UNIVERSITY OF CALCUTTA
Faculty of Engineering and Technology
Instrumentation Engineering
Department of Applied Physics

Course structure for 4-Year 8-Semester B. Tech. Degree in Instrumentation Engineering

Course Structure for 1st Semester

Serial No.	Name	Code	Credit	Weekly Load			Total Load
				L	T	P	
1	Communication English, Management and Social Sciences	HU101	03	2	1	0	03
2	Physics-I	PH102	03	2	1	0	03
3	Chemistry-I	CH103	03	2	1	0	03
4	Engineering Mathematics-I	MA104	03	2	1	0	03
5	Basic Electrical Engineering	EE105	03	2	1	0	03
6	Language Lab	HU106	1.5	0	0	3	03
7	Physics Lab -I	PH107	1.5	0	0	3	03
8	Chemistry Lab -I	CH108	1.5	0	0	3	03
9	Basic Electrical Engineering Lab	EE109	1.5	0	0	3	03
	TOTAL		**21**	10	5	11	27

Course Structure for 2nd Semester

Serial No.	Name	Code	Credit	Weekly Load			Total Load
				L	T	P	
1	Physics-II	PH201	03	2	1	0	03
2	Engineering Mathematics-II	MA202	03	2	1	0	03
3	Engineering Mechanics	ME203	03	2	1	0	03
4	Basic computer Science and Engineering	CS 204	03	2	1	0	03
5	Basic Electronics	BE205	03	2	1	0	03
6	Physics Lab –II	PH206	01	0	0	2	02
7	Workshop Practice	ME 207	1.5	0	0	3	03
8	Engineering Drawing	ME 208	1.5	0	0	3	03
9	Computer Programming Lab	CS 209	1.5	0	0	3	03
10	Basic Electronics Lab	BE210	1.5	0	0	3	03
	TOTAL		**22**	10	5	14	29

Course Structure for 3rd Semester

Serial No.	Name	Code	Credit	Weekly Load			Total Load
				L	T	P	
1	Analog Electronics	301-PCCIE01	03	3	0	0	03
2	Digital Electronics	302-PCCIE02	03	3	0	0	03
3	Electrical and Electronic Measuring Instruments	303-PCCIE03	03	3	0	0	03
4	Engineering Mathematics – III	304-ESC01	03	3	0	0	03
5	Circuit theory and Networks	305-PCCIE04	03	3	0	0	03
6	Analog Electronics Lab	306-PCCIE05	1.5	0	0	3	03
7	Digital Electronics Lab	307-PCCIE06	1.5	0	0	3	03
8	MATLAB Programming Lab	308-ESC02	1.5	0	0	3	03
9	Electrical Measurement Lab	309-PCCIE07	1.5	0	0	3	03
10	Slot for MC (Non Credit)		0	0	0	3	03
	TOTAL		**21**	15	**0**	**15**	**30**

Course Structure for 4th Semester

Serial No.	Name	Code	Credit	Weekly Load			Total Load
				L	T	P	
1	Industrial Instrumentation – I	401-PCCIE08	03	**3**	0	0	03
2	Sensors and Transducers	402-PCCIE09	03	**3**	0	0	03
3	Control Theory – I	403-PCCIE10	03	**3**	0	0	03
4	Microprocessor and Peripheral Devices	404-PCCIE11	03	**3**	0	0	03
5	Program Elective 1	405-PECIE01	03	3	0	0	03
6	Microprocessor Lab	406-PCCIE12	1.5	0	0	3	03
7	Network Theory Lab	407-PCCIE13	1.5	**0**	0	**3**	03
8	Numerical Programming Lab	408-ESC03	1.5	**0**	0	**3**	03
9	Sensor and Transducer Lab	409-PCCIE14	1.5	**0**	0	**3**	03
10	Slot for MC (Non Credit)		0	0	0	3	03
	TOTAL		**21**	**15**	**0**	**15**	**30**

Course Structure for 5th Semester

Serial No.	Name	Code	Credit	Weekly Load			Total Load
				L	T	P	
1	Communication Systems	501-PCCIE15	03	**3**	0	0	03
2	Industrial Instrumentation – II	502-PCCIE16	03	3	0	0	03
3	Control Theory – II	503-PCCIE17	03	3	0	0	03
4	Digital Signal Processing	504-PCCIE18	03	3	0	0	03
5	Process Control	505-PCCIE19	03	3	0	0	03
6	Process Control Lab	506-PCCIE20	1.5	0	0	3	03
7	Industrial Instrumentation Lab	507-PCCIE21	1.5	**0**	0	**3**	03
8	Control System I Lab	508-PCCIE22	1.5	0	0	3	03
9	Control System II Lab	509-PCCIE23	1.5	0	0	3	03
	TOTAL		**21**	**15**	**0**	**12**	**27**

Course Structure for 6th Semester

Serial No.	Name	Code	Credit	Weekly Load			Total Load
				L	T	P	
1	Program Elective 2	601-PECIE02	03	3	0	0	03
2	Program Elective 3	602-PECIE03	03	3	0	0	03
3	Program Elective 4	603-PECIE04	03	3	0	0	03
4	Open Elective 1	604-OECIE01	03	3	0	0	03
5	Open Elective II	605-OECIE02	03	3	0	0	03
6	Digital Signal Processing Lab	606-PCCIE24	1.5	0	0	3	03
7	Communication Lab	607-PCCIE25	1.5	0	0	3	03
8	Presentation / Group discussion on Technical topic	608-PCCIE26	02	0	2	0	02
	TOTAL		**20**	**15**	**2**	**6**	**23**

Course Structure for 7th Semester

Serial No.	Name	Code	Credit	Weekly Load			Total Load
				L	T	P	
1	Engineering Management	701-HSMC01	03	2	1	0	03
2	Open Elective 3	702-OECIE03	03	2	1	0	03
3	Design Lab	703-PCCIE27	1.5	0	0	3	03
4	Advanced Process Control Lab	704-PCCIE28	1.5	0	0	3	03
5	Summer Internship	705-PCCIE29	02	0	2	0	02
6	Project Ph-I	706-PROJIE01	04	0	2	4	06
	TOTAL		**15**	**4**	**6**	**10**	**20**

Course Structure for 8th Semester

Serial No.	Name	Code	Credit	Weekly Load			Total Load
				L	T	P	
1	Economics for Engineers	801-HSMC02	03	3	0	0	03
2	Open Elective 4	802-OECIE04	03	3	0	0	03
3	Seminar	803-PROJIE02	03	0	3	0	03
4	Project Ph-II	804-PROJIE03	07	0	2	10	12
5	General Viva Voce	805-PROJIE04	03	0	0	0	00
	TOTAL		**19**	**6**	**5**	**10**	21

PEC :

1. Analytical and Biomedical Instrumentation.
2. Optical Sensors and Nondestructive Evaluation
3. Advanced Measurement and Automation Techniques
4. Transmitters, Recorders and Hazardous Area Instrumentation
5. Electrical machines
6. Digital Communication
7. Process Plant Instrumentation
8. Non-Conventional Energy Sources
9. Sensor Technology
10. Biomedical Signal Processing
11. Advanced Control Engineering

OEC :

1. Advanced Microprocessor, Microcontroller and Interfacing
2. Software Engineering
3. Mechatronics
4. Computer Organization and Architecture
5. Database Management Systems
6. Power Electronics and Drives
7. Introduction to Robotics
8. Computer Networks
9. Data Structure & Algorithms
10. Object Oriented Programming
11. Data Analytics

Detailed Syllabus of each course

SEMESTER- I

THEORETICAL PAPERS

COMMUNICATION ENGLISH, MANAGEMENT AND SOCIAL SCIENCES

Sub Code: HU101 **L-T-P: 3-0-0**

Total Lectures 40 hours + Contact Hours **Credit: 3**

1.1 COMMUNICATIVE ENGLISH (GRAMMAR): (18L)

Course Objective: The objective of the course is to enhance the understanding of the students on the principles, techniques and application of grammar and to acquire appropriate proficiency and skills in reading, writing, speaking and comprehension.

Module 1: (3L)

Sentences: Clauses,Phrases, Types of Sentences, Sentence Structures and Transformation, Correction of Errors in Sentences.

Module 2: (1L)

Misplaced Modifiers and Modals.

Module 3: (4L)

Vocabulary Building and Usage: Word Formations (by adding suffixes and prefixes),Root words from foreign languages and their use in English; Synonyms; Antonyms; One Word Substitution/Single Word for a group of Words, Standard abbreviations; Redundant Words/ Redundancies/Redundantism; Clichés.

Module 4: (3L)

Remedial Grammar: Noun Pronoun Agreement, Articles, Prepositions, Agreement of Subject and Verb; Fill in the blanks using correct Words.

Module 5: (1L)

Précis Writing.

Module 6: (1L)

Essay, Paragraph Writing.

Module7: (1L)

Comprehension Passage.

Module 8: (3L)

Rapid reading- 'Bill Moss, Tentmaker' by Robert Gannon.

Module 9: (1L)

Taking notes: Dictation.

1.2 COMMUNICATIVE ENGLISH (TECHNICAL COMMUNICATION) (6L)

Course Objective: The objective of the course is to enhance the understanding of the students on the principles of effective technical communication and their application in official or professional communication.

Module 1: (2L)

The Theory of Communication –Definition & Scope; Barriers of Communication; Effective Communication (Verbal / Nonverbal).

Module 2: (1L)

Job Application Letter; C.V./Bio-data/Resume.

Module 3: (3L)

Organizational Communication:Memorandum; Notice;Official Notes; Minutes;Report (Technical Report): Progress Report, Event Report;ProjectProposal;Brochures; Newsletters; Technical Articles; Manuals; Business LetterCircular, Agenda,Invitation, Seminars, Press Release, Newspaper Insertion.

1.3 MANAGEMENT AND SOCIAL SCIENCES (16L)

Course Objective: To understand the principles of management and their application to the functioning of an organization.

Module 1: (2L)

The Development of Management: Scientific Management - Organic Organization,

Networked organization, Postmodern Organization, Debureaucratization, Transformation of Management.

Module 2: (1L)

Labour Management: Fordism, Post-Fordism and the Flexible Firm.

Module 3: (1L)

Principles of management and their application to the functioning of an organization Contents: Definition of management, science or art.

Module 4: (1L)

Manager vs entrepreneur; Types of managers- managerial roles and skills.

Module 5: (1L)

Evolution of management- scientific, human relations, system and contingency approaches.

Module 6: (1L)

Types of Business Organizations, sole proprietorship, partnership, company, public and private enterprises.

Module 7: (1L)

Organization culture and environment.

Module 8: (1L)

Current trends and issues in management.

Module 9: (1L)

Nature and purpose of Planning, types of Planning, objectives, setting objectives, policies.

Module 10: (1L)

Strategic Management, Planning Tools and Techniques, Decision making steps & processes.

Module 11: (1L)

Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and decentralization, job design, human resource management, HR planning.

Module 12: (1L)

Recruitment selection, Training & Development, Performance Management, Career planning and Management.

Module 13: (1L)

Directing, individual and group behavior, motivation, motivation theories, motivational techniques, job satisfaction, job enrichment.

Module 14: (1L)

Leadership, types & theories of leadership, effective communication.

Module15: (1L)

Controlling, system and process of controlling, budgetary and non-budgetary control techniques, use of computers and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting.

Course Outcomes:

1. The students will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.
2. The students will acquire proficiency in formal official communication skills.
3. Upon completion of this course, the students will get a clear understanding of management functions in an organization.

REFERENCE BOOKS:

1. Effective English Communication, by V. Syamala.
2. Best Science Writing: Reading and Insights edited by Robert Gannon prescribed text (Hyderabad: University Press (India) Limited, 1991).
3. Effective Technical Communication, M. Ashraf Rizvi, Tata Mc Graw-Hill.2005
4. Pronunciation Practice Activities – Martin Hewings – Cambridge University Press

5. A Textbook of English Phonetics for Indian Students – T. Balasubhramanian- Macmillan Publications
1. Concise Oxford Dictionary
2. Practical English Usage. Michael Swan. OUP. 1995.
3. Remedial English Grammar. F.T. Wood. Macmillan.2007
4. English For All edited by Nilanjana Gupta
5. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
6. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press
7. . David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. New York, 2004
8. Raman Sharma, Technical Communications, Oxford Publication, London, 2004.
9. Dale Jungk, Applied Writing for Technicians, McGraw Hill, New York, 2004. (ISBN: 07828357-4)
10. Sharma, R. and Mohan, K. Business Correspondence and Report Writing, TMH New Delhi 2002.
11. Robins S.P. and Coulter M., Management, Prentice Hall India, 10th ed., 2009.
12. Stoner JAF, Freeman RE and Gilbert DR, Management, 6th ed., Pearson Education, 2004.
13. P.C. Tripathy& P.N. Reddy, Principles of Management, Tata McGraw Hill, 1999.

PHYSICS-I

Sub Code: PH-102 **L-T-P: 3-0-0**

Total Lectures 40 hours + Contact Hours **Credit: 3**

Course objectives:

The objective of the course is to enhance the understanding of the Students' on some basic philosophies and corresponding application based reasoning of Physics. To help the students in acquiring the necessary skills to solve the application based problems useful for almost all branches of physics and engineering, on the basic of theoretical understanding.

1.1. Optics: [14L]

Module 1: [2L]

Introduction to interference and examples -Young's double slit experiment,Newton's rings (qualitative).

Module 2: [4L]

Diffraction: Introduction to diffraction, Fraunhofer andFresnel diffraction, Fraunhoffer diffraction due to single slit and plane diffraction grating, characteristics of diffraction grating and its applications.The Rayleigh criterion for limit ofresolution and resolving powerof Diffraction gratings.

Module 3: [3L]

Polarization– Polarisation by reflection,Brewster's law, polarisation by double refraction,polaroids, Malus Law, linearly, circularly and elliptically polarized light (qualitative), half wave and quarter wave plates, Optical activity

Module 4: [2L]

Fibre Optics: Introduction,total internal reflection,numerical aperture and various fibre parameters, stepand graded index fibres, application of optical fibres.

Module 5: [3L]

Lasers: Principles and working of Laser: population inversion, pumping, various modes, types of Laser (qualitative), application of Laser

1.2. Thermodynamics : [6]

Module 1: [2L]

Degrees of freedom and Equipartition of energy, Energy and Work,First Law of Thermodynamics.**Module 2: [4L]**

Second Law of Thermodynamics, Heat engines, Carnot's theorem, Entropy and equilibrium,Change in Entropy, Enthalpy, Free Energy, Chemical Potential, Gibb's function, Maxwell's relations(qualitative).

1.3. Quantum Mechanics- I: [12L]

Module 1: [5L]

Black body radiation, Planck's radiation law and its uniqueness, Compton effect and its significance-wavelength shift and recoil of electrons

Module 2: [4L]

Wave nature of Particles, De-Broglie hypothesis, Matter wave, Born interpretation of wave function, Uncertainty principle, Operators-Eigen value and Eigen function, operators and expectation values of some dynamical variables like momentum, total energy, angular momentum etc.

Module 3: [3L]

Schroodingerwave equation in three dimension and one dimension and its' significance, Time-dependent and timeindependent form, Application of Schroodingerwave equation in case of particle in one dimensional box (qualitative).

1.4. Dielectric and Magnetic Properties of Materials: [8L]

Module 1: [2L]

Divergence and Curl of electrostatic field, Gauss's law and its application, Laplace's and Poisson's equations for electrostatic potential

Module 2: [3L]

Dipole moments, electric field and potential due to dipole, Bound charges and Dielectric polarization, polar and non-polar dielectrics,Electric displacement vector, dielectric susceptibility, permittivity and dielectric constant,Boundary conditions,simple electrostatics problems inpresence of dielectrics

Module 3: [3L]

Magnetisation, magnetic field $\boldsymbol{B}$ and $\boldsymbol{H}$,permeability and susceptibility, classification of magnetic materials, discussion ofmagnetic field in presence of magnetic materials(qualitative).,

Course Outcomes:

I. Students will be enriched with some basic thoughts of Physics needed for advancement in Technology.
II. Developmentof the idea about the basic concepts of mechanics required for all branches of the engineering.

III. Students will be familiar with the idea about the most important physical phenomena corresponds to different wings of Physics and also will be knowledgeable about the logic behind those phenomena.

IV. Students will be able to utilize the concept which they gather in solving the problem having technological aspects.

Reference books:

1. Introduction to Optics by Hecht E. Addison-Wesley.

2. OPTICS by AjoyGhatak, 2nd edition,Tata McGraw Hill

3. Fundamentals of Optics by F. A. Jenkins and H.E. White, McGraw-Hill

4. Geometrical and Physical Optics by B K. Mathur

5. Principles of Optics by M. Born and E. Wolf, Cambridge University Press

6. Introduction to Electrodynamics by David Griffiths, Prentice Hall

7. Principles of Physics by David Halliday, Robert Resnick JearlWalker , 10ed,Wiley.

8. Electricity, Magnetism, and Light by Wayne M. Saslow, Academic Press.

9. Electromagnetism by Grant and Phillips, John Wiley.

10.Thermodynamics in Materials Science by Robert DeHoff, CRC Press.

11. A treatise on HeatBy M. N. Saha and B. N. Srivastava.The Indian Press.

12. Heat and Thermodynamics by Zemansky and Dittman, McGraw-Hill.

13. Fundamentals of Statistical and Thermal Physic byReif, Sarat Book Distributors.

14. Introduction to Quantum Mechanics by David J. Griffiths, Prentice Hall.

15. Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles by Eisberg&Resnick, Wiley.

16. Introduction to Electrodynamics by David Griffiths, Prentice Hall.

17. Electricity, Magnetism, and Light by Wayne M. Saslow, Academic Press.

18. Electromagnetism by Grant and Phillips, John Wiley.

19. Web Platform: NPTEL, SWAYAM, Archive.org etc

CHEMISTRY –I

Sub Code: CH-103 **L-T-P: 3-0-0**

Total Lectures 40 hours + Contact Hours **Credit: 3**

Course Objective: The objective is to Impart in depth understanding of fundamental concepts in chemistry that have been introduced at the 10+2 levels in school and to develop analytical skill among students necessary to design and solve the new problems. The course will familiarize students with different analytical techniques used in present day chemistry and explore the relevance in engineering applications.

Module I: Atomic and molecular structure (12L)

Introduction to quantum theory: Schrodinger equation. Origin of quantization.Particle in a box and its applications with respect to conjugated molecules and nanoparticles.Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations.

Bonding in molecules: Valence bond theory, Molecular orbital theory.Bonding and plots of molecular orbitals for diatomic and polyatomic molecules.Pi-molecular orbitals of butadiene and benzene and aromaticity.

Crystal field theory: Bonding in octahedral complexes, tetrahedral, tetragonally distorted octahedral and square planar complexes. Magnetic properties of all types of complexes.Color of complexes.

Band structure of solids and the role of doping on band structures.

Module II: Intermolecular forces and real gases (4L)

Ionic, dipolar and van der Waals interactions.Deviation of real gas from ideal behavior.Equations of state of real gases and critical phenomena.

Module III: Spectroscopic techniques and applications (6L)

Principles of spectroscopy and selection rules.Electronic spectroscopy.Vibrational spectroscopy.Nuclear magnetic resonance spectroscopy.Applications.

Module IV: Electrochemistry (8L)

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies.Free energy and emf.Electrochemical series and its application.Nernst equation and applications of emf measurements. Potentiometric titrations: Acid base, oxidation reduction, precipitation titrations. Corrosion.

Module V: Stereochemistry (4L)

Representations of three dimensional structures.Structural isomers and stereoisomers. Symmetry. Chirality and optical activity. Enantiomers, diastereomers, racemates. Configuration.Geometrical and conformational isomerism.Conformations of cyclic and acyclic systems.

Module VI: Organic reactions (6L)

Electronic influencing effects, Reactive intermediates. Aromaticity.Introduction to reactions involving rearrangement, substitution, addition, elimination, oxidation-reduction, cyclization and ring opening.Synthesis of a commonly used drug molecule.

Course Outcome:

The students will be able to

1. Understand and apply the concepts of basic quantum chemistry and chemical bonding to explain the molecular structure and physical/electronic properties of molecules.
2. Apply fundamental principles of electronic, vibrational, rotational and nuclear magnetic resonance spectroscopy towards identifying the structure of organic molecule.
3. Understand and apply fundamental concepts of electrochemistry.
4. Apply basic principles of organic chemistry for analyzing reaction mechanism and to develop methodology for synthesis.

Reference Books:

1. Chemistry: Principles and Applications by M. J. Sienko and R. A. Plane
2. Concise Inorganic Chemistry by J.D. Lee
3. General & Inorganic Chemistry, Vol I and Vol II by R.P. Sarkar
4. Physical Chemistry by P. W. Atkins and J. de Paula
5. Fundamentals of Molecular Spectroscopy by C. N. Banwell
6. Organic Spectroscopy by W. Kemp.
7. Organic Chemistry by I. L. Finar
8. Organic Chemistry by J. Clayden and N. Greeves
9. Organic Chemistry by R. T. Morrison and R. N. Boyd
10. Organic Chemistry by T. W. G. Solomons and C. B. Fryhle
11. A Guidebook to Mechanism in Organic Chemistry by P. Sykes
12. Engineering Chemistry (NPTEL Web book) by B. L. Tembe, Kamaluddin and M. S. Krishnan
13. Engineering Chemistry by PrasanthRath

ENGINEERING MATHEMATICS-I

Sub Code: MA-104 **L-T-P: 3-0-0**

Total Lectures 40 hours + Contact Hours **Credit: 3**

Course Objective:

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and vector algebra. At the end of this course students will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Module 1: Differential calculus: [11 L]

Differential calculus: Successive differentiation, Leibnitz Rule. Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and minima.

Multivariable Calculus:Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers.

Module 2: Sequences and series: [12 L]

Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval'stheorem.

Module 3: Vector Algebra: [7L]

Vector calculus: Brief review of vector algebra, scalar and vector triple products, Directional derivatives, gradient, divergence, curl, vector integration, statements and applications of Gauss's theorem, Green's theorem, Stokes' theorem, examples

Module 4: Integral Calculus (Integration): [10L]

Int. Calculus: Properties of definite integrals, Quadrature, Rectification, Double integral, Triple integrals,change of order of integration, change of variables, determination of length, area, volume.Applications of definite integrals to evaluate surface areas and volumes of revolutions

Course Outcome:

The students will learn:

- To Use Leibnitz Theorem to determine the nth derivative of product of functions. They will develop series expansion by Taylor's and Maclaurin's series. They will be examine the function for maxima and minima and discover its extreme value.
- To use the tool of power series and Fourier series for learning advanced Engineering Mathematics.
- To deal with functions of several variables that are essential in most branches of engineering.
- To recognize scalar and vector functions. They will evaluate Gradient, Divergence and Curl of a point function depending upon its nature.
- To apply the integral formulae to estimate length, surface area and volume of revolution of a curve.

Reference Books

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43nd Edition, 2015.
2. P.N. Wartikar& J.N .Wartikar, AppliedMathematics (Volume I and II) PuneVidyarthiGrihaPrakashan, 7th Edition 1994.

3. Erwin Kreyszig ,Advanced Engineering Mathematics, John Wiley & Sons Inc., 10th Edition, 2011
4. Peter V. O' Neil, Advanced Engineering Mathematics, Thomson Brooks/Cole, 7th Edition, 2011.
5. Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, 4th Edition, 2010.
6. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
7. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.
8. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.

BASIC ELECTRICAL ENGINEERING

Sub Code: EE-105 **L-T-P: 3-0-0**

Total Lectures 40 hours + Contact Hours **Credit: 3**

Course Objective: The objective of the course is to enhance the understanding of the Students' on the basics of AC & DC circuits alongwithbasics of three phase circuits and to help the students to understand the basics of basic electrical machines, also helps the students understand the necessity of power system components.

Module -1 [L- 3]

D.C. Circuits: Network theorems – Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem. Star-Delta & Delta-Star transformation.

Module -1 [L- 3]

Magnetic Circuit: MMF, Flux ,Reluctance. B-H Loop.Hysteresis and Eddy current loss.Magnetic circuit analysis with air gap.

Module -2 [L- 3]

A.C. Fundamentals : Sinusoidal quantities, phase & phase difference, average & RMS values, form factor & peak factor, concept of Sinusoids, impedance & admittance, power & power factor,

Module -3 [L- 3]

A.C. Circuits: Series and parallel R-L-C Circuits, Form Factor, Peak. Factor.Phasor concept of Sinusoids.Impedance and Admittance.Power, Power Factor, V A, V AR.

Module -3 [L- 3]

Balanced 3-phase: 3-phase AC balanced circuits. Phase-sequence, Star and Delta connections.Connection of wattmeter in 1-ph circuit for power measurement & Connection of two wattmeters in 3-ph circuit for power measurement.

Module -4 [L- 2]

Power Factor Improvement: Causes & effect of low power factor, advantages of power factor improvement, methods of power factor improvement.

Module -5 [L- 7]

DC Machines: Construction, working, different types, EMF equation, characteristic (Generator & Motor), starting and speed control.

Module -6 [L- 7]

1-PhaseTransformer: Construction. EMF equation.Phasor diagram. Equivalent circuits.. Open circuit and Short circuit test. Losses and Efficiency

Module -7 [L- 7]

3-Phase Induction Machine: Types of induction machines. Rotating magnetic field, slip ,torque equation, torque speed curve .DOL starting and reduced voltage starting.

Module -8 [L- 1]

Power System Structure: Single line diagram of a power system structure.

Course Outcome:

1) The students will be able to understand the basic laws of electrical engineering & its application
2) Students knowledge will be enhanced about the basics of AC & DC circuits
3) Students will get an idea about the three phase system
4) Students will be able to analyses the basic electrical machines with the help of basic concepts of electrical engineering gathered.
5) Get an idea about the components of power system.

Reference Books:-

1. Basic Electrical Engineering By I.J.Nagrath ,Tata McGraw-Hill Publishing Co. Ltd
2. Basic Electrical Engineering By T.K. Nagsarkar& M.S. Sukhija, Oxford University Press
3. Electrical & Electronics Technology By Hughes, Dorling Kindersley India, New Delhi
4. Electrical Technology By H. Cotton, CBS Publisher, New Delhi
5. A course in Electrical Engineering Vol-I & II ByC.L.Dawes Publisher: McGraw-Hill Book Co. Inc

PRACTICAL PAPERS:

Language Lab

Sub Code: HU-106 **L-T-P: 0-0-3**

Total : 36 hours **Credit: 1.5**

1.1 LANGUAGE LAB (36L)

Course Objective: The objective of the practical classes is to make the students familiar with the applied aspects of the English language, pronunciation, behavioural strategies and realistic dimensions of interpersonal interaction in the context of organizational communication. The practical exercises include the following topics:

EXERCISES:

- Group Discussion –Principle & Practice [Courtesy- Teaching Cohesion and Coherence strategies for handling criticism and adverse remarks. Teaching strategies of Turn- taking, timing, effective and creative intervention, formal and informal language, kinesics (use of body language), politeness and courtesies and all components of soft skills].
- Mock/Job Interview.
- Role Play/Conversation.
- Formal Presentation [power point presentation/extempore/ public speaking skills,Elementary Phonetics (theory): Pronunciation/ Stress/Intonation/ Rhythm/ Voice modulation/ Pitch and Accent of connected speech].
- Listening Comprehension: Audio File Analysis/Video File Analysis.

Course Outcomes:

1. The students will acquire skills on conflict management, presentation, decorum, grooming, courtesy, appropriate pronunciation.
2. The students will also acquire better verbal ability in Spoken English.

REFERENCE:

The manual corresponding to all the exercises will be provided to the students.

UNIVERSITY OF CALCUTTA
Faculty of Engineering and Technology
Instrumentation Engineering
Department of Applied Physics

Physics Lab –I

Sub Code: PH-107 **L-T-P: 0-0-2**

Total :24 hours **Credit: 1**

Course objectives:

The objective of the practical classes is to make the students familiar with the technological features of theory as well as to provide hand-on experience of corroboration between model theory and it's practical aspect.

Experiments:

Experiments are based on modern optics-Lasers, general properties of matter, mechanics with advanced measurement techniques and Virtual lab

Reference:

The manual corresponds to all experiments will be provided to the students.

Chemistry Lab –I

Sub Code: CH-108 **L-T-P: 0-0-3**

Total :36 hours **Credit: 1.5**

Choice of eight to ten experiments from the following:

- Titrations: Acid –base, Conductometric, pH-metric, Complexometric titrations.
- Estimation ofhardnessofwater.
- Determinationofchloridecontentofwater
- Colligativepropertiesusingfreezingpointdepression
- Determinationoftherateconstantofareaction
- Determinationofcellconstantandconductanceofsolutions
- Potentiometry-determinationofredoxpotentialsandemfs
- Determinationofthepartitioncoefficientofasubstancebetweentwoimmisciblleliquids
- Determinationofsurfacetensionandviscosity

- Thinlayerchromatography
- Synthesisofapolymer/drug
- Saponification/acidvalueofanoil
- Latticestructuresandpackingofspheres
- Modelsofpotentialenergysurfaces
- Chemicaloscillations-Iodineclockreaction
- Adsorptionofaceticacidbycharcoal

Electrical Engineering Lab–I EE- 109

Sub Code: EE-109 **L-T-P: 0-0-3**

Total : 36 hours **Credit: 1.5**

Course Objective:

The objective of this practical course is to familiarize the students to the various instruments & devices & its hand on use, to run the rotating electrical machines & to familiarize with the construction & use of single phase transformer.

Experiments on the following topic:

- Familiarization experiments (Variac, Potential divider, MCV.MIV,MCA,MIA &Wattmeter)
- Characteristics of Tungsten and Carbon filament lamps
- Experiments on DC circuits and DC machines
- Study of AC series R-L-C series circuit
- Experiments on Single phase Transformer
- Calibration of voltmeter, ammeter and energy meter
- Experiments on magnetic circuit principles

Course Outcome:

The students will be able to learn-

1) The use of different instruments & devices in a circuits
2) How to make an electrical circuit & the safety measures.

3) The practical application of basics of electrical engineering like AC/DC circuits.
4) The practical use of rotating & static electrical machines.

3rd SEMESTER

THEORETICAL PAPERS

301-PCCIE01	**Analog Electronics**	**3L0T0P**	**3 CREDITS**

30 Hours

Detail syllabus :

Module 1: [5L]
Opto-electronic devices: LED, LCD, Laser diode, photodiodes, photoconductive cells, photovoltaic cells, phototransistors, Light activated SCRs
Special semiconductor devices: Tunnel diode, CCD, MIS diode

Module 2: [5L]
Transistor biasing circuits: Brief overview, h-parameters and their application in analysis. Class A, B, C, D and S power amplifiers. Push-pull operation. JFET: Biasing and CS, CD and CG amplifier. MOSFET: Depletion type, Enhancement type MOSFET and their biasing.

Module 3: [15L]
Linear Op-Amp Circuits: V-I Converter with floating and grounded load, Current amplifier, Difference amplifier, Instrumentation amplifier
Non-linear Op-Amp Circuits: Schmitt trigger and applications, Precision rectifiers, Analog switches, Peak detectors, S/H circuits.
Practical Op-Amp limitations: DC errors, Slew rate, Frequency response, Noise effect, Frequency compensation. Ideal and Practical Integrators, Differentiators and solution of differential equations.

Module 4: [5L]
Multivibrators : Astable, Monostable, Bistable.
Integrated Circuit: Timer 555 and its applications
Log/Antilog Amplifiers, Analog Multipliers and their applications.
Voltage Controlled Oscillators, PLL and its applications, IC Voltage regulators, Introduction to Switched-Capacitor Circuits.

Course Outcomes:
Upon completion of this course a student will be familiar with:

CO1: Knowledge about the basics of Opto-electronic devices: LED, LCD, Laser diode, photodiodes, photoconductive cells, photovoltaic cells, phototransistors, Light activated SCRs, photo-triacs and Special semiconductor devices: Tunnel diode, CCD, MIS diode.
CO2: The working principle of Linear and non-linear Op-Amp Circuits; Discuss about Practical Op-Amp limitations.
CO3: The principle and applications on of Multivibrators : Astable, Monostable, Bistable; Controlled Oscillators, PLL and its applications, IC Voltage regulators.
CO4: The function of filter circuits.

Learning Resources
Text Books:
1.Sedra & Smith-Microelectronic Circuits- Oxford UP
2.Millman & Halkias – Integrated Electronics, McGraw Hill.
3.Boylested & Nashelsky- Electronic Devices and Circuit Theory- Pearson/PHI
4.Gayakwad R.A -- OpAmps and Linear IC's, PHI

Reference Books:
1. Rashid-Microelectronic Circuits-Analysis and Design- Thomson (Cengage Learning)
2. Schilling & Belove—Electronic Circuit:Discrete & Integrated , 3/e , McGraw Hill
3. Razavi- Fundamentals of Microelectronic s- Wiley
4.Coughlin and Driscol – Operational Amplifier and Linear Integrated Circuits – Pearson Education
5. Malvino—Electronic Principles , McGraw Hill
6. Horowitz & Hill- The Art of Electronics; Cambridge University Press
7. Bell- Operational Amplifiers and Linear ICs- Oxford UP
8. Tobey & Grame – Operational Amplifier: Design and Applications, McGraw Hill
9. Gayakwad R.A - OpAmps and Linear IC's, PHI

302-PCCIE02	**Digital Electronics**	**3L0T0P**	**3 CREDITS**

30 Hours

Detail syllabus :

Module 1: [3L]
Number systems and codes - Position number system, Radix conversion, Different types of codes- BCD, ASCII, EBCDIC, Gray.
Binary Arithmetic - R's and (R-1)'s complement representation, Subtraction using 1's and 2's complement representation, Concept of overflow, BCD addition.

Module 2: [3L]

Combinational Logic Design –Truth Table, SOP and POS realization from truth table, Logic minimization using K-map, Minterms and Maxterms, Minimization with don't care terms, Quine-McClusky's method of logic minimization, Error detection & correction: Hamming code.

Module 3: [7L]
Examples of combinational logic design : Adder / Subtractor circuits; 2's complement ripple carry adder/subtractor circuit, Parity generator/checker circuit, Circuit for Binary to Gray and Gray to Binary conversion.
Encoder, Decoder, Demultiplexer and Multiplexer, Function realization using decoder and multiplexer

Module 4: [8L]
Sequential machine design : Concept of Moore and Mealy machine, State transition diagram and State transition table, Various memory elements, NAND-latch and its use, Clocked flip-flops, S-R, J-K, D and T. Timing constraints on edge triggered flip-flops; Changing one type of Flip-flop to another type, Design of sequence detector. Asynchronous and synchronous counter design. Different types of registers.

Module 5: [4L]
Programmable Logic Devices – PROM, PLA, PAL, FPGA.
Integrated Circuit Logic Families - TTL, PMOS, NMOS, CMOS, ECL.
Semiconductor memories - ROM, RAM.

Module 6: [5L]
Digital to Analog Converters(weighted R, R-2R, ladder and current steering logic)and Analog to Digital Converters(successive approximation, integrating, flash and sigma-delta).Characteristics of ADC**s** and DACs (resolution, quantization, significant bits, conversion / settling time)

Course Outcomes:
Upon completion of this course a student will be familiar with:

CO1: The fundamental knowledge about Number systems, codes and Binary Arithmetic.
CO2: The principle of Combinational Logic Design with its real life application and the principle of sequential machine design.
CO3: Programmable Logic Devices – PROM, PLA, PAL, FPGA; Integrated Circuit Logic Families - TTL, PMOS, NMOS, CMOS, ECL; Semiconductor memories - ROM, RAM.
CO4: Interpretation of the application of Digital to Analog and Analog to Digital Converters.

Learning Resources
Text Books:
1. R.P.Jain—Modern Digital Electronics, Mc Graw Hill
2. Morries Mano- Digital Logic Design- PHI
3. A.Anand Kumar, Fundamentals of Digital Circuits- PHI
4. D.Ray Chaudhuri- Digital Circuits-Vol-I & II- Platinum Publishers

Reference Books:
1. Ronald J. Tocci - Digital Systems: Principles and Applications - Pearson
2. S. SALIVAHANAN & S Arivazhagan - Digital Circuits and Design -Vikas Publishing

3. H.Taub & D.Shilling, Digital Integrated Electronics- Mc Graw Hill
4. Givone—Digital Principles & Design, Mc Graw Hill
5. S.K.Mandal, Digital Electronics Principles and Applications- Mc Graw Hill
6. J.Bignell & R.Donovan-Digital Electronics- Cenage Learning
7. Leach & Malvino—Digital Principles & Application, Mc Graw Hill
8. Floyed & Jain- Digital Fundamentals-Pearson
9. S.Aligahanan, S.Aribazhagan, Digital Circuit & Design- Bikas Publishing

303-PCCIE03	**Electrical and Electronic Measuring Instruments**	**3L0T0P**	**3 CREDITS**

30 Hours

Detail syllabus :

Module 1: [3L]
SI units, systematic and random errors in measurement, expression of uncertainty - accuracy and precision index, Standardization: classification of standards.

Module 2: [5L]
Measurement of resistance: high, medium and low. Measurement of inductance (self, mutual), capacitance and frequency by ac bridge methods- Owen's, Heaviside-Campbell, Schering bridges, Wagner Earthing device.

Module 3: [7L]
General features of electrical measuring instruments: controlling, damping, and balancing of moving systems.
Instruments mechanism and dynamics: vibration galvanometer, Permanent magnet moving coil, moving iron, electro-thermal, rectifier, induction type and electrodynamic instruments for measuring voltage, current and power. Basic electrostatic instruments: voltmeters, wattmeters. Measurement of three phase power, Measurement of energy, Single Phase and Three Phase induction watt-hour meters, power factor meters, frequency meters, Q-Meter and Waveform analyzer.

Module 4: [4L]
DC and AC potentiometers: Crompton potentiometer, Drysdale polar type and Gall Coordinate type potentiometer, application of potentiometers, Magnetic Measurements.

Module 5: [3L]
Electronic Instruments: True R.M.S Voltmeter, Peak Response Voltmeter, Electronic Ohmmeters.

Module 6: [3L]
Cathode Ray Oscilloscopes: Dual-Trace Oscilloscopes, Oscilloscope Controls, Oscilloscope Probes, storage oscilloscope.

Module 7: [5L]

Digital instruments: Basic Digital Displays – LEDs and LCD panels.
Digital Voltmeters, digital phase and frequency meter.

Course Outcomes:
Upon completion of this course a student will be familiar with:

CO1: Knowledge about Standardization: classification, quantum standard
CO2: The principle of DC and AC potentiometers
CO3: The principles of general features and functions of electrical and electronic measuring instruments
CO4: The Measurement of three phase power and energy

Learning Resources

Text Books:
1. Golding E.W. & Wides F.C. : Electrical Measuring Instruments & Measurements ; Wheeler
2. Harris, F. K. – Electrical Measurements, Wiley.
3. Albert D.Helfrick and William D.Cooper – Modern Electronic Instrumentation and Measurement Techniques, Pearson / PHI

Reference Books:
1.Joseph J.Carr, Elements of Electronics Instrumentation and Measurement, Pearson Education, 2003.
2.Alan. S. Morris, Principles of Measurements and Instrumentation, 2nd Edition, Prentice Hall of India, 2003.
3.David A. Bell, Electronic Instrumentation and measurements, PHI
4.Reissland M.U.: Electrical Measurement, New Age International

304-ESC01	**Engineering Mathematics – III**	**3L0T0P**	**3 CREDITS**

30 Hours

Detail syllabus:

Module 1: [4L]
Linear Algebra: Matrix algebra, systems of linear equations, Eigen values and Eigen vectors.

Module 2: [6L]
Probability and Statistics: Sampling theorems, conditional probability, mean, median, mode and standard deviation, random variables, discrete and continuous distributions: normal, Poisson and binomial distributions.

Module 3: [6L]
Fourier Series: Introduction to Fourier series, Fourier series for Discontinuous functions, Fourier series for even and odd function, Half range sine series and Half range cosine series, Gibbs phenomenon.

Fourier Transform: Fourier integrals and its interpretation, Fourier transformation, Frequency spectrum, FT of different time functions, Fourier transform theorem, Inverse Fourier transform.

Module 4: [6L]
Laplace Transform: two sided and one sided Laplace Transform, Laplace Transform of standard time functions, LT of periodic and other time functions, Theorems of Laplace Transform, Inverse Laplace Transform, Solution of differential equations, Solving circuit problems using LT.

Module 5: [4L]
Functions of complex variable and conformal transformation: Analytical complex function: Cauchy-Rieman differential equations, harmonic function, line integral of complex function, Cauchy's integral theorem, derivative of analytical function, modulus and real value theorem.

Module 6: [4L]
Taylor and Laurent series, Residue and Cauchy's residue theorem; Definite integrals by the method of residue; Jordan's lemma, Mapping of complex functions: Conformal mapping, critical point of transformation.

Course Outcomes:
Upon completion of this course a student will be familiar with:

CO1: Linear transformation in vector spaces; can find Solution of linear equations. Eigen values and Eigen vectors.
CO2: The concept of probability to find the physical significance of various distribution phenomena.
CO3: The knowledge of Fourier integrals as the tool in signal processing and will be able to solve boundary value problems of engineering domain.
CO4: How to solve ODEs that describe circuit dynamics and be able to connect the time domain with frequency domain in control systems finding circuit responses using Laplace transform.
CO5: How to solve different engineering problems using complex variable techniques and will be able to evaluate the line integrals of a complex valued function.

Learning Resources
Text Books:
1. Das N.G.: Statistical Methods, TMH.
2. Brown J.W and Churchill R.V: Complex Variables and Applications, McGraw-Hill.
3. Lipschutz S., and Lipson M.L.: Probability (Schaum's Outline Series), TMH.
4. Grewal B S: Higher Engineering Mathematics, Khanna Publishers.

Reference Books:
1. Bhamra K. S.: Partial Differential Equations: An introductory treatment with applications, PHI
2. Dutta Debashis: Textbook of Engineering Mathematics, New Age International Publishers.
3. Kreyzig E.: Advanced Engineering Mathematics, John Wiley and Sons.
4. Potter M.C, Goldberg J.L and Aboufadel E.F.: Advanced Engineering Mathematics, OUP.
5. Ramana B.V.: Higher Engineering Mathematics, TMH.
6. James G.: Advanced Modern Engineering Mathematics, Pearson Education.

305-PCCIE04	**Circuit Theory and Networks**	**3L0T0P**	**3 CREDITS**

30 Hours

Detail syllabus :

Module 1: [2L]
Introduction: Continuous and Discrete, Fixed and Time varying, Linear and Nonlinear, Lumped and Distributed, Passive and Active networks and systems.

Module 2: [2L]
Sources: independent, dependent, ideal and practical; V-I relationships of resistor, inductor, mutual inductor and capacitor; Step, Ramp, Impulse, Sinusoidal, Square, Saw tooth signals.

Module 3: [4L]
Network analysis and theorems: generalized mesh and nodal analysis, duality of networks, analysis with dependent and independent sources, network minimization, numerical examples.

Module 4: [4L]
One-port and Two-port networks: impedance and admittance parameters, hybrid and inverse hybrid parameters, ABCD parameters, cascading of two port networks.

Module 5: [4L]
Networks Graph and Topology: Determination of incidence matrix, cut-set matrix, loop matrix and mesh matrix of large networks.

Module 6: [4L]
Circuit Transients: DC Transient in R-L & R-C circuits with and without initial charge, R-L-C circuits, AC transients in sinusoidal R-L, R-C, & R-L-C circuits, solution of problems.

Module 7: [6L]
Filters: Filter classification Lowpass, highpass, bandpass and bandstop filter, Passive filters, Advantages of active filters, Transfer function approximation: Butterworth, Chebychev and other approximations, realization of active filters, all pass filter, characteristic impedance of active filters.

Module 8: [4L]
Network synthesis: driving point impedance and admittance functions, positive reality concept. realizability conditions, Hurwitz and Sturm tests, general energy functions, two-elements realizability requirements, canonical realization methods, transfer-function synthesis.

Course Outcomes:
Upon completion of this course a student will be familiar with:

CO1: Understanding and identifying the available practical electrical sources and standard test input signals.

CO2: How to analyze behavior of basic circuit elements and to apply concept of mesh and node analysis in circuit theory.
CO3**:** How to apply the concept of one / two port network to get adequate knowledge about transmission lines including its modeling and calculations.
CO4: How to solve large and complex network problems using Graph and Topology.
CO5: How to analyze the transient and steady state for different electric networks.
CO6: How to analyze the frequency response of different electric networks.

Learning Resources

Text book:

1. Network Analysis by M.E.Vanvalkenburg, PHI Publication.
2. Circuit Theory (Analysis and Synthesis) By A. Chakrabarti, Dhanpat Rai & Company.
3. D. Roychoudhury: Networks and Systems, NEW AGE; Second edition

Reference Books:

1. Network Analysis and Synthesis by U.A.Patel 6th Edition, Mahajan Publishing House.
2. Linear Circuit Analysis by De Carlo/Lin 2nd Edition, Oxford University Press Indian Edition.

PRACTICAL PAPERS

306-PCCIE05	**Analog Electronics Lab**	**0L0T3P**	**1.5 CREDITS**

30 Hours

List of Experiments:

1) Study the Characteristics of BJT/FET
2) Precision Rectifiers – Inverting and Non-inverting types
3) Clipper and Clamper Circuits using op-amp
4) Zero Crossing Detector (ZCD)
5) Realization of V to I and I to V using op-amp
6) Realization of current mirror using Op-Amp
7) Study of class A & class B power amplifiers
8) Instrumentation Amplifiers
9) Realization of two-stage R-C coupled amplifier
10) Study on Linear Voltage Regulator using IC
11) Construction of Function Generator using IC
12) Study of optical coupling using Opto-Coupler IC
13) Study on 555 Timer – Monostable, Astable and Bistable Multivibrators
14) Study on VCO and PLL

307-PCCIE06	**Digital Electronics Lab**	**0L0T3P**	**1.5 CREDITS**

30 Hours

List of Experiments :

Combinational Circuits:

1. Introduction to Digital Laboratory Equipments & ICs
2. verification of the truth tables of logic gates.
3. Study and prove De-Morgan's Theorem.
4. Universal function using NAND and NOR gates
5. Implementation of different functions using Basic Logic gates in both sop and pos forms
4. Implementation of half and Full adder (3-bit) using basic logic gates and Universal logic gates (NAND & NOR).
5. Implementation of half and Full Subtractor (3-bit) using basic logic gates and Universal logic gates (NAND & NOR).
6. 1 Digit BCD adder using 7483 and other logic gates.
7. Design 4 to 1 multiplexer using logic/Universal gates and implement full adder/full subtractor.
8. Using 74153 and 74151 to implement full adder/ full subtractor and other functions.
9. Cascading of Multiplexers.
10. Design 2 to 4 decoder using basic / universal logic gates.
11. Study 74138 and 74139 and implement full adder / full subtractor and other functions.
12. Implementation of 1 bit Comparator using decoders.
13. Cascading of Decoders.
14. Design a parity generator and checker using basic gates.
15. Construct and study comparators using 7485.
16. Construct Comparator (2-bit) using logic gates
17. Design a seven segment display unit using Common anode/Common cathode and 7447 / 7448.
18. Study Priority Encoder Chip 74147/74148.

Sequential Circuits:

1. Realization of RS, D, JK Clocked/Gated Level Triggered Flip-Flop using basic/Universal logic gates.
2. Study and Conversion of Flip-Flops: D to JK, JK to D, JK to T, SR to JK, SR to D Flip-flop.
3. Design synchronous and asynchronous counters MOD-n (MOD-8, MOD-10) UP/ DOWN and connecting Seven Segment Display along with decoder for display of counting sequence.
4. Construction of ODD/EVEN 4 bit Synchronous Counter.
5. 4-bit binary arbitrary sequence synchronous counter.

308-ESC02	**MATLAB Programming Lab**	**0L0T3P**	**1.5 CREDITS**

30 Hours

List of Experiments :

1. Introduction to MATLAB environment (Desktop tools: Command Window , Command History, Launch Pad, Current Directory Browser, Help Browser, Editor/Debugger, Array Editor, Workspace Browser)
2. Elementary mathematics, Matrices and Linear Algebra
3. Polynomials, Differentiation, Integration, Differential Equations
4. Data Analysis
5. Programming in MATLAB (Overview of MATLAB Data Types, Variables, Operators, Program Control Statements, MATLAB Functions, Data imports and exports using FILES)
6. Introduction to MATLAB Graphics (2D, 3D plots and its formatting, Specialized Plots like Bar and area graphs, Pie charts, Histograms)

309-PCCIE07	**Electrical Measurement Lab**	**0L0T3P**	**1.5 CREDITS**

30 Hours

List of Experiments :

Measurement of low resistance and resistively by Kelvin Double Bridge.
2. Measurement of capacitance and dissipation factor by De Sauty Bridge.
3. Determination of Inductance distributed self – capacitance and r.f. resistance of a coil at radio frequency.
4. Determination of B-H loop by CRO for an iron sample.
5. Testing and calibration of D.C. energy meter.
6. Testing and calibration of A.C. single phase energy meter.
7. Calibration of wattmeter by DC potentiometer.
8. Measurement of inductance of a high Q-coil by Hay's bridge.
9. Study the construction and principle of operation of length counter.

4th SEMESTER

THEORETICAL PAPERS

401-PCCIE08	**Industrial Instrumentation – I**	**3L0T0P**	**3 CREDITS**

30 Hours

Detail syllabus :

Module 1: [5L]
Industrial Weighing systems: Various types of strain gauges, load cells-column type, shear type and bending beam type, pressductor, application consideration of load cells, belt conveyor weighing systems and weighfeeders.

Module 2: [10L]

Measurement of P**ressure and** V**acuum**: manometers, elastic pressure sensors - Bourdon tube, bellows, diaphragm and capsule, Bourdon tube pressure gauge, pressure switch, electronic pressure transmitters - capacitive, piezo-resistive and resonator type, installation of pressure measuring devices, accessories for pressure measurement - chemical seal and snubbers. Vacuum measurement using Mcleod gauge, thermal conductivity gauge, ionization gauge.

Module 3: [10L]
Temperature Measurement: Temperature scales, ITS90, temperature calibrators and simulators, thermowell, thermocouple, RTD, thermistors, IC temperature sensors, temperature switches, thermostats. radiation and optical pyrometry, quartz crystal thermometers, measurement of very high or steller temperature. Low temperature measurements

Module 4: [5L]
Acoustical methods: Basic acoustical parameters, psychoacoustic relationship, microphones, frequency weighting network and filters, sound level meter, sound pressure level meter, sound wave analyzers.

Course Outcomes:
Upon completion of this course a student will be familiar with:

CO1: different types of Industrial Weighing instruments like strain gauge, load cells, pressductor, weigh feeders etc.
CO2: The construction and working of various industrial devices used to measure pressure and vacuum.
CO3: The construction and working of various industrial devices used to measure temperature.
CO4: different types of temperature measuring instruments like RTD, Thermistor, and thermocouple.
CO5: The concept to analyze, formulate and select suitable sensor for the given industrial applications
CO6: The construction and working of various industrial devices used to measure sound level, sound pressure etc.

Learning Resources
Text Books:

1. D.Patranobis, Principles of Industrial Instrumentation, Tata McGraw-Hill Publishing Co., New Delhi.
2. R.K.Jain, Mechanical and Industrial measurements, Khanna Publishers, Delhi
3. Eckman D.P.M, Industrial Instrumentation, Wiley Eastern Limited.

Reference Books:

1. A.K. Sawhney, A course in Electrical and Electonics Measurement and Instrumentation, Dhanpat Raj and sons, New Delhi.
2. K.Krishnaswamy & S.Vijayachita, Industrial Instrumentation, New age International Private limited.
3. Ernest O.Doebelin, Measurement systems application and design international student 4th Edition, Tata Mcgraw-Hill Publishing Co., New Delhi.
4. S.K.Singh, Industrial instrumentation and control, Tata McGraw-Hill Publishing Co., New Delhi.

402-PCCIE09	**Sensors and Transducers**	**3L0T0P**	**3 CREDITS**

30 Hours

Detail syllabus :

Module 1: [10L]
Instrument transducers: description, functional element, active and passive transducers, input-output configuration, static and dynamic characteristics.
Current transformers and potential transformers – their design and performance characteristics, phasor diagrams, magnitude error, phase angle error, composite error, difference with power and distribution transformers, testing of CT and PT, metering and protection of CT.

Module 2: [5L]
Magnetic sensors: Sensors based on Villari effect for assessment of force, torque, proximity; Wiedemann effect for yoke coil sensors, Thomson effect.
Hall effect and Hall drive, performance characteristics
Geiger counters, Scintillation detectors

Module 3: [10L]
Working principle of transducers: elastic deformation, resistance, capacitance, and inductance change, thermoelectric, piezoelectric and photoelectric electro-mechanical, electro-chemical, and ultrasonic principles, digital transducers.
Measurement of displacement, velocity and acceleration: potentiometer, LVDT, capacitive transducer, Tachogenerators, tachometers, stroboscopes, encoders, seismic accelerometers- piezoelectric and piezoresistive types.

Module 4: [5L]
Torque measurement in rotating shafts. Introduction to vibration measurement and monitoring.
Proximity sensors: Inductive, optical, magnetic, capacitive, ultrasonic.
Introduction to Smart sensors

Course Outcomes:
Upon completion of this course a student will be familiar with:

CO1. The fundamental principles of various types of sensors and Transducers i.e. Mechanical, Electromechanical, Resistive, Inductive, Capacitive, Piezoelectric, Thermal, Magnetic etc.
CO2. The working principle of various types of sensors and transducers.
CO3. How to Choose a suitable sensor/transducer for a particular industrial application.
CO4. How to Differentiate various sensors/transducers based on their utility for a particular application.
CO5. How to Evaluate the output of a sensor/transducer for a particular industrial system.
CO6. How to Design simple sensing/transduction system for small industrial application

Learning Resources

Text Books:

1. John P. Bentley, Principle of Measurement Systems, Pearson Education
2. E. A. Doebelin, Measurement Systems: Application and Design, Mc Graw Hill, New York.
3. D.V.S Murthy, Sensors and Transducers, PHI.

Reference Books:

4. J. Fraden, "AIP Handbook of Modern Sensors, Physics, Designs and Applications," American Institute of Physics.
5. A. K. Ghosh, Introduction to Measurement and Instrumentation, PHI

403-PCCIE10	**Control Theory – I**	**3L0T0P**	**3 CREDITS**

30 Hours

Detail syllabus :

Module 1: [6L]
Control system: block diagram, transfer function, signal flow graph, Mason's gain formula. Mathematical model of dynamic system: electrical, electro-mechanical. Concept of open-loop, closed-loop control, feedback and feed-forward control.

Module 2: [4L]
Standard test input signals, Time domain analysis and specification, steady state and transient response, static and dynamic error.

Module 3: [10L]
Concept of stability: Routh-Hurwitz stability criteria, root locus concept, polar plot, Bode plot, log-magnitude vs. phase plot, Nyquist stability criteria, relative stability, gain and phase margin; constant magnitude and phase shift loci.

Module 4: [4L]
Control actions: On/Off, P, PI, PID controllers and basic compensation techniques.

Module 5: [6L]
Basic rules of representing a control loop component, basic control loops.
Control system components: signal comparator, synchro, servomotor, tachogenerator, stepper motor.

Course Outcomes:
Upon completion of this course a student will be familiar with:

CO1. Identifying the open and closed loop control system
CO 2. How to formulate mathematical model for physical systems.

CO 3. How to simplify representation of complex systems using reduction techniques.
CO 4. Standard test signals to identify performance characteristics of first and second-order systems.
CO 5. How to apply root locus technique for stability analysis and will be to analyze performance characteristics of system using Frequency response methods.
CO 6. Exposure on basic control actions.
CO 7. How to get acquainted with various control system components.

Learning Resources
Text Books:

1. Nagrath & Gopal , Control Systems, New Age International.
2. Hassan Sayeed, Automatic Control Systems: Katson Books.
3. Ogata, K., Discrete-time Control Systems, Pearson Education.

Reference Books:
1. D. Roy Chowdhury: Modern Control Engineering, Prentice-Hall of India Private Limited.
2. R. C. Dorf & R. H. Bishop - Modern Control Systems.

404-PCCIE11	**Microprocessor and Peripheral Devices**	**3L0T0P**	**3 CREDITS**

30 Hours

Detail syllabus :

Module 1: [1L]
Introduction to Microprocessors: Evolution, features and applications .

Module 2: [2L]
Microprocessor Architecture : Register section, Arithmetic and Logic Unit, Interface, Timing and Control section.

Module 3: [6L]
Organization of the Intel 8085 : MPU Block diagram, Pin description, Generating Control signals, Demultiplexing Address/Data bus, Bus buffering, 8085 Instruction and Timing processes.

Module 4: [9L]
Instruction Set and Programming of the 8085 : Data transfer, Arithmetic and Logic operation, Branching, Stack and Subroutines, Input and Output. Assembly Language Programming using the Instruction Set.

Module 5: [10L]
Interfacing Memory and I/O Devices : The Address map, Address decoding techniques, Memory Interfacing, Interfacing of I/O Ports, Keyboard and Display interfacing, DAC and ADC interfacing techniques .

Module 6: [2L]
The 8085 Interrupt systems : Multiple interrupts, Masking and non-masking interrupts, Enabling and disabling interrupts. Interrupt circuit.

Course Outcomes:
Upon completion of this course a student will be familiar with:

CO1: How to learn basic architecture of 8085 microprocessor with their applications
CO2: Expertise to develop assembly language programming in 8085 environment.
CO3: How to Learn hardware interfacing using 8085 microprocessor.

Learning Resources:
Text Books:
1.Microprocessor architecture, programming and applications with 8085/8085A, Wiley eastern Ltd,1989 by Ramesh S. Gaonkar.
2.Intel Corp: The 8085 / 8085A. Microprocessor Book – Intel marketing communication, Wiley inter science publications, 1980.

Reference Books:
1.Fundamental of Microprocessor and Microcontrollers, Dhanpat Rai Publications, By B.Ram
2.An introduction to micro computers – some real Microprocessor – Galgotia Book Source, New Delhi by Adam Osborne and J. Kane
3.Microprocessors and Interfacing by Douglas V. Hall, McGraw Hill International Ed. 1992

Program Elective 1	405-PECIE01	**3L0T0P**	**3 CREDITS**

30 Hours

One paper from Program Elective Course List

PRACTICAL PAPERS

406-PCCIE12	**Microprocessor Lab**	**0L0T3P**	**1.5 CREDITS**

30 Hours

List of Experiments :

1. Store 01, 02, 03, 04 & 05 in acc, reg B, reg C, reg D & reg E. Transfer the content serially in five consecutive locations starting from 8200H onwards.
2. Add 62H with the content of reg B. Store the result in 8150 H.
3. Add Acc, Reg B, Reg C, Reg D and Reg E. Store the result in 8200.

4. Add the content of mem.loc. <8210> with <8211>. Store the result in 8212.
5. Add 1122 with 2233 store the result in 8150 & 8151.
6. Find the larger of two numbers stored in mem location 8100H & 8101H. Store the result in 8102H.
7. Add 10 8 Bit Numbers stored in 8200H onwards. Store the result in 8250H and 8251H. Display the result.
8. Add 10 8 Bit BCD Numbers stored in 8200H onwards. Store the BCD result in 8250H and 8251H. Display the result.
9. Subtraction of Two 8 Bit Numbers.
10. Transfer a block of data from one memory zone to the other
11. Transfer the block of data from one memory zone to the other inverting the data sequence.
12. Add 10 16 Bit Numbers stored in 8200H onwards. Store the result in 8250H , 8251H and 8253. Display the result.
13. Unpack the BCD no stored in 8200H and store the unpacked BCD in 8200H and 8201H.
14. Two ASCII nos (say 34 and 38) are stored in memory location 8200H and 8201H. Generate the packed BCD no. and store it in 8202H.
15. Multiply 8 Bit Numbers stored in 8200H and 8201H. Display the result
16. Divide 8 Bit Numbers stored in 8200H and 8201H. Display the result
17 . Up And Down Hex Counter
18. Up And Down Decimal Counter
19. Digital Clock
Develop and use Delay + Display Subroutine
20. A number is stored in memory location 8500H. Write a program to count the number of 1's in the number. Store the number of 1's in 8501H.
21. Find the largest number in a given series of 8 bit numbers. The length of the series is stored in memory location 8200H. The numbers are stored from 8201H onwards. Display the result.
22. Find the smallest number in a given series of 8 bit numbers. The length of the series is stored in memory location 8200H. The numbers are stored from 8201H onwards. Display the result.
23. Sort a list of 10 numbers stored in memory location 8200H in ascending order.
24. Subtraction of two 16 bit numbers.
25 A number (0 to 9) is stored in memory location 8100H. Develop a program to display the square of the number in display field.
26. Identification of the ports and pins of I/O Ports of PPI 8255.
27. Development Of Waveforms Through DAC

(i) Generation Of Square Wave
(ii) Generation Of Triangular Wave
(iii) Generation Of Ramp Wave
(iv) Generation Of Staircase
(v) Generation Of Sine wave

28. To receive on line data through Analog To Digital Convertor (ADC) 0809
29. Calibration of Analog to Digital Convertor (ADC)
30. Design a microprocessor based dc 0-5 volt voltmeter.
31. Design a microprocessor based temperature monitoring and On-Off control.

407-PCCIE13	**Network Theory Lab**	**0L0T3P**	**1.5 CREDITS**

30 Hours

List of Experiments :

1. Generation of Periodic, Exponential, Sinusoidal, Damped Sinusoidal, Step, Impulse, Ramp signal using MATLAB in both continuous and discrete form.
2. Determination of Laplace transform and Inverse Laplace transform using MATLAB.
3. Realisation of Mathematical model and Transfer function in MATLAB
4. Transient response of R-L and R-C network: simulation with PSPICE and MATLAB
5. Transient and Steady state response of R-L-C series and parallel circuit: Simulation with PSPICE and MATLAB
6. Frequency response of LP and HP filters: simulation with PSPICE and MATLAB.
7. Frequency response of BP and BR filters: simulation with PSPICE and MATLAB.
8. Transient response of R-L and R-C network: simulation with Hardware.
9. Transient response of R-L-C series and parallel circuit: Simulation with Hardware.
10. Realisation of Transfer function from Time constant and Steady state response of a First Order Process.

408-ESC03	**Numerical Programming Lab**	**0L0T3P**	**1.5 CREDITS**

30 Hours

List of Experiments :

1. Derivation of the root of a function using Bisection Method
2. Derivation of the root of a function using False Position Method
3. Derivation of the root of a function using Newton-Raphson Method
4. Solving equations using Jacobi Iteration Method
5. Derivation of the root of a function using Secant Method
6. Estimation of the area of a section using Composite Trapezoidal Method
7. Solving first-order differential equation using Euler Method
8. Estimation of the area of a section using Simpson's $1/3^{rd}$ Rule
9. Solving linear equation using Gaussian Elimination Method
10. Solving linear equation using Gauss-Seidel Iteration
11. Curve-fitting using Linear Interpolation
12. Curve-fitting Polynomial Interpolation
13. Solving differential equation using fourth-order Runge-Kutta Method

409-PCCIE14	**Sensor and Transducer Lab**	**0L0T3P**	**1.5 CREDITS**

30 Hours

List of Experiments:

1. Calibration of RTD using Hg thermometer and measurement of unknown temperature
2. Calibration of thermocouple using Hg thermometer and measurement of unknown temperature
3. Displacement measurement using LVDT
4. Displacement measurement by inductive sensor
5. Calibration of strain gauge based transducer using standard weights
6. Measurement of speed using photoelectric transducer
7. Measurement of speed using magnetic pickup
8. Angular displacement measurement using capacitive transducer
9. Vibration measurement by piezoelectric crystal
10. Study of ON-OFF control for a temperature bath using thermocouple

5th SEMESTER
THEORETICAL PAPERS

501-PCCIE15	**Communication Systems**	**3L0T0P**	**3 CREDITS**

30 Hours

Detail syllabus :

Module 1: [4L]
Introduction to communication systems, concepts of baseband signal, transmitter, transmission medium/ channel, Noise, Receiver, past history and different types of communication systems.

Module 2: [13L]
Analog communication: Concepts of signal, Noise, Power, SNR, Spectral Density, analog signal sources, Modulation- AM, FM, PM, Double sideband suppressed carrier, Single sideband, Amplitude compensated single sideband and vestigial sideband. IF stages, Detection techniques, PLL, transmission bandwidth and distortion.

Module 3: [13L]
Digital Communication: Digital signals, Bandwidth of signals and Noise, Concepts of Pulse Amplitude Modulation, Pulse code modulation, Differential Pulse code modulation, Delta Modulation, Coding :

Huffman and CRC, Time Division Multiplexing, Frequency Division Multiplexing, Inter Symbol Interference, Digital signaling formats, Spectral Efficiency, Bit Error Rate, Synchronization, Spread Spectrum Systems- DSSS and FHSS.

Course Outcomes:

Upon completion of this course a student will be familiar with:

CO1**:** The knowledge of basic communication systems, like concepts of baseband signal, transmitter, transmission medium/ channel etc.

CO2**:** The knowledge of analog and Digital communication.

CO3: The knowledge of different coding systems, time division multiplexing and frequency division multiplexing.

CO4: The knowledge of inter symbol interference, digital signaling formats etc.

Learning Resources

Text Books:

1.Taub and Schilling , Principles of Communication Systems, Mc-Graw Hill
2.B.P.Lathi -Communication Systems- BS Publications
3.Digital Communications, S. Haykin, Wiley India.

Reference Books:

1. Carlson—Communication System, Mc-Graw Hill
2. Proakis & Salehi Fundamentals of Communication Systems- Pearson
3. Singh & Sapre—Communication Systems: TMH
4. P. K. Ghosh- Principles of Electrical Communications- University Press
5. L.W. Couch Ii, "Digital and Analog Communication Systems", Macmillan Publishing
6. Digital Communication, A. Bhattacharya, TMH Publishing Co.
7. Modern Digital and Analog Communication Systems, B.P.Lathi and Z.Ding, Oxford University Press.

502-PCCIE16	**Industrial Instrumentation – II**	**3L0T0P**	**3 CREDITS**

30 Hours

Detail syllabus :

Module 1: [10L]

Flow Measurement:

Mechanical type flow meters :

Fluid properties, turbulent & laminar flow, Reynolds number, velocity profile. Theory of fixed restriction variable head type flow meters.

Different types of variable head type flow meters : orifice plate , venturi tube , flow nozzle , dall tube , pilot tube, elbow flow meters.
Installation of head flow meters – piping arrangement.
Variable area type flow meters.
Electrical type flow meter :
Principle and constructional details of electromagnetic flow meter , different types of excitation schemes used, turbine flow meter, ultrasonic flow meters, vortex shedding flow meter
Anemometers :
Hot wire anemometer, laser Doppler anemometer .
Positive displacement flow meters :
Constructional details and theory of operation of mutating disc, reciprocation piston, oval gear and helix type flow meters.
Mass flow meters
Turbine mass flow meter, thermal mass flow meter, Coriolis mass flow meter.
Open channel flow metering, measurement of flow of bulk solids. Criteria for selection of flow meters.

Module 2: [6L]
Measurement of level: float and displacer gauges; hydrostatic type, thermal effect type, electrical types of level gauges using resistance, capacitance, nuclear radiation and ultrasonic sensors.

Module 3: [6L]
Measurement of Humidity and Moisture Content: hygrometer, dew point determination, electrical methods, crystal oscillator instrument, radio frequency absorption, microwave absorption, infrared absorption.

Module 4: [4L]
Density and Specific Gravity Measurement : scales, hydrometers, balanced flow vessel, displacement meter, bubbler, nuclear absorption method, fixed volume method.

Module 5: [4L]
Measurement of viscosity and consistency: definition, units, Newtonian and Non-Newtonian behavior, Measurement of viscosity using laboratory viscometer, industrial viscometers, viscometer selection and application

Course Outcomes:
Upon completion of this course a student will be familiar with:

CO1: Basics of flow measurements and different industrial flow sensors, their advantages and limitations and criteria for selection of flowmeters
CO2: Different industrial level sensors, level switches, their advantages and limitations
CO3: Description of humidity and moisture measurement technique
CO4: Description of Density, Specific Gravity, viscosity and consistency measurement techniques

Learning Resources
Text Books:
1. D Patranabis, Industrial Instrumentation, PHI
2. E. A. Doebelin, Measurement Systems: Application and Design ,Mc Graw Hill, New York
3. B. G. Liptak, Instrument Engineers Handbook, vol-I and vol-II, Chilton Book Co. Philadelphia

4. Jones, Instrumentation technology – Vol. 1 :- Mechanical Measurement.
5. Instruments for measurement and control – W. G. Holzbock.

Reference Books:

1.H. K. P. Neubert, Instrument Transducers, Oxford University Press, London and Calcutta
2. D. M. Considine and G. D. Considine (Eds.) Process Instruments and controls Handbook, Mc Graw Hill, New York
3. A. Barua, Fundamentals of Industrial Instrumentation, Wiley India

503-PCCIE17	**Control Theory – II**	**3L0T0P**	**3 CREDITS**

30 Hours

Detail syllabus:

Module 1: [6L]
Digital control system: sampling, aliasing, reconstruction; zero, first and fractional order holds; Theory of Z- transform, inverse Z- transform, pulse transfer function,

Module 2: [6L]
Time response, Concept of Z-domain stability, Routh stability criteria, Schur-Cohn criterion, Jury's stability test.

Module 3: [8L]
State space analysis: state model, canonical representation; solution of linear state dynamical equation, fundamental and state transition matrices, stability concept from state variables.

Module 4: [5L]
Concept of Controllability and Observability. Linear state feedback control: pole placement method, concept of observer based system design.

Module 5: [5L]
Introduction to Non-linear control: phase-plane method, describing function method, Lyapunov stability criteria.

Course Outcomes:
Upon completion of this course a student will be familiar with:

CO 1. How to derive discrete-time mathematical models in both time domain (difference equations, state equations) and z-domain (transfer function using z-transform).
CO 2. How to predict stability condition and analyze transient and steady-state responses and stability and sensitivity of both open-loop and closed-loop linear, time-invariant, discrete-time control systems.
CO 3. The knowledge of state space and state feedback in modern control systems, pole placement, design of state observers and output feedback controllers.
CO 4. How to demonstrate non-linear system behavior by phase plane and describing function methods.

CO 5. How to perform the stability analysis of nonlinear systems by Lyapunov method.

Learning Resources

Text Books:

1. D. Roy Chowdhury: Modern Control Engineering, Prentice-Hall of India Private Limited
2. B.C. Kuo, Automatic Control Systems, Prentice Hall India
3. Ogata, K., Discrete-time Control Systems, Pearson Education

Reference Books:

1. S. Hasan Saeed, Automatic Control Systems, Arihant
2. Bandyopadhyay, M.N., Control Engineering: Theory and Practice, Prentice-Hall of India Private Limited
3. Slotine & Li, Applied Non-Linear Control, Englewood Cliffs, NJ: Prentice-Hall

504-PCCIE18	**Digital Signal Processing**	**3L0T0P**	**3 CREDITS**

30 Hours

Detail syllabus :

Module 1: [5L]

Discrete-time signals: Concept of discrete-time signal, Basic idea of sampling and reconstruction of signal, sampling theorem

Types of discrete-time signal - periodic, energy, power, unit-sample, unit-step, unit-ramp, real & complex exponentials, arithmetic operations on sequences.

Module 2: [8L]

LTI Systems: Definition, representation, impulse response, derivation for the output sequence, Convolution sum, Properties of convolution, Calculation of convolution by graphical and tabular method, Convolution of long duration sequences, Interconnections of LTI systems, stability and causality conditions, recursive and non-recursive systems, Linear Constant coefficient difference equation.

Module 3: [9L]

Discrete time signals in transform domain - Z transform, Properties of Z transform; Inverse Z transform, Discrete Fourier Transform (DFT), DFT properties, IDFT, Fast Fourier Transform.

Module 4: [8L]

Digital processing of continuous-time signals; Digital filters: Basic digital filters, IIR and FIR filters, Design of IIR filters - impulse invariant method, bilinear z-transform method of coefficient calculation; realization structure for IIR filters, FIR filter design methods – Window technique, frequency sampling method.

Course Outcomes:
Upon completion of this course a student will be familiar with:

CO 1. The distinctions between analog, continuous-time, discrete-time and digital signals, and describe the basic operations involved in analog-digital (A/D) and digital-analog (D/A) conversion
CO2. The digitization process produces additive quantization noise; state the Relationship between SNR (dB) and the number of A/D converter bits; give typical sampling and bit rates for common types of signal
CO3. The z-transform of a sequence; identify its region of convergence, Inverse z-transform by partial fractions, Discrete Fourier transform of discrete signals
CO4. The knowledge to implement the DFT in terms of the FFT, as well as some of its applications (computation of convolution sums, spectral analysis)
CO5. The tests to demonstrate linearity, time-invariance, causality and stability, and hence show whether or not a given system belongs to the important class of causal, LTI systems

Learning Resources

Text Books:

1. John G. Proakis and D. G. Manolakis, Digital Signal Processing – Principles, Algorithms and Applications, Prentice Hall International Inc
2. A. V. Oppenheim and R. W. Schafer, Digital Signal Processing, PHI

Reference Books:

1. Sanjit K. Mitra , Digital Signal Processing – a computer based approach**,** McGraw Hill
2. S. Salivahanan, A Vallavaraj, C Gnanapriya, Digital Signal Processing, TMH

505-PCCIE19	**Process Control**	**3L0T0P**	**3 CREDITS**

30 Hours

Detail syllabus:

Module 1: [4L]
Process Characteristics: Process dynamics of liquids, gas and thermal processes, dynamic response of non-interacting and interacting first order elements in series, transient response of control systems in a single or multiple capacity process, set point and load response self regulation, steady state model, dynamic model.

Module 2: [3L]
Different control modes: On-off control, suppression of chattering, proportional, proportional-integral, proportional -derivative, proportional-integral-derivative, integral windup, bumpless transfer, derivative overrun, inverse derivative control, controller selection guideline, offset minimization.

Module 3: [3L]

Control strategies: Feedback and feedforward control, feedforward load balancing, feedback control with dynamic compensation, continuous control, batch control.

Module 4: [4L]
Controllers: Self operated, pneumatic, electric, hydraulic and electronic controllers, different forms of PID controllers.

Module 5: [4L]
Tuning of controllers: Concept of good control, close loop and open loop tuning methods, concept of model based and model free tuning, comparison of tuning methods, controller performance indices.

Module 6: [6L]
Advanced control techniques: Ratio control of a flow process, ratio station, manual set mode and variable mode, cascade control, primary and secondary loop, cascade loop saturation, feedforward control, feed-forward and feedback control, auctioneering control, split range control, override control.

Module 7: [6L]
Final control elements: Classification, actuators: self-operated, pneumatic, electro-pneumatic, hydraulic, electric motor operated and stepper motor operated actuators, valve positioner and transmitter, classification of control valves, performance and application of different control valves, valve type and construction, valve sizing, valve characteristics, valve noise, valve testing, valve selection guidelines, safety valve and their selection.

Course Outcomes:
Upon completion of this course a student will be familiar with:

CO 1. The basic principles & importance of process control in industrial process plants;
CO 2. The required instrumentation and final elements to ensure that well-tuned control is achieved;
CO 3. The use of block diagrams & the mathematical basis for the design of control systems;
CO 4. The knowledge about the design and tuning of process (PID) controllers;
CO 5. The use appropriate software tools (e.g. MATLAB Control Toolbox & Simulink) for the modeling of plant dynamics and the design of well tuned control loops;
CO 6. The importance and application of good instrumentation for the efficient design of process control loops for process engineering plants and sizing of control valves
CO 7. PID (Process & Instrumentation Diagram) & devise simple but effective plant wide control strategies using appropriate heuristics.

Learning Resources

Text Books:

1. Process Control- B. W. Bequette, Prentice-Hall
2. Process Dynamics and Control- Seborg, Edgar, Mellichamp, Wiley.
3. Process Control Systems- F. G. Shinsky, McGraw-Hill.

Reference Books:

1. Process Instruments & Controls Handbook- D. M. Considine, McGraw-Hill.
2. Process Control Handbook- B. G. Liptak, Chilton Book Company.

PRACTICAL PAPERS

506-PCCIE20	**Process Control Lab**	**0L0T3P**	**1.5 CREDITS**

30 Hours

List of experiments:

1. To Study the Proportional Control System Response.
2. To Study the Proportional plus Integral Control System Response.
3. To Study the Proportional plus Integral plus Derivative Control System Response.
4. To Study the Different Closed Loop Tuning Methods of the Controller.
5. To Study the Open Loop Tuning Method of the Controller from Process Reaction Curve.
6. To Study the Open Loop Frequency Response of the Simulated System (PCS 327).
7. To Study the Open Loop Frequency Response of a Real System (PT 326).
8. To Study the Distance / Transport Lag & Exponential Lag of the Real System (PT 326).

507-PCCIE21	**Industrial Instrumentation Lab**	**0L0T3P**	**1.5 CREDITS**

30 Hours

List of experiments:

1. Calibration of thermistor using Hg thermometer
2. Flow measurement using orifice meter
3. Flow measurement using venturi meter
4. Flow measurement using rotameter
5. Study of water level measurement by capacitive sensor
6. PneumaticPressure measurement.
7. Speed measurement using stroboscope.
8. Measurement of vacuum pressure using McLeod gauge
9. Noncontact type temperature measurement by IR sensor
10. Thermistor based temperature ON – OFF controller
11. Calibration of pressure gauge using Dead Weight Tester

508-PCCIE22	**Control System I Lab**	**0L0T3P**	**1.5 CREDITS**

30 Hours

List of experiments:

1. DC Servo position control
2. DC Servo speed control
3. AC Servo position control
4. Study of Transfer function simulation
5. Steady state error analysis for Type-0, Type-1 & Type-2 systems
6. Study of Synchro Transmitter & Receiver
7. Study of potentiometer as an error detector
8. Study of stepper motor control

509-PCCIE23	**Control System II Lab**	**0L0T3P**	**1.5 CREDITS**

30 Hours

List of experiments:

1. Familiarization with MATLAB control system toolbox and MATLAB Simulink.
2. Realization of Mathematical modelling and Transfer function of control systems in MATLAB environment.
3. Realisation of state model in MATLAB environment and conversion of state model to Transfer function and vice-versa.
4. Determination of impulse and step response for first order and second order system with unity feedback & calculation of control system specifications (Time constant, % peak overshoot. Settling time etc. from the response) using MATLAB.
5. Simulation of Step response & impulse response for Type-0, Type-1 & Type-2 system with unity feedback using MATLAB.
6. Realization of pole / zero location and absolute stability with change in the damping factor for a 2^{nd} order system.
7. Realisation of Routh-Hurwitz criteria in MATLAB.
8. Construction of Root-locus and finding of Gain and Oscillation frequency for marginal condition.
9. Construction of Bode plot and Nyquist plot and finding of relative stability margins.
10. Familiarization with MATLAB Simulink library.
11. Construction of Block Diagram and its reduction in Simulink.
12. Construction of PID controller and its deployment with a standard process in Simulink.

6^{th} SEMESTER
THEORETICAL PAPERS

Program Elective 2	**601-PECIE02**	**3L0T0P**	**3 CREDITS**

30 Hours

One paper from Program Elective Course List

Program Elective 3	**602-PECIE03**	**3L0T0P**	**3 CREDITS**

30 Hours

One paper from Program Elective Course List

Program Elective 4	**603-PECIE04**	**3L0T0P**	**3 CREDITS**

30 Hours

One paper from Program Elective Course List

Open Elective 1	**604-OECIE01**	**3L0T0P**	**3 CREDITS**

30 Hours

One paper from Open Elective Course List

Open Elective 1	**605-OECIE02**	**3L0T0P**	**3 CREDITS**

30 Hours

One paper from Open Elective Course List

PRACTICAL PAPERS

606-PCCIE24	**Digital Signal Processing Lab**	**0L0T3P**	**1.5 CREDITS**

30 Hours

List of experiments:

1. Representation of basic signals in MATLAB: (i) Exponential (ii) Ramp (iii) Unit step (iv) Unit impulse (v) Sine function (vi) Cosine function

2. Write a function for Addition of two sequences and call it to perform an Addition operation of any two sequences.
3. Write a function for multiplication of two sequences and call it to find out the product of any two sequences.
4. Create a function to perform the shifting operation of a discrete signal and execute the following: Let x(n) = {1, 2, 3↑, 4, 5, 6, 7, 6, 5, 4, 3, 2, 1}. Determine and plot the following sequences. (a) x1(n) = 2x(n − 5) (b) X2(n)= 3x(n + 4)
5. Create a function to perform the folding operation of a discrete signal and execute the following:
6. Let x(n) = {1, 2, 3↑, 4, 5, 6, 7, 6, 5, 4, 3, 2, 1}. Determine and plot the following sequences. (a) x1(n) = x(-n) (b) x2(n)=x(2-n)
7. Develop a program to perform discrete convolution of two given sequences.
8. Determine the discrete-time Fourier transform of and evaluate $X(e^{j\omega})$ in at 501 equispaced points between [0, π]. Also plot its magnitude, angle, real, and imaginary parts.
9. Determine the frequency response $H(e^{j\omega})$ of a system characterized by $h(n) =(0.9)^n u(n)$. Plot the magnitude and the phase responses
10. Compute the partial fraction expression of a given system function in z domain.

11. (a) Develop a function to compute DFT of any given sequence and find out the 8 point DFT of a given sequence. Also find out the magnitude and phase angles of the samples of X(k).
    (b) Develop a function to compute IDFT of any given sequence. Find out the IDFT of X(k) and check the result.
12. Develop a function for circular shift of a given sequence. Given an 11-point sequence $x(n) = 10(0.8)^n$,
    $0 \le n \le 10$, determine and plot $x\,(n-6)_{15}$ using the function.
13. Write a MATLAB program to develop a function to perform N point circular convolution of two sequences.
    Find out the circular convolution of the sequences are x1(n) = {1, 2, 2} and x2(n) = {1, 2, 3, 4}.
14. Perform linear convolution of sequences x1 = [1,2,2,1] and x2 = [1,-1,-1,1] using circular convolution
15. Develop a function in MATLAB to execute Overlap and save method for convolution of long duration sequences. Perform the convolution of x(n)=1:10 and h(n)=(1,0,-1) using the function.
16. Design a lowpass BW filter with less than 3 dB of ripple in the passband, defined from 0 to 40 Hz, and at least 60 dB of attenuation in the stopband, defined from 150 Hz to 500 Hz. Plot the filter's frequency response.
17. Transform $H_a(s) = \dfrac{s+1}{s^2+5s+6}$ into a digital filter using the bilinear transformation. Choose $T = 1$.
18. Develop a BP BW filter with pass band between 2.5 MHz to 29 MHz of order 6. Use second-order sections model conversion method and plot the magnitude response o the filter.
19. Study of TMS6713 series DSP starter kit and development of HP and LP filters

607-PCCIE25	Communication Lab	0L0T3P	1.5 CREDITS

30 Hours

List of Experiments:

1. Study amplitude modulation and demodulation.
2. Study frequency modulation and demodulation.
3. Study of Amplitude Shift Keying (ASK) Modulator and Demodulator.
4. Study of Frequency Shift Keying (FSK) Modulator and Demodulator.
5. Study of Phase Shift Keying (PSK) Modulator and Demodulator.
6. Study of Pulse Width Modulation (PWM) and Demodulation.
7. Study Amplitude Modulation and Demodulation in simulation.
8. Study Frequency Modulation and Demodulation in simulation.
9. Study different types of filters in simulation.

608-PCCIE26	Presentation / Group discussion on Technical topic	0L2T0P	2.0 CREDITS

20 Hours

Presentation and Group discussion will be given by students on relevant topics.

7th SEMESTER

THEORETICAL PAPERS

701-HSMC01	Engineering Management	3L0T0P	3 CREDITS

30 Hours

Detail syllabus :

Module 1: [8L]
Engineering Management: Management, administration: planning, decision making, organization and staff, controlling, communication.

Module 2: [4L]
Location of factory: building and plant layout, Material handling: maintenance dept procedure.

Module 3: [6L]

Industrial relation: personnel selection and recruitment, training and placement, transfer and promotion, discipline, redress of grievances.

Module 4: [6L]
Labour turnover: prevention of accident and safety measure, Welfare scheme, Union relation: workers' participation in management. Wage administration, method of wage payment.

Module 5: [6L]
Production : projection planning, scheduling, routing of work order, flow chart, inspection and avoidance of waste, time and motion study.

Course Outcomes:
On successful completion of this course, the student will be familiar with:

CO1. How to demonstrate an understanding of, and apply, the fundamentals of project planning and project management.
CO2. How to prepare and evaluate cost estimates, tender documentation and contract documentation.
CO3. How to administer and supervise contracts in accordance with the relevant Standards and/or Codes of Practice.
CO4. How to critically evaluate professional practice principles and their application to an engineering environment.

Learning Resources:
Text Books:
1. Burke, R., Project Management, Planning and Control Techniques, 5th Ed., Burke Publishing, UK, 2006..
2. Futrell, R. T., Shafer, D. F., & Shafer, Quality Software Project Management, Prentice Hall, New Jersey, 2002.
3. Bateman, T & Snell, S, Management: Building competitive advantage, 3rd Ed, McGraw-Hill Companies, US, 1996.

Reference Books:

1. Belbin, R. Meredith, Beyond the Team, Butterworth-Heinemann, Oxford, 2000.
2. Managing for Excellence, Moi ali et al., Dorling Kindersley Limited (DK), 2009, ISBN 978-1-4053-4156-1
3. Project Management, A systems approach to planning, scheduling and controlling, Tenth Edition, Harold Kerzner, John Wiley and Sons, 2009, ISBN 978-0-470-27870-3
4. Project Management, A Managerial Approach, Sixth Edition, J.R. Meredith and S.J. Mantel Jr., John Wiley and Sons, 2006, ISBN 13-978-0471-715375

Open Elective 3	**702-OECIE03**	**3L0T0P**	**3 CREDITS**

30 Hours

One paper from Open Elective Course List

PRACTICAL PAPERS

703-PCCIE27	**Design Lab**	**0L0T3P**	**1.5 CREDITS**

30 Hours

List of experiments:

1. Study of step down transformer and rectifier circuit.
2. Design of PCB using software.
3. Construction of a simple dc regulated power supply (+5v/-5v or +12v /-12v, +18v /-18v)
4. Construction of Dual power supply with given specifications (ripple limit, current and voltage ratings are set beforehand)
5. Construction of P, PI and PID controller using Op-amp
6. Deployment of P, PI and PID controller to a 2^{nd} order (R-L-C) circuit to manipulate the voltage across capacitor.
7. Design of Lag, Lead and Lag-lead compensator for given plants using MATLAB.

704-PCCIE28	**Advanced Process Control Lab**	**0L0T3P**	**1.5 CREDITS**

30 Hours

List of experiments:

1. Physical identification of DCS configuration
2. Identification various I/O modules, data bus, redundant CPU and power supply cards
3. Concepts of DCS programming
4. Simulation and emulation of 210 Thermal Power Plant
5. Fuel, Air, Water, Steam, Flue gas cycles path tracing of 210 Thermal Power Plant
6. Disturbance input and its consequences in 210 Thermal Power Plant operation
7. Alarm generation and its corrective measure
8. Functionalities of Tuning Panel, Graphic Panel, Control Group Panel, Trend Panel, Overview Panel, Instrument Faceplate, Alarm Summary Panel

705-PCCIE29	Summer Internship	**0L2T0P**	**2 CREDITS**

20 Hours

Report preparation and presentation on Summer Internship after 6^{th} Semester.

706-PROJIE01	**Project Ph-I**	**0L2T4P**	**4 CREDITS**

60 Hours

Planning and knowledge acquiring for project formulation. Report preparation and presentation before board of examiners.

8th SEMESTER

THEORETICAL PAPERS

801-HSMC02	**Economics for Engineers**	**3L0T0P**	**3 CREDITS**

30 Hours

Detail syllabus:

Module 1: [10L]
Nature and significance of economics, Concepts of demand, supply, equilibrium, short and long term analysis, static and dynamic state, macro and micro economics, want and utility. Marginal analysis: cost, money and real cost.

Module 2: [4L]
Tax and profit, competition, monopoly, distribution.

Module 3: [6L]
Economic systems: capitalism, socialism, mixed economy, Factors of production, national income land labour capital, organization and enterprise. Laws of return, pnp, nnp and national income.

Module 4: [10L]
Economic development of India: features, industrialization, labour economics, agriculture, economic planning, banking and international trade.

Course Outcomes:
On successful completion of this course, the student will be familiar with:

CO1. The knowledge of mathematics, economics, and engineering principles to solve engineering problems.
CO 2. The major capabilities and limitations of cash flow analysis for evaluating proposed capital investments.
CO 3. How to recognise, formulate, analyse and solve cash flow models in practical situations. Understand the assumptions underlying these models, and the effects on the modelling process when these assumptions do not hold.
CO 4. How to develop the ability to account for time value of money using engineering economy factors and formulas, as well as the implications and importance of considering taxes, depreciation, and inflation.

CO 5. How to apply engineering economic techniques on solving engineering problems by using computer tools such as spreadsheets.
CO 6. How to communicate the results of the modeling process to management and other non-specialist users of engineering analyses in a lucid, informative manner (graphs, tables and/or text).

Learning Resources:
Text Books:

1. James L.Riggs,David D. Bedworth, Sabah U. Randhawa : Economics for Engineers 4e , Tata McGraw-Hill
2. Donald Newnan, Ted Eschembach, Jerome Lavelle : Engineering Economics Analysis, OUP
3. John A. White, Kenneth E.Case,David B.Pratt : Principle of Engineering Economic Analysis, John Wiley
4. Sullivan and Wicks: Engineering Economy, Pearson
5. R. Paneer Seelvan: Engineering Economics, PHI
6. Michael R Lindeburg : Engineering Economics Analysis, Professional Pub

Reference Books:
1. Peters and Timmerhaus: Plant Design and Economics for Engineers, McGraw-Hill.
2. Stewart, Wyskida, Johannes: Cost Estimator's Reference Manual, J. Wiley, 2nd Edition
1. William Webster, Accounting for Managers, , McGraw Hill, 2004,
2. John whitely, Mastering Financial Management, , Palgrave Macmillan, 2004,

Open Elective 4	**802-OECIE04**	**3L0T0P**	**3 CREDITS**

30 Hours

One paper from Open Elective Course List

PRACTICAL PAPERS

803-PROJIE02	**Seminar**	**0L3T0P**	**3 CREDITS**

30 Hours

Seminar on some engineering topic relevant to the course content.

804-PROJIE03	**Project Ph-II**	**0L2T10P**	**7 CREDITS**

120 Hours

Execution of the formulated project. Report preparation and presentation before board of examiners.

805-PROJIE04	**General Viva Voce**	**0L0T0P**	**2 CREDITS**

00 Hours

To appear before the group of examiners for General Viva Voce

Program Elective PAPERS (PEC) : 3 CREDITS : 30 Hours

PEC 01 : Analytical and Biomedical Instrumentation

Detail syllabus :

Module 1: [6L]
Gas Analyzers
Thermal Conductivity Type, Heat of Reaction Method, Paramagnetic for O2, Dumbell and Servomax for O_2, Thermomagnetic for O2, Zirconia Cell Type for O_2, Cell for Continuous O_2 analysis microelectrodes.

Module 2: [6L]
Spectroscopic Analyzer
Spectroscopic Techniques, monochromators and detectors, sources, IR Radiation Absorption Type, Dual-Channel IR Spectrometry, Single-Channel IR Spectrometry, IR Sources, Comparison of their performances, IR detectors, Spectroscopic Techniques: Absorption in Visible and UV- Colorimetry, range, Visible, UV and X-rays; sources, principles, detectors, sample preparation etc.,

Module 3: [4L]
Dissolved O_2 and pH measurement
Dissolved Oxygen Analysis Cells, pH electrodes, pH measuring circuits and applications.

Module 4: [4L]
Gas Chromatography
Chromatography, GC, GLC, LC, HPLC, Columns, Detectors.

Module 5: [10L]
Biomedical Instruments
Introduction to physiology of cardiac, nervous, muscular systems; Measurement of electrical activities of heart and brain, ECG measurement and instrumentation techniques; Medical equipment: Plethysmography, Diathermy, Defibrillator, pace maker, blood pressure monitor, Blood flow monitor, Endoscope; Instrumentation in clinical laboratory: measurement of pH, ESR, oxygen, Hb in blood; X-ray and Ultrasonography.

Course Outcomes:
On successful completion of this course, the student will be familiar with:

CO 1. The knowledge to select the required instruments for spectroscopic analysis, opacity measurement.
CO 2. Understanding regarding the effects of different constituent in a process outcome and analysis the performance of various on-line or off-line instruments.
CO 3. The knowledge of chromatography to separate the constituents from a complex mixture.
CO 4. How to describe and differentiate between online and offline process and identifies suitable instruments for analysis gaseous, liquid or solid substance.
CO 5. How to decide the dominate frequency characterize the substance from spectrum analysis.
CO 6. How to perform experimental analysis for different offline test like humidity, moisture, dissolve oxygen etc.
CO 7. Knowledge about online and offline pH measurement.

Learning Resources:
Text Books:
1. Willard, Merrit, Dean & Settle, Analytical methods of instrumental analysis, CBS Publisher.
2. Skoog & Larry, Principles of instrumental analysis, Cengage
3. Khandpur, Analytical instruments, McGraw-Hill
4. Cromwell, Weibell and Pfpiffer, Biomedical Instrumentation and Measurements, PHI

Reference Books:
1. D. M. Considine, Process instruments handbook, McGraw-Hill.
2. B. G. Liptak, Process measurement handbook, Chilton Book Company

PEC 02 : Optical Sensors and Nondestructive Evaluation

Detail Syllabus:

Module 1: [10L]
Optical Sensors
Opto-electronic Instrumentation: Significance, application of optical sensors in instrumentation, Block diagram of an optical measurement system, Types of sensors, extrinsic and intrinsic, Optical sources and detectors - structure and principles: LEDs, LASERs. pin photodiodes, APD. Optical components: Couplers, splitters, connectors.

Module 2: [5L]
FO Sensors
Different FO sensors- principles and structure: Position sensor, Proximity sensor, Temperature sensor, Pressure sensor, Liquid level sensor, FO accelerometer, strain sensor, Vibration sensors.

Module 3: [15L]

Non Destructive Testing
Significance and application, basic principles, classification, probing media, NDT methods: Penetrant Test, MPI, EPI, Ultrasonic testing, Eddy Current probes, Film Radiography, Tomography, Microwave based NDT measurements.

Course Outcomes:
Upon completion of this course a student will be familiar with:

CO1: Significance, application, basic principles, and methods of Non Destructive Testing
CO2: Various types of optical and fiber optic sources, detectors, Optical components
CO3**:** Industrial application of optic and fiber optic sensors

Learning Resources:
Text Books:
1. J. Haus, Optical Sensors, Wiley-VCH
2. Z.Fang, K. K. Chin, R. Qu, H. Cai, Fundamentals of Optical Fiber sensors, Wiley

Reference Books:
1. Ravi Prakash, Non Destructive Testing Technique, New Age international
2. Edited by R.C. McMaster, Non Destructive Testing Hand Book , The Ronald Press

PEC 03 : Advanced Measurement and Automation Techniques

Detail syllabus:

Module 1: [4L]
Computer based process control
Introduction to computer controlled process, elements in a digital control loop, simple case study, introduction to digital PID control algorithm, advantage and limitations of digital control.

Module 2: [10L]
Programmable Logic Controller
Characteristic, classification, block diagram representation of processor, memory layout, different languages used in PLC, types of program loaders. Input and output module, coils and contacts, PLC function block timers, function block counters, arithmetic function blocks, real time LADDER diagram; programming examples for maintenance and control. PLC communication protocol, RS-232 communication interface, DF1 Full duplex protocol, DF1 half duplex slave protocol, DH-485 communication protocol, I^2C and SPI protocol, PLC interfacing technique.

Module 3: [8L]
DCS

Computer based control, History and overview of DCS, Concept of centralized and distributed control systems, system architecture, brief view on operator station, engineering station, field control station, communication techniques between different modules, concept of different standard panels over view, graphic, tuning, control, alarm etc., and applications.

Module 4: [8L]
SCADA
Computer based data acquisition, overview and history of SCADA, primitive and modern SCADA architecture, SCADA hardware and software, modems use in SCADA, communication techniques, RTU structure, Comparison of DCS, SCADA and PLC, SCADA applications.

Course Outcomes:
Upon completion of this course a student will be familiar with:

CO 1. Industrial automation, its importance, expectations from automation and computer based automation in industry.
CO 2. Working of PLC, I/O modules of PLC, Programming languages and instructions of PLC, design PLC based application by proper selection and sizing criteria, developing GUI and ladder program.
CO 3. Evolution and architecture of DCS, hierarchical control in DCS, programming DCS through function Block Diagram (FBD) method.
CO 4. SCADA architecture, communication in SCADA, develop any application based on SCADA along with GUI using SCADA software.

Learning Resources:
Text Books:
1. Webb J.W-Programmable controllers: Principle and Applications, PHI New Delhi
2. Parr A –Programmable Controllers : An Engineers' Guide, Newnes, Butterworth-HeinnemanLtd1993.
3. Noltinc - Handbook for Instrumentation Engineers.
4. Process instruments handbook- D. M. Considine, McGraw-Hill.

Reference Books:
1. Bollinger J.G and Duffie N.A-Computer control of machines and processes, Reading M A, Addison-Wesley, 1988.
2. Overview of Industrial Process Automation- K. L. S. Sharma, Elsevier
3. Process measurement handbook- B. G. Liptak, Chilton Book Company

PEC 04 : Transmitters, Recorders and Hazardous Area Instrumentation

Detail syllabus:

Module 1: [8L]

Basic requirement, general classification, dead zero & live zero, zero elevation & zero suppression, general block diagram, pneumatic, electric, electro-pneumatic and electronic transmitters: differential pressure transmitter, pressure transmitter, flow transmitter, temperature transmitter and level transmitter.

Module 2: [4L]
Telemetry for current, voltage, frequency, position and impulse, fiber optic transmitter, smart transmitter: smart sensor, HART protocol.

Module 3: [4L]
Recorder: moving coil, pen, oscillograph, curvilinear and linear records, servo recorder, potentiometer recorder UV recorder, magnetic tape recorder, X-Y recorder, digital recorder.

Module 4: [8L]
Concept of safe area and hazardous area, Hazardous area classification, Protection techniques, Material classification, Methods of explosion prevention-encapsulation; pressurization; purging; immersion; alarms and interlock, Explosion suppression system, Suppression techniques and suppression chemicals, Explosive actuated rupture disc, Deluge system.

Module 5: [6L]
Intrinsic safety, Classification of Intrinsic safety, Intrinsically safe loop, Safety barrier and their classifications, Enclosure classifications, Fuses and Circuit breakers, Flame arrester, Fire and smoke detector, Flame scanner and Flame sensors.

Course Outcomes:
Upon completion of this course a student will be familiar with:

CO 1. The operation of various types of transmitter
CO 2. The knowledge of the operation for conventional and PC based recorders
CO 3. The importance of industrial safety measures to prevent fire and explosion
CO 4. The understanding of safe instrumentation scheme
CO 5. How to describe various safety measures with the concept of intrinsic safety.

Learning Resources:
Text Books:
1. Process instruments handbook- D. M. Considine, McGraw-Hill.
2. Process measurement handbook- B. G. Liptak, Chilton Book Company
3. Instrumentation Reference Book- Walt Boyes, Butterworth-Heinemann

Reference Books:
1. A. Barua, Fundamentals of Industrial Instrumentation, Wiley India
2. M.M.S. Anand, Electronic Instruments and Instrumentation Technology, PHI, Delhi
3. C. R. Alavala, Principles of Industrial Instrumentation and Control Systems, Cengage Learning

PEC 05 : Electrical machines

Detail syllabus :

Module 1: [5L]

Magnetic fields and magnetic circuits

Review of magnetic circuits - MMF, flux, reluctance, inductance; review of Ampere Law and Biot Savart Law; Visualization of magnetic fields produced by a bar magnet and a current carrying coil - through air and through a combination of iron and air; influence of highly permeable materials on the magnetic flux lines.B-H curve of magnetic materials; flux-linkage vs current characteristic of magnetic circuits; energy stored in the magnetic circuit; force as a partial derivative of stored energy with respect to position of a moving element; torque as a partial derivative of stored energy with respect to angular position of a rotating element. Examples - galvanometer coil, relay contact.

Module 2: [7L]

DC machine - motoring and generation

Armature circuit equation for motoring and generation, Types of field excitations – separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines

Module 3: [7L]

Induction Machines

Polyphase induction machine: construction, rotating magnetic field, simplified theory with constant flux, vector diagram, torque slip curve, power slip curve, effects of rotor resistance; frequency changer, equivalent circuit, circle diagram, performance calculations using circle diagram, performance test, starting, braking .

Module 4: [4L]

Single-phase induction motors

Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications

Module 5: [7L]

Transformers

Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses

Course Outcomes:

Upon completion of this course a student will be familiar with:

CO1: The basic knowledge about DC machines, study their characteristic curves and uses of DC Machines.
CO2: The basic knowledge about single phase transformer.

CO3: The different characteristic tests and thereby predicts the performance of the transformer regarding different losses, efficiency and regulation.
CO4: The construction and principle of operation of poly-phase and single phase induction machine.
CO5: The regulation using different methods.

Learning Resources:

Text Books:

1.Electrical Machinery, P.S. Bhimra, 6th Edition, Khanna Publishers

2.Electric Machinery & transformer, Irving L Kosow, Prentice Hall India

3.Electric machines, D.P. Kothari & I.J Nagrath, Tata Mc Graw-Hill PublishingCompany Limited.

Reference Books:

1. Electric Machinery & Transformers, Bhag S. Guru and H.R. Hiziroglu, Oxford University press
2. Electrical Machines, R.K. Srivastava, Cengage Learning
3. Theory of Alternating Current Machinery, Alexander S Langsdorf, Tata Mc Graw Hill
4. The performance and Design of Alternating Current Machines, M.G.Say, CBS Publishers & Distributors

PEC 06 : Digital Communication

Detail syllabus:

Module 1: [7L]
Pulse Modulation-Sampling process –PAM- other forms of pulse modulation – Bandwidth –Noise trade off –Quantization –PCM- Noise considerations in PCM Systems-TDM Digital multiplexers-Virtues, Limitation and modification of PCM-Delta modulation –Linear prediction –differential pulse code modulation – Adaptive Delta Modulation.

Module 2: [5L]
Baseband Pulse Transmission- Matched Filter- Error Rate due to noise –Inter-symbol Interference-Nyquist's criterion for Distortionless Base band Binary Transmission- Correlative level coding – Baseband and M-ary PAM transmission –Adaptive Equalization –Eye patterns.

Module 3: [8L]
Passband Data Transmission-Introduction – Pass band Transmission model- Generation, Detection, Signal space diagram, bit error probability and Power spectra of BPSK, QPSK, FSK and MSK schemes – Differential phase shift keying – Comparison of Digital modulation systems using a single carrier – Carrier and symbol synchronization.

Module 4: [5L]
Error Control Coding- Discrete memory-less channels – Linear block codes – Cyclic codes - Convolutional codes –Maximum likelihood decoding of convolutional codes-Viterbi Algorithm, Trellis coded Modulation, Turbo codes.

Module 5: [5L]

Spread Spectrum Modulation- Pseudo- noise sequences –a notion of spread spectrum – Direct sequence spread spectrum with coherent binary phase shift keying – Signal space Dimensionality and processing gain – Probability of error – Frequency hop spread spectrum – Maximum length and Gold codes.

Course Outcomes:
On successful completion of this course, the student will be familiar with:

CO 1: The basics difference between of analog and digital communication techniques.
CO 2: The basic concepts of digital modulation techniques.
CO 3: The basic concepts of digital data and pulse communication.
CO 4: How to explain and analyze different digital modulation techniques.
CO 5: How to describe different wireless area networks and their applications.

Learning Resources:

Text Books:

1. Ian A Glover and Peter M Grant, "Digital Communications", Pearson Education, Third Edition, 2010.
2. B. P. Lathi and Zhi Ding, "Modern Digital and Analog communication Systems", Oxford University Press, 4th Edition, 2010.
3. Simon Haykin, John Wiley & Sons, "Introduction to Analog and Digital Communications"- Second Edition, 2012.

Reference Books:

1. John G Proakis and MasoudSalehi, "Fundamentals of Communication Systems", 2014 Edition, Pearson Education
2. Dr. Sunil Kumar S.Manvi, Mahabaleshwar S. Kakkasageri, "Wireless and Mobile Networks Concepts and Protocols", John Wiley & sons, 2014 Edition,

PEC 07 : Process Plant Instrumentation

Detail syllabus :

Module 1: [10L]
Chemical plant instrumentation: description of ammonia, methanol, urea and nitric acid plant, Instrumentation system: shift conversion section, H_2S removal section, absorption and refrigeration section

Module 2: [10L]
Power plant instrumentation: description of a plant, major process cycle, Instrumentation scheme: combustion fuel control, air control, furnace draft control, steam temperature control, boiler drum level control; combinational panel: desk design and layout; control room layout.

Module 3: [10L]

Steel plant instrumentation: Steel processing, blast furnace instrumentation: Stock line measurements, blast temperature control, air blast moisture control, instrumentation systems of hot strip mill, cold rolling mill and steel melting shop.

Course Outcomes:
After completion of this course students will be familiar with:

CO 1. The control and instrumentation of chemical process plants
CO 2. The knowledge about the instrumentation scheme of various chemical processes
CO 3. How to describe the operation of thermal power plant
CO 4. The understanding about the role of control room
CO 5. How to describe the operation for various instrumentation schemes of steel plant

Learning Resources:
Text Books:
1. Power Plant Instrumentation and Control Handbook – S. Basu, A. Debnath, Academic Press
2. Introduction to Chemical Process Instrumentation (Process Measurement & Control) – I. Nagy, Elsevier Science

Reference Books:
1. SAIL- Instrumentation Engineering – G. K. Publisher
2. Process measurement handbook- B. G. Liptak, Chilton Book Company

PEC 08 : Non-Conventional Energy Sources

Detail syllabus :

Module 1: [4L]
Introduction to Energy Sources: Energy and environment,. conventional sources of energy, different forms of non conventional energy sources : solar, biogas, wind, tidal, geothermal etc and prospects of renewable energy sources.

Module 2: [3L]
Biomass as a Source of Energy: Basic bio-conversion mechanism, sources of waste, simple digesters, composition and calorific value of biogas, photosynthesis, Bio-gas generation, types of bio-gas plants.

Module 3: [6L]
Wind and tidal energy: generation, special characteristics, turbine parameters and optimum operation, Electric power generation from wind/tidal energy.
Ocean thermal energy conversion, Geothermal energy- hot springs and steam injection, power plant based on OTEC and geothermal springs.

Module 4: [8L]

Solar Energy: Techniques of collection, storage and utilization, types of solar collectors, selective surfaces, solar thermal processes, heating, cooling, drying, power generation etc.
Photovoltaics, amorphous semiconductors, limitation of photovoltaics efficiency. Fuel cells, peak load demands, developments in fuel cells and applications.

Module 5: [3L]
Direct energy conversion methods: Photoelectric, thermo-electric, thermionic, MHD (magneto-hydrodynamics) and electro chemical devices, photovoltaic and solar cells.

Module 6: [6L]
Fusion energy: Controlled fusion of hydrogen, helium etc. Energy release rates, present status and problems, future possibilities. Integrated energy packages using solar, biomass, wind etc. Comparative study of non-conventional energy sources, cost considerations and economics.

Course Outcomes:
After completion of this course students will be familiar with

CO1: The different non conventional sources and the power generation techniques to generate electrical
CO2: The environmental aspects of non-conventional energy resources in Comparison with various conventional energy systems, their prospects and limitations.
CO3: The use of solar energy and the various components used in the energy production with respect to daily life applications like - heating, cooling, desalination, power generation, drying, cooking etc.
CO4: The need of Wind Energy and the various components used in energy generation and know the classifications.
CO5: The concept of Biomass energy resources and their classification, types of biogas Plants-applications
CO6: Solar, Wind and bio energy systems, their prospects, advantages and limitations through acquiring the knowledge of fuel cells, wave power, tidal power and geothermal principles and applications

Learning Resources:
Text Books:
1. Non-Conventional Sources of Energy by: G.D. Rai, Khanna Publishers.
2. Bio Energy by David Boyles, Elis Horwood Ltd.,
3. Renewable energy sources and conversion technology by N.K. Bansal, M. Kleemann, M. Heliss, Tata McGraw Hill 1990.

Reference Books:
1. Direct Energy Conversion by R. A. Coombie, Pitman.
2. Bio Energy Spectrum, Bio Energy and Wasteland Development Organization by O.P Vimal and P.D. Tyagi.

PEC 09 : Sensor Technology

Detail syllabus :

Module 1: [7L]

Sensors: Classification and Characteristics
Development schemes of different types of conventional sensors with examples. Contrast between conventional and micro/nano sensors. General description of micro-sensor and nano-sensor technologies.

Module 2: [8L]

Sensor design and packaging. Techniques of crystal growing, ion-implementation, doping, etching, masking, embedding, deposition, erosion, encapsulation and packaging.

Module 3: [8L]

Techniques of metal-semiconductor "plating" for developing sensors for thermal, electrical, magnetic and mechanical parameter sensing. Thin and thick film processes

Module 4: [7L]
Single chip electro-analytic sensor technology, photonic sensors, smart sensors in microelectronic systems, Interface and data acquisition systems. Sensor modeling and design optimization.

Course Outcomes:
On successful completion of this course, the student will be familiar with:

CO1. Sensor classification
CO 2. Physical principles of the conversion of measured quantities into electric signal
CO 3. Sensor technical specifications
CO 4. Sensor manufacturing technologies
CO 5. International standards for particular sensors
CO 6. Suitable sensor for given application
CO 7. Scientific experiment with a focus on sensors and measurement science.

Learning Resources:
Text Books:
1 P. Ripka and A. Riptek (ed.), Modern Sensors Handbook, ISTE
2. Jacob Fraden, Handbook of Modern Sensors, Physics, Design and Applications, Springer
3. M. Bhuyan , Intelligent Instrumentation, principles and Practice: CRC Press

Reference Books:
1. R. Frank, Understanding smart sensors, Artech House
2. J. G. Webster (1998.), The Measurement, Instrumentation and Sensors Handbook, CRC Press
3. Liptak, B. G., editor-in-chief (2003.), Instrument Engineers Handbook, 4th edition: Process Measurement and Analysis, CRC Press

PEC 10 : Biomedical Signal Processing and Analysis

Detail syllabus :

Module 1: [5L]
Objectives and difficulties in biomedical signal processing and analysis; Details of biomedical Signals - ECG, EEG and respiration signals and their spectral properties, Signal pattern in normal and different abnormal conditions.

Module 2: [10L]
Noise and artifacts in biosignals and its effect in diagnosis; Methods for noise elimination by conventional filtering and adaptive techniques.

Module 3: [8L]
Detection of events - Time domain analysis of biosignals, Frequency domain analysis of biosignals. Basics of Fourier Transform, Wavelet Transform and their applications in biosignal processing

Module 4: [7L]
Diagnostic decision making – feature extraction, feature selection, classification techniques Introduction to analysis of non- stationary and multi-component signals

Course Outcome:

On successful completion of this course, the student will be familiar with:

CO1. How to identify and differentiate the biosignals from different sources
CO2. How to detect and remove the noises in biosignals
CO3: How to extract the events of interest from biosignals
CO4. How to develop different classification techniques for abnormal event detection
CO5. How to develop a computer based automated biosignal analysis and classification system

Learning Resources:
Text Books:
1. R. M. Rangayyan, Biomedical Signal Processing and Analysis, IEEE press

2. E. N. Bruce, Biomedical Signal Processing and Signal Modeling, Wiley (India)

Reference Books:

1. Devasahayam, Suresh R.,Signals and Systems in Biomedical Engineering: Physiological Systems Modeling and Signal Processing, Springer

2. Katarzyn J. Blinowska, Jaroslaw Zygierewicz,Practical Biomedical Signal Analysis Using MATLAB, CRC Press

PEC 11 : Advanced Control Engineering

Detail Syllabus:

Module 1: [6L]
State Space Analysis of Continuous System: Review of state variable representation of continuous system, conversion of state variable models to transfer function and vice-versa, solution of state equations and state transition matrix, controllability and observability, design of state observer and controller.

Module 2: [8L]
Optimal Control: Introduction, formation of optimal control problem, calculus of variations minimization of functions, constrained optimization. Pontryagin's Minimum Maximum Principle, Linear Quadratic Problem-Hamilton Jacobi equation, Riccati equation and its solution.

Module 3: [6L]
Adaptive Control: Introduction, modal reference adaptive control systems, controller structure, self tuning regulators, MIT rule, Lyapunov method.

Module 4: [2L]
Introduction to non linear systems: Types of non linearities, phenomena related to non –linear systems. Analysis of non linear systems-Linearization method

Module 5: [8L]
Stability analysis: Concept of phase plane, types of phase portraits, singular points, system analysis by phase-plane method, Lyapunov's stability analysis, methods for generating Lyapunov function, Popov's criterion, Describing function and its application to non linear system analysis.

Course Outcomes:

On successful completion of this course, the student will be familiar with:

CO 1. The knowledge over state space and state feedback in modern control systems, pole placement, design of state observers and output feedback controllers.
CO 2. How to solve the optimal control problems and can design a LQR.
CO 3. Practical Adaptive control problems and can solve the same.
CO 4. How to demonstrate non-linear system behavior by phase portrait.
CO 5. The stability analysis of nonlinear systems by phase plane, describing function and Lyapunov method.

Learning Resources:

Text Books:

1. Slotine & Li, Applied Non-Linear Control, Englewood Cliffs, NJ: Prentice-Hall.
2. H.K. Khalil, Nonlinear System, Pearson
3. M. Gopal, Digital Control and State Variable Methods, McGraw-Hill

Reference Books:

1. Benjamin C. Kuo, Farid Golnaraghi, Automatic Control Systems, Wiley
2. D. Roy Chowdhury: Modern Control Engineering, Prentice-Hall of India Private Limited.

Open Elective PAPERS (OEC) : 3 CREDITS : 30 Hours

OEC01 : Advanced Microprocessor, Microcontroller and Interfacing

Detail syllabus:

Module 1: [6L]
Microprocessor architectures: 80X86 configuration; Minimum and maximum mode system; addressing mode, flags, data transfer, string instruction, arithmetic and logic operations, bit manipulation, programme transfer and control operation;

Module 2: [4L]
Assembly language programming, - Modular programming; assembler, linker, libraries, macros System, bus and timing diagram; Real mode and protected mode of memory addressing,

Module 3: [2L]
Interrupt processing: hardware and software interrupt, vector table, sequence, multiple interrupt, interrupt service routine; Arithmetic coprocessor;

Module 4: [6L]
Microcontroller – MCS-51 Family : Introduction, Architecture, Memory Organization, Internal RAM structure, Special Function Registers and their functions, their orientation within the SFR space, I/O ports and their multiplexed functions, concept of bit address and the bit addressable memory space organization, Interrupts, ISR space allocation and interrupt control,

Module 5: [3L]
Timer/Counter: various modes of operations, UART for serial communication & its various modes and controls. Internal schematics of timers or serial controller.

Module 6: [3L]
Interfacing of MCS-51 with ADC, DAC, ZCD, Peak detector , Keyboard and 7-segment LEDs. Stepper motor control.

Module 7: [6L]
Interfacing of computer keyboard, LCD display, Phase control of power electronic devices to have variable ac and dc voltages, Infrared remote control encoder and decoder, interfacing of serial EPROM / flash memory, Flash programming technique of microcontroller.

Course Outcomes:

On successful completion of this course, the student will be familiar with:

CO1: The architecture**,** memory organization, interrupts, timer, counter etc for MCS-51 Family
CO2**:** The basic assembly programming techniques with MCS-51 family
CO3**:** The concept about Real mode memory addressing and Intel 8086 environment.
CO4**:** The memory Interfacing, I/O interfacing and peripheral interfacing techniques.

Learning Resources
Text Books:
1. Douglas V. Hall – Microprocessors & Interfacing, Tata McGraw-Hill
2. Mohamed Rafiquzzaman – Microprocessors and Microcomputer based system Design, PHI
3. Muhammad Ali Mazidi – The 8051 Microcontroller and embedded systems, Pearson Ed. Asia
4. Ray & Bhurchandi, Advanced Microprocessors & Peripherals, TMH
5. Predko, Programming & Customising 8051 Microcontroller, TMH
6. The 8051 microcontroller - K. Ayala (Thomson)

Reference Books:
1. John Uffenbeck – Microcomputers and Microprocessors, PHI/ Pearson Education
2. Chowdhury & Chowdhury, Microprocessor & Perpherals, Scitech
3. Thyagarajan, Microprocessor & Microcontrollers, Scitech
4. Michel Slater – Microprocessor Based Design, PHI
5. Walter A. Tribel – The 8088 and 8086 Microprocessors, PHI
6. Barry B. Brey – The Intel Microprocessors, PHI/Pearson Ed. Asia
7. Mathivanan, Microprocessors PC Hardware & Interfacing, PHI

OEC02 : Software Engineering

Detail syllabus :

Module 1: [6L]
Introduction- Notion of Software as a Product – characteristics of a good Software Product.
Engineering aspects of Software production – necessity of automation. Job responsibilities of Programmers and Software Engineers as Software developers.

Module 2: [4L]
Process Models and Program Design Techniques- Software Development Process Models – Code & Fix model, Waterfall model, Incremental model, Rapid Prototyping model, Spiral (Evolutionary) model.

Module 3: [8L]
Good Program Design Techniques – Structured Programming, Coupling and Cohesion, Abstraction and Information Hiding, Automated Programming, Defensive Programming, Redundant Programming, Aesthetics.

Module 4: [10L]
Software Modelling Tools – Data flow Diagrams, UML and XML. Jackson System Development. Verification and Validation: Testing of Software Products – Black-Box Testing and White-Box Testing, Static Analysis, Symbolic Execution and Control Flow Graphs – Cyclomatic Complexity.

Module 5: [2L]
Introduction to testing of Real-time Software Systems.

Course Outcomes:
On successful completion of this course, the student will be familiar with:

CO1: Software system, component, or process to meet desired needs within realistic constraints.
CO2: Professional and ethical responsibility
CO3: Function on multi-disciplinary teams
CO4: The use of techniques, skills, and modern engineering tools necessary for engineering practice

Learning Resources
Text Books:
1. Ian Sommerville: Software Engineering, 9th Edition, Pearson Education, 2012.
2. Jalote: An Integrated Approach to Software Engineering, Wiley India

Reference Books / Documents:
1. Roger S. Pressman: Software Engineering-A Practitioners approach, 7th Edition, Tata McGraw Hill.
2. Pankaj, The SCRUM Primer, Ver 2.0, (http://www.goodagile.com/scrumprimer/scrumprimer20.pdf)

OEC03 : Mechatronics
Detail syllabus:

Module 1: [4L]
Introduction to Mechatronics and its Systems; Evolution, Scope, Measurement Systems,

Module 2: [6L]
Control Systems, open and close loop systems, sequential controllers, microprocessor based controllers, mechatronics approach.

Module 3: [6L]
Sensors and transducers: Introduction, performance terminology-Displacement, Position and Proximity, Velocity and motion, force, Fluid Pressure-Temperature Sensors-Light Sensors-Selection of Sensors-Signal Processing.

Module 4: [8L]
Pneumatic and Hydraulic actuation systems: actuation systems, Pneumatic and hydraulic systems, directional control valves, pressure control valves, cylinders, process control valves, rotary actuators.

Mechanical actuation systems -Mechanical systems, types of motions, kinematics chains, cams, gear trains, ratchet and pawl, belt and chain drives, bearings, mechanical aspects of motor selection.

Module 5: [6L]
Robotics- Introduction, types of robots, Robotic control, Robot drive systems Robot end effectors, selection parameters of a robot, applications.

Course Outcomes:
On successful completion of this course, the student will be familiar with:

CO1: Knowledge of Mechatronics system, understand the working of Mechatronics components, signal conditioning, have knowledge of types of control systems, mathematical modeling of physical systems (Mechanical and Electrical System) and can be able to solve classical control problems.
CO2: The knowledge of architectural concepts of microprocessor and its instructions, different addressing modes and understand the interfacing concepts and be able to write programs for microprocessor.
CO3: Knowledge of Instrumentation domain on Functional Element of Instruments and can apply working principles of Measurement of Strain, Pressure, Force, Displacement, Level and Study of Various Kinds of Transducers in practical problems.
CO4: Knowledge of hydraulic and pneumatic system and its components, understand the working principle of various hydraulic and pneumatic components, apply working principles of Hydraulic and Pneumatic Systems for various applications, and be able to determine cause for hydraulic and pneumatic system break down and performance of hydraulic pumps, motors.
CO5: Knowledge of Joints, Links, Sensors, Control units, actuators, elements of Automation; can be able to describe motions and control system of Robots.

Learning Resources
Text Books:
1. W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Pearson Education Asia, 4th Edition, 2013.
2. Godfrey C. Onwubolu, Mechatronics: Principles and Applications , Elsevier (BH) Publications, India Reprint 2013.
3. Nitaigour Premchand Mahailik, Mechatronics: Principles, Concepts and applications , TMH, 2003.
4. David G. Alciatore& Michel BiHistand, Introduction to mechatronics and measurement systems, Tata McGraw Hill –2000.

Reference Books :
1. H.D. Ramachandra, Mechatronics, Sudha Publication 2003 Mechatronics by HMT Ltd. Tata

McGraw-Hill, 2000.
2. Devadas Shetty and Richard A. Kark, Mechatronics System design, Thomas Learning, 1997.
3. Robert H Bishop, Mechatronics an Introduction, CR, 2005.
4. Rolf Isermann, Mechatronics Systems Fundamentals, Springer, 2005
5. Mechatronics, Bolton, Pearson Education
6. B.C.Kuo, Automatic Control Systems, Prentice Hall.

OEC04 : Computer Organization and Architecture:
Detail syllabus :

Module 1: [8L]
Introduction to basic computer architecture, register transfer, bus and memory transfers, arithmetic, logic and shift micro operations. Instruction codes, computer registers, computer instructions, timing and control, instruction cycle, memory reference instructions, I/O interrupt, complete computer description, design of basic computer, design of accumulator logic.

Module 2: [2L]
Micro programmed control, control memory, address sequencing, micro program example, design of control unit.

Module 3: [4L]
Central Processing Unit: Introduction, general register organization, stack organization, instruction formats, addressing modes, data transfer and manipulation, program control, RISC.

Module 4: [8L]
Pipeline and Vector Processing: Parallel processing, pipelining, arithmetic pipeline, instruction pipeline, RISC pipeline, vector processing, array processors.
Input-output Organisation: Peripheral devices, input-output interface, asynchronous data transfer, modes of transfer, priority interrupt, DMA, IOP serial communication.

Module 5: [8L]
Memory Organisation: Memory hierarchy, main memory, auxillary memory, associative memory, cache memory, virtual memory, memory management, hardware multiprocessor architectures and their characteristics, interconnection structures, inter processor arbitration, inter-processor communication and synchronization, cache coherence.

Course outcomes:
On successful completion of this course, the student will be familiar with:

CO1: The basic organization of a computer system.
CO2: Functioning of different sub systems, such as processor, Input/output, and memory.
CO3: Simple programming constructs and programs using assembly language.
CO4: Hardwired control and micro programmed control. pipelining, embedded and other computing systems.
CO5: How to build simple arithmetic and logical units.
CO6: The advances in microelectronics and their implication on computer design.

Learning Resources
Text Books:
1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky: Computer Organization, 5th Edition, Tata McGraw Hill, 2002.
2. William Stallings: Computer Organization & Architecture, 9th Edition, Pearson, 2015.
3. M. Morris Mano: Computer System Architecture, Pearson Education

Reference Books :
4. Tanenbaum : Structured Computer Organization, Pearson; 6th Edition
5. Hayes : Computer Architecture and Organization, McGraw Hill Education; 3rd Edition

OEC05 : Database Management Systems

Detail syllabus :

Module 1: [4L]
Introduction - Database Systems versus File Systems, View of Data, Data Models, database languages, Database Users and Administrators.

Module 2: [5L]
Transaction Management, Decision Support Systems, Components of a Database management System. Distributed Processing and Client- Server Architecture.

Module 3: [5L]
Entity-Relationship Model – Basic Concepts, Constraints, Keys, Design Issues, E-R Diagrams. Relational Model- Structures of relational databases, Integrity Constraints, Logical database Design, Tables, Views,

Module 4: [5L]
Data Dictionary. Relational Algebra, Relational Calculus. SQL – Basic Structures, Query Handling, Embedded SQL, Open Database Connectivity (ODBC), Java Database Connectivity (JDBC), Triggers, Security and Authorization. Query By Example (QBE),

Module 5: [5L]
User Interfaces and Tools, Forms and Graphical User Interfaces. Report Generators. Overview of Relational Query Optimization.

Module 6: [6L]
Relational Database Design- Functional Dependencies, Multi-valued Dependencies, Normal Forms, Decomposition into Normalized Relations, Physical Database Design – File Structures. Object-Relational Databases – Nested Relations, Complex Data types, Object-Relational Features in SQL:1999.

Course outcomes:
On successful completion of this course, the student will be familiar with:

CO1: The concepts of database objects; enforce integrity constraints on a database using RDBMS.
CO2: The use of Structured Query Language (SQL) for database manipulation.
CO3: How to design simple database systems
CO4: How to design code for some application to interact with databases.

Learning Resources
Text Books:
1. Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.
2. Database management systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill,

Reference Books:
1. Silberschatz Korth and Sudharshan, Database System Concepts, 6th Edition, McGrawHill, 2013.
2. Coronel, Morris, and Rob, Database Principles Fundamentals of Design, Implementation and Management, Cengage Learning 2012.

OEC06 : Power Electronics and Drives

Detail syllabus :

Module 1: [4L]
Power Semiconductor Devices: Diodes, Power BJT, Power MOSFET. The thyristor family: SCR, triac, gate turn-off thyristor (GTO), Insulated gate bipolar transistor (IGBT); basic structure, firing circuit, commutation techniques, basic characteristics, turn-on and turn-off characteristics, paralleling of devices, protective circuits, heat sinks.

Module 2: [3L]
Converters: Single Phase Uncontrolled and Controlled Rectification, Half wave Converter and Full wave Converter and half Controlled Converter: with Load.

Module 3: [3L]
Inverters : Single Phase Series Inverter, Parallel Inverter, Single-phase H- bridge inverter circuits with R, RL Load. Inverter Control: Hysteresis Control, Different PWM Control techniques, Analysis of Inverter Performance.

Module 4: [3L]
Chopper Circuits: Step up and Step down, Step up/down Chopper. Chopper performance analysis, Classes of chopper for different applications.

Module 5: [5L]
Introduction of Electrical drives: Dynamics of electrical drives, closed loop control, selection of motor power ratings. Different components of drive: speed measurement, torque measurement, current measurement, phase locked loop, ZCD etc.

Module 6: [4L]
DC motor drive: DC motor characteristics, braking, speed control methods of DC motor. Contactor based DC motor speed control, Controlled rectifier based DC motor drive, Chopper fed Dc Drive, PLC based DC Drive.

Module 7: [4L]
Induction Motor Drive: Induction motor characteristics, NEMA classification, Braking, Different methods of speed control: voltage control, frequency control, Variable Voltage variable frequency Control, rotor resistance control, slip power recovery control.

Module 8: [4L]
Traction Drive: General overview of traction and Indian traction services, Different drives for different electrical motors and their different operating modes: Electrical traction service, nature of traction load, braking, Applications of electric drive in Industry.

Course outcomes:
On successful completion of this course, the student will be familiar with:

CO 1. The construction, characteristics of thyristor family and understand the basic principle of operation of SCR.
CO 2. The operation of various triggering circuits for series and parallel operation of SCR's and various protection circuits of thyristors.
CO 3. The analysis and design inverter and converter circuit.
CO 4. How to examine different applications of power converters.
CO 5. How to select type of drive for AC and DC motor
CO 6. How to derive dynamic model of ac motor, compare scalar and vector control of induction motor

Learning Resources
Text Books:
1.M.H. Rashid, Power Electronics, PHI/ Pearson Education
2.C.W. Lander, Power Electronics, McGraw Hill
3.Power Electronics, M.D. Singh and K.B. Khanchandani, Tata Mc Graw Hill. 2007

Reference Books:
1.P.C. Sen, Power Electronics
2.B.K.Bose, Modern Power Electronics, JAICO
3.Mohan, N Undeland, TM & Robbins, WP- Power Electronics, John Wiley & Sons
4.P. S. Bimbhra – Power Electronics, Khanna Publishers
5.Power Electronics, V.R. Moorthi, Oxford
6.Element of power Electronics, Phillip T Krein, Oxford
7.Power Electronics systems, J.P. Agarwal, Pearson Education

OEC07 : Introduction to Robotics

Detail syllabus :

Module 1: [2L]
Introduction, components and structure of robotics system.

Module 2: [2L]
Kinematics of manipulators, rotation translation and transformotion, David – Hastemberg Representation,

Module 3: [10L]
Inverse Kinematics. Dyamics – modelling using Newton Euler equation. Linearization of Robot Dynamics – State variable continuous and discrete models.

Module 4: [8L]
Robotic Motion: Different types of trajectories and introduction to their generation.

Module 5: [8L]
Position Control: Independent joint control. Introduction to advanced control for robot application.

Course outcomes:
On successful completion of this course, the student will be familiar with:

CO 1. The basic components of robot system and its functionality
CO 2. The representation of robot and homogenous transformation for various arm configurations.
CO 3. The functions of sensors in the robot.
CO 4. How to solve forward and inverse kinematic problems.
CO 5. How to evaluate and compare the use Robots in different applications.
CO 6. How to recognize material-handling applications, processing operations, assembly and inspection operations to increase product quality and uniformity in minimize cycle times and effort.

Learning Resources
Text Books:
1. Mikell P. Groover, Mitchel Weiss, Roger N. Nagel, Nicholas G. Odrey and AshishDutta, "Industrial Robotics: Technology, Programming and Applications", 2nd Edition, Tata McGraw Hill, 2012.
2. SrinivasMedida, Pocket Guide on Industrial Automation: For Engineers and Technicians, 1st Edition, IDC Technologies, 2007.

Reference Books:
1. Roland Siegwart, Illah R. Nourbakhsh, and Davide Scaramuzza, "Introduction to Autonomous Mobile Robots", 2nd Edition, PHI, 2011.
2. Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998.
3. Asfahl C.R., Robots and manufacturing Automation, John Wiley, USA 1992.

OEC08 : Computer Networks

Detail syllabus :

Module 1: [4L]
Introduction- Goals and applications of Networks, Network structure and architecture, The OSI reference model, services, Network Topology, Design-Delay Analysis, Back Bone Design,

Module 2: [4L]
Local Access Network Design. Physical Layer Transmission Media, Switching methods, ISDN, Terminal Handling. Medium Access Control sub layer: Medium Access sub layer: Channel Allocation,

Module 3: [6L]
LAN protocols-ALOHA protocols-Overview of IEEE standards – FDDI, Data Link Layer –Elementary data Link Protocols, Sliding Window protocols,

Module 4: [6L]
Error Handling. Network Layer: Network Layer – Point – to Point Networks, routing, Congestion control, Internetworking – TCP /IP –IP packet, IP address, IP v6.

Module 5: [10L]
Transport Layer: Transport Layer – Design issues, connection management, session Layer – Design issues, remote procedure call, Presentation Layer – Design issues, data compression techniques, cryptography – TCP Window Management. Application Layer: Application Layer-File Transfer, Access and Management, Electronic mail, Virtual Terminals, Other application, Example Networks – Internet and Public Networks.

Course outcomes:
On successful completion of this course, the student will be familiar with:

CO1. The OSI Reference Model and in particular have a good knowledge of Layers 1-3.
CO2. The requirements for a given organizational structure and select the most appropriate networking architecture and technologies;
CO3. The basic knowledge of the use of cryptography and network security;
CO4. How to specify and identify deficiencies in existing protocols, and then go onto formulate new and better protocols;
CO5. Understanding of the issues surrounding Mobile and Wireless Networks.
CO6. Working knowledge of datagram and internet socket programming

Learning Resources
Text Books:
1. Computer Networks - Andrew S. Tanenbaum, Pearson Education
2. Data & Computer Communications - William Stallings, Pearson

Reference Books:

1. Computer networks and internets – D. Comer, Pearson
2. Cryptography and Network Security: Principles and Practice - Prentice hall

OEC09 : Data Structure & Algorithms

Detail syllabus :

Module 1: [2L]
Overview of C language Time and Space analysis of Algorithms - Order Notations.

Module 2: [4L]
Linear Data Structures - Sequential representations - Arrays and Lists, Stacks, Queues and Dequeues, strings, Application.

Module 3: [4L]
Linear Data Structures, Link Representation - Linear linked lists, circularly linked lists. Doubly linked lists, application.

Module 4: [4L]
Recursion - Design of recursive algorithms, Tail Recursion, When not to use recursion, Removal of recursion.

Module 5: [11L]
Non-linear Data Structure: Trees - Binary Trees, Traversals and Threads, Binary Search Trees, Insertion and Deletion algorithms, Height-balanced and weight-balanced trees, B-trees, B+ -trees, Application of trees; Graphs - Representations, Breadth-first and Depth-first Search.
Hashing - Hashing Functions, collision Resolution Techniques.

Module 6: [5L]
Radix Sort. File Structures - Sequential and Direct Access. Relative Files, Indexed Files - B+ tree as index. Multi-indexed Files, Inverted Files, Hashed Files.

Course outcomes:
On successful completion of this course, the student will be familiar with:

CO 1. How to choose appropriate data structure as applied to specified problem definition.
CO 2. How to handle operations like searching, insertion, deletion, traversing mechanism etc. on various data structures.
CO 3. How to apply concepts learned in various domains like DBMS, compiler construction etc.
CO 4. How to use linear and non-linear data structures like stacks, queues, linked list etc.

Learning Resources
Text Books:

1. Data Structures and Algorithms – O.G. Kakde & U.A. Deshpandey, ISTE/EXCEL BOOKS
2. Aho Alfred V., Hopperoft John E., UIlman Jeffrey D., "Data Structures and Algorithms", Addison Wesley
3. Drozdek- Data Structures and Algorithms,Vikas

Reference Books :

1.Heileman:data structure algorithims &Oop Tata McGraw Hill
2. Data Structures Using C – M.Radhakrishnan and V.Srinivasan, ISTE/EXCEL BOOKS
3. Weiss Mark Allen, "Algorithms, Data Structures, and Problem Solving with C++", Addison Wesley.
4. Horowitz Ellis & Sartaj Sahni, "Fundamentals of Data Structures", Galgotria Pub.
5. Tanenbaum A. S. , "Data Structures using 'C' "
6. Ajay Agarwal: Data structure Through C. Cybertech

OEC10 : Object Oriented Programming

Detail syllabus :

Module 1: [2L]
Evolution of Programming methodologies, Introduction to OOP and its basic features, Basic components of a C++, Program and program structure, Compiling and Executing C++ Program. Selection control statements in C++.

Module 2: [2L]
Data types, Expression and control statements Iteration statements in C++, Introduction to Arrays, Multidimensional Arrays, Strings and String related Library Functions.

Module 3: [2L]
Functions, Passing Data to Functions, Scope and Visibility of variables in Functions, Structures in C++.

Module 4: [2L]
Creating classes and Abstraction: Classes objects, data members, member functions, this Pointer, Friends, Friend Functions, Friend Classes, Friend Scope, and Static Functions.

Module 5: [2L]
Constructors and Destructors, Static variables and Functions in class.

Module 6: [2L]
Operator Overloading in C++, Overloading Unary Operators, Overloading binary operators.

Module 7: [2L]
Inheritance in C++, Types of Inheritance, Pointers, Objects and Pointers, Multiple Inheritance.

Module 8: [2L]
Virtual Functions, Polymorphism, Abstract classes.

Module 9: [2L]

Files and streams in C++: Character and String input and output to files, Command Line Arguments and Printer Output.

Module 10: [2L]
Standard input and output operations: C++ iostream hierarchy, Standard Input/output Stream Library, Organization Elements of the iostream Library, Programming using Streams, Basic Stream Concepts.

Module 11: [2L]
File input and output: Reading a File, Managing I/O Streams, Opening a File – Different Methods, Checking for Failure with File Commands, Checking the I/O Status Flags, Dealing with Binary Files, Useful Functions.

Module 12: [3L]
Class templates: Implementing a class template, Implementing class template member functions, Using a class template, Function templates, Implementing function templates, Using template functions, Template instantiation, Class template specialization, Template class partial specialization, Template function specialization, Template parameters, Static members and variables, Templates and friends, Templates and multiple-file projects.

Module 13: [2L]
Standard Template library: Containers, iterators and application of container classes.

Module 14: [3L]
Exception handling: Throwing an exception, catching an exception: The try block, Exception handlers, Termination vs. Resumption, Exception specification, rethrowing an exception, uncaught exceptions, Standard exceptions, Programming with exceptions.

Course outcomes:
On successful completion of this course, the student will be familiar with:

CO1: Classes, objects, members of a class and relationships among them needed for a specific problem
CO 2: How to demonstrate the concepts of polymorphism and inheritance
CO 3: The difference between object oriented programming and procedural oriented language and data types in C++.
CO 4: Program using C++ features such as composition of objects, Operator overloading, inheritance, Polymorphism etc.
CO 5: How to simulate the problem in the subjects like Operating system, Computer networks and real world problems.

Learning Resources
Text Books:
1. Schildt, H., The Complete Reference C++, McGraw – Hill.
2. Debasish Jana, C++ object oriented programming paradigm, PHI
3. Rambaugh, James Michael, Blaha – "Object Oriented Modelling and Design" – Prentice Hall, India

Reference Books :

1. Ali Bahrami – "Object Oriented System Development" – Mc Graw Hill
2. Programming In C++, Y.I. Shah and M.H. Thaker, ISTE/EXCEL BOOKS
3. Rajaram: Object Oriented Programming and C++, New Age International
4. Pooley, R and P. Stevens, Using UML , Addison-Wesley.

OEC 11: Data Analytics

Detailed Syllabus

Module 1: [4L]
Data Definitions and Analysis Techniques Elements

Variables, and Data categorization, Levels of Measurement, Data management and indexing, Introduction to statistical learning and R-Programming

Module 2: [6L]
Descriptive Statistics

Measures of central tendency, Measures of location of dispersions, Practice and analysis with R

Module 3: [8L]
Basic analysis techniques

Statistical hypothesis generation and testing, Chi-Square test, t-Test, Analysis of variance, Correlation analysis, Maximum likelihood test, Practice and analysis with R

Module 4: [6L]
Data analysis techniques

Regression analysis, Classification techniques, Clustering, Association rules analysis, Practice and analysis with R

Module 5: [6L]
Case studies and projects

Feature engineering and visualization, Scalable and parallel computing with Hadoop and Map-Reduce, Sensitivity Analysis

Course outcomes:
On successful completion of this course, the student will be familiar with:

CO1: The meaningful patterns in data
CO2: Graphical interpretation of data
CO3: Implementation of the analytic algorithms
CO4: Handling large scale analytics projects from various domains
CO5: Development of intelligent decision support systems

Learning Resources

Text Books:

1. Probability & Statistics for Engineers & Scientists (9th Edn.), Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Prentice Hall Inc.
2. The Elements of Statistical Learning, Data Mining, Inference, and Prediction (2nd Edn.), Trevor Hastie Robert Tibshirani, Jerome Friedman, Springer, 2014
3. An Introduction to Statistical Learning: with Applications in R, G. James, D. Witten, T Hastie, and R. Tibshirani, Springer, 2013

Reference Books :

1. Software for Data Analysis: Programming with R (Statistics and Computing), John M. Chambers, Springer, 2012
2. Mining Massive Data Sets, A. Rajaraman and J. Ullman, Cambridge University Press, 2012.
3. Advances in Complex Data Modeling and Computational Methods in Statistics, Anna Maria Paganoni and Piercesare Secchi, Springer, 2013