (DT) sequences — Different representations of DT sequence-Operations on DT sequence - LTI system - properties — Linear and circular convolution - correlation. (9)

TRANSFORMS : Discrete Fourier Transform — Properties — Fast Fourier Transform - Decimation in Time FFT algorithm- Decimation in Frequency FFT algorithm- Frequency response of LTI system. (9)

FIR FILTERS : Characteristics, symmetry, linear phase and types — Design of FIR filter using windowing technique Frequency sampling technique- introduction to optimal FIR filter design- Realization of FIR filter. (9)

IIR FILTERS AND FINITE WORD LENGTH EFFECT : Design of analog prototype filter — Types of IIR filter — Frequency transformation — Impulse Invariant technique — Bilinear transformation technique — Realization of IIR filter- Effect of coefficient quantization-Effect of round-off noise in digital filters-Limit cycle due to round-off and truncation. (9)

TWO DIMENSIONAL SIGNALS AND SYSTEMS : 2D unit impulse, unit step sequence - separable sequence - properties of 2-D systems: linearity, time invariance, causality and stability - 2-D convolution-2-D Z transform - Region of Convergence-2-D Discrete Fourier Transform - properties (9)

Total L: 45

TEXT BOOKS:

1. John G Proakis, Dimitris G Manolakis , "Digital Signal Processing, Principles, Algorithms and Applications", Pearson, 2006.
2. Tamal Bose , "Digital Signal and Image Processing", Wiley,2010.

REFERENCES:

1. Alan V.Oppenheim, Ronald W.Schafer , "Discrete Time Signal Processing", Pearson,2014.
2. Sanjit K Mitra , "Digital Signal Processing: A Computer based Approach", McGraw Hill Education,2014.
3. Jae S Lim , "Two Dimensional Signal and Image Processing", 1st Edition, Prentice Hall, 1989.
4. Mersereau and Dudgeon , "Multidimensional Signal Processing", 2nd Edition, Prentice Hall, 2004.

19U505 COMPUTER NETWORKS

3 0 0 3

INTRODUCTION TO DATA COMMUNICATION : Characteristics and Components of Data Communication, Data representation, Data flow, Network topology, Protocols and Standards, Data and signals- analog and digital signals, Transmission Impairment, Network performance, Transmission media-guided media and unguided media. (9)

COMPUTER COMMUNICATION ARCHITECTURE : Network Models ,Layered tasks,OSI model-functions of layers in OSI model, Switching-Circuit switched networks, Datagram networks and Virtual circuit networks. (9)

NETWORK AND TRANSPORT LAYERS : Introduction to TCP/IP Protocol suite, Logical Addressing — Ipv4 and IPv6 addresses , Internet protocol — Internetworking, IPv4, Ipv6, Transition from IPv4 to IPv6, Process to process delivery, UDP, TCP (9)

LOCAL AREA NETWORKS : Objectives and advantages of PC LANs, Medium access control techniques - CSMA, CSMA/CD, Token passing, Connecting devices - Passive hubs, Repeaters, Active hubs, Bridges, Layer 2 switches, Routers, Layer 3 switches, Gateway. (9)

INTERFACE : Communication protocols- EIA232, EIA485 serial interface standard, Industrial Ethernet,Local Interconnect Network, Controller Area Network, Flexray. (9)

Total L: 45

TEXT BOOKS:

1. Behrouz A.Forouzan, Sophia Chung Fegan , "Data Communications and Networking", 4th Edition, Tata Mc Graw Hill, 2017.
2. Douglas E. Comer , "Internetworking with TCP/IP Principles, Protocols and Architecture Volume-I", 6th Edition, Pearson, 2013.

REFERENCES:

1. Larry L. Peterson, Bruce S. Davie , "Computer Networks: A Systems Approach", 4th Edition, Elsevier Publishers, 2007.
2. Stallng W , "Data and Computer Communications", 10th Edition, Prentice Hall, New Delhi,2017.
3. Andrew S. Tanenbaum, David J. Wetherall , "Computer Networks", 5th Edition, Pearson,2013.
4. Buchanan W , "Computer Buses", 1st Edition, Arnold,2000.

19U510 CONTROL SYSTEMS LABORATORY

0 0 2 1

LIST OF EXPERIMENTS:

1. Realization of electronic P, PI, PD and PID controllers
2. Determination of Transfer function of DC Servo motor
3. Determination of Transfer function of AC Servo motor
4. Frequency response based PID controller design
5. Time response based PID controller design
6. Design of compensation networks
7. Design of state feedback controller
8. Design of state observer
9. Design of observer based controller
10. Design of simple robust controller

Total P: 30

REFERENCES:

1. Dorf R.C., Bishop R.H. , "Modern Control Systems", Prentice Hall, 2010.
2. Daniel H. Sheingold , "Transducer Interfacing Handbook — A Guide to Analog Signal Conditioning," , Analog Devices Inc., 1980.
3. Department of Instrumentation and Control Systems Engineering , "Laboratory Manual", 2019.

19U511 MICROPROCESSOR AND DSP LABORATORY**0 0 2 1****LIST OF EXPERIMENTS:****MICROPROCESSOR BASED EXPERIMENTS :**

1. Binary addition and subtraction
2. BCD addition and subtraction
3. Multiplication and division
4. Table processing
5. Interfacing with peripherals (15)

SIGNAL PROCESSING BASED EXPERIMENTS :

1. Generation of signals and operation on signals
2. Sampling and Quantization of signals
3. Transform domain analysis of signals and systems
4. Design of FIR filter
5. Design of IIR filter (15)

Total P: 30**REFERENCES:**

1. Mukhopadhyay A. K. , "Microprocessor-Based Laboratory Experiments and Projects", 3rd Edition, I K International Publishing House Pvt. Ltd, 2010.
2. Department of Instrumentation and Control Systems Engineering , "Laboratory Manual", 2019.

19Q513 BUSINESS AND MANAGERIAL COMMUNICATIONS**0 0 2 1****BUSINESS AND MANAGERIAL COMMUNICATIONS :**

1. Advanced Group discussion
2. Advanced Resume writing
3. Mock Group discussion
4. Advanced Personal Interview
5. Mock Personal Interview
6. Cracking special Interviews
7. Essential Grammar for Placements
8. Vocabulary for Placements
9. Email writing
10. Paragraph writing
11. Essay writing

Total P: 30**REFERENCES:**

1. Priyadarshi Patnaik , "Group Discussion and Interview Skills", Cambridge, New Delhi, 2011.
2. Hari Mohan Prasad, Rajnish Mohan , "How to Prepare for Group Discussion and Interview", 2nd Edition, Tata McGrawhill, New Delhi, 2009.

SEMESTER - 6**19U601 INDUSTRIAL INSTRUMENTATION II****3 0 0 3**

VARIABLE HEAD AND AREA FLOW METERS : Flow terminologies – Units - Variable head type flow meters: Orifice plate — Venturi tube — Flow nozzle — Dall tube — Elbow taps - Pitot tube - Installation of head flow meters — Piping arrangement for different fluids - Variable area type flow meter: Rotameter — Theory and installation (9)

QUANTITY METERS AND MASS FLOW METERS : Positive displacement flow meters - Constructional details and theory of operation of nutating disc, reciprocating piston, oval gear and helix type flow meters - Inferential meter — Turbine flow meter - Angular momentum mass flow meter — Coriolis mass flow meters — Thermal mass flow meters — Volume flow meter plus density measurement - Calibration of flow meters- Dynamic weighing method. (9)

ELECTRICAL TYPE FLOW METER : Principle and constructional details of electromagnetic flow meter - Different types of excitation schemes used - Different types of ultrasonic flow meters — Laser Doppler anemometer systems Vortex shedding flow meter - Target flow meter - Open channel flow measurement - Solid flow rate measurement - Guidelines for selection of flow meter (9)

ELECTROMAGNETIC COUPLING : Introduction, Interference coupling mechanism, basics of circuit layout and grounding, concepts of interfaces, filtering and shielding - Safety: Introduction, electrical hazards, hazardous areas and classification - Non hazardous areas, enclosures — NEMA types, fuses and circuit breakers - Protection methods: purging, explosion proofing and intrinsic safety (9)

ENGINEERING DOCUMENTATION : Engineering types and its documentation - International codes and standard - Process Scheme - Process Flow Diagram - Piping and Instrumentation Diagrams - Instrumentation engineering documentation and its route maps -Instrument index - Instrument specification sheets (Data Sheets) - Instrument selection criteria - Purchase specification - Loop diagram - Wiring diagram and its types - Panel drawings - Layouts (9)

Total L: 45

TEXT BOOKS:

1. John P Bentley , "Principles of Measurement Systems", 3rd Edition, Pearson Education,2009.
2. Spitzer D. W , "Industrial Flow measurement", 3rd Edition, ISA Press, 2005.

REFERENCES:

1. Liptak B.G , "Process Measurement and Analysis", 4th Edition, Chilton Book Company, Radnor, Pennsylvania, 2003.
2. Noltingk .B.E , "Instrumentation Reference Book", 3rd Edition, Butterworth Heinemann, 2003.
3. W.G.Andrews and H.B.Williams , "Applied Instrumentation in the Process Industries — Volume 2", 2nd Edition, 1980.
4. Renganathan S , "Flow Meters", Allied Publisher, 2003.

19U602 PROCESS CONTROL

3 1 0 4

PROCESS DYNAMICS : Piping and Instrumentation Diagram : Instrument terms and symbols - Feedback control concepts - Classification of variables - Servo and regulator Control - Process Characteristics: Degrees of freedom, Self-regulation, Process lag, Dead time, Inverse response - Continuous and batch process - Mathematical model of first order level, pressure, hydraulic and thermal processes - Higher order Process : Interacting and non- interacting systems - Linearization of nonlinear models - Approximation of higher order transfer functions - Development of empirical models from process data: Fitting first and second order models using step tests and PRBS. (9 + 3)

BASIC CONTROL ACTIONS AND CONTROLLERS : Characteristics of on-off, proportional, single-speed floating, integral and derivative control modes - P+I, P+D and P+I+D control modes - Integral windup and prevention - Auto / Manual transfer: Bumpless transfer - Electronic controllers to realize various control actions - Response of controllers for test inputs - Effects of P,I and D actions on closed loop response - Selection of controller modes for control of level, pressure, flow and temperature process. (9 + 3)

FINAL CONTROL ELEMENT : Current to pressure converter - Pneumatic and electric actuators - Valve positioner - Pneumatic control valve: parts and classification - Characteristics of control valves: Inherent and Installed characteristics - Commercial valve bodies - Control valve sizing - Cavitation and flashing - Control valve types: flow control valve, pressure control valve and directional control valve - Valve selection criteria - Motorised actuators. (9 + 3)

CONTROLLER DESIGN : Model based controller design - Direct synthesis method - Internal Model Controller (IMC) - Model Predictive Controller (MPC) - Evaluation criteria: IAE, ISE, ITAE - ¼ decay ratio criterion - Determination of optimum settings for mathematically described processes using time response and frequency response methods - Online controller tuning: Process reaction curve method, Ziegler Nichols method, damped oscillation method - Relay auto tuning. (9 + 3)

MULTI LOOP & MULTIVARIABLE CONTROL : Feed forward control - Ratio control - Cascade control - Time delay compensation - Inferential control - Split range control - Selective Control - Introduction to Adaptive Control - Multi Input Multi Output Processes: Process interactions and control loop interactions - Pairing of controlled and manipulated variables - Case studies: Binary distillation column control, boiler drum level control and chemical reactor control. (9 + 3)

Total L: 45 +T: 15 = 60

TEXT BOOKS:

1. George Stephanopoulos , "Chemical Process Control: An Introduction to theory and Practice", 1st Edition, Pearson Education India, 2008.
2. Dale. E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp and Francis J. Doyle , "Process Dynamics and Control", 3rd Edition, John Wiley & Sons, 2016.

REFERENCES:

1. Donald P. Eckman , "Automatic Process Control", 1st Edition, Wiley India Pvt Ltd, 2009.
2. Donald R. Coughanowr and Steven E. LeBlanc , "Process Systems Analysis and Control", 3rd Edition, McGraw Hill Education, 2017.
3. Bela G. Liptak , "Instrument Engineers Handbook: Process Measurement and Analysis", 4th Edition, CRC Press, 2012.
4. Curtis D. Johnson , "Process Control Instrumentation Technology", 8th Edition, Pearson Education India, 2015.

19U603 EMBEDDED SYSTEM DESIGN**3 0 0 3**

INTRODUCTION : Embedded Systems Overview - Embedded system Design process - Design Challenge: Optimizing Design Metrics—Processor Technology—IC Technology—Design Technology—Trade-offs. (9)

ARCHITECTURE AND PROGRAMMING : Hardware architecture — Software architecture — Application Software Process of Generating executable image – Development / Testing Tools – Programming for Embedded Systems: Overview of ANSI C- GNU development tools - Memory Management — Productivity Tools — Code optimization Introduction to GPU Programming. (9)

INTERFACING AND NETWORKS : Parallel I/O interface Serial Communications Interface (SCI) device driver - Arbitration, Multilevel Bus Architecture – Serial protocols: I2C, CAN, FireWire, USB – ARM bus – Wireless protocols: IrDA, Bluetooth, IEEE 802.11 - Internet Enabled systems - Sensor Networks. (9)

RTOS FOR EMBEDDED SYSTEMS : Interrupt driven systems-Need for Real-time Operating System-RTOS Concepts Tasks, Context switching, Interrupt latency, Memory management, Scheduling, Task synchronization- Introduction to RTOS APIs- Power optimization strategies for processes-Basic design using RTOS- Response time calculation-Comparison of commercial RTOSs. (9)

EMBEDDED-BASED CONTROL SYSTEM : Introduction to digital control systems – Open-Loop and Closed-Loop control system — General control systems and PID controllers — Software coding of a PID controller — PID Tuning — Practical issues related to computer-control implementations. (9)

Total L: 45**TEXT BOOKS:**

1. Frank Vahid, Tony Givargis , "Embedded System Design: A unified hardware software introduction", John Wiley & Sons, 2014.
2. Wayne Wolf , "Computers as Components - Principles of Embedded Computer System Design", 2nd Edition, Morgan Kaufmann Publisher, 2010.

REFERENCES:

1. K.V.K.K.Prasad , "Embedded Real-Time Systems: Concepts, Design and Programming", Dreamtech Press, 2011.
2. Jonathan W. Valvano, "Embedded Microcomputer Systems — Real Time Interfacing", 3rd Edition, Cengage Learning, 2012.
3. Raj Kamal , "Embedded Systems: Architecture, Programming and Design", 3rd Edition, Tata McGraw-Hill Education, 2014.
4. K V Shibu , "Introduction to Embedded Systems", 2nd Edition, McGraw Hill Education India Private Limited, 2017.

19U604 POWER ELECTRONICS AND DRIVES**3 0 0 3**

REVIEW OF POWER ELECTRONIC DEVICES : Power diodes and transistors. Thyristors, GTO, IGBT, other devices in thyristor family. Thyristor protection circuits — Thyristor triggering circuits — series and parallel operation of thyristors, commutation techniques. (9)

CONVERTERS : Principle of phase-controlled rectifier operation. Single phase thyristor converters with R, RL loads and freewheeling diode. Three phase thyristor converters with R and RL loads. Dual converters. Introduction to cycloconverters and AC voltage regulators. (9)

CHOPPER AND INVERTER: : Choppers - Chopper classification - step up and step down choppers. Single phase Voltage Source Inverter — Harmonics- Three phase bridge inverters - voltage control in single phase inverters - Current source inverters - Series and Parallel inverters. (9)

DC AND AC DRIVES: : Basic characteristics of DC motor - Control of DC motor - Regenerative and dynamic braking Closed loop control scheme - Speed torque characteristic of induction motor - stator voltage control — Sensor less vector control – Flux vector control- Static rotor resistance control - Slip power recovery scheme - Self control of synchronous motor. (9)

APPLICATIONS: : Switched mode power supplies, Uninterrupted power supplies, High Voltage DC transmission — control of HVDC converters, Solid state relays, Static circuit breakers. Introduction to FACTS controllers. (9)

Total L: 45

TEXT BOOKS:

1. Rashid MH, "Power Electronics — Circuits, Devices and Applications," 3rd Edition, Prentice Hall India, New Delhi, 2014.
2. Dubey G.K, "Fundamentals of Electric Drives," Taylor and Francis, 2010.

REFERENCES:

1. Bimal K Bose , "Modern Power Electronics and AC Drives", Pearson Education, 2017.
2. Dubey G.K., Doradla S R, Joshi A, Sinha RMK , "Thyristorised Power Controllers", New Age International, 2009.
3. Vedam Subramaniam , "Electrical Drives Concepts and Applications", Tata McGraw-Hill, New Delhi, 2011.
4. Bimbhra P.S , "Power Electronics", Khanna Publishers, New Delhi, 2015.

19U610 PROCESS CONTROL LABORATORY

0 0 2 1

LIST OF EXPERIMENTS:

1. First principle modeling and validation of Interacting and non-interacting systems
2. Experimental study of ON-OFF and proportional controller responses on temperature loop
3. Experimental study of controller response and analysis on flow loop.
4. Experimental study of controller response and analysis on level loop
5. Experimental study of controller response and analysis on pressure loop.
6. On line controller tuning using open loop and closed loop methods
7. Comparisons of inherent and installed characteristics of control Valves.
8. Implementation of cascade control system.
9. Design and implementation of Feed forward-feedback Controller and inferential control schemes
10. Design and Implementation of PID controller for MIMO process

Total P: 30

REFERENCES:

1. Stephanopoulos G , "Chemical Process Control:An Introduction to theory and Practice", 1st Edition, Pearson Education India, 2008.
2. Department of Instrumentation and Control Systems Engineering , "Laboratory Manual", 2019.

19U611 EMBEDDED SYSTEM LABORATORY

0 0 2 1

LIST OF EXPERIMENTS:

1. GPIO Programming.
2. I/O interfacing.
3. Polling and interrupt service mechanism using Timer/ Counter Peripheral.
4. Sensor interfacing.
5. Implementation of Pulse Width Modulation.
6. Implementation of serial communication protocols.
7. Microcontroller based TRIAC control for AC loads.
8. Microcontroller based PID implementation for real time system.
9. Microcontroller based fixed point implementation.
10. Microcontroller based power consumption analysis.

Total P: 30

REFERENCES:

1. ATMEL , "ATMEL Datasheet" , .
2. Department of Instrumentation and Control Systems Engineering , "Laboratory Manual", 2019.

19Q613 QUANTITATIVE AND REASONING SKILLS

0 0 2 1

QUANTITATIVE AND REASONING SKILLS :

1. Number System, Time and Work
2. Percentages , Simple and Compound Interests
3. Time, Speed and Distance
4. Permutation, Combination and Probability
5. Ratio and Proportion
6. Profit, Loss and Partnership
7. Logarithms, Progressions, Geometry and Quadratic Equations
8. Coding and Decoding
9. Series, Analogy and Odd Man Out
10. Visual Reasoning
11. Data Arrangements
12. Blood Relations
13. Clocks, Calendars and Direction Sense
14. Cubes, Logical Connectives and Syllogisms
15. Venn Diagrams, Interpretations and solving

Total P: 30

REFERENCES:

1. Aggarwal R S , "Quantitative Aptitude for Competitive Examinations", 3rd Edition, S Chand Publishing, New Delhi, 2017.
2. ETHNUS , "Aptimithra", 1st Edition, McGraw-Hill Education Pvt Ltd, 2013.
3. FACE , "Aptipedia Aptitude Encyclopedia", 1st Edition, Wiley Publications, Delhi, 2016.

19U620 INNOVATION PRACTICES

0 0 4 2

Students will

- Learn about current practices in product / process development Identify key issues, priorities, and tasks
- Perform literature survey, including Patents
- Perform feasibility analysis
- Develop prototypes and test or re-use recent innovations systematically and submit a report

Total P: 60

SEMESTER - 7

19U701 LOGIC AND DISTRIBUTED CONTROL SYSTEM

3 0 0 3

COMPUTER BASED PROCESS CONTROL : Data loggers - Data Acquisition Systems (DAS) - Functional block diagram of computer control systems - sampling considerations - Supervisory Control and Data Acquisition Systems (SCADA): Hardware and software, Remote terminal units, Master station, communication architectures. (8)

PROGRAMMABLE LOGIC CONTROLLER (PLC) : Introduction - architecture of PLC - working principle - memory types - Input/Output modules - sink and source I/O cards - programming methods - programming device - - Basic Programming Instructions: User and bit Instructions, Instruction addressing, branch instructions, internal relay instructions - Ladder diagram for Boolean Gates - Concept of Latching and Unlatching - Timer instruction - Counter instruction (9)

ADVANCED FUNCTIONS IN PLC : Program Control Instructions: Master Control Reset, Jump, SKIP and Subroutines - Data Manipulation Instructions: Data transfer, Data Compare - Math instructions: Addition, Subtraction, Multiplication, Division - Sequencer instructions - PID functions - Design of alarm and interlocks -Networking of PLC - PLC installation , maintenance and troubleshooting. (10)

DISTRIBUTED CONTROL SYSTEMS (DCS) AND COMMUNICATION FACILITIES: DCS - Various Architectures and Comparison - Local control unit (LCU) - Process interfacing issues - Operator Interfaces - Engineering Interfaces - Redundancy concept - Interoperability and Interchangeability - Communication facilities: HART Protocol, Wireless HART, Foundation Field bus and Profibus - Case Study of any one DCS (10)

ADVANCED TOPICS IN AUTOMATION : Introduction to Networked Control systems - Plant wide control – Industrial Internet of things (IIoT) - Cloud based Automation - Introduction to OLE for Process Control(OPC) - Safety PLC (8)

TEXT BOOKS:

1. John W Webb, Ronald A Reis , "Programmable Logic Controllers - Principles and Applications", 5th Edition, Pearsons Education, 2008.
2. Michael P Lukas , "Distributed Control Systems", 1st Edition, Van Nostrand Reinhold Co., New York, 1986..

REFERENCES:

1. Stuart A. Boyer , "SCADA: Supervisory Control and Data Acquisition Systems", 4th Edition, ISA Press, 2010.
2. Curtis Johnson , "Process Control Instrumentation Technology", 8th Edition, Pearson Education, 2014.
3. Frank D. Petruzella , "Programmable Logic Controllers", 3rd Edition, Tata McGraw Hill, New York, 2010.
4. John Park, Steve Mackay, Edwin Wright , "Practical Data Communications for Instrumentation and Control", 1st Edition, Elsevier, 2003.

19U702 ANALYTICAL INSTRUMENTATION

3 0 0 3

INTRODUCTION TO SPECTROSCOPY : UV-Visible Spectroscopy - Electromagnetic radiation and its interaction with matter - Absorption spectroscopy - Absorption laws - Types of electronic transitions - Radiation sources - Monochromators - Filters - Prisms - Diffraction gratings - Detectors - Choice of solvents for UV -Visible spectrometers - single-beam and double-beam instruments. (9)

INFRA-RED SPECTROSCOPY : Basic principles - Hooks law - Calculation of wave numbers - Degrees of freedom - Types of vibrations - IR sources - Cells - Detectors - Sample preparation. Analysis using Attenuated Total Reflectance (ATR). Atomic absorption spectrometry (AAS) - Wavelength choice - Sources - Cells - Detectors. Flame emission spectrometry. Atomic fluorescence spectrometry. (9)

NMR AND X-RAY SPECTROSCOPY : Nuclear magnetic Resonance (NMR) spectroscopy - Basic principles -The NMR phenomenon - Magnetic moments - Number of signals - Chemical shift - Continuous wave NMR spectrometer - Pulsed Fourier Transform NMR spectrometer - NMR applications. X-ray absorption methods - X-ray fluorescence methods - X-ray diffraction. Radioactive measurement - Units of radioactivity - Application of radio nuclides in analysis - Radioactivity detectors (9)

CHROMATOGRAPHY : Basic principles of chromatography - Types of Chromatography - Gas chromatography - Column details - Detectors for chromatography - Thermal conductivity detector - Flame ionization detector - Flame photometric detector - Electron capture detector - Effect of temperature programming - High pressure liquid chromatography (HPLC). Mass spectroscopy - Instrumentation - Base peak - Molecular ion peak - metastable peak - Isotopic peaks - Applications. (9)

SAMPLING AND ELECTROCHEMICAL TECHNIQUES : Sample collection for gas, liquid and solid analysis. Ion selective electrodes - Glass and reference electrodes. pH measurement - pH meter and its calibration. Electrical conductivity measurement - Measuring circuit. Flue gas analysis for pollution control - Measurement of Oxygen, Carbon monoxide, Carbon dioxide, NOX and SOX, dust and smoke measurement, Continuous Emission Monitoring System. (9)

Total L: 45

TEXT BOOKS:

1. Willard H H, Merit L.L, Dean J A and Seattle F L , "Instrumental Methods of Analysis", 7th Edition, CBS Publishing and Distribution, New Delhi, 1996.
2. Ewing G W , "Instrumental Methods of Analysis", 5th Edition, McGraw-Hill, New York, 2013.

REFERENCES:

1. Robert D Braun , "Introduction to Instrumental Analysis", BSP Books P Ltd, Hyderabad, 2016.
2. Skoog D A, James Holler F and Stanley R Crouch , "Principles of Instrumental Analysis", Cengage India P Ltd, New Delhi, 2017.
3. Liptak B G , "Instrument Engineers Handbook: Process Measurement and Analysis", 3rd Edition, CRC Press, Boca Raton, 2005.
4. Khandpur R S , "Handbook of Analytical Instruments", 3rd Edition, McGraw-Hill Education (I) P Ltd, Chennai, 2017.

19U710 INDUSTRIAL AUTOMATION LABORATORY

0 0 2 1

LIST OF EXPERIMENTS :

1. Implementation of basic logic operations Using PLC
2. Implementation of timer operations using PLC
3. Implementation of counter operations using PLC
4. Study of Analog and Digital I/O interfacing in PLC
5. Implementation of actuator control using PLC
6. Implementation of sequential control using PLC sequencer function
7. Implementation of PLC programming for practical applications
8. Study of various function blocks in DCS
9. Implementation of control logic using DCS
10. On-line monitoring and control using DCS
11. Study of IoT based Automation using PLC

Total P: 30

REFERENCES:

1. Frank D. Petruzella , "Programmable Logic Controllers", 3rd Edition, Tata McGraw Hill, New York, 2014.
2. Department of Instrumentation and Control Systems Engineering , "Laboratory Manual", 2019.

19U711 INDUSTRIAL AND VIRTUAL INSTRUMENTATION LABORATORY

0 0 2 1

LIST OF EXPERIMENTS :

1. Study of zero elevation and zero suppression in differential pressure transmitter
2. Design of alarm circuit
3. Linearization of thermistor and cold junction compensation of thermocouple
4. Design of temperature transmitter
5. Calculation of discharge co-efficient of orifice plate, venturi and pitot tube
6. Implementation of GUI for a transducer output with options to moderate static characteristics
7. 7) Signal acquisition and creation of GUI for real-time display and data logging from a temperature sensor (RTD/Thermistor)
8. Signal Acquisition from thermocouple and creation of GUI with compensation
9. Implementation of virtual PID controller
10. Implementation of single loop and multi loop controllers using virtual instrument

Total P: 30

REFERENCES:

1. Bela G Liptak , "Process Measurement and Analysis", 4th Edition, CRC Press, 2003.
2. Jovitha Jerome , "Virtual Instrumentation Using LabVIEW", PHI, 2010.

19U720 PROJECT WORK I

0 0 4 2

- Identification of a real life problem in thrust areas.
- Developing a mathematical model for solving the identified problem.
- Finalisation of system requirements and specification.
- Proposing different solutions for the problem based on literature survey.
- Future trends in providing alternate solutions.
- Consolidated report preparation.

Total P:60

SEMESTER – 8

19U820 PROJECT WORK II

0 0 8 4

The Project involves the following:

- l) Preparing a project — brief proposal including
 - Problem Identification
 - A statement of system / process specifications proposed to be developed (Block Diagram / Concept tree)

- List of possible solutions including alternatives and constraints
 - Cost benefit analysis
 - Time line of activities
- II) A report highlighting the design finalization [based on functional requirements & standards (if any)]
- III) A presentation including the following:
- Implementation Phase (Hardware / Software / both)
 - Testing & Validation of the developed system
 - Learning in the Project
- IV) Consolidated report preparation

Total P:120

PROFESSIONAL ELECTIVES

19U001 BIOMEDICAL INSTRUMENTATION

3 0 0 3

BIOELECTRIC POTENTIALS AND ELECTRODES : Cells and their structures - Transport of ions through cell membrane - Biopotential - action and resting potential - propagation of action potential - Bioelectric potential - Biopotential electrodes – Types of electrodes: surface, needle and microelectrodes (12)

CARDIOVASCULAR SYSTEM AND MEASUREMENTS : Heart and cardiovascular system — ECG — 12 lead system - principle of vector cardiography - blood pressure and its measurement — heart sound and its measurement- Defibrillator : principle and types -pacemakers: principle and types. (9)

NERVOUS SYSTEM AND MEASUREMENTS : Central and peripheral nervous system - parts of human brain- Action potential of brain - brain wave - EEG- 10-20 electrode system. (8)

RESPIRATORY SYSTEM AND MEASUREMENTS : Physiology of respiratory system - Principle of pneumograph - Spirometer - ventilators: principle and types. (8)

MEDICAL IMAGING : X-ray imaging - Computed Tomography (CT) - Ultrasonic Scanner - Magnetic Resonance Imaging - Positron Emission Tomography (PET). (8)

Total L: 45

TEXT BOOKS:

1. Leslie Cromwell, Fred J Weibell, Erich A. Pfeiffer , "Biomedical Instrumentation and Measurements", Prentice Hall, 2010.
2. Khandpur RS , "Handbook of Biomedical Instrumentation", McGraw Hill Education, 2014.

REFERENCES:

1. John G Webster, "Medical Instrumentation: Application and Design", John Wiley and Sons, 2010.
2. Joseph J Carr, John M Brown, "Introduction to Biomedical Equipment Technology", Pearson, 2002.
3. L.A.Geddes, L.E. Baker, "Principles of Applied Biomedical Instrumentation", John Wiley and Sons, 2009.
4. Richard Aston, "Principles of Biomedical Instrumentation and Measurement", Merrill Publishing Company, New York, 1990.

19U002 FIBER OPTICS AND LASER INSTRUMENTATION

3 0 0 3

OPTICAL FIBERS AND THEIR PROPERTIES : Characteristics of optical radiation, luminescence - Fiber materials and their characteristics - Principles of light propagation through a fiber - Types of optical fibers - Properties - Transmission characteristics - Absorption losses - Scattering losses - Dispersion - Fibers splicing, connector and couplers - Optocouplers – Optrodes (9)

OPTICAL SOURCES AND DETECTORS : LED — LED power and efficiency - Structures, planar, dome, ELED, SLED, super luminescent LEDs, characteristics and applications - General characteristics of photodetectors - Photodiode - Junction photodiodes - Heterojunction diode and PIN diode - APD - Special detectors – Schottky barrier diode - Photo- transistor and photo- thyristor - Solar cells (9)

INDUSTRIAL APPLICATION OF OPTICAL FIBERS : Fiber optic sensors - Fiber optic instrumentation system - Application in instrumentation: interferometric method of measurement of length - Moiré fringes - Measurement of pressure, temperature, current, voltage, liquid level and strain - Fiber optic gyroscope - Cavity dumping - Polarization maintaining fibers (9)

LASER FUNDAMENTALS : Characteristics of lasers - Three level and four level lasers - Properties of laser - Laser modes - Resonator configuration — Q switching and mode locking — Cavity dumping - Types of lasers: gas lasers, solid lasers, liquid lasers, semi conductor lasers (9)

INDUSTRIAL APPLICATIONS OF LASER : Laser for measurement of distance, length, velocity, acceleration, current, voltage and atmospheric effect - Material processing: laser heating, welding, melting, scribing, splicing and trimming of materials, removal and vaporization - Hologram: Principle of holography — Methods and holographic components - Holographic interferometry and applications, holography for nondestructive testing - Medical applications of lasers: laser and tissue interaction — Laser instruments for brain surgery, plastic surgery and oncology (9)

Total L: 45

TEXT BOOKS:

1. John M Senior , "Optical Fiber Communication: Principles and Practice", Prentice Hall, 2010.
2. R P Khare , "Fibre Optics and Optoelectronics", 1st Edition, Oxford Press, 2004.

REFERENCES:

1. Wilson, J.F.B. Hawkes , "Introduction to Opto Electronics", Prentice Hall of India, 2001.
2. Nambiar K R , "Laser: Principles, Types and Applications ", New Age International, 2010.
3. S.C. Gupta , "Opto Electronic Devices and Systems", Prentice Hall of India, 2010.
4. A Donald, Sterling Jr , "Technicians Guide to Fiber Optics", Vikas Publishing House., 2009.

19U003 INSTRUMENTATION SYSTEM DESIGN

3 0 0 3

DESIGN OF SIGNAL CONDITIONING CIRCUITS : Design of V/I and I/V converters - Analog and Digital filter design- Signal conditioning circuit for pH measurement - Temperature compensation circuit - software and hardware approaches - Thermistor linearization. (10)

DESIGN OF TRANSMITTERS : RTD and thermocouple based temperature transmitter- Capacitance based level transmitter - Air purge system for level measurement - Smart transmitters. (10)

DESIGN OF DATA ACQUISITION SYSTEM AND CONTROLLERS : Design of ON / OFF controller using linear integrated circuits- Electronic PID controller- Selection of ADC and DAC - Microcontroller based design: Measurement system and digital PID controller. (8)

DESIGN OF ORIFICE AND ROTAMETER, CONTROL VALVE SIZING : Orifice Sizing - Liquid - gas and steam services - Rotameter design - Control valves - Valve body- Commercial valve bodies- Control valve sizing - Liquid - gas and steam services- Selection criteria. (10)

DESIGN OF ALARM AND ANNUNCIATION CIRCUIT : Alarm and Annunciation circuits - Thyristor Power Controller - Design of Interlocks- software and hardware approaches. (7)

Total L: 45

TEXT BOOKS:

1. John P Bentley , "Principles of Measurement Systems", 4th Edition, Pearson Education, 2004.
2. C. D. Johnson , "Process Control Instrumentation Technology", 8th Edition, Pearson Education, 2014.

REFERENCES:

1. Miller R. W. , "Flow Measurement Engineering Handbook", 3rd Edition, McGraw Hill, 1996.
2. Gregory K McMillan and Douglas M Considine , "Process/ Industrial Instruments and Controls Handbook", 5th Edition, Tata McGraw Hill, 2009.
3. Norman.A.Anderson , "Instrumentation for Process Measurement and Control", 3rd Edition, CRC Press, 2010.
4. Andrew W G and Williams H B , "Applied Instrumentation in the Process Industries", 3rd Edition, Houghton Mifflincom, 2002.

19U004 POWER PLANT INSTRUMENTATION

3 0 0 3

OVERVIEW OF POWER GENERATION: Methods of power generation: Hydro, Thermal, Nuclear, Solar and Wind power, Ocean Energy System, Geothermal Energy, Energy from Bio mass. Building Blocks of Thermal power plant - Combined Cycle System— Combined Heat and Power System: Sub Critical and Supercritical boilers— Operating Pressure and Temperature ranges — Overview of Instrumentation System in Thermal power plant. (9)

MEASUREMENTS IN POWER PLANTS: Measurement of feed water flow, Fuel flow, Airflow and Steam flow with correction factor - Steam pressure and temperature measurement-Turbine speed and vibration measurement. (9)

ANALYZERS IN POWER PLANTS: Analysis of impurities in feed water and steam: Dissolved oxygen analyzer — Chromatography pH meter - Fuel analyser — Flue gas oxygen analyser - Pollution monitoring instruments – SOX and NOX measurements. (9)

CONTROL LOOPS IN BOILER:Combustion control — Air/fuel ratio control — Furnace draft control –Main steam and reheat steam temperature control — Super heater control– Distributed control system in power plants — Interlocks in boiler operation. (9)

NUCLEAR POWER PLANT INSTRUMENTATION : Different types of Nuclear power plant, Nuclear reactor control loops, Reactor dynamics, Control and Safety instrumentation, Reliability aspects. (9)

Total L: 45

TEXT BOOKS:

1. Sam G Dukelow , "The Control of Boilers", 2nd Edition, Instrument Society of America, 1991.
2. David Lindsley , "Power Plant Control and Instrumentation", Institution of Electrical Engineers,London, 2000.

REFERENCES:

1. Elonka S M, Kohal A L , "Standard Boiler Operations", McGraw Hill,New Delhi, 1994.
2. Jain R K , "Mechanical and Industrial Measurements", Khanna Publishers,New Delhi, 2009. Pergamon Press, Oxford, 1971.
3. Bela G Liptak , "Process Measurement and Analysis", Vol 1, CRC press, 2003.
4. M.W.Jervis, British Electricity International, "Modern Power Station Practice – Instrumentation, Controls and Testing", Vol.6, Pergamon Press, Oxford,1971.

19U005 INSTRUMENTATION AND CONTROL IN PETRO CHEMICAL INDUSTRIES

3 0 0 3

PETROLEUM PROCESSING: Petroleum exploration - Recovery techniques - Refining of crude oil - Constituents of Crude Oil - Refining Capacity in India - Consumption of Petroleum products in India. (9)

CONTROL OF DISTILLATION COLUMN: P and I diagram of petroleum refinery - Atmospheric Distillation of Crude oil – Vacuum Distillation process - Thermal Conversion process - Control of Distillation Column – Temperature Control -Feed Control - Reflux Control - Reboiler Control (9)

CONTROL OF CHEMICAL REACTORS AND DRYERS: Temperature Control - Pressure Control - Control of Dryers - Batch Dryers - Atmospheric and Vacuum Dryers - Continuous Dryers. (9)

CONTROL OF HEAT EXCHANGERS AND EVAPORATORS: Variables and Degrees of freedom - Liquid to Liquid Heat Exchangers - Steam Heaters - Condensers - Reboilers and Vaporizers - Cascade Control - Feed forward Control-Types of Evaporators (9)

CONTROL OF PUMPS: Centrifugal pump: On-Off Level control - Pressure control - Flow control - Throttling control. Rotary pumps: On-Off pressure control. Reciprocating Pumps: On-Off control and Throttling control. Effluent and Water Treatment Control: Chemical Oxidation - Chemical Reduction - Neutralization – Precipitation (9)

Total L: 45

TEXT BOOKS:

1. Balchan J G, Mumme K I , "Process Control Structures and Applications", Van Nostrand Reinhold Company, 1998.
2. Waddams A L , "Chemicals from Petroleum", Butter and Janner Ltd. , John Murray Publishers, 1978.

REFERENCES:

1. Liptak B G , "Instrument Engineer's Handbook, Vol. 2: Process Control and Optimization", CRC Press, 2005.
2. Austin G T , " Shreve's Chemical Process Industries", McGraw Hill Book Co, 1984.
3. Liptak B G , "Instrumentation in Processing Industries", Chilton book Company, 1994.
4. Wiseman P , "Petrochemicals", John-Wiley and Sons Inc,1986.

19U006 OPTIMAL AND ADAPTIVE CONTROL SYSTEMS

3 0 0 3

OPTIMAL CONTROL: Statement of optimal control problem - Problem formulation and types of optimal control — Selection of performance measure, cost function and norms — Hamilton Jacobi Equation - Pontryagin's minimum principle — State

inequality constraints — Necessary conditions for optimality — optimal control problems by Transfer function approach and State variable approach. (10)

LINEAR QUADRATIC CONTROL PROBLEMS: Choice of weighting matrices- LQG control — Matrix Riccati equation and solution methods of state regulator and discrete systems — Optimal control law - Optimal estimation. (8)

IDENTIFICATION METHODS: Conventional techniques of identification — Identifications of systems with dead time — Discrete systems — ARMA process — Discrete state model — Least squares techniques — Recursive Least Squares algorithms — Minimum variance method. (9)

INTRODUCTION TO ADAPTIVE CONTROL: Development of adaptive control problem-The role of Index performance (IP) in adaptive systems- Development of IP measurement process model. Pole placement design - Self tuning controller — Minimum variance controller. (8)

ADAPTIVE CONTROL OF DETERMINISTIC SYSTEMS : Gain scheduling controller — Model reference adaptive control — Adaptive predictive control — The MIT rule — Determination of adaptation gain - Minimum prediction error adaptive controls — Adaptive control of time varying systems. BIBO Stability — Model free adaptive control - Applications of adaptive control. (10)

Total L: 45

TEXT BOOKS:

1. Donald E. Kirk , "Optimal Control Theory: An Introduction", Prentice-Hall Networks Series, 2004.
2. Karl J Astrom , Bjorn Wittenmark , "Adaptive Control", Pearson Education Inc, 2003.

REFERENCES:

1. Desineni Subbaram Naidu , "Optimal Control Systems", CRC Press, 2009.
2. Arun K. Tangirala , "Principles of System Identification: Theory and Practice", CRC Press, 2014.
3. Nagrath I J, Gopal M , "Control System Engineering", 6th Edition, New Age International Pvt Ltd, 2018.
4. Ljung L , "System Identification: Theory for the User", Prentice Hall, Englewood Cliffs, 1999.

19U007 SYSTEM IDENTIFICATION

3 0 0 3

INTRODUCTION TO IDENTIFICATION AND MODELS : System Identification Procedure - Identifiability - Signal to Noise ratio - Over fitting - Models: Definition of a model, Classification of models - Models for discrete time linear time invariant Systems - Models for time varying systems and nonlinear systems, Models for linear stationary processes (9)

ESTIMATION METHODS : Types of estimation problems - Goodness of Estimators: Fisher information, Bias, Variance, Efficiency, Sufficiency, Cramer Rao's inequality - Asymptotic bias, Mean square error, Consistency — Estimation methods: Method of moments estimators - Least squares estimators - Nonlinear least squares - Maximum likelihood estimators - Bayesian estimators (9)

IDENTIFICATION OF PARAMETRIC TIME-SERIES MODELS : Nonparametric descriptions and parametric descriptions: - Estimation of AR models - Estimation of MA models - Estimation of ARMA models (9)

IDENTIFICATION OF NON-PARAMETRIC AND PARAMETRIC INPUT – OUTPUT MODELS : Identification of Non- Parametric Input Output Models:- Impulse response estimation - Step response estimation - Estimation of frequency response function - Identification of Parametric Input Output Models: - Prediction error minimization (PEM) methods - Properties of the PEM estimator (9)

STATISTICAL ELEMENTS OF MODEL BUILDING : Informative Data - Input design for identification – Data preprocessing - Model development (9)

Total L: 45

TEXT BOOKS:

1. Arun K Tangirala , "Principles of System Identification: Theory and Practice", 1st Edition, CRC Press, 2014.
2. Lennart Ljung , "System Identification: Theory for the User", 2nd Edition, Prentice Hall, Englewood Cliffs, 1999.

REFERENCES:

1. Michel Verhaegen, Vincent Verdult , "Filtering and System Identification: A Least Squares Approach", Cambridge University Press, 2007.
2. Johan Schoukens, Rik Pintelon, Yves Rolain , "Mastering System Identification in 100 Exercises", Wiley-IEEE Press, 2012.
3. Thomas Kailath, Ali H Sayed, Babak Hassibi , "Linear Estimation", Pearson, 2000.
4. Jer Nan Juang , "Applied System Identification", Pearson, 1994.

19U008 INDUSTRIAL CHEMICAL PROCESSES

3 0 0 3

UNIT OPERATIONS: Unit processes and equipments – Combustion – Mixing processes – Separation processes - Mechanical operations: Principles and equipment – Concepts of equilibrium and rate. (9)

HEAT MASS AND MOMENTUM TRANSFER: Entropy balance – Material balance – Heat transfer concepts and equipment – Heat exchangers – Furnaces – Evaporators – Refrigeration process. (9)

MASS TRANSFER CONCEPT OF STAGED PROCESSES: Distillation Drying Adsorption Humidification Crystallization. (9)

FLUID FLOW EQUIPMENT: Pipe fittings: Pumps, compressors and blowers – Chemical reactors: isothermal and non-isothermal operations – Concepts of reactor stability. (9)

CASE STUDIES OF OPERATION: Paper and pulp manufacturing – Thermal power plant – Iron and steel manufacturing – Petrochemical refinery. (9)

Total L: 45

TEXT BOOKS:

1. McCabe W L, Smith J C, Peter Harriot , "Unit Operations of Chemical Engineering", 7th Edition, McGraw Hill, 2005.
2. Austin G T , "Shreve's Chemical Process Industries", McGraw Hill, 1985.

REFERENCES:

1. Liptak B G , "Instrument Engineers Handbook: Process Measurement and Analysis", Butterworth Heinemann, 2003.
2. Luyben W C , "Process Modelling, Simulation and Control for Chemical Engineers", McGraw Hill, 1990.
3. Waddams A L , "Chemicals from Petroleum", John Murray Publishers, 1978.
4. Norris Shreve R , "Chemical Process Industries", McGraw Hill, 1967.

19U009 APPLIED SOFT COMPUTING

3 0 0 3

NEURAL NETWORKS : Introduction - Differences between biological and artificial neural networks - architecture - activation functions - single layer perceptron - multilayer perceptron - back propagation algorithm - Hopfield's networks - Kohonen's self organizing maps (9)

NEURAL NETWORKS FOR CONTROL : Pattern recognition - Control and Process Monitoring - Model identification - direct and indirect neuro control schemes - adaptive neuro controller - case study (9)

FUZZY LOGIC SYSTEMS: Fuzzy sets - Operations on Fuzzy sets - Fuzzy reasoning - Linguistic variables - Fuzzy propositions - fuzzy compositional rules of inference - fuzzy relations - methods of defuzzification – membership value assignments. (9)

FUZZY LOGIC FOR CONTROL: Mamdani and Takagi-Sugeno model of fuzzy logic control - Stability analysis of fuzzy control systems- fuzzy pattern recognition - fuzzy controllers - control and estimation. (9)

GENETIC ALGORITHM: Biological background - encoding - fitness function - reproduction - inheritance operator - crossover - mutation operator - bitwise operator - convergence of genetic algorithm - applications and advances in genetic algorithm (9)

Total L: 45

TEXT BOOKS:

1. Laurene V. Fausett , "Fundamentals of Neural Networks, Architectures, Algorithms and Applications", 1st Edition, Pearson Education, 2011.
2. Timothy J Ross , "Fuzzy Logic with Engineering Applications", 3rd Edition, Wiley, 2011.

REFERENCES:

1. Simon Haykin , " Neural Networks: A comprehensive Foundation", 2nd Edition, Pearson, 2008.
2. S.Rajasekaran and G.A. Vijayalakshmi Pai , "Neural Networks, Fuzzy logic and Genetic algorithms: Synthesis and Applications", 2nd Edition, PHI Learning Pvt. Ltd., 2014.
3. David E Goldberg , "Genetic Algorithms in search, Optimization and Machine Learning", 1st Edition, Pearson Education, 2012.
4. Yaochu Jin , "Advanced Fuzzy Systems Design and Applications", 1st Edition, Springer, 2010.

19U010 VLSI DESIGN

3 0 0 3

VLSI DESIGN METHODOLOGY: VLSI design process - Layout styles: Full-custom - Semi-custom approaches. Electrical Properties of MOS and CMOS Circuits: MOS Transistor - Threshold voltage - Basic DC equations - Second order effects - Small signal AC characteristics. nMOS and CMOS inverters - Inverter delay – Power consumption in CMOS gates: Static dissipation - Dynamic Dissipation. Pass transistor - Transmission gate. (10)

VLSI FABRICATION TECHNIQUES : CMOS processes - n well - p well - Twintub - Silicon on insulator . Design rules - Mead Conway design rules for the silicon gate nMOS - CMOS process - CMOS. Sheet resistance - Resistance estimation - Capacitance estimation - Driving large capacitive loads. Layer representations - Stick diagrams - nMOS design style - CMOS design style - Simple layout examples. (8)

LOGIC DESIGN: Switch logic- Pass transistor and transmission gate. Other forms of CMOS logic: Dynamic CMOS logic - Clocked CMOS logic - Precharged domino CMOS logic - Combinational logic design examples. Clocked sequential circuits - Two phase clocking - Charge storage - Dynamic register element - nMOS and CMOS Dynamic shift register - JK flip flop. (8)

SUBSYSTEM DESIGN PROCESS : General arrangement of a 4-bit arithmetic processor - Design of a 4-bit shifter - Design of an ALU subsystem - Implementation of ALU functions with an adder - Carry look ahead adder - Multipliers: Serial parallel multipliers - Pipelined multiplier array. (9)

VHDL : Introduction-identifiers-data objects- data types - operators- structural modeling - dataflow modeling- behavioral modeling- hardware modeling examples: encoder - clock divider - pulse shifter - adder - multiplexer - demultiplexer - decoder - parity generator and checker. (10)

Total L: 45

TEXT BOOKS:

1. Douglas A Pucknell, and Kamran, Eshraghian , "Basic VLSI design", Prentice Hall of India, New Delhi, 2015.
2. Bhasker J, "VHDL Primer", Pearson Education, 2016.

REFERENCES:

1. Jan M Rabaey, A Chandrakasan and Nikolic B, "Digital Integrated Circuits: A Design Perspective", Pearson, 2017.
2. James D. Plummer, Michael D. Deal and Peter B. Griffin, "Silicon VLSI Technology : Fundamentals Practice and Modeling", Prentice Hall, 2011.
3. Neil H E Weste, David Money Harris , "CMOS VLSI Design : A Circuits and Systems Perspective", Pearson Education, New Delhi, 2016.
4. Wayne Wolf , "Modern VLSI Design: System on Chip Design", Pearson Education, New Delhi, 2008.

19U011 OPERATING SYSTEMS

3 0 0 3

INTRODUCTION : Operating system objectives and functionalities - Types of Operating System - Structure of Operating system - Computer architecture support to operating systems: - Instruction execution, Interrupts, Memory hierarchy, - Cache memory, Direct Memory Access - Multiprocessor and Multicore organization – Time sharing - system programs and calls (8)

MEMORY MANAGEMENT: Single contiguous allocation - Partitioned allocation - Paging - Virtual memory concepts - Swapping - Demand paging - Page replacement algorithms - Segmentation - Segmentation with paging. (8)

PROCESS MANAGEMENT : Introduction to processes - Scheduling objectives - Scheduling Criteria - Types of scheduling algorithms - Performance comparison - Inter- process communications - Synchronization - Semaphores - Types of Semaphores - Deadlock: - Principles of Deadlock - Deadlock Prevention – Deadlock Avoidance - Deadlock Detection and Recovery (12)

REAL-TIME OPERATING SYSTEMS : Characteristics of real-time operating systems - classification of real-time systems, - architectures of real-time systems, - micro-kernels, Memory management schemes - scheduling in RTOS - rate monotonic scheduling, - Inter-task communication, Shared data problem, - priority inversion - Selection of RTOS - Design and implementation of a multitasking application using RTOS (9)

DEVICE INPUT OUTPUT AND FILE MANAGEMENT : Principles of I/O hardware and software - Device controllers - Device drivers - Interrupt driven device management - Interaction between operating system, - drivers and devices, File Systems - Files- Directories - File system implementation - Allocation methods - Security- Protection mechanisms. (8)

Total L: 45

TEXT BOOKS:

1. Dhamdhare D M , "Operating Systems: A Concept-based Approach", 2nd edition, Tata McGraw Hill, 2011.
2. William Stallings , "Operating Systems: Internals and Design Principles", 2nd edition ,Pearson, 2018.

REFERENCES:

1. Silberschatz A, Galvin P and Gagne G , "Operating Systems Concepts", 6th edition, John Wiley and Sons, Newyork, 2010.
2. Andrew S Tanenbaum , "Modern Operating System", 3rd edition ,Pearson, 2018.
3. Jane W S Liu , "Real Time Systems", 3rd edition, Pearson, Noida, 2016.
4. Deitel H M, "Operating Systems", 3rd edition , Prentice Hall of India, New Delhi, 2009.

19U012 ROBOTICS AND AUTOMATION**3 0 0 3**

INTRODUCTION TO ROBOTIC SYSTEMS: Structure of a Robot, Classification of Robots: Cartesian, Cylindrical, Spherical, Articulated, SCARA - Accuracy, Resolution and Repeatability of Robots, Degrees of Freedom of Serial and Parallel Manipulators, Robot Application in Manufacturing: Material Transfers - Machine Loading and Unloading - Processing Operations - Assembly and Inspection. (9)

TRANSFORMATIONS AND KINEMATICS: Homogeneous Coordinates, Coordinate Reference Frames, Homogeneous Transformations for the Manipulator, D-H Representation, Forward and Inverse Problem of Manipulator Kinematics (9)

DRIVES AND SENSORS : Hydraulic and Pneumatic Systems, Mechanical Power Drive, Rotary to Linear Motion Conversion Mechanisms, Electric Drive Systems: DC Motor, Servo Motor and Stepper Motor, Internal and External State Sensors, Touch and Tactile Sensors, Force and Torque Sensors, Proximity and Range Sensors, Vision Systems, Robot End Effectors, Gripper Force Analysis. (9)

DYNAMICS AND CONTROL : Differential Motion of Manipulators, Trajectory Planning, Manipulator Dynamics, Jacobian in terms of D-H Matrices, Manipulator Control, Controller Architecture, Robot Programming. (9)

COMPUTER AIDED MANUFACTURING APPROACHES : Robot Interface, Networking and Bus Standards, Flexible Manufacturing Systems (FMS), Computer Integrated Manufacturing (CIM) - Role of Robots in FMS and CIM – Case Studies. (9)

Total L: 45**TEXT BOOKS:**

1. Saeed B. Niku , "An Introduction to Robotics: Analysis, Systems and Applications", Pearson Education, 2009.
2. Nagrath I J, Mittal R K , "Robotics and Control", Tata McGraw Hill, 2010.

REFERENCES:

1. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel and Nicholas G. Odrey , "Industrial Robotics", Tata McGraw Hill, 2010.
2. Richard D Klafter, Michael Negin , "Robotics Engineering", Prentice Hall, 2009.
3. S K Saha , "Introduction to Robotics", Tata McGraw Hill, 2010.
4. Mikell P. Groover , "Automation, Production Systems and Computer Integrated Manufacturing", 3rd Edition, Prentice Hall, 2011.

19U013 PRODUCT DESIGN AND DEVELOPMENT**3 0 0 3**

INTRODUCTION: Product Development- Successful Product Development - Duration and Cost- Challenges. Product Planning: Planning Process- Identifying Customer Needs (10)

PRODUCT SPECIFICATIONS: Establishing Target Specification- Setting the Final specification. Concept Generation: The Activity of Concept Generation. Concept Selection: Concept Screening-Concept Scoring- Concept Testing (8)

PRODUCT ARCHITECTURE: Implications-Establishment-Delayed Differentiation — Platform Planning — Related System Level Design Issues. Industrial Design: Assessing the Need-The Impact-The Industrial Design Process- Management and Assessment. Design for Manufacturing. Prototyping-Basics-Principles-Prototyping Technologies-Planning. Robust Design(10)

PATENTS AND INTELLECTUAL PROPERTY : Formulate a Strategy and Plan- Study Prior Inventions- Outline Claims- Write the Description of the Invention- Refine Claims- Pursue Application- Reflect on the Results and the Process (7)

PRODUCT DEVELOPMENT ECONOMICS: Elements of Economic Analysis- Build a Base –Case Financial Model- Perform Sensitivity Analysis- Use Sensitivity Analysis to Understand- Consider the influence of the Qualitative Factors on Project Success- Carrying out Qualitative Analysis. Managing Projects: Understanding and Representing Tasks- Baseline Project Planning- Project Execution-Postmortem-Project Evaluation (10)

Total L: 45

TEXT BOOKS:

1. Karl. T. Ulrich, Steven D Eppinger , "Product Design and Development", 2nd Edition, Irwin McGraw Hill, 2000.
2. Kevin Otto, Kristin Wood , "Product Design", 1st Edition, Pearson Education, 2003.

REFERENCES:

1. A C Chitale, R C Gupta , "Product Design and Manufacturing", 6th Edition, Prentice Hall of India, New Delhi, 2003.
2. Timjones , "New Product Development", 1st Edition, Butterworth Heinmann, 1997.
3. Geoffery Boothroyd, Peter Dewhurst, Winston Knight , "Product Design for Manufacture and Assembly", 3rd Edition, Taylor and Francis, 2002.

19U014 MEASUREMENT DATA ANALYTICS**3 0 0 3**

INTRODUCTION: Terms pertaining to quantity - Measurement and statistics - Instruments and standards Distribution function (9)

EVALUATION OF MEASUREMENT DATA : Evaluation of validity of extreme values of measurement results - Evaluation of the means obtained from two sets of measurement results - Comparison of variances of two sets of measurement results - Measurements concerning travelling standards - F-test for internal and external consistency - Standard error of the overall mean - Analysis of variance - Tests for uniformity of variances (9)

ERROR PROPAGATION : Propagating the error in a single-variable function - Propagating the error through a multi- variable function - Experimental strategy based on error analysis - Combined experiments - The weighted mean (9)

UNCERTAINTY IN CALIBRATION OF ELECTRICAL INSTRUMENTS: Uncertainty in calibration of RF power sensor - Uncertainty in calibration of a Digital Instrument - Uncertainty calculation for correlated input quantities - Vector Measurands. Least-squares fitting with uncertainties in both variables - More complex error surfaces - Monte Carlo methods - Bootstrap methods (9)

ESTIMATION OF PARAMETERS : Simple Linear Regression - Multiple Linear Regression - Interpretation of regression coefficients - Visualizations - Visual Data Analysis techniques - Interaction techniques - Systems and applications (9)

Total L: 45**TEXT BOOKS:**

1. Semyon G. Rabinovich , "Measurement Errors and Uncertainties – Theory and Practice", 3rd Edition, Springer Publication, 2005.
2. S.V. Gupta , "Measurement Uncertainties: Physical Parameters and Calibration of Instruments", Springer Publication, 2012.

REFERENCES:

1. Ifan Hughes, Thomas Hase , "Measurements and Their Uncertainties: A Practical Guide to Modern Error Analysis", Oxford University Press, 2010.
2. Michael, Grabe , "Measurement Uncertainties in Science and Technology", 2nd Edition, Springer Publication, 2014.
3. Patrick F. Dunn , "Measurement and Data Analysis for Engineering and Science", 2nd Edition, CRC Press, 2010.
4. Hugh W. Coleman, W. Glenn Steele , "Experimentation, Validation, and Uncertainty Analysis for Engineers", 4th Edition, John Wiley and Sons, 2018.

19U015 ADVANCED DIGITAL SIGNAL PROCESSING**3 0 0 3**

MULTIRATE SIGNAL PROCESSING: Review of discrete time system - Decimation- Interpolation –time-domain characterization-frequency-domain characterization- Multirate identities — Polyphase representations - Design of quadrature filter bank — PR condition- Application of filterbank in speech and image coding. (9)

TIME-FREQUENCY ANALYSI: Fourier Transform — Limitation of Fourier Transform — Short Time Fourier Transform — Continuous Wavelet Transform — Discrete Wavelet Transform — Implementation of Discrete Wavelet Transform through Lifting Scheme and Filter bank — Applications of wavelet transform in instrumentation and image processing. (9)

RANDOM PROCESS: Random variables — Ensemble average — Gaussian random variables — Stationary processes — Wide sense Stationarity — Ergodicity — Types of random process — Auto regressive (AR), Moving Average (MA) and Autoregressive Moving Average Processes (ARMA). (9)

POWER SPECTRUM ESTIMATION : Nonparametric methods — The periodogram — Performance of the periodogram — The Modified Periodiogram — Bartlett's method — Welch Method — Blackman- Tukey method- Parametric methods - Performance comparisons (9)

ADAPTIVE FILTER : Need for Adaptive filter - Wiener filter - limitations - Gradient Descent algorithm - LMS algorithm - variants of LMS algorithm - introduction to RLS algorithm - Applications of adaptive filter (9)

Total L: 45

TEXT BOOKS:

1. Vaidyanathan P.P , "Multirate Systems and Filter Banks", Pearson Education, 2005.
2. Monson H Hayes , "Statistical Digital Signal Processing and Modelling", John Wiley and Sons, 2006.

REFERENCES:

1. Sidney Burrus, Ramesh A. Gopinath, Haito Guo , "Introduction to Wavelets and Wavelet Transforms: A Primer", Prentice Hall, 2005.
2. Behrouz Farhang-Boroujeny , "Adaptive Filters: Theory and Applications", Wiley, 2013.
3. Sophocles J. Orfanidis , "Optimum Signal Processing", McGraw Hill, 2000.
4. Steven M. Kay , "Modern Spectral Estimation Theory and Practice", Prentice Hall, 2009.

19U016 DIGITAL IMAGE PROCESSING

3 0 0 3

DIGITAL IMAGE FUNDAMENTALS: Pixel-Relationship between pixels - Gray level - resolution - image sampling and quantization - elements of image processing system. (9)

IMAGE TRANSFORM: Need for image transform - Fourier transform - Discrete Cosine Transform - KL transform - Singular Value Decomposition -Introduction to Wavelet transform. (9)

IMAGE ENHANCEMENT: Gray level transformation - histogram equalization - spatial domain filtering: smoothing, sharpening filters - frequency domain filters. (9)

IMAGE DENOISING: Types of noise in digital image - Methods to minimize impulse noise: Median filter and its variants - Spatial domain and frequency domain approach to minimize speckle noise - methods to minimize periodic noise. (9)

IMAGE SEGMENTATION AND COMPRESSION: Point, line and edge detection - Different edge detection operators - thresholding approach - region based segmentation - Watershed algorithm - Feature extraction techniques - Need for compression - Types of compression - Transform based compression - Compression Standards (9)

Total L: 45

TEXT BOOKS:

1. Rafael C Gonzalez and Richard E Woods , "Digital Image Processing", Pearson, 2008.
2. Anil K Jain , "Fundamentals of Digital Image Processing", Pearson, 2004.

REFERENCES:

1. Milan Sonka, Vaclav Hlavac, Roger Boyle , "Image Processing, Analysis, and Machine Vision", 3rd Edition, CL Engineering, 2007.
2. Alan C Bovik , "Handbook of Image and Video Processing", Elsevier, 2005.
3. John W. Woods , "Multidimensional Signal, Image, and Video Processing and Coding", Academic Press, 2011.
4. Kenneth R Castleman , "Digital Image Processing", Pearson, 2006.

19U017 COMPUTER ARCHITECTURE

3 0 0 3

BASIC COMPUTER ORGANISATION: Classification of Architectures: CISC and RISC- Instructions - Timing and Control - Instruction Cycle - Fetch and Decode - Execution - Processor clock- Measuring computer system performance (9)

CENTRAL PROCESSOR ORGANISATION: Introduction to CPU design-Hard wired control-Micro-programmed control-General register organization - Stack organization - Instruction formats - Addressing modes - Data transfer and manipulation-Program control-Address sequencer-Datapath structure. (9)

ARITHMETIC PROCESSING: Number system and representation- IEEE 754 representation- Addition, Subtraction, Multiplication and division Algorithms-Role of Flag register- Fixed -point and Floating point Arithmetic operations - Design of Arithmetic units. (9)

MEMORY AND INPUT/OUTPUT ORGANISATION:Basic concepts - Memory Hierarchy - Main memory - Auxiliary memory - Associative memory - Cache and Virtual memory concepts - Performance considerations- Input - Output interface- Modes of transfer: Asynchronous Data transfer - Direct memory access. (9)

INTRODUCTION TO PARALLEL PROCESSING : Parallelism in uniprocessor systems- Pipeline execution- Instruction level parallelization- Parallel Computer architecture classifications - Data level parallelization - Graphical Processing Unit

– Typical applications. (9)

Total L: 45

TEXT BOOKS:

1. David A. Patterson, John L.Hennessy, "Computer Organization and Design: The Hardware/Software Interface", 4th Edition, Elsevier, 2009.
2. Morris Mano.M , "Computer System Architecture", 3rd Edition, Prentice Hall India, 2008.

REFERENCES:

1. John P Hayes , "Computer Architecture and Organization", 3rd Edition, Tata McGraw Hill, 1998.
2. William Stallings , "Computer Organization and Architecture – Designing for Performance", 8th Edition, Pearson Education, 2010.
3. Behrooz Parhami , "Computer Architecture from up to Super Computer", Reprinted, Oxford press, 2014.
4. Carl Hamachar, Zvonkoran Vranesic, Safwatzaky , "Computer Organization", 6th Edition, Tata McGraw-Hill, 2011.

19U018 NON LINEAR SYSTEMS THEORY

3 0 0 3

NONLINEAR SYSTEMS: State space representation of nonlinear systems - Autonomy - Basic characteristics of nonlinear systems - Bifurcation - Chaos - Limit cycles - Types of nonlinear elements (9)

MATHEMATICAL BACKGROUND: Manifolds - Tangent and cotangent Spaces - Vector fields and flows - Lie bracket and Lie derivatives - Distributions and co distributions - Frobenius theorem (9)

PHASE PLANE ANALYSIS: Concepts of phase plane analysis - Phase portraits - Construction of phase portrait - Isocline and delta methods - Singular points - Phase plane analysis of linear system and nonlinear system- Existence of limit cycles (9)

DESCRIBING FUNCTION ANALYSIS: Describing function fundamentals - Computing describing functions for common nonlinearities in control systems - Describing functions analysis of nonlinear systems - Stability analysis (9)

STABILITY ANALYSIS: Linearization method - Stability analysis based on Lyapunov's direct method - Krasovski's method - Variable gradient method (9)

Total L: 45

TEXT BOOKS:

1. Jean-Jacques E. Slotine , "Applied Nonlinear Control", Prentice Hall Englewood Cliffs, New Jersey, 1991.
2. Khalil, H.K , "Nonlinear Systems", Third Edition, Prentice Hall Englewood Cliffs, New Jersey, 2002.

REFERENCES:

1. Vidyasagar.M , "Nonlinear System Analysis", Prentice Hall Englewood Cliffs, New Jersey, 1978.
2. Strogatz, S. H , "Nonlinear Dynamics & Chaos, with Applications to Physics, Biology, Chemistry and Engineering", 2nd Edition, Westview Press, 2014.
3. Harry G. KwatnyGilmer L. Blankenship , "Nonlinear Control & Analytical Mechanics: a Computational Approach", Springer, 2017.
4. M.Gopal , "Digital Control and State Variable Methods", 4th Edition, McGraw Hill Education, 2017.

19U019 FUNDAMENTALS OF PNEUMATICS AND HYDRAULICS

3 0 0 3

INTRODUCTION TO PNEUMATIC CONTROL: Characteristics of compressed air - Elements of pneumatic control system - Pneumatic Actuators: Linear and rotary types - End position cushioning, sealing (6)

PNEUMATIC VALVES: Symbolic representation as per ISO 1219 and ISO 5599 - Direct and indirect actuation pneumatic cylinders - Use of memory valve - Flow control valves and speed control of cylinders supply air throttling and exhaust air throttling - Use of quick exhaust valve - Signal Processing Elements - Use of Logic gates — OR and AND gates - Pressure dependent controls: types - Time dependent controls : principle, construction (12)

INTRODUCTION TO HYDRAULIC POWER : Elements of hydraulic system - Source of hydraulic power: Pumping theory - Classification of pumps - Gear pumps, vane pumps and piston pumps - Performance of pumps - Selection of pumps (9)

HYDRAULIC ACTUATORS AND VALVES: Linear hydraulic actuators - Hydraulic motors: gear motors, vane motors, piston motors - Control valves: Directional control valves, Constructional features and working principle – Pressure control valves: Direct and

pilot operated types - Flow control valves

(9)

HYDRAULIC CIRCUIT DESIGN AND ANALYSIS: Control of single and double acting hydraulic cylinders - Speed control of hydraulic actuators - Regenerative circuit - Pump unloading circuit - cylinder synchronizing circuits – Accumulators (9)

Total L: 45

TEXT BOOKS:

1. Anthony Esposito , "Fluid Power with applications", 5th Edition, Pearson education, 2000.
2. Andrew Parr , "Hydraulics and Pneumatics: A technician's and engineer's guide", 3rd Edition, Butterworth Heinemann (Elsevier), 2011.

REFERENCES:

1. Niranjana Murthy, R.K.Hegde , "Hydraulics & Pneumatics Fundamentals of Fluid Power Engineering", 1st Edition, Sapna Book House, 2014.
2. Majumdar, S.R. , "Pneumatic Systems – Principles and Maintenance", 1st Edition, Tata McGraw Hill, 2017.
3. Srinivasan. R , "Hydraulic and Pneumatic Control", 2nd Edition, Tata McGraw - Hill Education, 2012.
4. Shanmugasundaram.K , "Hydraulic and Pneumatic controls", 1st Edition, Chand & Co., 2006.

19U020 SAFETY INSTRUMENTED SYSTEMS

3 0 0 3

INSTRUMENTATION STANDARDS: Significance of codes and standards — Overview of various types of codes and standards - Introduction of various instrumentation standards — review, interpretation and significance of specific standards - Examples: Usage of standards on specific applications. (9)

INTRODUCTION TO SAFETY INSTRUMENTATION: Hazards and Risk – Process Hazards Analysis (PHA) – Safety Life Cycle - Allocation of safety functions to protective layers - SIS design and engineering. (9)

PROTECTION LAYERS: Process plant design - Process control system - Alarm systems - Physical protection. Mitigation layers:- Containment system - Scrubbers and flares - Fire and gas systems - Evacuation procedure. (9)

SAFETY INTEGRITY LEVEL: SIL determination methods - ALARP - Risk matrix - Risk graph - LOPA - Examples for design of SIL. (9)

SELECTION OF TECHNOLOGY: Relay systems - Solid-state systems - Microprocessor based systems - PLC based systems - Safety PLCs - Safety system complexity - Communication with other systems. (9)

Total L: 45

TEXT BOOKS:

1. Paul Gruhn, Harry Cheddie , "Safety Instrumented Systems:Design, Analysis, and Justification", 2nd Edition, ISA,, 2006.
2. Glisente Landrini, Basilio Abbamonte, Tino Vande capelle , "Safety Instrumented System", 5th Edition, GM International, 2017.

REFERENCES:

1. W.M.Goble, Harry Cheddie , "Safety Instrumented Systems Verification: Practical Probabilistic Calculations", ISA, 2005.
2. Id Goettsche , "ISA - Maintenance of Instruments and Systems," 2nd Edition, ISA, 2011.
3. Swapan Basu , "Safety Instrumentation Systems", Elsevier, 2017.
4. Bela G. Liptak , "Instrument Engineers' Handbook", 4th Edition, CRC Press -ISA, 2003.

19U021 SMART SENSORS AND ACTUATORS

3 0 0 3

SENSOR SYSTEMS IN ENGINEERING: Role of sensors and sensor systems — Innovative sensor Technologies — Application scenarios - Instrumentation Process — Instrumentation Steps — Application examples. Smart sensor basics - General sensing system — Classical sensor Model — Smart sensor model — Monolithic integrated smart sensor - Hybrid integrated smart sensor. (9)

SIGNAL CONDITIONING FOR SMART SENSORS: Instrumentation Amplifier – Step mode operational amplifier – Rail to rail Op-Amp — Switched Capacitor Amplifier — 4 to 20 mA Signal Transmitter — Inherent power supply rejection – Separate Versus Integrated Signal Conditioning – Digital Conversion. (9)

INTEGRATED SMART SENSORS: Monolithic sensor interface — MCU's for sensor interface — DSP for sensor interface — Techniques and system considerations: Linearization — PWM Control — Auto-zero and Auto range — Diagnostics. Software tools and support – Sensor integration – Alternative views of smart sensing. (9)

MICROMACHINED ACTUATORS: Micro valves—Micro motors—Micro Pumps—Micro dynamometer—Micro steam engines—Actuators in other semiconductor materials—Various Micromachined structures: Cooling channels—Micro optical actuator—Micro grippers. (8)

COMMUNICATION AND STANDARDS FOR SMART SENSORS: Automotive Protocols: SAE J 1850 – CAN protocol – Industrial networks. Industrial usage of CAN—Protocols in Silicon: MI-Bus. IEEE 1451 family of standards—Extending the system to network. (10)

Total L: 45

TEXT BOOKS:

1. Randy Frank , "Understanding Smart Sensors", 3rd Edition, Artech House, 2013.
2. Ananthasuresh G K, Vinoy K J, Gopalakrishnan S, Bhat K N, Aatre V K , "Micro and Smart Systems", Wiley Publishers, 2011.

REFERENCES:

1. Subhas Chandra Mukhopadhyay , "Smart Sensors, measurement and Instrumentation", Springer Heidelberg, New York, 2013.
2. Clarence W de Silva , "Sensors and Actuators: Control Systems Instrumentation", 2nd Edition, CRC Press, New York, 2014.
3. Tai Ran Hsu , "MEMS and Microsystems: Design and Manufacture", Tata Mcgraw Hill Publishing Co Ltd, 2017.
4. Gerard C M Meijer , "Smart Sensor Systems", John Wiley and Sons, 2008.

19U022 INDUSTRIAL INTERNET OF THINGS

3 0 0 3

INTRODUCTION TO INTERNET OF THINGS: : Overview of Internet of Things - The Edge, Cloud and the Application Development - Anatomy of the Thing - Industrial Internet of Things (IIoT - Industry 4.0) - Quality Assurance - Predictive Maintenance - Real Time Diagnostics - Design and Development for IoT - Understanding System- Design for IoT - Design Model for IoT (9)

SYSTEM DESIGN OF CONNECTED DEVICES: : Embedded Devices, Embedded Hardware - Connected Sensors and Actuators, Controllers - Battery Life Conservation and designing with Energy Efficient Devices, SoCs - CC3200 Architecture - CC3200 Launchpad for Rapid Internet Connectivity with Cloud Service Providers (9)

UNDERSTANDING INTERNET PROTOCOLS: : Simplified OSI Model - Network Topologies, Standards - Types of Internet Networking — Ethernet, WiFi - Local Networking, Zigbee, Sub 1 GHz, RFID, NFC - Proprietary Protocols - SimpliciTI - Networking Design - Push, Pull and Polling - Network APIs (9)

SYSTEM DESIGN PERSPECTIVE FOR IOT: : Products vs Services - Value Propositions for IoT - Services in IoT - Design views of Good Products - Understanding Context - IoT Specific Challenges and Opportunities (9)

ADVANCED DESIGN CONCEPTS FOR IOT: : Software UX Design Considerations - Machine Learning and Predictive Analysis - Interactions, Interusability and Interoperability considerations - Understanding Security in IoT Design - Design requirements of IoT - Security Issues and challenges - Privacy - Overview of Social Engineering (9)

Total L: 45

TEXT BOOKS:

1. Joe Biron & Jonathan Follett , "Foundational Elements of an IoT Solution – The Edge, The Cloud and Application Development", 1st Edition, O'Reilly Media Inc., 2016.
2. Elizabeth Goodman, Alfred Lui, Martin Charlier, Ann Light, Claire Rowland , "Designing Connected Products: UX for the Consumer Internet of Things", 1st Edition, O'Reilly Media Inc., 2015.

REFERENCES:

1. Lucas Darnell , "The Internet of Things (A Look at Real World Use Cases and Concerns)", Kindle Edition, 2016.
2. Perry Lea , "Internet of Things for Architects: Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security", Kindle Edition, Packt Publishing Ltd., 2018.
3. Arshdeep Bahga and Vijay K. Madiseti , "Internet of Things: A Hands-on Approach", 1st Edition, Orient Blackswan Private Ltd., 2015.
4. Honbo Zhou , "The Internet of Things in the Cloud: A Middleware Perspective", Kindle Edition, CRC Press, 2013.

19U023 NON-CONVENTIONAL ENERGY SYSTEMS

3 0 0 3

BACKGROUND OF ENERGY SCENARIO: : Energy Demand Scenario in India - Energy resources in India and its sustainability - Different types of conventional Power Plant - Limitation of fossil fuels - Pollution aspects and impact of various power plants - Industrial and transport emissions (5)

SOLAR PHOTO-VOLTAIC SYSTEM : Solar radiation and its measurement - Insolation and Temperature - Solar cells and characteristics, Solar PV module, PV system design and applications - Maximum Power Point Tracking algorithms - Stand-alone and grid connected systems (12)

WIND POWER GENERATION : Components of Wind Energy Conversion Systems - Classification of wind turbines - aerodynamic operation of wind turbine, extraction of wind turbine power, wind turbine power curve, horizontal axis wind turbine generator - modes of wind power generation - stand-alone and grid connected system (6)

FUEL CELL SYSTEM AND HYBRID ENERGY SYSTEMS : Principle of operation of fuel cell, technical parameters of fuel cell - Type of fuel cell - Advantages of fuel cell power plants, energy output, efficiency and emf of fuel cell - operating characteristics, applications - Hybrid energy systems: Need for hybrid systems, types, configuration and coordination, electrical interface - PV-Diesel, Wind-diesel, wind-PV, wind-PV- fuel cell (14)

BIOMASS AND GEOTHERMAL ENERGY RESOURCES: Biomass conversion Technologies - Feedstock pre- processing and treatment methods - Geothermal Energy resources: Ocean Thermal Energy Conversion – Tidal Energy (8)

Total L: 45

TEXT BOOKS:

1. Boyle G , "Renewable Energy: Power for a Sustainable Future", 2nd edition, Oxford University Press, 2012.
2. B H Khan , "Non-Conventional Energy Resources", 2nd edition, The McGraw –Hill, 2010.

REFERENCES:

1. G D Rai , "Non-conventional Energy sources", 5th edition, Khanna Publishers, 2014.
2. D P Kothari, K C Singal and RakeshRanjan , "Renewable Energy Sources and EmergingTechnologies", 2nd edition, 2012.
3. C S Solanki , "Solar Photovoltaics – Fundamentals, Technologies and Applications", 2nd Edition, PHI Pvt., Ltd., 2011.
4. Gilbert M. Masters , "Introduction to Environmental Engineering and Science", 2nd Edition, Prentice Hall, 2003.

ONE-CREDIT COURSES

19UF01 DISTRIBUTED CONTROL SYSTEM IN INDUSTRIES

1 0 0 1

INTRODUCTION : Evolution of process control system - DCS CS3000 System Architecture Configuration: PFCS,-FCS Hardware LFCS, KFCS, FFCS, FFCS-L. (3)

HIS CONFIGURATION : Application Capacity - Network Details - Address Setting. (3)

CS3000 SYSTEM BUILDER CONFIGURATION : Project Creation-Project Attribution Utility - Downloading-Introduction to CS3000 FCS Simulation S/W - User Login - IOM - Creation/ Signal Configuration. (3)

CONTROL STRATEGIES : Concept of Control Drawing - Concept of Function block Diagram - Configuration of Feed Back Control Functions: Creation of Open Loop, Creation of Closed Loop, and Creation of Cascade Loop - Introduction to Standard Display Windows: System Defined Windows, User Defined Windows - Operation of Instrument Faceplates. (3)

CREATION OF WINDOWS : Operation of Tuning Window - Control Group Window - Configuration of Trend Window - Graphics Window - Introduction to Switches/Interlocks. (3)

Total L: 15

TEXT BOOKS:

1. Michael P. Lukas , "Distributed Control Systems", Van Nostrand Reinhold Co., 1986.
2. Yokogawa India Private Limited , "CS 3000-Software Instruction Manual", , Bangalore, .

REFERENCES:

1. John Park, Steve Mackay, Edwin Wright , "Practical Data Communications for Instrumentation and Control Systems", Elsevier, 2003.
2. Bela G.Liptak , "Process Control and Optimization", 4th Edition, CRC Press, 2006.

19UF02 ADVANCED INDUSTRIAL AUTOMATION SYSTEMS

1 0 0 1

PROGRAMMABLE AUTOMATION CONTROLLERS : Multidisciplined Controllers-System Model-Backplane Communications - Different Form Factors - Networking Options - Operating System - Task Program and Routine as per IEC 61131-3 - Controller

Data Features - Programming Software - Anatomy and Memory Structure - Operating System Priorities - Concept of Connections for Industrial Automation Systems - Understanding Controller Communication to the external World (4)

HANDS ON PRACTICE : Logix Controller programming Software with examples on Process Control and PID Tuning (3)

INDUSTRIAL NETWORKING : Evolution of Industrial Networking - Need for Industrial Networking - Network functions - Open Vs Proprietary Industrial Networking - Netlinx - Seamless Industrial Networking - CIP and Netlinx - Netlinx networks - Implementation and application paradigm of Device net, Control net and Ethernet/IP networks - Applications (2)

DEMONSTRATION : Hands on Practice on Device net/Control net/Ethernet/IP Networks. (3)

HMI SYSTEMS AND VISUALIZATION SOLUTIONS : Integrated Architecture and Factory Talk Manufacturing Information platform - One Architecture for Plant wide Control and Information - Role of Industrial Visualization - Visualization fit within an Automation Environment - View technology Cornerstones - View Technologies - Machine level and PC Based platforms (3)

Total L: 15

REFERENCES:

1. John W. Webb and Ronald A. Reis , "Programmable Logic Controllers: Principles and Applications", 5th Edition, Prentice Hall India publication, 2002.
2. Instruction Manual , "Control and Configuration software", Rockwell Automation, Bangalore, .
3. Frank D Petruzella , "Programmable Logic Controllers", 5th Edition, Mc Graw Hill publication, 2010.
4. John Park, Steve Mackay , "Practical Industrial Networking for Engineers and Technicians", IDC Technologies, 2011.

19UF03 MARINE INSTRUMENTATION AND SYSTEMS

1 0 0 1

ELECTRICAL LAYOUT OF A SHIP : Main generators - Main switchboard - Paralleling of Generators - Synchronizing and load sharing - Generator protection - Emergency supply system - Emergency generator - Emergency batteries Shore supply electronic control of protective relays (2)

NAVIGATIONAL AIDS : Radar - Gyro - Echo sounder - Log - Voyage data recorder (2)

COMMUNICATION : Internal communication - Intercom - Sound powered telephones - External communication - VHF - GMDSS - Electronic components (3)

CONTROL SYSTEMS : Main engine controls - Generator controls - Propulsion control - Steering control - Vessel management systems - Application of PLC (4)

ELECTRICAL PROPULSION : Evolution - Advantages of electrical propulsion - Problems faced in electrical propulsion application of electronics in propulsion (4)

Total L: 15

TEXT BOOKS:

1. Elstan A. Fernandez , "Marine Electrical Technology", , 2nd edition, Shroff publishers, 2007.
2. Akber Ayub , "Marine Engineering", ANE Books pvt ltd, New delhi, 2010.

REFERENCES:

1. Elstan A. Fernandez , "Marine Electrical Technology", , 2nd edition, Shroff publishers, 2007.
2. Basic Marine electricity learning resources , DNV India, 2005.
3. D A Taylor , "Introduction to Marine Engineering" , , 2nd edition, Elsevier, Butterworth, 2005.
4. John C. Payne , "The Marine Electrical and Electronics Bible -A practical Handbook for Cruising sailors", , USA 2001, .

19UF04 MEDICAL IMAGE ANALYSIS

1 0 0 1

MEDICAL IMAGE MODALITIES : CT Basics, MRI Basics (T1/T2 weighted images), Physics of MRI. (2)

FEATURE DETECTOR : KLT, SIFT, Surf (2)

MEDICAL IMAGE SEGMENTATION : Active Shape, Active Contours, Graph Cuts (3)

MEDICAL IMAGE REGISTRATION : Rigid, Affine, Elastic Registration, Non-Rigid Registration- Introduction (BSplines), Mutual Information Metric (2)

COMPRESSED SENSING : CS and its application in MRI (2)

PATTERN CLASSIFICATION : Bayes Classifiers, Random Forests (2)

DEMO/HANDS ON PRACTICE ON SEGMENTATION, REGISTRATION : ITKSnap, c3d (Segmentation examples), Slicer3D, MevisLab, Elastix (Registration), Fiji (ImageAnalysis), Pythonxy. (2)

Total L: 15

REFERENCES:

1. Geoff Dougherty , "Digital Image Processing for Medical Applications", Cambridge University Press, 2009.
2. Isaac Bankman , "Handbook of Medical Imaging: Processing and Analysis", Academic Press, 2000.
3. Linda Shapiro, George C. Stockman , "Computer Vision", Prentice Hall, 2001.
4. J. R. Parker , "Algorithms for Image Processing and Computer Vision", 2nd Edition, 2011.

19UF05 SYSTEM DESIGN AND IMPLEMENTATION

1 0 0 1

INTRODUCTION TO CONTROL SYSTEM DESIGN AND SIMULATION : Developing a plant model, transfer function model, State space model - Overview of Control Design Toolkit-Control Design VIs, Model representation, Model forms - Constructing Transfer function models, state space models and zero pole gain models (3)

MODEL CONVERSION AND INTERCONNECTION : Converting Model Forms- Continuous to Discrete model conversion - Connecting Models in series, Connecting models in parallel - Placing models in closed loop configuration (3)

TIME RESPONSE ANALYSIS : Calculating the time domain specification - Case study: Spring mass damper system, RLC circuit - Analyzing the time response of a system for an applied step and impulse inputs, Analyzing initial response of a given system (3)

FREQUENCY RESPONSE ANALYSIS : Frequency domain specifications, Bode frequency analysis - Gain margin, Phase margin - Nichols frequency analysis, obtaining frequency response data (3)

STABILITY ANALYSIS AND CLASSICAL CONTROLLER DESIGN : Determining stability : Root locus method, Pole zero map - PID Controller design and prototyping - Implementation of auto tuning PID controller. Case study- Speed control of a DC motor, Level and Flow control (3)

Total L: 15

REFERENCES:

1. Dorf, Bishop , "Modern Control Systems", 11th Edition, Prentice Hall, 2017.
2. Ogata K , "Modern Control Engineering", Prentice-Hall of India Pvt Ltd., New Delhi, 1997.
3. Norman S Nise , "Control System Engineering", 4th Edition, John Wiley & sons, Inc, 2004.
4. Nagrath I J, Gopal M, "Control System Engineering", 3rd Edition, Wiley and Sons, 2004.

19UF06 CALIBRATION TECHNIQUES

1 0 0 1

MEASUREMENT UNCERTAINTY : Background — random and systematic errors - type A and type B uncertainty - sensitivity coefficients —uncertainty evaluation (3)

CALIBRATION : Introduction - meaning — objectives - necessity of calibration - basic calibration process — various components of a calibration system (3)

STANDARDS AND STANDARDIZATION : Working standards, check standards and international standards - levels of standard accuracies, accuracy ratio between levels of calibration pyramid - Requirements of traceability - metrology standardization documents (3)

CALIBRATION TECHNIQUES : Introduction — Calibration Curve Method, Standard Additions Method — Internal Standard Method, Comparative technique - choosing calibration method — determining calibration intervals (3)

CALIBRATION SETUPS : Electrical calibration - Temperature calibration - Pressure and Flow calibration — demonstrations (3)

Total L: 15

REFERENCES:

1. Stephanie Bell , "A Beginner's Guide to Uncertainty of Measurement", National Physical Laboratory, UK, 1999.
2. Allan. S. Moris , "Measurement and Calibration for Quality Assurance", Prentice Hall, 1991.
3. Mike Cable , "Calibration: A Technicians Guide", ISA Publisher, 2005.
4. International Organization for Standardization , "International Vocabulary of basic and general terms in Metrology", 2008.

19UF07 MOTION CONTROL SYSTEMS**1 0 0 1****INTRODUCTION** : Motion Control System, Micro and nano level motion systems. (2)**MOTION SENSING TECHNOLOGIES** : Optical and magnetic encoders, magnetic and optical readers, resolvers, MEMS based accelerometers / gyros, multi-axis force/moment sensors, piezoresistive sensors, PSD sensors, tactile sensors, nanometrology. (3)**ACTUATOR TECHNOLOGIES** : PMDC Motor, BLDC Motor, Induction Motor, Variable Reluctance motors, voice coil motors, piezoelectric actuators, magnetic actuators, shape memory alloys, linear actuation, electro-pneumatic and electro-hydraulic actuators. (2)**POWER TRANSMISSION SYSTEMS AND LOADS** : Planetary gears, cycloid gears, harmonic drives, series elastic drives, cable drives, ball screws, and CVT. Loads and motor sizing. (2)**CONTROL OF ACTUATORS** : Force/Torque, speed, position control loops, importance of stiffness, damping and inertia in various applications, auto-tuning, motion profiling and trajectory generation. (2)**ADVANCED MOTION CONTROL STRATEGIES** : Multi-axis motion systems, master-slave bilateral operations (2)**SAFETY IN MOTION SYSTEMS** : Application of brakes and clutches and international regulations. (2)**Total L: 15****REFERENCES:**

1. Urs Kafader , "Selection of High Precision Microdrives", Maxon Academic Series, 2010.
2. Kok Kiong Tan, Tong Heng Lee , "Precision Motion Control: Design and Implementation", Springer, 2010.
3. Asif Sabanovic, Kouhei Ohnishi , "Motion Control Systems", Wiley-IEEE Press, 2011.

19UF08 ELECTRICAL METROLOGY**1 0 0 1****BASIC METROLOGY** : Understanding metrology Vocabulary, Measurement significance and application - Common metrology terminologies - Calibration: Objective and benefits of calibration (3)**TRACEABILITY AND SI UNITS** : Traceability and its importance, International Metrology Structure – Calibration Hierarchy - Importance of SI Units and types of SI Units (3)**STANDARDS USED IN ELECTRICAL CALIBRATION** : Absolute, Primary, secondary, working and census standards – measurement setup - Interpretation of specifications of various calibration standards and Device Under Calibration (DUCs) (3)**CALIBRATION PROCEDURES FOR VARIOUS ELECTRICAL T & M INSTRUMENTS** : Methods of Calibration: Oscilloscopes, clamp meter, Panel meters - Calibration procedure of Voltmeter, Multimeter, DMM - Case studies (3)**MEASUREMENT UNCERTAINTY** : Overview on Uncertainty, reason for uncertainty and its importance - Uncertainty evaluation - best practice - Uncertainty in practice and Case studies (3)**Total L: 15****REFERENCES:**

1. International Organization for Standardization , "Guide to expression of Uncertainty in measurement", Switzerland, 1995.
2. International Organization for Standardization , "International Vocabulary of basic and general terms in Metrology", Switzerland, 1993.
3. International Organization for Standardization , "International Standard ISO 3534-1, statistics-Vocabulary and Symbols-part-I: Probability and General Statistical Terms", Switzerland, 1993.
4. National Accreditation Board for Testing and Calibration Laboratories , "Guidelines for Estimation and Expression of

19UF09 STANDARD PRACTICES FOR POWER PLANT INSTRUMENTATION

1 0 0 1

OVERVIEW OF POWER PLANT : Role of Instrumentation engineers in large power & process plants. - Evolution of Instrumentation (Gauges to DCS and beyond) (2)

STANDARDS AND CONTROL SCHEMES : Communication standards of Instrumentation - Standards of Instrumentation (National/International), Instrument numbering system, KKS coding, Typical control schemes in power plants. (5)

SAFETY : Instrumentation in hazardous areas - Standards of Instrument enclosures. (3)

INTERNATIONAL STANDARDS : International certification for Instruments - Underwriters Laboratories/Canadian Standards Association/Verband der Elektrotechnik (UL/CSA/VDE), Instrument installation guidelines. (5)

Total L: 15

REFERENCES:

1. Alan. S. Morris , "Measurement and Instrumentation Principles", Butterworth-Heinemann, 2011.
2. Bouwens A. J , "Digital Instrumentation", Tata McGraw-Hill Education, 2001.
3. Bela. G. Liptak , "Instrument Engineers' Handbook - Process Measurement and Analysis", Vol 1, CRC Press, 2003.
4. Bela. G. Liptak , "Instrument Engineers' Handbook - Process Control and Optimization", Vol 2, CRC Press, 2005.
5. Bela. G. Liptak , "Instrument Engineers' Handbook - Process Software and Digital Networks", Vol 3, CRC Press, 2011.
6. Sam G. Dukelow , "The Control of Boilers", 2nd Edition, Instrument Society of America, 1991.

19UF10 AUTOMOTIVE INSTRUMENTATION AND CONTROL

1 0 0 1

AUTOMOTIVE INSTRUMENTATION CLUSTER : Measurement and display techniques of Vehicle Speed, Engine Speed and Odometer, Fuel Level, Oil Pressure, Engine Temperature, Battery Status, Gear Shift Indication, Seat Belt Indication, Door Open indication. (3)

VEHICLE CONTROL FUNCTION : Cruise Control (Simple and Adaptive), Speed Limiter, Vehicle Stability control. (3)

ENGINE CONTROL FUNCTION : Air system Control, Fuel System Control, Ignition Control, Exhaust Control, Water temperature control(Electric fan and pump), Engine speed control and Engine speed limitation. (3)

BODY ELECTRONICS : Immobilizer for vehicle security, Power Window control, Wiper speed control (with and without rain sensing) Head lamp intensity control based on Ambient light sensing. (3)

AUTOMOTIVE COMMUNICATION PROTOCOLS : Controller Area Network(CAN), Local Interconnect Network(LIN), FlexRay, Media Oriented Systems Transport(MOST). (3)

Total L: 15

REFERENCES:

1. Robert Bosch GmbH , "Automotive Handbook", 9th Edition, Bentley Publishers, 2014.
2. Konrad Reif , "Automotive Mechatronics: Automotive Networking, Driving Stability Systems, Electronics (Bosch Professional Automotive Information)", Springer Vieweg, 2015.

19UF11 AIRCRAFT INSTRUMENTATION

1 0 0 1

OVERVIEW : Introduction to aircraft instrumentation, Types of instruments, Location inside the cockpit. (2)

INTRODUCTION TO FLIGHT INSTRUMENTATION AND BAROMETRIC INSTRUMENTS : Pitot Static System, Air Speed Indicator(ASI), Altimeter, Rate of Climb Indicator(ROCI), Mach Meter. (3)

INTRODUCTION TO POWER PLANT INSTRUMENTATION AND ENGINE PARAMETER MONITORING INSTRUMENT : Auxiliary Engine Gas Temperature Indicator, Main Engine Rpm Gauge, Exhaust Gas Temperature Indicator(EGTI), Engine Oil Temperature Indicator, Engine Oil Pressure Indicator, Engine Vibration Measurer, Fuel Flow Meter, Fuel Quantity Gauge, Engine Regime Indicator, Hydraulic System Pressure/Temperature Indicator. (5)

INTRODUCTION TO NAVIGATION INSTRUMENTS AND GYRO INSTRUMENTS : Artificial Gyro Horizon, Combined Course Indicator(CCI), Flight Director Indicator(FDI), Null Indicator, Turn and Slip Indicator. (3)

INDEPENDENT INSTRUMENTS : Chronometer, Magnetic Compass, Bomb Bay Compartment Temperature Indicator, Cabin Temperature Indicator, Cabin Pressure Indicator. (2)

Total L: 15

REFERENCES:

1. S Nagabhushan. , "Aircraft Instrumentation and Systems", I. K. International Pvt Ltd,2013.
2. EHJ Pallett. , "Aircraft Instruments", Longman Scientific & Technical, 1988.
3. MaxF Henderson , "Aircraft Instrument and Avionics", Jeppesen Sanderson, 1993.
4. Dale Crane , "A Pilot Guide to Aircraft and Their Systems", Aviation Supplies & Academics, Incorporated, 2002.

19UF12 AUTOMATIC FLIGHT CONTROL SYSTEM

1 0 0 1

INTRODUCTION : Aircraft Stability, Directional Divergence, Spiral Divergence, Dutch Roll and Controllability. (2)

NEED AND ROLE OF FLIGHT CONTROL SYSTEM : Elements of flight control system. Functional diagram of a basic closed loop flight control system. Purpose of Altitude hold and airspeed hold (4)

CLASSIFICATION OF FCS : Single axis, two axis and three axis. Functional components of three axis FCS. (2)

INTRODUCTION TO SENSORS/ERROR DETECTORS : Gyros (Vertical, Directional, Displacement, Rate), Altitude Sensor, Air speed Sensor, Compass/Heading Sensor, Accelerometers (INS), Synchros. (3)

INTRODUCTION TO ACTUATORS : Electro Pneumatic Servo Actuators, Electro Hydraulic Servo Actuators, Electro Mechanical Servo Actuators, Position Control Servomechanism, Speed Control Servomechanism. (2)

SIGNAL PROCESSING : Functions of signal processing elements in a FCS, Signal Processing channel and its elements, Limiting Synchronizing, Gain and Adaptive Control, Feedback in a FCS. (2)

Total L: 15

REFERENCES:

1. E H J Pallett, S Coyle , "Automatic Flight Control", 4th Edition, Oxford : Blackwell Science, 2005.
2. E. H. J. Pallett , "Aircraft Instruments", Himalaya Publishing House, New Delhi, 1993.
3. John P fielding , "Introduction to Aircraft Design,", 4th Edition, Cambridge University Press, 1999.
4. L J Clancy , "Aerodynamics", Pitman Publishing, 1978.

ENGLISH

19GF01 INTERPERSONAL AND ORGANIZATIONAL COMMUNICATION

1 0 0 1

INTRA ORGANIZATIONAL COMMUNICATION : Communication Networks in an Organization; Intra- organizational communication (2)

INTER ORGANIZATIONAL COMMUNICATION : Flow Nomenclature; Workplace diversity and intercultural aspects of communication (2)

COMMUNICATION FUNCTIONS IN ORGANIZATIONS : Teamwork and team dynamics; Conflict resolution strategies and styles; Leading and influencing others-facilitation skills (3)

WRITTEN COMMUNICATION : Email Writing, Professional Reports, and Memos (4)

INTERPERSONAL SKILLS : Nature and Dimensions of Interpersonal Communication; Personality and Communication styles; Active listening and intentional responding; Working with emotional intelligence (4)

Total L: 15

REFERENCES:

1. Bagchi Subroto , "The Professional", Penguin Publications, UK, 2011.
2. PMBOK guide , "A Guide to the Project Management Body of Knowledge", Project Management Institute Inc, USA, 2013.

19GF02 HUMAN VALUES THROUGH LITERATURE

1 0 0 1

PROSE : Kalam's vision of college education in Wings of fire - Emerson's advocacy of independence of Human will in Self-reliance - Harmony in Education-views of Bertrand Russel (4)

POETRY : Maintaining Human relations in Robert Frost's Mending Wall - Quest for identity and freedom in Kamala Das's An Introduction (2)

DRAMA : Statesmanship and friendship in Girish Karnad's Tughlaq (3)

ONE-ACT PLAY : The theme of love in Chekhov's The Bear (3)

SHORT STORY : Empathy in Somerset maugham's Mr. Know-all - Family bond in Anita Desai's Devoted son (3)

Total L: 15

TEXT BOOKS:

1. Faculty - Department of English , "Course materials", PSG College of Technology, Coimbatore, 2019.

REFERENCES:

1. Abrams M .H, Harpham , "A Glossary of Literary Terms", Cengage, Boston, 2015.
2. Scholes R, et.al. , "Elements of Literature", IV, Indian Rpt. OUP, New Delhi, 2013.

HUMANITIES

19OFA1 EXPORT – IMPORT PRACTICES

1 0 0 1

INTRODUCTION : Export – Import Business – Preliminaries for starting Export – Import Business Registration. (3)

EXPORT PROCEDURES : : Obtaining an Export License – Export Credit Insurance – Procedures and Documentation (4)

FOREIGN EXCHANGE : Finance for Exports – Pricing - Understanding Foreign Exchange Rates. (3)

IMPORT PROCEDURES : Import Policy – License - Procedure and Documentation. (3)

EXPORT INCENTIVES : Incentives - Institutional support (2)

Total L: 15

REFERENCES:

1. Ramagopal C , "Export Import Procedures - Documentation and Logistics", New Age International, 2014.
2. Cherian and Parab , "Export Marketing", Himalaya Publishing House, New Delhi, 2008.
3. Parul Gupta , "Export Import Management", MC-Graw Hill, 2017.
4. Justin Paul, Rajiv Aserkar , "Export Import Management", Oxford, 2013.

19OFA2 INSURANCE - CONCEPTS AND PRACTICES

1 0 0 1

INTRODUCTION TO INSURANCE AND RISK MANAGEMENT : Origin, History, Nature and Scope of insurance – Meaning, types

and significance of risk. (3)

INSURANCE LAWS AND REGULATIONS : Insurance Act, IRDA Act, Consumer Protection Act, Ombudsman Scheme. (2)

INSURANCE UNDERWRITING AND RISK MANAGEMENT : Meaning of underwriting and underwriter, guidelines and steps in the process of underwriting – characteristics, significance and principles of risk management. (4)

FINANCIAL ASPECTS OF INSURANCE MANAGEMENT : Role and functions of financial institutions, determination of premium for various insurance products. (3)

SETTLEMENT OF INSURANCE CLAIMS : Documents needed during various claims, Factors affecting insurance claims (3)

Total L: 15

REFERENCES:

1. Scott Harrington, Gregory Niehaus , "Risk Management and Insurance", McGraw Hill Education, 2017.
2. George E Rejda , "Principles of Risk Management & Insurance", Pearson Education, 2017.
3. John Hull , "Risk Management & Financial Institution", John Wiley and Sons, 2018.
4. Arjun Mittal, D D Chaturvedi , "Insurance and Risk Management", Scholar Tech Press, 2017.

19OFA3 PUBLIC FINANCE

1 0 0 1

INTRODUCTION: Nature and Scope of public finance – Principles of taxation. (2)

PUBLIC REVENUE AND TAXATION: Sources of Revenue – Tax and non-tax revenue – Classification of Taxes, GST. (4)

PUBLIC EXPENDITURE: Importance – Types – Causes of increase in public expenditure – Effects of public expenditure in India. (3)

DEFICIT FINANCING AND BUDGET: Sources of public debt – Debt redemption – Budget – Types – Preparation of Budget in India. (3)

FEDERAL FINANCE: Centre-State financial relations – Finance commissions. (3)

TOTAL: 15

REFERENCE BOOKS:

1. Richard A Musgrave and Peggy B Musgrave, "Public Finance in Theory and Practice" – Tata McGraw Hill Education, New Delhi, 2004.
2. Bhatia H.L, "Public Finance" – Vikas Publishing House, 29th Edition, New Delhi, 2012.
3. David N Hyman, "Public Finance: A contemporary application of theory and policy", Cengage Publication, 11th Edition, Noida, 2014.
4. Santhosh Dalvi and Krishnan Venkatasubramanian, "An introduction to Goods and Service Tax: The biggest tax reform in India", CCH Publisher, New Delhi, 2015.

19OFA4 SECURITY ANALYSIS AND PORTFOLIO MANAGEMENT

1 0 0 1

INVESTMENT ENVIRONMENT : Financial Markets - Classification - Financial Instruments – Security Trading. (2)

TYPES OF SECURITIES : Trading – Orders, Margin Trading – Clearing and Settlement Procedures. (5)

SECURITY ANALYSIS I : Industry Analysis –Estimation of Rates of Return. (2)

SECURITY ANALYSIS II : Company Analysis — Estimation of Rates of Return. (2)

PORTFOLIO MANAGEMENT : Measuring Risk and Returns and Treatment in Portfolio Management. (4)

Total L: 15

REFERENCES:

1. William F Sharpe, Gordon J. Alexander, Jeffery V Bailey , "Investments", Prentice Hall, 2012.
2. Prasanna Chandra , "Investment Analysis and Portfolio Management", TATA McGraw Hill Publishing, 2011.
3. Ranganathan , "Investment Analysis and Portfolio Management", Pearson, 2004.
4. Bhalla V K , "Investment Management", TATA McGraw Hill Publishing, 2011

19OFA5SOCIAL ENTREPRENEURSHIP

1 0 0 1

INTRODUCTION TO SOCIAL ENTREPRENEURSHIP: Social Entrepreneur - Meaning, qualities and skills. Social Entrepreneurship – Characteristics, process and ecosystem – Case Studies. (3)

SOURCES OF FUNDING FOR SOCIAL ENTREPRENEURSHIP: The Social Entrepreneurship Frame work. Start-ups and funding - Internal and External. Schemes for social entrepreneurship. (4)

STRATEGIES IN SOCIAL ENTREPRENEURSHIP:Industry and Market Analysis, Business planning, concepts of value creation,new ideas and risk taking. (4)

PROSPECTS AND PROBLEMSIN SOCIAL ENTREPRENEURSHIP: Opportunities for Social entrepreneurs, an overview of legal structure, tax structure and other liabilities. (4)

TOTAL: 15

REFERENCE BOOKS:

- 1.S.S.Khanka, "Creativity and Innovation in Entrepreneurship", Sultan Chand & Sons, 2021.
- 2.C. Paramasivan, "Social Entrepreneurship", New Century Publications, 2016.
- 3.Robert A. Philips Margret Bonefiel Ritesh Sharma, "Social entrepreneurship, the next big business opportunity", Global Vision Publishing House, 2011.
- 4.Drucker, Peter, "Innovation and Entrepreneurship", Harper Business, 2006.

LANGUAGE ELECTIVES

19G001 COMMUNICATION SKILLS FOR ENGINEERS

0 0 4 2

COMMUNICATION CONCEPTS:

Process of Communication
Inter and Intrapersonal Communication
Inter and Intrapersonal CommunicationActivities (9)

FOCUS ON SOFT SKILLS:

Etiquette — Work Place etiquette — Telephone etiquette
Body Language
Persuasive Communication
Public Speaking
Critical Reasoning and Conflict Management based on Case Studies
Group Communication
Meetings
Interview Techniques

(14)

TECHNICAL WRITING :

Technical Writing Principles
Style and Mechanics
Technical Definitions – Physical, Functional and Process Descriptions
Technical Report Writing
Preparing Instructions and Manuals
Interpretation of Technical Data

(15)

BUSINESS CORRESPONDENCE :

Writing Emails
Preparing Resumes
Memos
Technical and Business Proposals

(7)

TECHNICAL COMMUNICATION :

Seminars
Process Description and Group Discussions
Use of Visual Aids

(15)

Total P: 60

TEXT BOOKS:

1. Faculty Incharge "Course Material on "Communication Skills for Engineers"", PSG College of Technology., Coimbatore, 2019

REFERENCES:

1. Jeff Butterfield "Soft Skills for Everyone", Cengage Learning., New Delhi, 2013
2. Jean Naterop B and Rod Revell "Telephoning in English", Cambridge University Press., Cambridge, 2011
3. David A Mc Murrey and Joanne Buckley "Handbook for Technical Writing", Cengage Learning., New Delhi, 2011
4. Simon Sweeney "English for Business Communication", Cambridge University Press., New Delhi, 2012

19G002 GERMAN- LEVEL A1.1

0 0 4 2

GUTEN TAG! :

1. To greet, learn numbers till 20, practice telephone numbers & e mail address, learn alphabet, speak about countries & languages
2. Vocabulary: related to the topic
3. Grammar: W — Questions, Verbs & Personal pronouns I. (10)

FREUNDE, KOLLEGEN UND ICH :

1. To speak about hobbies, jobs, learn numbers from 20; build dialogues and frame simple questions & answers
2. Vocabulary: related to the topic
3. Grammar: Articles, Verbs & Personal pronouns II, sein & haben verbs, ja/nein Frage, singular/plural (10)

IN DER STADT :

1. To know places, buildings, question, know transport systems, understand international words; build dialogues and write short sentences
2. Vocabulary: related to the topic
3. Grammar: Definite & indefinite articles, Negotiation, Imperative with Sien verbs (12)

GUTEN APPETIT! :

1. To speak about food, shop, converse; Vocabulary: related to the topic; build dialogues and write short sentences
2. Grammar: Sentence position, Accusative, Accusative with verbs, personal pronouns & prepositions, Past tense of haben & sein verbs (13)

TAG FÜR TAG/ZEIT MIT FREUNDEN :

1. To learn time related expressions, speak about family, about birthdays, understand & write invitations, converse in the restaurant; ask excuse, fix appointments on phone
2. Vocabulary: related to the topic
3. Grammar: Time related prepositions, Possessive articles, Modalverbs (15)

Total P: 60

TEXT BOOKS:

1. Dengler Stefanie "Netzwerk A1.1", Klett-Langenscheidt Gmbh., München, 2013
2. Sandra Evans, Angela Pude "Menschen A1", Hueber Verlag., Germany, 2012

REFERENCES:

1. Stefanie Dengler "Netzwerk A1", Klett-Langenscheidt Gmbh., München, 2013
2. Hermann Funk, Christina Kuhn "Studio d A1", Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2009
3. Rosa-Maria Dallapiazza "Tangram Aktuell 1 (Deutsch als Fremdsprache)", Max Hueber Verlag., Munchen, 2004
4. Christiane Lemcke und Lutz Rohrmann "Grammatik Intensivtrainer A 1", Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2012

19G003 FRENCH LANGUAGE LEVEL 1

0 0 4 2

PARTS OF SPEECH :

1. inviter et répondre à une invitation, Pronoms sujets
2. L'article définis, l'article indéfinis
3. Conjugation : présent, adjectifs possessifs
4. interrogation, décrire les personnes
5. La vie de quatre parisiens de professions différentes (12)

ELEMENTS OF GRAMMAR :

1. Exprimer l'ordre et l'obligation demander et commander
2. l'adjectif possessifs, l'article partitif, l'article démonstratif, négation ne
3. pas, l'article contracté
4. verbe pronominaux
5. prepositions (12)

SENTENCE STRUCTURE :

1. Raconter et reporter-donner son avis
2. Futur simple, pronom complètement d'objet direct, passé composé
3. plusieurs région de France, imparfait, pronom y/en, imparfait (12)

TENSES AND NUMBERS :

1. Demander l'autorisation-passé récent, futur proche
2. La vie administrative et régionale, Pluriel des noms, moyens de transport (12)

DISCOURSE :

1. le discours rapporté, décrire un lieu, exprimer ses préférences
2. décrire la carrière, discuter d'un système éducation de France
3. parler de la technologie de l'information (12)

Total P: 60

TEXT BOOKS:

1. Christine Andant étal "À propos (livre de l'élève", LANGER., NEW DELHI, 2012
2. Myrna Bell Rochester "Easy French Step By Step", MCGrawhill Companies., USA, 2008

REFERENCES:

1. Michael D. Oates "Entre Amis: An Interactive Approach", Houghton Mifflin., 2005 , 5th
2. Bette Hirsch, Chantal Thompson "Moments Literaries : An Anthology for intermediate French", ..
3. Simone Renaud, Dominique van Hooff "En bonne forme", ..

19G004 BASIC JAPANESE

0 0 4 2

JAPANESE PEOPLE AND CULTURE :

1. Basic greetings and responses
2. Basic script— Method of writing hiragana and katakana— Combination sounds and simple words
3. Selfintroductions: "Hajimemashite"-Demonstratives "Kore", "Sore", "Are"— Demonstrative "Kono", "Sono", "Ano"
4. Possessive noun particle "no"— Japanese apartments: Greeting your neighbor (12)

PATICLE "NI (AT)" FOR TIME :

1. kara (from) ~ made(until) — Particle "to (and)"
2. Time periods: Days of the week, months, time of day –Verbs (Present / future and pasttense)
3. Telephone enquiry: Asking for a phone no. And business hours- Destination particle "e". (12)

LIKES AND DISLIKES :

1. Potential verbs (wakarimasu and dekimasu) — “Kara (~ because)”
2. Adverbs — Asking someone over the phone-Verbs denoting presence
3. Introduction to Adjectives (na and i type) -Verb groups — I, II and III — Exercises to group verbs- Please do (te kudasai)
4. Present continuous tenses (te imasu) — Shall I? (~ mashou ka) — Describing a natural phenomenon (It is raining)
(12)

DIFFERENT USAGES OF ADJECTIVES :

1. Comparison — Likes and dislikes — Going to a trip- Need and desire (ga hoshii) — Wanting to . . . (Tabetai desu)- Going for a certain purpose (mi -ni ikimasu)
2. Choosing from a menu-Adjectives (“i” and “na” type) — Adjectives (Positive and negative usage) (12)

ROLE PLAYS IN JAPANESE :

1. Framing simple questions & answers
2. Writing Short paragraphs & Dialogues
3. A demonstration on usage of chopsticks and Japanese tea party (12)

Total P: 60**TEXT BOOKS:**

1. Minna no Nihongo, Honsatsu Roma "ji ban (Main Textbook Romanized Version)", . International publisher — 3A Corporation., Tokyo, 2012

REFERENCES:

1. Eri Banno et.al "Genki I: An Integrated Course in Elementary Japanese I -Workbook", ., 1999
2. Tae Kim "A Guide to Japanese Grammar: A Japanese Approach to Learning Japanese Grammar", ., 2014
3. Minna No Nihongo "Translation & Grammatical Notes In English Elementary"