



Applied Electronics & Instrumentation Engineering Department

CURRICULAR STRUCTURE & SYLLABUS FOR B.TECH PROGRAMME

1st Year 1st Semester Syllabus:

| Theory | | | | | | | |
|---------------------|-------------|------------------------------|----------------------|----------|----------|-----------|---------------|
| Sl. No | Course Code | Course Name | Contact Hrs per Week | | | | Credit Points |
| | | | L | T | P | Total | |
| 1 | HMTS1101 | Business English | 2 | - | - | 2 | 2 |
| 2 | CHEM1001 | Chemistry I | 3 | 1 | - | 4 | 4 |
| 3 | MATH1101 | Mathematics I | 3 | 1 | - | 4 | 4 |
| 4 | ELEC1001 | Basic Electrical Engineering | 3 | 1 | - | 4 | 4 |
| 5 | MECH1101 | Engineering Mechanics | 3 | 1 | - | 4 | 4 |
| Total Theory | | | 14 | 4 | - | 18 | 18 |

| Laboratory | | | | | | | |
|-------------------------|-------------|----------------------------------|----------------------|----------|-----------|-----------|---------------|
| Sl. No | Course Code | Course Name | Contact Hrs per Week | | | | Credit Points |
| | | | L | T | P | Total | |
| 1 | CHEM1011 | Chemistry I Lab | - | - | 3 | 3 | 2 |
| 2 | ELEC1011 | Basic Electrical Engineering Lab | - | - | 3 | 3 | 2 |
| 3 | MECH1012 | Engineering Drawing | 1 | - | 3 | 4 | 3 |
| 4 | HMTS1111 | Language Practice Lab (Level 1) | - | - | 2 | 2 | 1 |
| Total Laboratory | | | 1 | - | 11 | 12 | 8 |

| Sessional | | | | | | | |
|--------------------------|-------------|--------------------------|----------------------|----------|-----------|-----------|---------------|
| Sl. No | Course Code | Course Name | Contact Hrs per Week | | | | Credit Points |
| | | | L | T | P | Total | |
| 1 | HMTS1121 | Co-curricular Activities | - | - | 2 | 2 | 1 |
| Total Sessional | | | - | - | 2 | 2 | 1 |
| Total of Semester | | | 15 | 4 | 13 | 32 | 27 |

1st Year 2nd Semester Syllabus:

| Theory | | | | | | | |
|---------------------|-------------|------------------------------------------------|----------------------|----------|----------|-----------|---------------|
| Sl. No | Course Code | Course Name | Contact Hrs per Week | | | | Credit Points |
| | | | L | T | P | Total | |
| 1 | CSEN1201 | Introduction to Computing | 3 | 1 | - | 4 | 4 |
| 2 | PHYS1001 | Physics I | 3 | 1 | - | 4 | 4 |
| 3 | MATH1201 | Mathematics II | 3 | 1 | - | 4 | 4 |
| 4 | ECEN1001 | Basic Electronics Engineering | 3 | 1 | - | 4 | 4 |
| 5 | MECH1201 | Engineering Thermodynamics and Fluid Mechanics | 3 | 1 | - | 4 | 4 |
| Total Theory | | | 15 | 5 | - | 20 | 20 |

| Laboratory | | | | | | | |
|--------------------------|-------------|-----------------------------------|----------------------|----------|-----------|-----------|---------------|
| Sl. No | Course Code | Course Name | Contact Hrs per Week | | | | Credit Points |
| | | | L | T | P | Total | |
| 1 | CSEN1211 | Introduction to Computing Lab | - | - | 3 | 3 | 2 |
| 2 | PHYS1011 | Physics I Lab | - | - | 3 | 3 | 2 |
| 3 | ECEN1011 | Basic Electronics Engineering Lab | - | - | 3 | 3 | 2 |
| 4 | MECH1011 | Workshop Practice | 1 | - | 3 | 4 | 3 |
| Total Laboratory | | | 1 | - | 12 | 13 | 9 |
| Total of Semester | | | 16 | 5 | 12 | 33 | 29 |

2nd Year 1st Semester Syllabus:

| Theory | | | | | | | |
|---------------------|-------------|--------------------------------------|----------------------|----------|----------|-----------|---------------|
| Sl. No | Course Code | Course Name | Contact Hrs per Week | | | | Credit Points |
| | | | L | T | P | Total | |
| 1 | HMTS2001 | Human Values and Professional Ethics | 2 | - | - | 2 | 2 |
| 2 | MATH2001 | Mathematical Methods | 3 | 1 | - | 4 | 4 |
| 3 | MATH2002 | Numerical and Statistical Methods | 3 | - | - | 3 | 3 |
| 4 | CSEN2001 | Data Structure and Basic Algorithms | 3 | 1 | - | 4 | 4 |
| 5 | AEIE2101 | Analog Electronics | 3 | 1 | - | 4 | 4 |
| 6 | AEIE2102 | Circuit Theory and Networks | 3 | 1 | - | 4 | 4 |
| Total Theory | | | 17 | 4 | - | 21 | 21 |

| Laboratory | | | | | | | |
|--------------------------|-------------|-----------------------------------------|----------------------|----------|-----------|-----------|---------------|
| Sl. No | Course Code | Course Name | Contact Hrs per Week | | | | Credit Points |
| | | | L | T | P | Total | |
| 1 | MATH2012 | Numerical and Statistical Methods Lab | - | - | 2 | 2 | 1 |
| 2 | CSEN2011 | Data Structure and Basic Algorithms Lab | - | - | 3 | 3 | 2 |
| 3 | AEIE2111 | Analog Electronics Lab | - | - | 3 | 3 | 2 |
| 4 | AEIE2112 | Circuits and Networks Lab | - | - | 3 | 3 | 2 |
| Total Laboratory | | | - | - | 11 | 11 | 7 |
| Total of Semester | | | 17 | 4 | 11 | 32 | 28 |

2nd Year 2nd Semester Syllabus:

| Theory | | | | | | | |
|---------------------|-------------|---------------------------------------------|----------------------|----------|----------|-----------|---------------|
| Sl. No | Course Code | Course Name | Contact Hrs per Week | | | | Credit Points |
| | | | L | T | P | Total | |
| 1 | HMTS2002 | Indian Culture and Heritage | 2 | - | - | 2 | 1 |
| 2 | CHEM2001 | Basic Environmental Engineering and Ecology | 3 | - | - | 3 | 3 |
| 3 | PHYS2001 | Physics II | 3 | 1 | - | 4 | 4 |
| 4 | AEIE2201 | Digital Electronic Circuits | 3 | 1 | - | 4 | 4 |
| 5 | AEIE2202 | Sensors and Transducers | 3 | 1 | - | 4 | 4 |
| 6 | AEIE2203 | Electrical Measurement and Instruments | 3 | 1 | - | 4 | 4 |
| Total Theory | | | 17 | 4 | - | 21 | 20 |

| Laboratory | | | | | | | |
|--------------------------|-------------|---------------------------------|----------------------|----------|-----------|-----------|---------------|
| Sl. No | Course Code | Course Name | Contact Hrs per Week | | | | Credit Points |
| | | | L | T | P | Total | |
| 1 | HMTS2011 | Language Practice Lab (Level 2) | - | - | 3 | 3 | 2 |
| 2 | PHYS2011 | Physics II Lab | - | - | 3 | 3 | 2 |
| 3 | AEIE2211 | Digital Electronic Circuits Lab | - | - | 3 | 3 | 2 |
| 4 | AEIE2212 | Electrical Measurement Lab | - | - | 3 | 3 | 2 |
| Total Laboratory | | | - | - | 12 | 12 | 8 |
| Total of Semester | | | 17 | 4 | 12 | 33 | 28 |

3rd Year 1st Semester Syllabus:

| Theory | | | | | | | |
|---------------------|--------------------|-----------------------------------------------|-----------------------------|----------|----------|--------------|----------------------|
| Sl. No | Course Code | Course Name | Contact Hrs per Week | | | | Credit Points |
| | | | L | T | P | Total | |
| 1 | HMTS3101 | Economics for Engineers | 3 | - | - | 3 | 3 |
| 2 | AEIE3101 | Communication Techniques | 3 | 1 | - | 4 | 4 |
| 3 | AEIE3102 | Microprocessor- Architecture and Applications | 3 | 1 | - | 4 | 4 |
| 4 | AEIE3103 | Industrial Instrumentation | 3 | 1 | - | 4 | 4 |
| 5 | AEIE3104 | Control Systems | 3 | 1 | - | 4 | 4 |
| Total Theory | | | 15 | 4 | - | 19 | 19 |

| Laboratory | | | | | | | |
|--------------------------|--------------------|--------------------------------|-----------------------------|----------|-----------|--------------|----------------------|
| Sl. No | Course Code | Course Name | Contact Hrs per Week | | | | Credit Points |
| | | | L | T | P | Total | |
| 1 | AEIE3111 | Sensors and Transducers Lab | - | - | 3 | 3 | 2 |
| 2 | AEIE3112 | Microprocessor Lab | - | - | 3 | 3 | 2 |
| 3 | AEIE3113 | Industrial Instrumentation Lab | - | - | 3 | 3 | 2 |
| 4 | AEIE3114 | Control Engineering Lab | - | - | 3 | 3 | 2 |
| Total Laboratory | | | - | - | 12 | 12 | 8 |
| Total of Semester | | | 15 | 4 | 12 | 31 | 27 |

3rd Year 2nd Semester Syllabus:

| Theory | | | | | | | |
|---------------------|------------------------------------|----------------------------------------------------------------------------------------------------------|----------------------|----------|----------|-----------|---------------|
| Sl. No | Course Code | Course Name | Contact Hrs per Week | | | | Credit Points |
| | | | L | T | P | Total | |
| 1 | HMTS3201 | Principles of Management | 2 | - | - | 2 | 2 |
| 2 | AEIE3201 | Process Control | 3 | 1 | - | 4 | 4 |
| 3 | AEIE3202 | Electronic Instrumentation and Measurement | 3 | 1 | - | 4 | 4 |
| 4 | AEIE3203 | Advanced Microprocessors and Microcontrollers | 3 | 1 | - | 4 | 4 |
| 5 | AEIE3231/ AEIE3232/ AEIE3233 | Fundamentals of Digital Signal Processing/ Mobile Communication/ Opto Electronics and Fibre Optics | 3 | - | - | 3 | 3 |
| 6 | AEIE3241/ AEIE3242/ AEIE3243 | Biomedical Instrumentation/ Advanced Sensors/ Non Conventional Energy Sources | 3 | - | - | 3 | 3 |
| Total Theory | | | 17 | 3 | - | 20 | 20 |

| Laboratory | | | | | | | |
|-------------------------|-------------|---------------------------------------------------|----------------------|----------|----------|----------|---------------|
| Sl. No | Course Code | Course Name | Contact Hrs per Week | | | | Credit Points |
| | | | L | T | P | Total | |
| 1 | AEIE3211 | Process Control Lab | - | - | 3 | 3 | 2 |
| 2 | AEIE3212 | Electronic Instrumentation and Measurement Lab | - | - | 3 | 3 | 2 |
| 3 | AEIE3213 | Advanced Microprocessors and Microcontrollers Lab | - | - | 3 | 3 | 2 |
| Total Laboratory | | | - | - | 9 | 9 | 6 |

| Sessional | | | | | | | |
|--------------------------|-------------|-------------------------|----------------------|----------|-----------|-----------|---------------|
| Sl. No | Course Code | Course Name | Contact Hrs per Week | | | | Credit Points |
| | | | L | T | P | Total | |
| 1 | HMTS3221 | Personality Development | 1 | - | - | 1 | 1 |
| 2 | AEIE3221 | Technical Seminar I | - | - | 3 | 3 | 2 |
| Total Sessional | | | - | - | 3 | 4 | 3 |
| Total of Semester | | | 18 | 3 | 12 | 33 | 29 |

4th Year 1st Semester Syllabus:

| Theory | | | | | | | |
|---------------------|-------------------------------------------------|-------------------------------------------------------------------------------------------|----------------------|----------|----------|-----------|---------------|
| Sl. No | Course Code | Course Name | Contact Hrs per Week | | | | Credit Points |
| | | | L | T | P | Total | |
| 1 | AEIE4101 | Telemetry & Remote Control | 3 | 1 | - | 4 | 4 |
| 2 | AEIE4102 | Power Electronics and Drives | 3 | 1 | - | 4 | 4 |
| 3 | AEIE4141/ AEIE4142/ AEIE4143 | Advanced Process Control/ Soft Computing/ Power plant Instrumentation | 3 | - | - | 3 | 3 |
| 4 | BIOT4181/ CSEN4182/ ECEN4181/ MATH4182 | Biosensors/ Big Data and Web Technology/ VLSI Design Automation/ Linear Algebra/ | 3 | - | - | 3 | 3 |
| Total Theory | | | 12 | 2 | - | 14 | 14 |

| Laboratory | | | | | | | |
|-------------------------|-------------|----------------------------------|----------------------|----------|----------|----------|---------------|
| Sl. No | Course Code | Course Name | Contact Hrs per Week | | | | Credit Points |
| | | | L | T | P | Total | |
| 1 | AEIE4111 | Telemetry & Remote Control Lab | - | - | 3 | 3 | 2 |
| 2 | AEIE4112 | Power Electronics and Drives Lab | - | - | 3 | 3 | 2 |
| Total Laboratory | | | - | - | 6 | 6 | 4 |

| Sessional | | | | | | | |
|--------------------------|-------------|--------------------------------|-----------------------------------------------------------------|----------|-----------|-----------|---------------|
| Sl. No | Course Code | Course Name | Contact Hrs per Week | | | | Credit Points |
| | | | L | T | P | Total | |
| 1 | HMTS4121 | Professional Development | - | - | 3 | 3 | 2 |
| 2 | AEIE4131 | Industrial Training Evaluation | 4 Weeks during 6 th – 7 th Semester Break | | | | 2 |
| 3 | AEIE4191 | Project I | - | - | 6 | 6 | 4 |
| Total Sessional | | | - | - | 9 | 9 | 8 |
| Total of Semester | | | 12 | 2 | 15 | 29 | 26 |

**** Free Elective Papers offered by Dept. of AEIE**

| Theory | | | | | | | |
|--------|-------------|----------------------------------|----------------------|---|---|-------|---------------|
| Sl. No | Course Code | Course Name | Contact Hrs per Week | | | | Credit Points |
| | | | L | T | P | Total | |
| 1 | AEIE4181 | Instrumentation and Telemetry | 3 | 0 | 0 | 3 | 3 |
| 2 | AEIE4182 | Introduction to Embedded Systems | 3 | 0 | 0 | 3 | 3 |

4th Year 2nd Semester Syllabus:

| Theory | | | | | | | |
|---------------------|------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------|----------|----------|---------------|
| Sl. No | Course Code | Course Name | Contact Hrs per Week | | | | Credit Points |
| | | | L | T | P | Total | |
| 1 | HMTS4201 | Organizational Behaviour | 2 | - | - | 2 | 2 |
| 2 | AEIE4241/ AEIE4242/ AEIE4243 | Analytical Instrumentation/ Ultrasonic Instrumentation/ Digital Control Systems | 3 | 1 | - | 4 | 4 |
| 3 | BIOT4281/ CSEN4281/ ECEN4281/ INFO4281/ MATH4282 | Computational Biology/ Fundamentals of RDBMS / Cellular and Satellite Communications/ Fundamentals of Cryptography/ Advanced Computational Mathematics and Graph Theory | 3 | - | - | 3 | 3 |
| Total Theory | | | 8 | 1 | - | 9 | 9 |

| Sessional | | | | | | | |
|--------------------------|-------------|-------------------------|----------------------|----------|-----------|-----------|---------------|
| Sl. No | Course Code | Course Name | Contact Hrs per Week | | | | Credit Points |
| | | | L | T | P | Total | |
| 1 | AEIE4231 | Comprehensive Viva Voce | - | - | - | - | 3 |
| 2 | AEIE4232 | Technical Seminar II | - | - | 3 | 3 | 2 |
| 3 | AEIE4291 | Project II | - | - | 12 | 12 | 8 |
| Total Sessional | | | - | - | 15 | 15 | 13 |
| Total of Semester | | | 8 | 1 | 15 | 24 | 22 |

**** Free Elective Papers offered by Dept. of AEIE**

| Theory | | | | | | | |
|--------|-------------|----------------------------------|----------------------|---|---|-------|---------------|
| Sl. No | Course Code | Course Name | Contact Hrs per Week | | | | Credit Points |
| | | | L | T | P | Total | |
| 1 | AEIE4281 | Sensor Technology | 3 | - | - | 3 | 3 |
| 2 | AEIE4282 | Control Systems and Applications | 3 | - | - | 3 | 3 |

| | | | | | |
|---------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Business English | | | | | |
| Course Code: HMTS1101 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 2 | - | - | 2 | 2 |

Module I – [5L]

Communication Skill
 Definition, nature & attributes of Communication
 Process of Communication
 Models or Theories of Communication
 Types of Communication
 Levels or Channels of Communication
 Barriers to Communication

Module II-[12L]

Business Communication- Scope & Importance
 Writing Formal Business Letters
 Writing Reports
 Organizational Communication: Agenda & minutes of a meeting, notice, memo, circular
 Project Proposal
 Technical Report Writing
 Organizing e-mail messages
 E-mail etiquette
 Tips for e-mail effectiveness

Module III-[10L]

Language through Literature
 Modes of literary & non-literary expression
 Introduction to Fiction, (An Astrologer's Day by R.K. Narayan and Monkey's Paw by W.W. Jacobs), Drama (The Two Executioners by Fernando Arrabal) or (Lithuania by Rupert Brooke) & Poetry (Night of the Scorpion by Nissim Ezekiel and Palanquin Bearers by Sarojini Naidu)

Module IV-[3L]

Grammar in usage (nouns, verbs, adjectives, adverbs, tense, prepositions, voice change) -to be dealt with the help of the given texts.

References

1. Armand Matterlart and Michele Matterlart, Theories of Communication: A Short Introduction, Sage Publications Ltd., 1998.
2. Chan, Janis Fisher, and Diane Lutovich. Professional Writing Skills. San Anselmo, CA: Advanced Communication Designs, 1997.
3. Geffner, Andrew P. Business English. Hauppauge, New York: Barron's Educational Series, 1998.
4. Good, Edward C. Mightier Than the Sword. Charlottesville: Word Stone Publications, 1989.
5. Edward P. Bailey, Writing and Speaking at Work: A Practical Guide for Business Communication, Prentice-Hall, 7th edn, 2004.
6. Kitty O. Locker, Business and Administrative Communication, McGraw-Hill/ Irwin, 7th edn, 2004.
7. Lillian Chaney and Jeanette Martin, Intercultural Business Communication, Prentice Hall, 4th edn, 2005.
8. Yudkin, Marcia. Persuading on Course Name. Lansing, IL: Infinity Publishing, 2001.

Course Outcomes:

After the completion of the course students will be able to

1. Analyse the dynamics of business communication and communicate accordingly.
2. Write business letters and reports
3. Learn to articulate opinions and views with clarity
4. Appreciate the use of language to create beautiful expressions
5. Analyse and appreciate literature.
6. Communicate in an official and formal environment.

| | | | | | |
|----------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Chemistry I | | | | | |
| Course Code: CHEM1001 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | 1 | - | 4 | 4 |

Module I [10L]

Thermodynamics & Spectroscopy

Chemical Thermodynamics & Thermochemistry

Concept of Thermodynamic system, Introduction to first law of thermodynamics, Enthalpy Heat Capacity, Reversible and Irreversible processes, Adiabatic changes, Application of first law of thermodynamics to chemical processes, 2nd law of thermodynamics, Evaluation of entropy, Work function and free energy, Phase Changes, Clausius Clapeyron Equation, Chemical Potential, Gibbs Duhem Relation, Activity and Activity coefficient.

Spectroscopy

Electromagnetic Radiation, Basic idea of UV-visible & IR spectroscopy.

Module II [10L]

Structure & Bonding

Chemical Bonding

Covalent bond, VSEPR Theory, Molecular Orbital Theory, Hydrogen bond, Intermolecular forces-vander Waals forces, Ionization energy, Electronegativity, Electron affinity, Hybridisation, Dipole moment

Solid State Chemistry

Introduction to stoichiometric defects (Schottky & Frenkel) and non – stoichiometric defects (Metal excess and metal deficiency). Role of silicon and germanium in the field of semiconductor.

Ionic Equilibria and Redox Equilibria

Acid Base Equilibria in water, Strength of acids and bases, Hydrogen ion exponent, Ionic product of water, Salt Hydrolysis and Henderson Equation, Buffer solutions, pH indicator, Common ion Effect, Solubility product, Fractional Precipitation, Redox Equilibria,

Structure and reactivity of Organic molecule

Inductive effect, resonance, hyperconjugation, electromeric effect, carbocation, carbanion and free radicals.

Brief study of some addition, eliminations and substitution reactions.

Module III [10L]

Electrochemistry & Reaction Dynamics

Conductance

Conductance of electrolytic solutions, specific conductance, equivalent conductance, molar conductance, ion conductance, effect of temperature and concentration (Strong and Weak electrolyte). Kohlrausch's law of independent migration of ions, transport numbers and hydration of ions. Conductometric titrations: SA vs SB & SA vs WB; precipitation titration KCl vs AgNO₃.

Electrochemical Cell

Cell EMF and thermodynamic derivation of the EMF of a Galvanic cell (Nernst equation), single electrode potentials, hydrogen half-cell and calomel half cell (construction, representation, cell reaction, expression of potential, discussion, application) Storage cell, fuel cell (construction, representation, cell reaction, expression of potential, discussion, application). Application of EMF measurement on a) the change in thermodynamic function (ΔG , ΔH , ΔS) b) the equilibrium constant of a reversible chemical reaction c) the valency of an ion.

Kinetics

Reaction laws: rate expression, order and molecularity, zero, first and second order kinetics. Pseudounimolecular reaction, Arrhenius equation.

Mechanism and theories of reaction rates (Collision theory and Transition state theory,).

Catalysis: Homogeneous catalysis (Definition, example, mechanism, kinetics).

Module IV [10L]

INDUSTRIAL CHEMISTRY & POLYMERIZATION

Industrial Chemistry

Solid Fuel: Coal, Classification of coal, constituents of coal, carbonization of coal (HTC and LTC), Coal analysis: Proximate and ultimate analysis.

Liquid fuel: Petroleum, classification of petroleum, Refining, Petroleum distillation, Thermal cracking, Octane number, Cetane number, Aviation Fuel (Aviation Gasoline, Jet Gasoline), Bio-diesel.

Gaseous fuels: Natural gas, water gas, coal gas, bio gas.

Polymerization

Concepts, classifications and industrial applications. Polymer molecular weight (number avg. weight avg. viscosity avg.: Theory and mathematical expression only), Poly dispersity index (PDI). Polymerization processes (addition and condensation polymerization), degree of polymerization, Copolymerization, stereo-regularity of polymer, crystallinity (concept of T_m) and amorphicity (Concept of T_g) of polymer.

Preparation, structure and use of some common polymers: plastic (PE: HDPE, LDPE, PVC, Bakelite, PP), rubber (natural rubber, SBR, NBR) and Vulcanization., fibre(nylon 6.6, Nylon 6, Polyester).

Conducting and semi-conducting polymers.

Text Books

1. Engineering Chemistry, Gourkrishna Dasmohapatra, Vikas Publishing House
2. A Text book of Engineering Chemistry, Shashi Chawla, Dhanpat Rai & Co Pvt Ltd
3. Engineering Chemistry, K. L. Chugh, Kalyani Publishers.

Reference Books

1. General & Inorganic Chemistry, R. P. Sarkar, Fuels and Combustion, New Central Book Agency P Ltd
2. L. Finar, Organic Chemistry, Addison Wesley Longman, Inc
3. Organic Chemistry, Morrison & Boyd, Prentice Hall of India
4. Physical Chemistry, K. L. Kapoor, McMillan
5. P. C. Rakshit, Physical Chemistry, Sarat Book House (7th Edition).

Course Outcomes:

1. Knowledge of understanding the operating principles and reaction involved in batteries and fuel cells and their application in automobiles as well as other sectors to reduce environmental pollution
2. An ability to design and conduct experiments, as well as to organize, analyzes, and interprets data
3. An ability to identify and formulate polymers and have a knowledge of various polymers like polyethylene, PVC, PS, Teflon, Bakelite, Nylon which have engineering applications
4. Knowledge of synthesizing Nanomaterials and their applications in industry, carbon nano tube technology is used in every industry now-a-days
5. An ability of synthesizing bio fuels as a renewable and environment friendly alternative source for natural fuel
6. Elementary knowledge of IR and UV spectroscopy is usable in structure elucidation and characterisation of various molecules

| | | | | | |
|------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Mathematics I | | | | | |
| Course Code: MATH1101 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | 1 | - | 4 | 4 |

Module I [10L]

Matrix:

Matrices and their basic attributes, Determinant of a square matrix, Minors and Cofactors, Laplace's method of expansion of a determinant, Product of two determinants, Adjoint of a determinant, Jacobi's theorem on adjoint determinant. Singular and non-singular matrices, Adjoint of a matrix, Inverse of a non-singular matrix and its properties, Orthogonal matrix and its properties, Special Complex Matrices: Hermitian, Unitary, Normal(definition only), Rank of a matrix and its determination using elementary row and column operations, Solution of simultaneous linear equations by :Cramer's Rule and Matrix inversion method, Consistency and inconsistency of a system of homogeneous and inhomogeneous linear simultaneous equations, Characteristic Equation and computation of eigenvalues and eigenvectors of a square matrix (of order 2 or 3), Cayley-Hamilton theorem and its applications(with special reference to higher power of matrices, e.g. Idempotent and Nilpotent matrices)

Module II [10L]

Mean Value Theorems & Expansion of Functions:

Rolle's theorem: its geometrical interpretation and its application, Concavity and Convexity of curves, Mean Value theorems – Lagrange & Cauchy and their application, Taylor's theorem with Lagrange's and Cauchy's form of remainders and its application, Expansions of functions by Taylor's and Maclaurin's theorem, Maclaurin's infinite series expansion of the functions: $\sin x, \cos x, e^x, \log(1+x), (a+x)^n$, n being an integer or a fraction (assuming that the remainder $R_n \rightarrow 0$ as $n \rightarrow \infty$ in each case).

Infinite Series:

Preliminary ideas of sequence, Infinite series and their convergence/divergence, Infinite series of positive terms, Tests for convergence: Comparison test, Cauchy's Root test, D' Alembert's Ratio test(statements and related problems on these tests), Raabe's test, Proof of e being irrational, Alternating series, Leibnitz's Test (statement, definition) illustrated by simple examples, Absolute convergence and Conditional convergence,

Module III [10L]

Successive differentiation:

Higher order derivatives of a function of single variable, Leibnitz's theorem (statement only and its application, problems of the type of recurrence relations in derivatives of different orders and also to find $(y_n)_0$).

Calculus of Functions of Several Variables:

Recapitulation of some basic ideas of limit and continuity of functions of single variable, Introduction to functions of several variables with examples, Knowledge of limit and continuity, Determination of partial derivatives of higher orders with examples, Homogeneous functions and Euler's theorem and related problems up to three variables, Chain rules, Differentiation of implicit functions, Total differentials and their related problems, Jacobians up to three variables and related problems, Maxima, minima and saddle points of functions and related problems.

Module-IV [10L]

Multiple Integration and Vector Calculus:

Concept of line integrals, Double and triple integrals. Vector function of a scalar variable, Differentiation of a vector function, Scalar and vector point functions, Gradient of a scalar point function, divergence and curl of a vector point function, Directional derivative, Related

problems on these topics, Green's theorem, Gauss Divergence Theorem and Stoke's theorem (Statements and applications).

Reduction formula:

Reduction formulae both for indefinite and definite integrals of types:

$$\int \sin^n x, \int \cos^n x, \int \sin^m x \cos^n x, \int \cos^m x \sin^n x, \int \frac{dx}{(x^2 + a^2)^n}, m, n \text{ are positive integers.}$$

References

1. Advanced Engineering Mathematics: Erwin Kreyszig by Wiley India
2. Engineering Mathematics: B.S. Grewal (S. Chand & Co.)
3. Higher Engineering Mathematics: John Bird (Elsevier)
4. Advanced Engineering Mathematics: Wiley and Barrett (Tata McGraw-Hill)
5. Calculus: M. J. Strauss, G. L. Bradley and K. L. Smith (Pearson Education)
6. Engineering Mathematics: S. S. Sastry (PHI)
7. Advanced Engineering Mathematics: M.C. Potter, J.L. Goldberg and E.F. Abonfadel (OUP), Indian Edition.
8. Linear Algebra(Schaum's outline series): Seymour Lipschutz, Marc Lipson (McGraw Hill Education)
9. Vector Analysis(Schaum's outline series): M.R. Spiegel, Seymour Lipschutz, Dennis Spellman (McGraw Hill Education)
10. Introduction to Real Analysis: S.K.Mapa (Sarat Book Distributors)

Course Outcomes:

After the completion of the course students will be able to

1. Apply the concept of rank of matrices to find the solution of a system of linear simultaneous equations.
2. Develop the concept of eigen values and eigen vectors.
3. Use Mean Value Theorems for power series expansions of functions of one variable.
4. Analyze the nature of sequence and infinite series.
5. Describe the concept of differentiation and integration for functions of several variables with their applications in vector calculus.
6. Combine the concepts of gradient, curl, divergence, directional derivatives, line integrals, surface integrals and volume integrals.

| | | | | | |
|---------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Basic Electrical Engineering | | | | | |
| Course Code: ELEC1001 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | 1 | - | 4 | 4 |

Module-I: [12 L]

DC Network Theorem: Kirchhoff's law, nodal analysis, mesh analysis, Superposition theorem, Thevenin's theorem, Norton theorem, Maximum power transfer theorem, star-delta conversion.

DC Machines: Construction, EMF equation, Principle of operation of DC generator, open circuit characteristics, external characteristics, Principle of operation of DC motor, Speed-torque characteristics of shunt and series machine, starting of DC motor, speed control of dc motor.

Module-II [8L]

Electrostatics: Gauss's law and its applications to electric field and potential calculation. Capacitor, capacitance of parallel plate capacitor, spherical capacitor and cylindrical capacitor.

Electromagnetism: Amperes law, Biot-savart's law, Ampere's circuital law and their applications, Magnetic circuits, analogy between magnetic and electric circuits, Faraday's law, self and mutual inductance. Energy stored in a magnetic field, Hysteresis and Eddy current losses.

Module-III [10L]

AC single phase system: concept of alternating signal, average and RMS values of alternating signal, peak factor, form factor, phase and phase difference, phasor representation of alternating quantities, phasor diagram, AC series, parallel and series parallel circuits, Active power, Reactive power, power factor, Resonance in RLC series and parallel circuit, Q factor, bandwidth.

Three phase system: balanced three phase system, delta and star connection, relationship between line and phase quantities, phasor diagrams. Power measurement by two wattmeter method.

Module-IV [10L]

Single phase transformer: Construction, EMF equation, no load and on load operation and their phasor diagrams, Equivalent circuit, Regulation, losses of a transformer, open and short circuit tests, efficiency.

3-phase induction motor: Concept of rotating magnetic field, principle of operation, Construction, equivalent circuit and phasor diagram, torque-speed/slip characteristics, Starting of Induction Motor.

Text Books:

1. Basic Electrical engineering, D.P Kothari & I.J Nagrath, TMH, Second Edition
2. Basic Electrical Engineering, V.N Mittle & Arvind Mittal, TMH, Second Edition
3. Basic Electrical Engineering, Hughes
4. Electrical Technology, Vol-I, Vol-II, Surinder Pal Bali, Pearson Publication
5. A Text Book of Electrical Technology, Vol. I & II, B.L. Theraja, A.K. Theraja, S.Chand & Company

Reference Books:

1. Electrical Engineering Fundamentals, Vincent Del Toro, Prentice-Hall
2. Advance Electrical Technology, H.Cotton, Reem Publication
3. Basic Electrical Engineering, R.A. Natarajan, P.R. Babu, Sictech Publishers
4. Basic Electrical Engineering, N.K. Mondal, Dhanpat Rai
5. Basic Electrical Engineering, Nath & Chakraborti
6. Fundamental of Electrical Engineering, Rajendra Prasad, PHI, Edition 2005.

Course Outcomes:

After attending the course, the students will be able to

1. Analyse DC electrical circuits using KCL, KVL and network theorems like Superposition Theorem, Thevenin's Theorem, Norton's Theorem and Maximum Power Transfer Theorem.
2. Analyse DC Machines; Starters and speed control of DC motors.
3. Analyse magnetic circuits.
4. Analyse single and three phase AC circuits.
5. Analyse the operation of single phase transformers.
6. Analyse the operation of three phase induction motors

| | | | | | |
|--------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Engineering Mechanics | | | | | |
| Course Code: MECH1101 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | 1 | - | 4 | 4 |

Module-I [10L]

Importance of Mechanics in Engineering; Definition of Mechanics; Concepts of particles & rigid bodies;

Vector and scalar quantities; Vector algebra –definition and notation; Types of vectors – equal, equivalent, free, bound, sliding; Addition, subtraction of vectors; Parallelogram law, triangle law, vector polygon; Scalar multiplication of vectors; Resolution of vectors in Cartesian co-ordinate system; Unit vector, unit co-ordinate vectors (\hat{i} , \hat{j} , \hat{k}); Direction cosines; Addition/subtraction of vectors in components form.

Definition of force vector; Dot product, cross product and the application; Important vector quantities (position vector, displacement vector); Moment of a force about a point and about an axis, moment of a couple; Representation of force and moments in terms of \hat{i} , \hat{j} , \hat{k} . Principle of transmissibility of force (sliding vector); Varignon's theorem for a system of concurrent forces with proof; Resolution of a force by its equivalent force-couple system; Resultant of forces.

Module-II [10L]

Type of forces – collinear, concurrent, parallel, concentrated, distributed; Active and reactive forces, different types of reaction forces; Free body concept and diagram; Concept and equilibrium of forces in two dimensions; Equations of equilibrium; Equilibrium of three concurrent forces -- Lami's theorem.

Concept of friction: Laws of Coulomb's friction; Angle of friction, angle of repose, coefficient of friction -- static and kinematic.

Module-III [12L]

Distributed force system; Centre of gravity; Centre of mass & centroid; Centroid of an arc; Centroid of plane areas – triangle, circular sector, quadrilateral and composite area consisting of above figures.

Area moment of inertia: Moment of inertia of a plane figure; Polar moment of inertia of a plane figure; Parallel axes theorem.

Concept of simple stress and strain; Normal stress, shear stress, normal strain, shear strain; Hooke's law; Poisson's ratio; stress-strain diagram of ductile and brittle material; Proportional limit, elastic limit, yield point, ultimate stress, breaking point; Modulus of elasticity.

Module-IV [16L]

Introduction to dynamics: Kinematics & kinetics; Newton's laws of motion; Law of gravitation and acceleration due to gravity; Rectilinear motion of particles with uniform & non-uniform acceleration.

Plane curvilinear motion of particles: Rectangular components (projectile motion), normal and tangential components.

Kinetics of particles: D'Alembert's principle and free body diagram; Principle of work & energy; Principle of conservation of energy.

Impulse momentum theory: Conservation of linear momentum

References:

1. Engineering Mechanics:- Statics and Dynamics by Meriam & Kreige, Wiley india
2. Engineering Mechanics:- Statics and Dynamics by I.H. Shames, PHI
3. Engineering Mechanics by Timoshenko, Young and Rao, TMH

4. Element of strength of materials by Timoshenko & Young, E W P
5. Fundamentals of Engineering Mechanics by Nag & Chanda – Chhaya Prakashani.

COURSE OUTCOME:

After going through the course, the students will be able to

1. Understand basic concepts of vector algebra as applied to engineering mechanics.
2. Analyze free body diagram of a system under equilibrium / non equilibrium along with the consideration of frictional forces.
3. Interpret dynamics of members/ links in a mechanism and evaluate inertia force with the help of D' Alembert's principle.
4. Know how to evaluate mechanical stability from CG calculations.
5. Apply MI values required for engineering design calculations.
6. Apply the principles of work - energy and impulse- momentum for analysis of dynamic systems

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|--------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Chemistry I Lab | | | | | |
| Course Code: CHEM1011 | | | | | |
| Contact hrs per | L | T | P | Total | Credit Points |
| week: | - | - | 3 | 3 | 2 |

List of Experiments:

1. To determine the alkalinity in a given water sample.
2. Estimation of iron using KMnO_4 : self indicator.
3. Estimation of iron using $\text{K}_2\text{Cr}_2\text{O}_7$: redox sensitive indicator.
4. To determine total hardness and amount of calcium and magnesium separately in a given water sample.
5. To determine the value of the rate constant for the hydrolysis of ethyl acetate catalyzed by hydrochloric acid.
6. Heterogeneous equilibrium (determination of partition coefficient of acetic acid between n-butanol and water).
7. Conductometric titration for determination of the strength of a given HCl solution by titration against a standard NaOH solution.
8. pH- metric titration for determination of strength of a given HCl solution against a standard NaOH solution.
9. Iodometric estimation of Cu^{2+} .
10. To determine chloride ion in a given water sample by Argentometric method (using chromate indicator solution)

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|-------------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Basic Electrical Engineering Lab | | | | | |
| Course Code: ELEC1011 | | | | | |
| Contact hrs per | L | T | P | Total | Credit Points |
| week: | - | - | 3 | 3 | 2 |

List of Experiments:

1. Characteristics of Fluorescent lamps
2. Characteristics of Tungsten and Carbon filament lamps
3. Verification of Thevenin's & Norton's theorem.
4. Verification of Superposition theorem
5. Verification of Maximum Power Transfer theorem
6. Calibration of ammeter and voltmeter.
7. Open circuit and Short circuit test of a single phase Transformer.
8. Study of R-L-C Series / Parallel circuit
9. Starting and reversing of speed of a D.C. shunt Motor
10. Speed control of DC shunt motor.
11. No load characteristics of D.C shunt Generators
12. Measurement of power in a three phase circuit by two wattmeter method.

Course Outcomes:

The students are expected to

1. Get an exposure to common electrical apparatus and their ratings.
2. Make electrical connections by wires of appropriate ratings.
3. Understand the application of common electrical measuring instruments.
4. Understand the basic characteristics of different electrical machines.

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|------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Engineering Drawing | | | | | |
| Course Code: MECH1012 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 1 | - | 3 | 4 | 3 |

List of Experiments:

1. Importance of engineering drawing; Acquaintance with different drafting equipment & accessories;
2. Introduction to lines : Practising different types of lines; Basic concepts in Lettering : Practising vertical & inclined letters (Practice Sheet 1)
3. Different systems of dimensioning with practice. Introduction to the concept of scale of drawing. (Practice Sheet 2)
4. Introduction to concept of orthographic projection: 1st angle and 3rd angle projection method; Symbols; projection of points. (Practice Sheet 3)
5. Projection of straight lines for different orientation including inclined to both the planes. (Practice Sheet 4)
6. Projection of plane surfaces inclined to HP and parallel to VP; Inclined to VP and Parallel to HP (Practice Sheet 5)
7. Projection of solids: Cube, rectangular prism, Hexagonal prism, Cylinder, Pyramid, Cone. (Practice Sheet 6)
8. Section of solids and their projections on principal and auxiliary planes for true shape: Cylinder, hexagonal pyramid. (Practice Sheet 7)
9. Isometric projections: Basic concepts, isometric scale; Isometric projection and view.
10. Practice with simple laminar and solid objects. (Practice Sheet 7)

References:

1. "Elementary Engineering Drawing" by Bhatt, N.D; Charotan Book Stall, Anand
2. "Engineering Graphics" by Narayana, K.L. and Kannaaiah P; TMH
3. "Engineering Graphics" by Lakshminarayanan, V. and Vaish Wanar, R.S, JainBrothers.

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|------------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Language Practice Lab (Level 1) | | | | | |
| Course Code: HMTS1111 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | - | - | 2 | 2 | 1 |

Module I [3P]

Introduction to Linguistics (Phonology)

Phonetics-Vowel and Consonant Sounds (Identification & articulation)

Word- stress

Intonation (Falling and rising tone)

Voice Modulation

Accent training

Module II [3P]

Listening Skills

Principles of Listening

Approaches to listening

Guidelines for Effective Listening

Listening Comprehension

Audio Visual (Reviews)

Module III [2P]

Discourse Analysis-

Spoken Discourse

Conversational Skills/Spoken Skills

Analysing Speech dynamics

(Political Speeches

Formal Business Speeches)

Module IV [9P]

Writing Skill-

Descriptive, narrative and expository writing

Writing with a purpose---Convincing skill, argumentative skill/negotiating Skill (These skills will be repeated in oral skills).

Writing reports/essays/articles—logical organization of thoughts

Book review

References

1. Munter, Mary. Guide to Managerial Communication. 5th ed. Upper Saddle River, NJ: Prentice Hall, 1999.
2. Cypres, Linda. Let's Speak Business English. Hauppauge, NY: Barron's Educational Series, 1999. Crystal, David. 1971. *Linguistics*. Baltimore: Penguin Books.
3. Larsen-Freeman, D. (1986). "Techniques and principles in language teaching." Oxford: Oxford University Press.
4. Littlewood, W. (1981). "Language teaching. An introduction." Cambridge: Cambridge University Press.
5. Savignon, S. J., & Berns, M. S. (Eds.). (1983). "Communicative language teaching: Where are we going? Studies in Language Learning," 4(2). (EDRS No. ED 278 226, 210 pages)

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|-----------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Co-curricular Activities | | | | | |
| Course Code: HMTS1121 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | - | - | 2 | 2 | 1 |

Objective: This course aims at instilling a sense of social responsibility. This objective can be achieved by bringing in awareness about the contemporary issues relevant to the GenX and Gen Y through enlightened discussions and active participation. Since the course has 1 credit detailed planning regarding the area of activities and method of evaluation should be charted at the start of the semester.

Module I:

Project Work

Development of projects based on integral and holistic developmental models to be implemented in rural areas or underdeveloped areas in the peripheral areas of cities. This could include a wide area of activity – from taking up a research projects to analyse the need of a particular under-developed area to trying to implement a project already formulated. This could also relate to mobilizing funds for a specific project.

Module II:

Action-oriented schemes

e.g.Organising Blood –donation camps
 Conducting child –healthcare services
 Helping the old and sick
 (in coordination with NGOs and other institutes)

Module III:

Society and Youth

Developing Awareness among the youth about social issues both local and global for e.g. Eradication of social evils like drug abuse, violence against women and others.

Module IV:

Youth and Culture

Generating new ideas and help the participants to be creative and innovative for e.g.Enacting street plays, encouraging creative writing by organizing workshops and competitions. Active participation of the students in the nation building process by making positive changes in the social and individual space.

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|------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Introduction to Computing | | | | | |
| Course Code: CSEN1201 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | 1 | - | 4 | 4 |

Learning Objective: Introduction to the concept of computer and computation and solving of problems using C as a programming language. Coverage of C will include basic concepts, arithmetic and logic, flow control, and data handling using arrays, structures, pointers and files.

Module I: [13L]

Fundamentals of Computer

History of Computers, Generations of Computers, Classification of Computers.

Basic Anatomy of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices. Assembly language, high level language, compiler and assembler (basic concepts).

Binary & Allied number systems (decimal, octal and hexadecimal) with signed and unsigned numbers (using 1's and 2's complement) - their representation, conversion and arithmetic operations. Packed and unpacked BCD system, ASCII. IEEE-754 floating point representation (half- 16 bit, full- 32 bit, double- 64 bit). Binary Arithmetic & logic gates. Boolean algebra – expression, simplification, Karnaugh Maps.

Basic concepts of operating systems like MS WINDOW, LINUX. How to write algorithms & draw flow charts.

Module II: [5L]

Basic Concepts of C

C Fundamentals:

The C character set identifiers and keywords, data type & sizes, variable names, declaration, statements.

Operators & Expressions:

Arithmetic operators, relational and logical operators, type, conversion, increment and decrement operators, bit wise operators, assignment operators and expressions, precedence and order of evaluation. Standard input and output, formatted output -- printf, formatted input scanf.

Module III: [8L]

Program Structures in C

Flow of Control:

Statement and blocks, if-else, switch-case, loops (while, for, do-while), break and continue, go to and labels.

Basic of functions, function prototypes, functions returning values, functions not returning values. Storage classes - auto, external, static and register variables – comparison between them. Scope, longevity and visibility of variables.

C preprocessor (macro, header files), command line arguments.

Module IV: [14L]

Data Handling in C

Arrays and Pointers:

One dimensional arrays, pointers and functions – call by value and call by reference, array of arrays. Dynamic memory usage– using malloc(), calloc(), free(), realloc(). Array pointer duality. String and character arrays; C library string functions and their use.

User defined data types and files:

Basic of structures; structures and functions; arrays of structures.

Files – text files only, modes of operation. File related functions – fopen(), fclose(), fscanf(), fprintf(), fgets(), fputs();

Text Books

1. Schaum's outline of Programming with C – Byron Gottfried
2. Teach Yourself C- Herbert Schildt
3. Programming in ANSI C – E Balagurusamy

Reference Books

1. C: The Complete Reference – Herbert Schildt
2. The C Programming Language- D.M.Ritchie, B.W. Kernighan

Course Outcomes:

After the completion of the course students will be able to

1. Understand and remember functions of the different parts of a computer.
2. Understand and remember how a high-level language (C programming language, in this course) works, different stages a program goes through.
3. Understand and remember syntax and semantics of a high-level language (C programming language, in this course).
4. Understand how code can be optimized in high-level languages.
5. Apply high-level language to automate the solution to a problem
6. Apply high-level language to implement different solutions for the same problem and analyze why one solution is better than the other.

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|--------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Physics I | | | | | |
| Course Code: PHYS1001 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | 1 | - | 4 | 4 |

Module I: [22 L]

Optics

1. Interference :

The principle of superposition of waves, Superposition of waves: Two beam superposition, Multiple-beam superposition, coherent and incoherent superposition. Two source interference pattern (Young's double slit), Intensity distribution. Interference in thin films, wedge shaped films and Newton's rings, applications of interference. Newton's rings: Determination of wavelength of light, refractive index of liquid.

2 Diffraction:

Diffraction of light waves at some simple obstacles. Fraunhofer diffraction through double slit and diffraction grating, grating spectra, resolving power of grating.

3. Polarisation & Fibre Optics:

Elementary features of polarization of light waves. Production and analysis of linearly, elliptic and Circularly polarized light, polaroids and application of polarizations. fibre optics - principle of operation, numerical aperture, acceptance angle

4 Laser

Characteristics of Lasers, Spontaneous and Stimulated Emission of Radiation, Meta-stable State, Population Inversion, Lasing Action, Einstein's Coefficients and Relation between them, Ruby Laser, Helium-Neon Laser, Semiconductor Diode Laser, Applications of Lasers.

Module II : [8L]

Waves & Oscillation

Superposition of two linear SHMs (with same frequency), Lissajous' figures. Damped vibration – differential equation and its solution, Critical damping, Logarithmic decrement, Analogy with electric circuits. Forced vibration – differential equation and solution, Amplitude and Velocity resonance, Sharpness of resonance and Quality factor. Progressive wave- Wave equation and its differential form, Difference between elastic (mechanical) and electromagnetic waves.

Module III : [9L]

Quantum Mechanics

Need for Quantum physics-Historical overviews, Particle aspects of radiation-Black body radiation, Compton scattering, pair production., Origin of X-ray spectrum. Wave aspect of particles- matter wave, de Broglie Hypothesis, Heisenberg Uncertainty principles- Statement, Interpretation and application.

Module IV: [6L]

Introduction of Crystallography

Space Lattice, Unit Cell, Lattice Parameters, Crystal Systems, Bravais Lattices, Miller Indices and its applications, Crystal Planes and Directions, Inter Planar Spacing of Orthogonal Crystal Systems, Atomic Radius, Co-ordination Number and Packing Factor of SC, BCC, FCC. Bragg's law and its applications.

Text Books

1. Atomic Physics Vol 1 – S.N. Ghoshal
2. Optics – Ajoy Ghak
3. Waves & Oscillation – N.K. Bajaj
4. Quantum Physics of Atoms , Molecules, Solids, Nuclei and particles – Eisberg and Resnick

Reference Books

1. Introduction to Special Relativity – Robert Resnick
2. Perspective on Modern Physics - Arthur Beiser
3. Optics – Jenkins and White
4. University Press – Sears & Zemansky
5. Introduction to modern Physics – Mani and Meheta
6. Optics – Brijlal and Subrahmanyam

Course Outcomes:

After the completion of the course students will be able to

1. Interpret oscillations under different conditions, with the understanding of Resonance phenomena followed by calculation of Q factor
2. Analyze the Quantum phenomenon like Black body radiation , Compton effect and origin of X-ray spectrum
3. Understand the wave character of light through the phenomenon of interference, diffraction and polarization.
4. Study of various crystal structures and classification of different crystal planes.
5. Explain the working principle of LASER, and apply the knowledge in different lasing system and their engineering applications in holography
6. Understand the dual nature of matter, Heisenberg's uncertainty relation and it's various application.

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|-------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Mathematics II | | | | | |
| Course Code: MATH1201 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | 1 | - | 4 | 4 |

Module I [10 L]

Ordinary differential equations (ODE)-

First order and first degree: Exact equations, Necessary and sufficient condition of exactness of a first order and first degree ODE (statement only), Rules for finding Integrating factors, Linear and non-linear differential equation, Bernoulli's equation. General solution of ODE of first order and higher degree (different forms with special reference to Clairaut's equation).

Second order and first degree:

General linear ODE of order two with constant coefficients, C.F. & P.I., D-operator methods for finding P.I., Method of variation of parameters, Cauchy-Euler equations.

Module II:[10L]

Basics of Graph Theory

Graphs, Digraphs, Weighted graph, Connected and disconnected graphs, Complement of a graph, Regular graph, Complete graph, Subgraph,; Walks, Paths, Circuits, Euler Graph, Cut sets and cut vertices, Matrix representation of a graph, Adjacency and incidence matrices of a graph, Graph isomorphism, Bipartite graph.

Tree:

Definition and properties, Binary tree, Spanning tree of a graph, Minimal spanning tree, properties of trees, Algorithms: Dijkstra's Algorithm for shortest path problem, Determination of minimal spanning tree using DFS, BFS, Kruskal's and Prim's algorithms.

Module III [10L]

Improper Integral:

Basic ideas of improper integrals, working knowledge of Beta and Gamma functions (convergence to be assumed) and their interrelations.

Laplace Transform:

Introduction to integral transformation, functions of exponential order, Definition and existence of LT (statement of initial and final value theorem only), LT of elementary functions, Properties of Laplace Transformations, Evaluation of sine, cosine and exponential integrals using LT, LT of periodic and step functions Definition and properties of inverse LT Convolution Theorem (statement only) and its application to the evaluation of inverse LT, Solution of linear ODEs with constant coefficients (initial value problem) using LT.

Module IV [10L]

Three Dimensional Geometry

Equation of a plane. General form. Transformation to the normal form. Intercepts. Equation of the plane through three given points. Equation of a plane passing through the intersection of two planes. Angle between two intersecting planes. Bisectors of angles between two intersecting planes. Parallelism and perpendicularity of two planes.

Canonical equation of the line of intersection of two intersecting planes. Angle between two lines. Shortest distance between two lines. Condition of coplanarity of two lines. Length of the perpendicular from a point to a given line.

References:

1. Advanced Engineering Mathematics, Erwin Kreyszig, (Wiley Eastern)
2. Graph Theory: V. K. Balakrishnan, (Schaum's Outline, TMH)
3. A first course at Graph Theory: J. Clark and D. A. Holton (Allied Publishers LTD)

4. Introduction to Graph Theory: D. B. West (Prentice-Hall of India)
5. Graph Theory: N. Deo (Prentice-Hall of India)
6. Engineering Mathematics: B.S. Grewal (S. Chand & Co.)
7. Higher Engineering Mathematics: John Bird (4th Edition, 1st Indian Reprint 2006, Elsevier)
8. Calculus: Strauss, Bradley and Smith (3PrdP edition, Pearson Education)
9. Engineering Mathematics (Volume 2): S. S. Sastry (Prentice-Hall of India)
10. Introductory Course in Differential Equations: Daniel A. Murray (Longmans & Green).
11. Co-ordinate Geometry – S. L. Loney.
12. Analytical Geometry And Vector Algebra- R M Khan

Course Outcomes:

After the completion of the course students will be able to

1. Construct differential equation as a mathematical model of a physical phenomena.
2. Choose proper method for finding solution of a specific differential equation.
3. Discuss the elementary concepts of graph theory, for example, walk, path, cycle, Eulerian graph, Hamiltonian graph and tree.
4. Apply basic graph algorithms for searching and finding minimal spanning tree and shortest path.
5. Solve improper integrals and initial value problems with the help of Laplace transformation.
6. Evaluate distance, angle between planes and shortest distance between two skew lines in three dimension.

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|----------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Basic Electronics Engineering | | | | | |
| Course Code: ECEN1001 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | 1 | - | 4 | 4 |

Module I [10 L]

Semiconductors:

Crystalline material, Energy band theory, Fermi levels; Conductors, Semiconductors and Insulators: electrical properties, band diagrams. Semiconductors: intrinsic and extrinsic, energy band diagram, electrical conduction phenomenon, P-type and N-type semiconductors, drift and diffusion carriers.

Diodes and Diode Circuits:

Formation of P-N junction, energy band diagram, built-in-potential forward and reverse biased P-N junction, formation of depletion zone, V-I characteristics, Zener Diode and its Application, Zener and Avalanche breakdown.

Simple diode circuits, load line, piecewise linear model; Rectifier circuits: half wave, full wave, PIV, DC voltage and current, ripple factor, efficiency, idea of regulation.

Module II [10 L]

Bipolar Junction Transistors:

Formation of PNP / NPN junctions, energy band diagram; transistor mechanism and principle of transistors, CE, CB, CC configuration, transistor characteristics: cut-off, active and saturation modes of operation, transistor action, input & output characteristics, load line & amplifier operation and current amplification factors for CB and CE modes. Biasing and Bias stability: calculation of stability factor.

Module III [9 L]

Field Effect Transistors:

Junction field effect transistor (JEET): Principle of operation, JFET parameters, eqv. Circuit, JFET biasing, self bias, design of bias circuits, load line, amplifier characteristics.

MOSFETs:

Construction & principle of operation of p- & n-channel enhancement & depletion mode MOSFETs, drain & transfer characteristics, threshold voltage & its control.

Cathode Ray Osilloscope:

Construction and working principle of CRO, Lissajous pattern.

Module IV [9 L]

Feed Back Amplifier:

Concept-block diagram, properties, positive and negative feedback, loop gain, open loop gain, feedback factors; topologies of feedback amplifier; effect of feedback on gain, condition of oscillation, Barkhausen criteria.

Operational Amplifier:

Introduction to integrated circuits, operational amplifier and its terminal properties; Application of operational amplifier; Concept of op-amp saturation, inverting and non-inverting mode of operation, Adders, Subtractors, Voltage follower, Integrator, Differentiator, Basic Comparator Circuit.

References:

1. Boylestad & Nashelsky:Electronic Devices & Circuit Theory
2. R.A Gayakwad:Op Amps and Linear IC's, PHI
3. D. Chattopadhyay, P. C Rakshit : Electronics Fundamentals and Applications
4. Adel S. Sedra, Kenneth Carless Smith: Microelectronics Engineering

5. Millman & Halkias: Integrated Electronics.
6. Salivahanan: Electronics Devices & Circuits.
7. Albert Paul Malvino: Electronic Principle.

Course Outcomes:

After the completion of the course students will be able to

1. Categorize different semiconductor materials based on their energy bands and analyze the characteristics of those materials for different doping concentrations based on previous knowledge on semiconductors acquired.
2. Describe energy band of P-N Junction devices and solve problems related to P-N Junction Diode both from device and circuit perspectives.
3. Design different application specific circuits associated with diodes operating both in forward and reverse bias.
4. Analyze various biasing configurations of Bipolar Junction Transistor and categorize different biasing circuits based on stability.
5. Categorize different field-effect transistors based on their constructions, physics and working principles and solve problems associated with analog circuits based on operational amplifiers.
6. Design and implement various practical purpose electronic circuits and systems meant for both special purpose and general purpose and analyze their performance depending on the type of required output and subsequently the applied input

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|---------------------------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Engineering Thermodynamics and Fluid Mechanics | | | | | |
| Course Code: MECH1201 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | 1 | - | 4 | 4 |

Module I [10 L]

Basic concepts of Thermodynamics:

Introduction; Macroscopic and microscopic concept; Definition of Thermodynamic systems; Surrounding, universe; Open, closed and isolated systems; Concept of control volume; Thermodynamic properties: intensive, extensive & specific properties; state.

Thermodynamic equilibrium; Change of state; Thermodynamic processes and cycles; Quasi-static processes; Reversible processes; Zeroth law of Thermodynamics -concept of temperature.

Heat & Work:

Definition of Thermodynamic work; Work transfer-displacement work for a simple compressible system, path function, PdV work in various quasi-static processes(isothermal, isobaric, adiabatic, polytropic, isochoric); Free expansion; Indicated diagram (P-V diagram).

Definition of heat; Heat transfer-a path function; Similarities and dissimilarities between heat and work.

Module II [8 L]

First law of Thermodynamics: Statement; 1st law for a closed system executing a cycle; Concept of stored energy; Energy as a property, different forms of stored energy, internal energy, first law for a non-flow process; Flow work; Definition of enthalpy, C_p , C_v ; Energy of an isolated system; Flow energy; First law for an open system - steady flow energy equation; Examples of steady flow devices(nozzle and diffuser, turbine, pump, compressor, boiler, condenser and throttling device); PMM-I

Module III [10 L]

Second law of Thermodynamics:

Qualitative difference between heat and work; Definition of source & sink: cyclic heat engine, heat pump and refrigerator, thermal efficiency of heat engine, C.O.P of heat pump and refrigerator; Kelvin-Planck and Clausius statements of second law; Equivalence of the two statements.

Reversible process; Irreversible process; Factors for irreversibility; Carnot cycle and Carnot efficiency; Reversible heat engine and heat pump; PMM-II

Entropy: Mathematical statement of Clausius Inequality: Entropy as a property; Entropy principle; T-s plot for reversible isothermal, adiabatic, isochoric & isobaric processes.

Air standard Cycles:

Otto cycle & Diesel cycle, P-V & T-s plots, Net work done and thermal efficiency.

Module IV [10 L]

Properties & Classification of Fluid:

Definition of fluid; Concept of Continuum; Fluid properties- density, specific weight, specific volume, specific gravity; Viscosity : definition , causes of viscosity , Newton's law of viscosity, dimensional formula and units of viscosity, kinematic viscosity; Variation of viscosity with temperature. Ideal and Real fluids; Newtonian and Non-Newtonian fluids; No-slip condition.

Compressibility and Bulk modulus of elasticity.

Difference between compressible and incompressible fluids.

Fluid Statics:

Introduction; Pascal's Law--statement and proof; Basic Hydrostatic Law and its proof; Variation of pressure with depth in incompressible fluid, piezometric head, pressure head; Unit and scales of pressure measurement.

Measurement of fluid pressure: Piezometer, Manometers -Simple and Differential U-tube manometer, Inverted tube manometer, Inclined tube manometer.

Characteristics and choice of manometric fluid.

Module V [10 L]**Fluid Kinematics:**

Definition; Flow field and description of fluid motion(Eulerian & Lagrangian method), steady and unsteady flow, uniform and non-uniform flow-examples.

Acceleration of a fluid particle-local acceleration, convective acceleration. Stream line, Stream tube, Path line and Streak line; Laminar and Turbulent flow, Reynolds Number. Equations of streamlines and path lines.

Continuity equation for unidirectional flow and for differential form in 3-D Cartesian coordinate system.

Dynamics of Ideal fluids:

Introduction, Euler's equation of motion along a streamline; Bernoulli's equation-assumptions and significance of each term of Bernoulli's equation.

Application of Bernoulli's equation-problem on pipe line. Measurement of flow rate: Venturimeter and orificemeter .

Static pressure, Dynamic pressure, Stagnation pressure-measurement of velocity by Pitot tube.

References:

1. Engineering Thermodynamics- Nag, P.K. - T. M.H
2. Fundamentals of Thermodynamics- Sonntag, Borgnakke & Van Wylen, Wiley India
3. Thermodynamics- an Engineering approach - 6e, Cengel & Boles, TM
4. Fluid Mechanics & Hydraulic Machines – R.K. Bansal, Laxmi Publications Ltd, India
5. Introduction to Fluid Mechanics and Fluid Machines- S.K. Som, G. Biswas, & S. Chakraborty , T.M.H
6. Fluid Mechanics – A.K. Jain, Khanna Publishers.

Course Outcomes:

After going through the course, the students will be able to

1. To analyze a thermodynamic system and calculate work transfer in various quasi-static processes.
2. To understand and apply the first law and 2nd law of thermodynamics.
3. To analyze thermal efficiency of Otto, Diesel cycles.
4. To understand physical properties of fluids
5. To apply mass, momentum and energy conservation principles to incompressible fluid flow.
6. To describe fluid flow and analyze acceleration of fluid particles.

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|----------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Introduction to Computing Lab | | | | | |
| Course Code: CSEN1211 | | | | | |
| Contact hrs per | L | T | P | Total | Credit Points |
| week: | - | - | 3 | 3 | 2 |

Basic Computation & Principles of Computer Programming Lab

Softwares to be used: Cygwin and notepad++, Tiny C

Day 1: LINUX commands and LINUX based editor

Day 2: Basic Problem Solving

Day 3: Control Statements (if, if-else, if-elseif-else, switch-case)

Day 4: Loops - Part I (for, while, do-while)

Day 5: Loops - Part II

Day 6: One Dimensional Array

Day 7: Array of Arrays

Day 8: Character Arrays/ Strings

Day 9: Basics of C Functions

Day 10: Recursive Functions

Day 11: Pointers

Day 12: Structures and Unions

Day 13: File Handling

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|------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Physics I Lab | | | | | |
| Course Code: PHYS1011 | | | | | |
| Contact hrs per | L | T | P | Total | Credit Points |
| week: | - | - | 3 | 3 | 2 |

List of Experiments:

1. Determination of Young's modulus by Flexure Method and calculation of bending moment and shear force at a point on the beam.
2. Determination of modulus of rigidity by Static/Dynamic Method.
3. Determination of thermal conductivity of a good conductor by Searle's Method.
4. Determination of thermal conductivity of a bad conductor by Lee's and Chorlton's Method.
5. Determination of dielectric constant of a given dielectric material.
6. Use of Carey Foster's bridge to determine unknown resistance.
7. Determination of wavelength of light by Newton's ring method.
8. Determination of wavelength of light by Fresnel's biprism method.
9. Determination of wavelength of light by Laser diffraction method.
10. Determination of dispersive power of the material of a given prism.
11. Determination of co-efficient of viscosity of a liquid by Poiseuille's capillary flow method.

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|--------------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Basic Electronics Engineering Lab | | | | | |
| Course Code: ECEN1011 | | | | | |
| Contact hrs per | L | T | P | Total | Credit Points |
| week: | - | - | 3 | 3 | 2 |

List of Experiments:

1. Familiarisation with passive and active electronic components such as Resistors, Inductors, Capacitors, Diodes, Transistors (BJT) and electronic equipment like DC power supplies, multimeters etc.
2. Familiarisation with measuring and testing equipment like CRO, Signal generators etc.
3. Study of I-V characteristics of Junction diodes.
4. Study of I-V characteristics of Zener diodes.
5. Study of Half and Full wave rectifiers with Regulation and Ripple factors.
6. Study of I-V characteristics of BJTs in CB mode
7. Study of I-V characteristics of BJTs in CE mode
8. Study of I-V characteristics of Field Effect Transistors.
9. Determination of input-offset voltage, input bias current and Slew rate of OPAMPs.
10. Determination of Common-mode Rejection ratio, Bandwidth and Off-set null of OPAMPs.
11. Study of OPAMP circuits: Inverting and Non-inverting amplifiers, Adders, Integrators and

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|----------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Workshop Practice | | | | | |
| Course Code: MECH1011 | | | | | |
| Contact hrs per | L | T | P | Total | Credit Points |
| week: | 1 | - | 3 | 4 | 3 |

Job 1: General awareness of a typical workshop.

Theory requirements: Workshop definition, various shops in a typical workshop, Carpentry, Fitting, Foundry; Sheet Metal Shop, Welding and Brazing Shop, Machine Shop , Forging & Blacksmithy, Safety precautions to be followed in a workshop, Familiarization of Various safety devices and their uses.

Job 2: Making of a wooden pattern.

Theory requirements: Market forms of converted Timber ,eg, log, balk, plank,batten, beam ,Types of Wood, Hard Wood, Soft Wood, particle board; Seasoning of wood, Natural seasoning, Artificial seasoning, Carpentry Tools-Marking Tools, Cutting Tools, Planing Tools, Boring Tools, Striking Tools , Holding & Misc. Tools, Carpentry Processes (marking, sawing, planning, chiselling, boring, grooving, joining etc.), Safety precautions in Carpentry Shop.

Job 3: Making of a matched profile form MS plate.

Theory requirements: Work Bench, Fitting Tools (Bench Vice,Chisel,Hammer,Different types of Files, (Rough,Bastard, Second Cut, Half Round, Triangular File),Saw(Hack saw etc.), Scriber, Punch, Try Square, Angle Plate, caliper (outside & inside), Universal Surface Gauge, Centre Punch, Prick Punch, Drill (Flat,straight fluted, taper shank twist drill). Fitting Operations,Filing, Marking, Drilling, Tapping (Rougher,Intermediate, Finisher taps), Tap Drill size ($D=T-2d$), Sawing, Dieing . Safety precautions in Fitting Shop.

Job 4: Making of an internal and external thread.

Theory requirements : Thread standards and thread classifications, Internal Thread,External Thread, Thread Nomenclature (Major dia, Minor dia, Pitch dia, pitch, Lead, TPI, Metric, BSP , Nominal size), Specifications of threaded fasteners (in Metric System). Safety precautions in Dieing and Tapping.

Job 5: Making of a green sand mould using the pattern made under Job no. 2.

Theory requirements: Mould making, Preparation of sand, (silica, clay, moisture, and misc items and their functions), Properties of a good sand mould, General procedure for making a good sand mould, Different tools used for preparation of a mould, Explanation of various terms , Cope and Drag Box, Runner, Riser, Gating and its utility, Parting sand, Vent holes.

Job 6: Demonstration of metal melting and casting

Theory requirements: Metal melting furnaces: Ladles, Using of Tongs, Molten metal pouring procedure, Safety precautions in pouring molten metal in a mould.

Job 7. Making of a stepped pin in a centre lathe. (2 Classes)

Theory requirements: Machining and common machining operations , Lathe M/c and its specifications, Head stock, Tailstock, Chuck-Self centering chuck , 4 jaw chuck, Bed, Carriage, Feed mechanism, Screw cutting mechanism, various lathe operations like turning, facing, grooving, chamfering, taper turning ,Thread cutting, Knurling, Parting, Cutting speed, Feed, Depth of cut , Different types of cutting tools-Safety precautions in a machine shop.

Job 8: Making of square prism from a round shaft by Shaping Machine

Theory requirements: Description of a Shaping machine, Base , Column, Saddle, Clapper box, Quick return mechanism, Feed Mechanism, Table, Rotation of table, Adjustment of stroke length, Adjustment of starting point of cut. Safety Precautions while working in Shaping Machine.

Job 9: Making of square prism from a round shaft by Milling Machine

Theory requirements: Description of a milling machine, Specification of a Milling machine, Types of Milling-Up Milling, Down Milling, Vertical Milling Machine, Horizontal Milling Machine , Safety precautions while working in Milling Machine.

Job 10 : Arc Welding practice and making of a welded joint

Theory requirements: Welding, Weldability, Types of Welding, MMAW, Gas Welding, Electrode , Functions of Flux, Equipment for MMAW, Different types of Flames in Gas Welding and Gas Cutting (Neutral-Oxidising-Reducing Flames), Different types of welding joints, AC Welding , DC Welding; Safety precautions in Welding Shop.

Job 11 : Sheet Metal forming & Brazing

Theory requirement: Specification of sheet metal, SWG vs. mm, HR sheet, CR sheet, GI Sheet, Stainless Steel Sheet, Aluminum sheets, Tin Plates, Sheet metal working Tools, Micrometer, Chisels, Punches, Hammers, Mallets, Hand Shear or Snippets, Various sheet metal forming operations, Shearing, Marking, Punching, Drilling, Bending, Drawing, Brazing, Safety precautions in Sheet Metal Working Shop.

References:

1. Elements of Workshop Technology (Vol- I and II)- Hajra Choudhury, Media Promoter &Publishers Privet Limited.
2. Workshop Technology (Vol- I and II) – Chapman , Viva Books Privet Limited.

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|-----------------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Human Values and Professional Ethics | | | | | |
| Course Code: HMTS2001 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 2 | - | - | 2 | 2 |

Module I:

Human society and the Value System:

Values: Definition, Importance and application.

Formation of Values: The process of Socialization

Self and the integrated personality

Morality, courage, integrity

Types of Values:

Social Values: Justice, Rule of Law, Democracy, Indian Constitution, Secularism

Aesthetic Values: Perception and appreciation of beauty

Organizational Values: Employee: Employer--- rights, relationships, obligations

Psychological Values: Integrated personality and mental health

Spiritual Values & their role in our everyday life

Value Spectrum for a Good Life, meaning of Good Life

Value Crisis in Contemporary Society

Value crisis at---

Individual Level

Societal Level

Cultural Level

Value Crisis management --- Strategies and Case Studies

Module II:

Ethics and Ethical Values

Principles and theories of ethics

Consequential and non-consequential ethics

Egotism, Utilitarianism, Kant's theory and other non-consequential perspectives

Ethics of care, justice and fairness, rights and duties

Ethics-- Standardization

Codification

Acceptance

Application

Types of Ethics--- Ethics of rights and Duties

Ethics of Responsibility

Ethics and Moral judgment

Ethics of care

Ethics of justice and fairness

Work ethics and quality of life at work

Professional Ethics

Ethics in Engineering Profession;

moral issues and dilemmas, moral autonomy(types of inquiry)

Kohlberg's theory, Giligan's theory (consensus and controversy)

Code of Professional Ethics Sample Code of ethics like ASME, ASCE. IEEE, Institute of Engineers, Indian Institute of materials management, Institute of Electronics and telecommunication engineers

Violation of Code of Ethics---conflict, causes and consequences

Engineering as social experimentation, engineers as responsible experimenters (computer ethics, weapons development)

Engineers as managers, consulting engineers, engineers as experts, witnesses and advisors, moral leadership

Conflict between business demands and professional ideals
social and ethical responsibilities of technologies.

Whistle Blowing: Facts, contexts, justifications and case studies

Ethics and Industrial Law

Institutionalizing Ethics: Relevance, Application, Digression and Consequences

Module III:

Science, Technology and Engineering

Science, Technology and Engineering as knowledge and profession

----Definition, Nature, Social Function and Practical application of science

Rapid Industrial Growth and its Consequences

Renewable and Non- renewable Resources: Definition and varieties

Energy Crisis

Industry and Industrialization

Man and Machine interaction

Impact of assembly line and automation

Technology assessment and Impact analysis

Industrial hazards and safety

Safety regulations and safety engineering

Safety responsibilities and rights

Safety and risk, risk benefit analysis and reducing risk

Technology Transfer: Definition and Types

The Indian Context

Module IV:

Environment and Eco- friendly Technology

Human Development and Environment

Ecological Ethics/Environment ethics

Depletion of Natural Resources: Environmental degradation

Pollution and Pollution Control

Eco-friendly Technology: Implementation, impact and assessment

Sustainable Development: Definition and Concept

Strategies for sustainable development

Sustainable Development--- The Modern Trends

Appropriate technology movement by Schumacher and later development

Reports of Club of Rome.

References:

1. Tripathi,A.N., *Human Values*, New Age International, New Delhi,2006
2. Ritzer, G., *Classical Sociological Theory*, The McGraw Hill Companies, New York,1996.
3. Doshi,S.L., *Postmodern Perspectives on Indian Society*, Rawat Publications, New Delhi,2008.
4. Bhatnagar, D.K., *Sustainable Development*, Cyber Tech Publications, New Delhi, 2008.
5. Kurzwell,R., *The age of Spiritual Machines*, Penguin Books, New Delhi,1999.
6. Weinberg, S.K., *Social Problems in Modern Urban Society*, Prentice Hall,Inc.,USA, 1970.
7. Giddens, Anthony 2009. *Sociology*. London: Polity Press (reprint 13th Edition).

Course Outcomes:

After going through the course, the students will

1. Be aware of the value system and the importance of following such values at workplace
2. Learn to apply ethical theories in the decision making process
3. Follow the ethical code of conduct as formulated by institutions and organizations
4. Implement the principles governing work ethics
5. Develop strategies to implement the principles of sustainable model of development
6. Implement ecological ethics wherever relevant and also develop eco-friendly technology

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|-------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Mathematical Methods | | | | | |
| Course Code: MATH2001 | | | | | |
| Contact hrs per | L | T | P | Total | Credit Points |
| week: | 3 | 1 | - | 4 | 4 |

Module I:

Functions of Complex Variables (12L)

Complex numbers and its geometrical representation .

Functions of a complex variable – Limits, Continuity , Differentiability .

Analytic Functions , Cauchy- Riemann equations , Necessary and sufficient conditions for analyticity of complex functions(Statement only) , Harmonic functions.

Line Integral on complex plane , Cauchy-Goursat theorem , Cauchy's Integral Formula.

Taylor's and Laurent's series expansion .

Zeros, Different types of Singularities. Definitions of poles and residues , Residue Theorem , Evaluation of real integrals using residue theorem.

Module II:

Fourier Series , Integrals and Transforms (12L)

Definite Integral , Orthogonality of Trigonometric Functions , Power Series and its convergence.

Periodic Functions , Even and Odd Functions , Dirichlet's Conditions , Euler Formulas for Fourier coefficients , Fourier series representation of a function, e.g. Periodic square wave, Half wave rectifier, Unit step function.

Half Range series , Parseval's Identity.

Fourier Integral theorem , Fourier transform , Fourier sine and cosine transform, Linearity, Scaling , Frequency Shifting and Time shifting properties, Convolution Theorem.

Discussion of some physical problems : e.g Forced oscillations.

Module III:

Series solutions to Ordinary Differential equations and Special Functions (12L)

Series solution of ODE: Ordinary point , Singular point and Regular Singular point, series solution when is an ordinary point, Frobenius method.

Legendre's Equation , Legendre's polynomials and its graphical representation.

Bessel's equation , Bessel's function of first kind and its graphical representation.

Finite Difference Method and its application to Boundary Value Problem.

Module IV:

Partial Differential Equations (12L)

Introduction to partial differential equations, Formation of partial differential equations, Linear and Nonlinear pde of first order, Lagrange's and Charpit's method of solution .

Second order partial differential equations with constant coefficients , Illustration of wave equation, one dimensional heat equation, Laplace's equation, Boundary value problems and their solution by the method of separation of variables.

Solution of Boundary value problems by Laplace and Fourier transforms.

References:

1. Complex Variables and Applications, Brown Churchill, MC Graw Hill
2. Complex Variable, Murrey R. Spiegel, Schaum's Outline Series
3. Theory of Functions of a Complex Variable, Shanti Narayan, P. K. Mittal, S. Chand
4. Larry C. Andrew, B. K. Shivamoggi, Integral Transforms for Engineers and Applied Mathematicians, Macmillan
5. Fourier Analysis with Boundary Value Problem, Murrey R. Spiegel, Schaum's Outline Series

6. Mathematical Methods, Potter, Merle C., Goldberg, Jack., PHI Learning
7. Ordinary and Partial Differential Equations, M. D. Raisinghania, S. Chand
8. Elements of Partial Differential Equation, Ian Naismith Sneddon, Dover Publications
9. Advanced Engineering Mathematics, Kreyszig, Willey
10. Higher Engineering Mathematics, B. V. Ramana, Tata McGraw-Hill

Course Outcome:

After the completion of the course student will be able to

1. Synthesize components of a physical phenomenon and consequently construct a mathematical model of the system.
2. Classify engineering problems like forced oscillations, RLC Circuits etc.
3. Apply suitable analytic methods to solve wave equations, heat conduction equation.
4. Evaluate the efficiency of a method to solve ordinary and partial differential equations.

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|--------------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Numerical and Statistical Methods | | | | | |
| Course Code: MATH2002 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | - | - | 3 | 3 |

Module I:

Numerical solution to linear and non-linear equations (8L)

Solution of non-linear algebraic equations and transcendental equations:

Bisection Method, Newton-Raphson Method, Regula-Falsi Method.

Solution of linear system of equations:

Gauss elimination method, Gauss-Seidel Method, LU Factorization Method.

Module II:

Numerical solution to integration and ordinary differential equations (8L)

Interpolation and integration:

Newton's Forward and Backward Interpolation Method, Lagrange's Interpolation, Trapezoidal and Simpson's 1/3rd Rule.

Solution of ordinary differential equations:

Euler's and Modified Euler's Method , Runge-Kutta Method of 4th order.

Module III:

Fundamentals of probability (5L)

Prerequisites- Set Theory.

Random experiment, Sample space , Events .

Definition of Probability ,

Addition law of probability, Multiplication law and Conditional Probability.

Bayes' Theorem (Statement only)

Module IV:

Probability distributions and statistics (15L)

Random Variables – Discrete and Continuous, Probability Mass Function, Probability Density and Cumulative Distribution Functions, Mathematical Expectation and Variance. Special Distributions: Binomial, Poisson, Uniform, Exponential and Normal. Measures of Central Tendency and Dispersion – Mean, Median, Mode and Standard Deviation for grouped and ungrouped frequency distribution.

Simple Correlation and Regression.

References:

1. Miller & Freund's Probability and Statistics for Engineers, R.A.Johnson, Prentice Hall of India
2. Numerical Mathematical Analysis, J.B.Scarborough, Oxford and IBH Publishing Co. Pvt. Ltd.
3. Numerical Methods (Problems and Solution), Jain, Iyengar , & Jain, New Age International Publishers
4. Fundamentals of Mathematical Statistics, S.C. Gupta and V.K. Kapoor, Sultan Chand & Sons
5. A First course in Probability, Sheldon Ross, Pearson

Course Outcomes:

After the completion of the course students will be able to

1. Apply numerical methods to obtain approximate solutions to mathematical problems where analytic solutions are not possible.

2. Develop algorithmic solutions for problems like system of linear equations, integration, ordinary differential equations which are pertinent to many physical and engineering problems.
3. Apply probabilistic methods to engineering problems where deterministic solutions are not possible and analyze probability distributions required to quantify phenomenon whose true value is uncertain.
4. Find numerical solutions to algebraic and transcendental equations appearing in a vast range of engineering problems e.g in the study of Ideal and non ideal gas laws, pipe friction, design of electric circuits.
5. Apply numerical methods to find solutions to linear system of equations appearing in spring-mass systems, resistor circuits, steady state analysis of a system of reactors.
6. Solve problems in data analysis, least-squares treatment of wastewater where the knowledge of interpolation will be required and compute numerical solution to integrals to find root mean square current.

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|----------------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Data Structure and Basic Algorithms | | | | | |
| Course Code: CSEN2001 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | 1 | - | 4 | 4 |

Pre-requisites:

Introduction to Computing, Mathematics, Set theory

Module I:

Linear Data Structure I (8L)

Introduction (2L):

Why we need data structure?

Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type. Algorithms and programs, basic idea of pseudo-code. Algorithm efficiency and analysis, time and space analysis of algorithms – order notations.

Array (2L):

Different representations – row major, column major. Sparse matrix - its implementation and usage. Array representation of polynomials.

Linked List (4L):

Singly linked list, circular linked list, doubly linked list, linked list representation of polynomial and applications.

Module II:

Linear Data Structure II (7L)

Stack and Queue (5L):

Stack and its implementations (using array, using linked list), applications.

Queue, circular queue, deque. Implementation of queue- both linear and circular (using array, using linked list), applications. Implementation of deque- with input and output restriction.

Recursion (2L):

Principles of recursion – use of stack, differences between recursion and iteration, tail recursion.

Module III:

Nonlinear Data structures (13L)

Trees (9L):

Basic terminologies, tree representation (using array, using linked list). Binary trees - binary tree traversal (pre-, in-, post- order), threaded binary tree. Binary search tree- operations (creation, insertion, deletion, searching). Height balanced binary tree – AVL tree (insertion, deletion with examples only). B- Trees – operations (insertion, deletion with examples only).

Graphs (4L):

Graph representations/storage implementations – adjacency matrix, adjacency list, Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS)

Module IV:

Searching, Sorting, Hashing (12L)

Sorting Algorithms (7L):

Bubble sort, insertion sort, shell sort, selection sort, merge sort, quicksort, heap sort, radix sort.

Searching (2L):

Sequential search, binary search, Interpolation Search

Hashing (3L):

Hashing functions, collision resolution techniques (Open and closed hashing).

References:

1. “Data Structures And Program Design In C”, 2/E by Robert L. Kruse, Bruce P. Leung.

2. "Fundamentals of Data Structures of C" by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed.
3. "Data Structures in C" by Aaron M. Tenenbaum.
4. "Data Structures" by S. Lipschutz.
5. "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein.

Course Outcomes:

After the completion of the course, the students are expected to be:

1. Capable of understanding the data structures, their advantages and drawbacks,
2. Implement them in C (or in any other programming language), how to overcome their drawbacks, what their applications are and where they can be used.
3. Learn about the data structures/ methods/ algorithms mentioned in the course with a comparative perspective so as to make use of the most appropriate data structure/ method/algorithm in a program to enhance the efficiency (i.e. reduce the running time) or for better memory utilization, based on the priority of the implementation.
4. Understand the efficiency aspects of the graph and sorting algorithms covered in this course.
5. Convert an inefficient program into an efficient one using the knowledge gathered from this course.

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|-----------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Analog Electronics | | | | | |
| Course Code: AEIE2101 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | 1 | - | 4 | 4 |

Module I- [6L]

Diode and Diode circuits: Diode characteristics and Peak Inverse Voltage, Analysis of Ideal and Practical diode circuits, Rectifier circuits (half wave and full wave rectifier circuits), Bridge rectifier circuit, Voltage Regulator circuits, series and shunt voltage regulators, percentage regulation, Clippers and Clampers.

Module II – [16L]

Transistor Biasing, Amplifiers and Feedback Circuits: Operating-point, fixed bias, collector to emitter bias, voltage divider bias, variation of operating point and its stability, RC coupled amplifier, Effect of Emitter and coupling capacitors, Frequency Response of single-stage and multistage.

CE transistor amplifier, Transistor Hybrid model, Analysis (Voltage gain, Current gain, Input and Output Impedance, Trans-resistance & Trans-conductance) of a Transistor amplifier circuit by h-parameters, Bandwidth and concept of wide band amplifier, Principle of frequency translation, concept of heterodyne principle.

Power Amplifier (Class A, B, AB and C), Concepts of distortion in amplifier circuits, Feedback concept, Effect of positive and negative feedbacks, voltage/current, series/shunt feedback, Barkhausen criterion, Colpitts, Hartley, Phase shift, Wein bridge and crystal oscillators.

Module III-[8L]

Basics of Operational Amplifier: Basics of OPAMP, Differential (ac and dc analysis) and Common mode operation, Constant current source, level shifter, Open & Closed loop circuits, importance of feedback loop (positive & negative), inverting & non-inverting amplifiers, voltage follower/buffer circuit, Adder, Subtractor, Integrator & differentiator, Multiplier, Divider, comparator.

Module IV-[10L]

Applications of Operational Amplifier: Zero crossing detector, Schmitt Trigger. Generalised Impedance Converter, Instrumentation Amplifier, Log & Anti-log amplifiers, Trans-conductance multiplier, Precision Rectifier (Half & Full wave), voltage to current and current to voltage converter, Peak detector, Multivibrators: Monostable, Bistable, and Astable, Multivibrators (using the 555 timer): Monostable, Bistable, and Astable, VCO and PLL.

References:

1. Sedra & Smith-*Microelectronic Circuits*- Oxford UP
2. Franco—*Design with Operational Amplifiers & Analog Integrated Circuits* , 3/e, McGraw Hill
3. Boylested & Nashelsky- *Electronic Devices and Circuit Theory*- Pearson/PHI.
4. Coughlin and Driscoll – *Operational Amplifier and Linear Integrated Circuits* – Pearson Education
5. Millman & Halkias – *Integrated El;ectronics*, McGraw Hill.
6. Rashid-*Microelectronic Circuits-Analysis and Design*- Thomson (Cenage Learning)
7. Schilling & Belove—*Electronic Circuit:Discrete & Integrated* , 3/e , McGraw Hill
8. Razavi- *Fundamentals of Microelectronics* - Wiley
9. Malvino—*Electronic Principles* , 6/e , McGraw Hill
10. Horowitz & Hill- *The Art of Electronics*; Cambridge University Press.
11. Bell- *Operational Amplifiers and Linear ICs*- Oxford UP
12. Gayakwad R.A -- *OpAmps and Linear IC's*, PHI.

13. Problems in Electrical Engineering (English) 9th Edition, N N Parker Smith.

Course Outcomes:

After completing the course the students will be able to

1. Apply the knowledge of semiconductor fundamentals to analyze simple electronic circuits based on diodes and transistors with special focus on designing different biasing methods of BJT.
2. Design and analyze BJT amplifiers for small and large signal.
3. Learn basic function of operational amplifier, ideal and practical characteristics and their mathematical applications.
4. Design and compare between different types of Oscillators to meet the specified needs with appropriate consideration.
5. Design, analyze and understand the application of different types of multivibrators with and without IC 555.
6. Analyze and design analog electronic circuits using discrete components with specified needs for the betterment of human living.

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|--------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Circuit Theory and Networks | | | | | |
| Course Code: AEIE2102 | | | | | |
| Contact hrs per | L | T | P | Total | Credit Points |
| week: | 3 | 1 | - | 4 | 4 |

Module I – [17L]

Analysis of DC & AC circuits: Analysis of circuits with and without controlled sources using mesh, node analysis, Superposition, Thevenin's, Norton's, Millman's, and Maximum Power Transfer Theorem.

Analysis of coupled circuits: Self and mutual inductances, coefficient of coupling, dot convention, equivalent circuit, solution using loop analysis.

Series and parallel resonance circuits: Condition of resonance, impedance curve, current curve, half power points, bandwidth, quality factor, selectivity, application to different combination of parallel circuits.

Module II – [8L]

Time domain analysis of R-L and R-C circuits: Forced and natural response, time constant, initial and final values.

Solution using first order equation for standard input signals: Transient and steady state time response, solution using universal formula.

Time domain analysis of R-L-C circuits: Forced and natural response, effect of damping.

Solution using second order equation for standard input signals: Transient and steady state time response.

Frequency domain analysis of RLC circuits: S-domain representation, applications of Laplace Transform in solving electrical networks, driving point and transfer function.

Module III – [9L]

Two Port Network: open circuit, short circuit, transmission and hybrid parameters, relationships among parameters, reciprocity and symmetry conditions.

Series/parallel connection: T and Pi representations, interconnection of two-port networks.

Graph Theory: Concept of graph, tree, branches, twigs, links, incidence matrix, reduced incidence matrix, tie-set matrix, cut-set matrix.

Module IV – [6L]

Basic filter circuit Design & Synthesis: Low pass, high pass, band pass and band reject filters, transfer function, frequency response, cutoff frequency, bandwidth, quality factor, attenuation constant, phase shift, Butterworth filter 2nd, 3rd and 4th order design (RC).

Network function, driving point impedance & admittance function. Synthesis tools: Foster form-I, form-II, Cauer form-I and form-II.

References:

1. Franklin F Kuo, *Network Analysis and Synthesis*, Wiley India Edition.
2. M E Van Valkenburg, *Network Analysis*, Prentice-Hall of India Pvt Ltd, New Delhi.
3. K V V Murty and M S Kamth, *Basic Circuit Analysis*, Jaico Publishing house, London.
4. Reinhold Ludwig and Pavel Bretchko, *RF Circuit Design*, Pearson Education, Asia.
5. Joseph J. Carr, *Secrets of RF Circuit Design*, Tata McGraw-Hill, New Delhi.
6. William H. Hayt, Jack E. Kemmerly, *Engineering Circuit Analysis*, McGraw-Hill Higher Education.
7. K.M.Soni, *Circuit Analysis & Synthesis*, S. K. Kataria & Sons.

Course outcome:

After completing the course the students will be able to

1. Apply knowledge of mathematics, science, and engineering to the analysis and design of electrical circuits.
2. Identify, formulate, and solve engineering problems in the area circuits and systems.
3. Acquire skills in analyzing electrical measuring devices, analog electronic circuits, power electronic circuits.
4. Analyze and synthesize RL, RC and RLC networks.
5. Obtain circuit matrices of linear graphs and analyze networks using graph theory.
6. Design an electric system, components or process to meet desired needs within realistic constraints.

| | | | | | |
|------------------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Numerical and Statistical Methods Lab | | | | | |
| Course Code: MATH2012 | | | | | |
| Contact hrs per | L | T | P | Total | Credit Points |
| week: | - | - | 2 | 2 | 1 |

Development of computer programs in C for the following problems:

1. Regula-Falsi Method
2. Newton-Raphson Method
3. Gauss-elimination Method
4. Gauss-Seidel Method
5. Newton's Forward Interpolation
6. Lagrange's Interpolation
7. Trapezoidal and Simpson's 1/3rd rule
8. Euler's and Modified Euler's Method
9. Runge-Kutta method of 4th order
10. Computation of Mean , Median , Mode and Standard Deviation for grouped and ungrouped frequency distribution
11. Computation of Correlation coefficient and Regression equation for Bivariate data.

Course outcome:

After completing the course the student will be able to:

1. Reproduce customized programs to solve problems based on Numerical Methods.
2. Develop algorithms to handle large systems of equations appearing in physical and engineering problems.

| | | | | | |
|--------------------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Data Structure and Basic Algorithms Lab | | | | | |
| Course Code: CSEN2011 | | | | | |
| Contact hrs per | L | T | P | Total | Credit Points |
| week: | - | - | 3 | 3 | 2 |

List of Experiments:

1. Implementation of array operations.
2. Stacks and Queues: adding, deleting elements Circular Queue: Adding & deleting elements Merging Problem.
3. Evaluation of expressions operations on Multiple stacks & queues.
4. Implementation of linked lists: inserting, deleting, inverting a linked list.
5. Implementation of stacks & queues using linked lists:
6. Polynomial addition, Polynomial multiplication.
7. Sparse Matrices : Multiplication, addition.
8. Recursive and Nonrecursive traversal of Trees.
9. Threaded binary tree traversal.
10. DFS and BFS.
11. Application of sorting and searching algorithms.

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|---------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Analog Electronics Lab | | | | | |
| Course Code: AEIE2111 | | | | | |
| Contact hrs per | L | T | P | Total | Credit Points |
| week: | - | - | 3 | 3 | 2 |

List of Experiments:

1. Introduction: Study of characteristics curves of B.J.T.
2. Study the effect of different parameters on frequency response of a two-stage R-C coupled amplifier and verify phase difference between input and output voltage.
3. Study of Integrator and Differentiator circuits with different types of input waveforms.
4. Study of class C & Push-Pull amplifiers.
5. Realization of Zero crossing detector & level shifter circuit using Operational Amplifiers.
6. Study of timer circuit using NE555 & configuration for monostable & astable multivibrator.
7. Construction & study of Bistable multivibrator using NE555.
8. Study of Switched Mode Power Supply & construction of a linear voltage regulator using regulator IC chip.
9. Realization of a Phase Locked Loop using Voltage Controlled Oscillator (VCO).
10. Design of an Oscillator circuit (Phase shift/ Wien Bridge).

Course Outcome:

Students will be able to

1. Analyze and identify different components of electronic circuits.
2. Set up testing strategies and select proper instruments to evaluate the performance characteristics of electronic circuits.
3. Design different kind of electronic circuits appropriately to obtain the best possible circuits that can be applied to any electronic systems.
4. Evaluate possible causes of discrepancy in practical experimental observations in comparison to theory.
5. Practice different types of wiring and instruments connections keeping in mind technical, economical, safety issues.
6. Evaluate the use of computer based analysis tools to review the performance of electronic circuit.

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|------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Circuits and Networks Lab | | | | | |
| Course Code: AEIE2112 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | - | - | 3 | 3 | 2 |

A. Hardware Based Experiment:

1. Verification of Thevenin's and Norton's theorem.
2. Transient response in RC, RL & RLC network.
3. Frequency response of Passive and active (LP, HP, BP, BR) filters of 1st & 2nd order

B. Software Based Experiment

1. PSPICE Based:
 - i. Transient analysis of RC and RL circuits.
 - ii. Leading and lagging analysis for RC and RL circuits
 - iii. Over damped, under damped, critically damped analysis of a 2nd order system by Applying different inputs
 - iv. Frequency response of 2nd order system
2. MATLAB Based:
 - i. Different types of signal generation
 - ii. Laplace and inverse Laplace transform

Course outcome:

After completing the course the students will be able to

1. Apply network theorems to analyze the experimental result using hardware circuits.
2. Analyze RL, RC, and RLC circuits in time domain using hardware components.
3. Design and analyze the frequency response of passive and active (LP, HP, BP, BR) filters of 1st & 2nd order.
4. Carry out time & frequency domain measurements on elementary RL, & RC circuits using simulation software.
5. Design the RLC circuits to study the performance characteristics.
6. Become proficient with computer skills (e.g., PSPICE and MATLAB) for the analysis and design of circuits.

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|--------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Indian Culture and Heritage | | | | | |
| Course Code: HMTS2002 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 2 | - | - | 2 | 1 |

Module I

Indian Philosophical Thought

Basic features of Indian Philosophy

Different Schools of Indian Philosophy (Brief Introduction)

Module II

Modern Indian Thinkers

Brief biographical introduction and importance of their contribution

Raja Rammohan Roy

Swami Vivekananda

Rabindranath Tagore

Mohandas Karam Chand Gandhi,

Dr. B.R. Ambedkar

Module III

Ancient Indian Science & Technology

Mathematics: Vedic Mathematics, geometry and geometric algebra, arithmetic.

Post-Vedic-discovery of zero and decimal, value of pi, trigonometry and algebra, quadric equation, binomial theorem, area of triangle.

Works of mathematicians: Baudhayana, Aryabhatta, Brahmagupta, Bhaskaracharya.

Astronomy: Vedic astronomy-concept of solstices, months, year, time.

Post-vedic- solar system, planets and their motions, earth as a sphere.

Works of Aryabhatta 1, Varahamihira, Brahmagupta, Bhaskara I and Bhaskara II

Medicine: Ayurveda and its scope,

Medicines and medicinal plants, Diagnosis and treatment,

Ayurvedic texts-SusrutaSamhita, CharakaSamhita, MadhavasNidan Sutra.

Architecture: Civil works of Indus Valley period, Town planning in Kautilya's Arthashastra, Buddhist Stupas and Viharas, Ajanta and Ellora.

Temple and Monument architecture- Mahabalipuram, Lingaraj temple, Khajuraho, FatehpurSikrI and TajMahal.

Technology: Knowledge of agriculture in Vedic and post-vedic period, crops, tillage and irrigation

Mining in Indus Civilization, literature in mining and geology.

Shipbuilding in ancient India, ships and their categories, sea going vessels and international trade.

Module IV

Art and Literature

Overview of Indian Art and Literature (Dance, music, natyashastra)

Iconic Texts of Ancient India

Gita and its Relevance

Vedas and Upanishads

Puranas

Mahabharata

Ramayana

Suggested Readings::

1. Chatterjee, S. &Datta, Outlines of Indian Philosophy. Calcutta: Calcutta University Press, 1939.
2. Prabhananda, Swami. Spiritual Values to Live By. Calcutta: Ramakrishna Mission Institute of Culture, 2010.
3. Valerian, Rodrigues. The Essential Writings of B.R. Ambedkar. New Delhi: OUP, 2004.
4. The Complete Works of Swami Vivekananda (Volumes 4,5,6). Calcutta: Sri Ramakrishna Math.
5. The Cultural Heritage of India. Vol 6. Calcutta: The Ramakrishna Mission Institute of Culture.
6. Eternally Talented India-108 Facts. Hyderabad: Vivekananda Institute of Human Excellence.

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|------------------------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Basic Environmental Engineering and Ecology | | | | | |
| Course Code: CHEM2001 | | | | | |
| Contact hrs per | L | T | P | Total | Credit Points |
| week: | 3 | - | - | 3 | 3 |

Module I

Environment & Ecology (General discussion) (9L)

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|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Basic ideas of environment and its component | 1L |
| Mathematics of population growth: exponential and logistic and associated problems, definition of resource, types of resource, renewable, non-renewable, potentially renewable, Population pyramid and Sustainable Development. | 2L |
| General idea of ecology, ecosystem – components, types and function. | 1L |
| Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem (special reference to Sundarban); Food chain [definition and one example of each food chain], Food web. | 2L |
| Biogeochemical Cycle- definition, significance, flow chart of different cycles with only elementary reaction [Oxygen, carbon, Nitrogen, Phosphorus, Sulphur]. | 2L |
| Biodiversity- types, importance, Endemic species, Biodiversity Hot-spot, Threats to biodiversity, Conservation of biodiversity. | 1L |

Module II

Air pollution and control (9L)

| | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere, Tropopause and Mesopause. | 1L |
| Green house effects: Definition, impact of greenhouse gases on the global climate and consequently on sea water level, agriculture and marine food. Global warming and its consequence, Control of Global warming. Acid rain: causes, effects and control. Earth's heat budget, carbon capture, carbon footprint | 2L |
| Lapse rate: Ambient lapse rate, adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion). Atmospheric dispersion, Maximum mixing depth | 2L |
| Definition of pollutants and contaminants, Primary and secondary pollutants: emission standard, criteria pollutant. Sources and effect of different air pollutants- Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN. | 1L |
| Smog: Photochemical smog and London smog. Depletion Ozone layer: CFC, destruction of ozone layer by CFC, impact of other green house gases, effect of ozone modification | 1L |
| Standards and control measures: Industrial, commercial and residential air quality standard, control measure (ESP, cyclone separator, bag house, catalytic converter, scrubber (ventury), Statement with brief reference). | 2L |

Module 3

Water Pollution and Control (9L)

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|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Hydrosphere, Hydrological cycle and Natural water. Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides | 2L |
| River/Lake/ground water pollution: River: DO, 5 day BOD test, Unseeded and Seeded BOD test, BOD reaction rate constants, COD. | 1L |
| Lake: Eutrophication [Definition, source and effect]. Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only) | 1L |

Water Treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening]

Waste water treatment system, primary and secondary treatments [Trickling filters, rotating biological contractor, Activated sludge, sludge treatment, oxidation ponds] 2L

Water pollution due to the toxic chemicals effects: Lead, Mercury, Cadmium, Arsenic. 1L

Noise Pollution

Definition of noise, effect of noise pollution, noise classification [Transport noise, occupational noise, neighbourhood noise]. Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, L_{10} (18hr Index), effective perceived noise level.

Noise pollution control. 2L

Module 4

Land Pollution (9L)

Solid Waste: Municipal, industrial, commercial, agricultural, domestic, pathological and hazardous solid wastes, electronic waste 2L

Recovery and disposal method- Open dumping, Land filling, incineration, composting, recycling. 2L

Social Issues, Health and Environment

Environmental disasters: Bhopal gas tragedy, Chernobyl disaster, Three Mile Island disaster, cancer and environment: carcinogens, teratogens and mutagens (general aspect) 2L

Environmental impact assessment, Environmental audit, Environmental laws and protection act of India. 1L

Energy audit, Green building, Green sources of energy, Concept of Green Chemistry, Green catalyst, Green solvents (replacement of VOC) 2L

References

1. Masters, G. M., "Introduction to Environmental Engineering and Science", Prentice-Hall of India Pvt. Ltd., 1991.
2. De, A. K., "Environmental Chemistry", New Age International.
3. Asim K. Das, Environmental Chemistry with Green Chemistry, Books and Allied P. Ltd
4. S. C. Santra, Environmental Science, New Central Book Agency P. Ltd
5. GourKrishna Das Mahapatra, Basic Environmental Engineering and Elementary Biology, Vikas Publishing House P. Ltd.

Course Outcomes:

After completing the course, the students will be able to:

1. Understand importance of protection and conservation of our indiscriminate release of pollution (air, water, land and noise) into the environment. It is incumbent upon us to save the humanity from extinction. Consequent to our activities, constricting the environment and depleting the biosphere, in the name of development.
2. Learn the methods to determine the operating point of a transistor amplifier in the active region of the characteristics and to manipulate the operating point due to the variation of temperature. Students will be able to analyze different kind of regulators.
3. Recognize and appreciate the significant role of biodiversity in sustaining life on our planet and articulate the role and relevance of environmental science in society.
4. Demonstrate a broad knowledge in ecology and conservation biology and geographical science and an understanding of the multi-disciplinary and inter-disciplinary nature of environmental science.

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|---------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Physics II | | | | | |
| Course Code: PHYS2001 | | | | | |
| Contact hrs per | L | T | P | Total | Credit Points |
| week: | 3 | 1 | - | 4 | 4 |

Module I:

Lagrange and Hamiltonian (4L)

Generalised coordinates, constraints, Lagrange's Equation of motion and Lagrangian, generalised force potential, momenta and energy. Hamiltonian formulation, Hamilton's Equation of motion.

Course should be discussed along with physical problems of 1-D motion

Quantum Mechanics (6L)

Concept of probability and probability density, operator, Commutator, Formulation of quantum mechanics and Basic postulates, Operator correspondence, Time dependent Schrödinger's equation, formulation of time independent Schrödinger's equation by method of separation of variables, Physical interpretation of wave function Ψ (normalization and probability interpretation), Expectation values, Application of Schrödinger equation-Particle in an infinite square well potential (1-D and 3-D potential well), Discussion on degenerate levels.

Module II:

Statistical Mechanics (6L)

Concept of energy levels and energy states. Microstates, Macrostates and thermodynamic probability, equilibrium macrostate. MB, FD, BE statistics (no deduction necessary), fermions, bosons (definitions in terms of spin, examples), physical significance and application, classical limits of quantum statistics. Fermi distribution at zero and non-zero temperature.

Applications of Statistical Mechanics (4L)

Planck's Black body radiation, Fermi Level in Intrinsic and Extrinsic Semiconductors, Intrinsic Semiconductors and Carrier Concentration, Extrinsic Semiconductors and Carrier Concentration, Equation of Continuity, Direct & Indirect Band Gap Semiconductors

Module III:

Dielectric Properties (5L)

Electric Dipole Moment, Dielectric Constant, Polarizability, Electric Susceptibility, Displacement Vector, Electronic, Ionic and Orientation Polarizations and Calculation of Polarizabilities - Internal Fields in Solids, Piezo-electricity, Pyro-electricity and Ferro-electricity.

Magnetic Properties (5L)

Permeability, Field Intensity, Magnetic Field Induction, Magnetization, Magnetic Susceptibility, Origin of Magnetic Moment, Bohr Magneton, Classification of Dia, Para and Ferro Magnetic Materials on the basis of Magnetic Moment, Domain Theory of Ferro Magnetism on the basis of Hysteresis Curve, Soft and Hard Magnetic Materials, Properties of Anti-Ferro and Ferri Magnetic Materials, Ferrites and their Applications, Concept of Perfect Diamagnetism

Module IV:

Band Theory of Solids (6L)

Electron in a periodic Potential, Bloch Theorem, Kronig-Penny Model (Qualitative Treatment), Origin of Energy Band Formation in Solids, Classification of Materials into Conductors, Semi Conductors & Insulators, Concept of Effective Mass of an Electron and Hole.

Super Conductivity (4L)

Introduction (Experimental survey), General Properties of SC, Effect of Magnetic field, Meissner effect, Explanation in view of wave mechanical property, , Hard and Soft superconductors, Thermal properties of SC, London equations, penetration depth.

Recommended Text Book:

Quantum Physics

- Atomic Physics – S.N. Ghoshal – S Chand
- Quantum Physics– Eisberg and Resnick – Wiley
- Quantum Mechanics – A.K. Ghatak and S. Lokenathan –Springer

Classical Mechanics

- Introduction to Classical Mechanics – R.G Takwale & P S Puranik –Tata MaGraw Hill
- Classical Mechanics – N C Rana & P S Joag – Tata MaGraw Hill

Solid State Physics

- Atomic Physics – S.N Ghoshal
- Elementary Solid State Physics – M.Ali Omar – Pearson Education
- Solid State Physics – A.J Dekkar – Macmillan
- Introduction to Solid state Physics – C.Kittel

Statistical Mechanics

- Thermodynamics, Kinetic Theory, and Statistical Mechanics–Sears and Salinger–Narosa

Course Outcomes:

After completing the course the student will be able to:

1. Develop a basic understanding of quantum mechanics with thorough knowledge of operator functions and solution and applications of Schrodinger equation;
2. Acquire the concepts of basic solid state physics and classification of solids;
3. Develop an idea of the different types of statistical distributions and be able to understand semiconductor behavior by application of statistical methods.
4. Understand different dielectric materials, physical interpretation of magnetic properties of matter, and basic understanding of superconductivity. In all cases they must build an ability of addressing related problems and explore the applications of the different theories.

| | | | | | |
|--------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Digital Electronic Circuits | | | | | |
| Course Code: AEIE2201 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | 1 | - | 4 | 4 |

Module I - [10L]

Data and number systems: Binary, Octal and Hexadecimal representation and their conversions, BCD, ASCII, EBCDIC, Gray codes and their conversions; Signed binary number representation with 1's and 2's complement methods, Binary arithmetic.

Boolean algebra: Various Logic gates- their truth tables and circuits, Representation in SOP and POS forms; Minimization of logic expressions by algebraic method, K-map method and Quine-McClauskey method.

Module II - [08L]

Combinational circuits: Adder and Subtractor circuits; Applications and circuits of Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer and Parity Generator and Checkers.

Module III - [12L]

Sequential Circuits: Basic Concepts, Flip-Flop, RS, JK, Master Slave, T and D Flip-Flops, Shift Registers and their applications, Synchronous and asynchronous counters, Up/Down counters, Ring counter. State table and state transition diagram, sequential circuits design methodology.

Module IV - [10L]

A/D (Ramp-compare, Successive - approximation and Flash type) and D/A (Binary weighted and R-2R Ladder type) conversion techniques.

Introduction to Various Logic Families: TTL, ECL, MOS and CMOS, their operation and specifications.

Memories and Programmable Logic Devices: RAM, ROM, EPROM, EEROM, PLA and PAL.

References:

1. Malvino & Brown, *Digital Computer Electronics*, TMH
2. H.Taub & D.Shilling, *Digital Integrated Electronics*, Mc Graw Hill
3. M. Mano, *Digital Logic and Design*, PHI
4. A. Anand Kumar, *Fundamentals of Digital Circuits*, PHI
5. Kharate, *Digital Electronics*, Oxford
6. Floyd & Jain, *Digital Fundamentals*, Pearson.
7. S Salivahanan & S Arivazhagan, *Digital Circuits and Design*, Vikas Publication

Course outcome:

After the completion of the course the students will be able to:

1. Understand the fundamentals of converting from one number system to another.
2. Explain the basic logic operations of NOT, AND, OR, NAND, NOR, and XOR.
3. Analyze, design and implement combinational logic circuits.
4. Analyze, design and implement sequential logic circuits.
5. Describe the nomenclature and technology in the area of memory devices: ROM, RAM, PROM, PLD etc. and different kind of ADCs and DACs.
6. Understand the basic electronics of logic circuits and be able to use integrated circuit packages.

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|----------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Sensors and Transducers | | | | | |
| Course Code: AEIE2202 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | 1 | - | 4 | 4 |

Module I – [13L]

Definition, principles of sensing and transduction, classification; concept of signal conditioning.

Mechanical and Electromechanical sensors

Resistive (potentiometric) type: Forms, materials, resolution, accuracy, sensitivity

Strain Gauges: theory, types, materials, design consideration, sensitivity, gauge factor, temperature dependence, adhesives, rosettes, applications-force, velocity and torque measurements

Inductive sensors: common types- reluctance change type, mutual inductance change type,

LVDT: Construction, materials, output-input relationship, discussion

Capacitive sensors: Variable distance- parallel plate type, Variable area- parallel plate, serrated plate/teeth type and cylindrical type, variable dielectric constant type: calculation of sensitivities; proximity measurement, Stretched Diaphragm type: microphones, response characteristics

Module II – [10L]

Magnetic sensors: Sensors based on Villari effect for assessment of force, torque, rpm meters, proximity measurement

Hall Effect and Hall drive, performance characteristics

Piezoelectric elements: piezoelectric effects, charge and voltage coefficients, crystal model, materials, natural and synthetic types – their comparison, force and stress sensing, piezoelectric accelerometer

Tachometers – Stroboscopes, Encoders, seismic accelerometer, Measurement of vibration.

Module III – [9L]

Industrial weighing systems : Link–lever mechanism, Load cells – pneumatic, piezo-electric, elastic and magneto-elastic types - their mounting, connections & circuits, pressductor, different designs of weighing systems, conveyors type, weighfeeder type.

Thermal sensors: RTD – materials, construction, types, working principle, 2-wire, 3-wire and 4-wire configuration and circuit arrangement.

Thermistor – materials, construction, types, working principle

Thermo-emf sensors: Thermocouple – Thermoelectric Laws, types, working principle, Thermopile, series and Parallel configuration of thermocouple, Wien's displacement Law, Pyrometer (total radiation and optical types)

Module IV – [8L]

Optical Sensors: Introduction to optical fibres, LDR, Photodiode, Photovoltaic cell, Photomultiplier Tube.

Geiger counters, Scintillation detectors, Ultrasonic sensors: working principle, medical & industrial applications. Introduction to Smart sensors, Advantages of Smart sensor over conventional sensors.

References:

1. D Patranabis, *Sensors and Transducers*, PHI, 2nd ed.
2. E. A. Doebelin, *Measurement Systems: Application and Design*, Mc Graw Hill, New York
3. H. K. P. Neubert, *Instrument Transducers*, Oxford University Press, London and Calcutta.
4. S. Renganathan, *Transducer engineering*, Allied Publishers Limited, 2003.
5. D. V. S. Murty, *Transducer and instrumentation*, PHI, second edition, 2008.

6. Jacob Fraden, *Handbook of Modern Sensors: Physics, Designs and applications*, Third edition, Springer International, 2010.

Course Outcomes:

After the completion of the course students will be able to

1. Understand and explain the working principles, characteristics and comparative studies of sensors and transducers to measure various industrial variables such as temperature, pressure, level, flow etc.
2. Understand the operational conditions, range and limitations of sensors and transducers.
3. Select the best-fit sensors for specific applications.
4. Understand the interfacing of the sensors with the electrical circuits in measuring and controlling devices.
5. To get the basic ideas of compensatory measures to reduce errors associated with measurement.
6. Use the sensors in IoT based applications.

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|-------------------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Electrical Measurement and Instruments | | | | | |
| Course Code: AEIE2203 | | | | | |
| Contact hrs per | L | T | P | Total | Credit Points |
| week: | 3 | 1 | - | 4 | 4 |

Module I – [10L]

Static characteristics of instruments: Accuracy, Sensitivity, Repeatability, Precision, Significant figures, Drift, Hysteresis, Threshold, Resolution, Dynamic characteristics of instruments: Fidelity, Speed of response.

Classification of analog instruments, Types of torques in indicating instruments, Ballistic galvanometer, Construction and principle of operation of Permanent Magnet Moving coil, Moving iron, Dynamometer and Electrostatic type instruments, Extension of instrument ranges using shunts and multipliers.

Module II – [7L]

Instrument transformer: Current transformer & Potential Transformer

D.C. Potentiometer: Basic slide wire potentiometer, Crompton's potentiometer,

A.C. Potentiometer: Drysdale polar potentiometer, Gall-Tinsley potentiometer; Measurement of energy by single phase induction type meter.

Module III – [11L]

Measurement of medium resistance: Ammeter-voltmeter methods, Substitution method, Wheatstone bridge method; Measurement of low resistance by Kelvin Double bridge; Measurement of high resistance: Direct deflection method, Loss of charge method, Megger ; Measurement of self inductance: Maxwell's Inductance bridge, Maxwell's inductance-capacitance bridge, Hay's bridge, Anderson's bridge; Measurement of capacitance: De Sauty's bridge, Schering bridge, Carey Foster bridge (in terms of standard mutual inductance), Measurement of mutual inductance: Heaviside mutual inductance bridge, Heaviside Campbell bridge; Measurement of frequency by Wien's bridge, Wagner Earthing device.

Module IV – [8L]

Localization of cable faults using Murray and Varley loop methods;

Static calibration of instruments & Curve fitting methods (sequential differences, extended differences and least squares method); Errors; Combination of limiting errors; Statistical treatment of Errors: Measures of Central Tendency and Dispersion; Error estimation from Normal Distribution, Chi-Square test; Reliability Principles: Reliability, Un-reliability, MFR, MTTF, MTBF, MDT, MTTR, Bath Tub curve.

References:

1. Golding & Widdis, *Electrical Measurements & Measuring Instruments* ; Wheeler
2. W. D. Cooper, *Electronic Instrument & Measurement Technique*; Prentice Hall of India
3. Forest K. Harris, *Electrical Measurement*; Willey Eastern Pvt. Ltd. Indi
4. M.B. Stout, *Basic Electrical Measurement*; Prentice Hall of India
5. A. K. Ghosh, *Introduction to Measurements & Instrumentation*, Prentice Hall, India

Course Outcome:

The students will be able to

1. Explain the static and dynamic characteristics of measuring instruments
2. Compare among the operation of measuring instruments and Select the suitable one for measurement of electrical quantities
3. Select appropriate devices for extension of range for measuring instruments

4. Apply the knowledge about the instruments to use them more effectively
5. Choose appropriate bridge for measurement of impedance
6. Estimate & analyze the errors associated with static calibration

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|------------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Language Practice Lab (Level 2) | | | | | |
| Course Code: HMTS2011 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | - | - | 3 | 3 | 2 |

Module 1

Formal verbal communication:

- Introduction to formal verbal communication, Interpersonal Skills & Public Speaking: Building Positive Relationships, Focusing on Solving Problems, Time Management, Dealing with Criticism: Offering Constructive Criticism, Responding to Criticism – Managing Conflict: Approaches to Conflict, Resolving Conflict
- Conversational skills in the business scenario: One-to-one and Group communication, Gender and Culture Sensitivity, Etiquette, Sample Business Conversation, Telephonic Conversation

Module II

Presentation skills

- Speech Purposes - General: Informative Speeches, Persuasive Speeches, Entertaining Speeches, Methods of Speaking: Speaking from a Manuscript, Speaking from Memory, Impromptu Delivery, Extemporaneous Delivery, Analyzing the Audience, Nonverbal Dimensions of Presentation
- Organising the Presentation: the Message Statement, Organising the Presentation: Organizing the Speech to Inform, The Conclusion, Supporting Your Ideas – Visual Aids: Designing and Presenting Visual Aids, Selecting the Right Medium, Post- presentation Discussion

Module III

Group Discussion

- Introduction to Group Communication
Factors in Group Communication, Status – Group Decision Making: Reflective Thinking, Brainstorming, Body Language, Logical Argument, The Planning Process, Strategies for Successful GDs, Role of Social Awareness (Newspapers, Magazines, Journals, TV News, Social Media), Practice GDs

Module IV

Job Application and Personal Interview

- **Job Application** Letter: Responding to Advertisements and Forced Applications, Qualities of Well-Written Application Letters: The You-Attitude, Length, Knowledge of Job Requirement, Reader-Benefit Information, Organization, Style, Mechanics – Letter Plan: Opening Section, Middle Section, Closing Section
- **Resume and CV:** Difference, Content of the Resume – Formulating Career Plans: Self Analysis, Career Analysis, Job Analysis, Matching Personal Needs with Job Profile – Planning your Resume – Structuring the Resume: Chronological Resume, The Functional Resume, Combination Chronological and Functional Resume – Content of the Resume: Heading, Career Goal or Objectives, Education, Work Experience, Summary of Job Skills/Key Qualifications, Activities, Honours and Achievements, Personal Profile, Special Interests, References

- **Interviewing**

Types of Interviews, Format for Interviews: One-to-one and Panel Interviews, Employment Interviews, Frequently Asked Questions, Dress Code, Etiquette, Questions for the Interviewer, Simulated Interviews

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|-------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Physics II Lab | | | | | |
| Course Code: PHYS2011 | | | | | |
| Contact hrs per | L | T | P | Total | Credit Points |
| week: | - | - | 3 | 3 | 2 |

Group 1: Experiments on Electricity and Magnetism

1. Determination of dielectric constant of a given dielectric material.
2. Determination of resistance of ballistic galvanometer by half deflection method and study of variation of logarithmic decrement with series resistance.
3. Determination of the thermo-electric power at a certain temperature of the given thermocouple.
4. Determination of specific charge (e/m) of electron.

Group 2: Quantum Physics

5. Determination of Planck's constant.
6. Determination of Stefan's radiation constant.
7. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.
8. Determination of Rydberg constant by studying Hydrogen/ Helium spectrum

Group 3: Modern Physics

9. Determination of Hall co-efficient of semiconductors
10. Determination of band gap of semiconductors.
11. To study current-voltage characteristics, load response, areal characteristics and spectral response of photo voltaic solar cells.

Note: A candidate is required to perform at least 5 experiments taking one from each group. Emphasis should be given on the estimation of error in the data taken.

Course Outcome:

After taking this course, which is a laboratory paper students will be able to

1. Apply theoretical knowledge of electricity and magnetism, quantum physics and semiconductor physics to perform various experiments that will help them determine some very important material constants viz. dielectric constant, Hall coefficient, band gap of semiconductors etc., as well as some universal constants of great importance like Stefan's constant, Planck's constant etc.
2. Develop skills of result analysis and graph plotting along with operational skills of the different experimental apparatus.

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|------------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Digital Electronic Circuits Lab | | | | | |
| Course Code: AEIE2211 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | - | - | 3 | 3 | 2 |

List of Experiments:

Design and Implementation of:

1. Basic gates using Universal logic gates.
2. Adder/Subtractor.
3. BCD to Excess-3 and Excess-3 to BCD Code Converters.
4. Binary to Gray and Gray to Binary Code Converters.
5. Simple Decoder & Multiplexer circuits using logic gates.
6. 4-bit parity generator & comparator circuits.
5. RS, JK & D flip-flops using Universal logic gates.
7. Synchronous Up/Down counter.
8. Asynchronous Up/Down counter.
9. Shift register (Right and Left) using flip-flops.
10. Ring counter.
11. Johnson's counter.

Course outcome:

After the completion of the course the students will be able to:

1. Analyze and identify different components of digital electronic circuits.
2. Set up testing strategies and select proper instruments to evaluate the performance characteristics of digital electronic circuits.
3. Evaluate possible causes of discrepancy in practical experimental observations in comparison to theory.
4. Analyze, design and implement combinational logic circuits.
5. Analyze, design and implement sequential logic circuits.
6. Develop necessary digital logic and apply it to solve real life problems keeping in mind technical, economical, safety issues.

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|-------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Electrical Measurement Lab | | | | | |
| Course Code: AEIE2212 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | - | - | 3 | 3 | 2 |

List of Experiments:

1. Calibration of Single Phase A.C. energy meter.
2. Calibration of moving iron and electro-dynamometer type ammeter/voltmeter by potentiometer.
3. Calibration of dynamometer type wattmeter by potentiometer.
4. Measurement of low resistance using Kelvin Double Bridge.
5. Measurement of Power using Instrument Transformer.
6. Measurement of Inductance by Anderson's Bridge.
7. Measurement of Capacitance by De Sauty's Bridge.
8. Measurement of unknown frequency of an A.C. supply using Wien Bridge.

Course Outcome:

The students will be able to

1. Demonstrate the calibration process of Ammeter, Voltmeter and Wattmeter
2. Estimate the value of unknown impedance using bridge circuits
3. Measure energy using Single Phase A.C. energy meter
4. Evaluate the unknown frequency of an A.C. supply using Wien Bridge
5. Determine the power using Instrument Transformer
6. Apply the knowledge about the instruments to use them more effectively

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|----------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Economics for Engineers | | | | | |
| Course Code: HMTS3101 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | - | - | 3 | 3 |

Module I - [6L]

Market: Meaning of Market, Types of Market, Perfect Competition, Monopoly, Monopolistic and Oligopoly market.

The basic concept of economics – needs, wants, utility.

National Income-GDP, GNP. Demand & Supply, Law of demand, Role of demand and supply in price determination, Price Elasticity.

Inflation: meaning, reasons, etc.

Module II - [4L]

Business: Types of business, Proprietorship, Partnership, Joint-stock company, and cooperative society – their characteristics.

Banking: role of commercial banks; credit and its importance in industrial functioning. Role of central bank: Reserve Bank of India.

International Business or Trade Environment.

Module III - [14L]

Financial Accounting-Journals, Ledgers, Trial Balance, Profit & Loss Account, Balance Sheet. Financial Statement Analysis (Ratio and Cash Flow analysis). [8L]

Cost Accounting- Terminology, Fixed, Variable and Semi-variable costs.

Break Even Analysis. Cost Sheet. Budgeting and Variance Analysis.

Marginal Cost based decisions. [6L]

Module IV - [12L]

Time Value of Money: Present and Future Value, Annuity, Perpetuity.

Equity and Debt, Cost of Capital. [4L]

Capital Budgeting: Methods of project appraisal - average rate of return - payback period - discounted cash flow method: net present value, benefit cost ratio, internal rate of return.

Depreciation and its types, Replacement Analysis, Sensitivity Analysis. [8L]

References:

1. R. Narayanswami, *Financial Accounting- A Managerial Perspective*. Prentice-Hall of India Private Limited. New Delhi
2. Horne, James C Van, *Fundamentals of Financial Management*. Prentice-Hall of India Private Limited, New Delhi
3. H. L. Ahuja., *Modern Economic Theory*. S. Chand. New Delhi.
4. Newman, Donald G., Eschenbach, Ted G., and Lavelle, Jerome P. *Engineering Economic Analysis*. New York: Oxford University Press. 2012.

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|-----------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Communication Techniques | | | | | |
| Course Code: AEIE3101 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | 1 | - | 4 | 4 |

Module I – [10L]

Analog Communication: Introduction to baseband transmission & modulation (basic concept); elements of communication systems (mention of transmitter, receiver and channel); Origin of noise and its effect, importance of SNR in system design; AM modulator & demodulator, basic principles of non-linear modulation (angle modulation - FM, PM); bandwidth requirements for angle modulated waves, comparison of various analog communication system (AM –FM – PM), VCO and PLL.

Maxwell's equations-interpretation of equations, displacement current, continuing, transmission lines-field distribution of E & H field, concept on transmission of EM wave (mention of lumped & distributed parameters, line parameters, propagation constant, characteristic impedance, wavelength, velocity of propagation, distortion-less line, reflection and transmission coefficients).

Module II – [9L]

Digital Communication: Bit rate, baud rate; information capacity, Shanon's limit; m-ary encoding, introduction to the different digital modulation techniques - ASK, FSK, PSK, BPSK, QPSK, FSK & QPSK modem, quadrature amplitude modulation (QAM); Delta modulation, adaptive delta modulation (basic concept and applications); Introduction to DPCM and spread spectrum modulation.

Module III – [13L]

Digital Transmission: Sampling theorem, sampling rate, impulse sampling, reconstruction from samples, aliasing; analog pulse modulation - PAM (natural & flat topped sampling), PWM, PPM; basic concept of pulse code modulation, block diagram of PCM; Multiplexing - TDM, FDM.

Concept of quantization & quantization error, uniform quantizer; non-uniform quantizer, conceptual idea of A-law & μ -law companding; encoding, coding efficiency, source, line coding channel coding & properties, NRZ & RZ, AMI, manchester coding PCM, DPCM; baseband pulse transmission, matched filter (its importance and basic concept), error rate due to noise; error control & coding, nyquist criterion for distortion-less base-band binary transmission, concept of eye pattern, signal power in binary digital signals.

Module IV – [8L]

Multiple Access Techniques and Radio Communication: Multiple access techniques, TDMA, FDMA and CDMA in wireless communication systems, advanced mobile phone system (AMPS), global system for mobile communications (GSM), cellular concept and frequency reuse, channel assignment and handoff, Bluetooth, introduction to satellite communication.

References:

1. Simon Haykin, *Communication Systems*; 4th Edition, John Wiley & Sons. 2001.
2. B.P.Lathi, *Modern Analog And Digital Communication systems*; 3/e, Oxford University Press, 2007.
3. H.Taub,D L Schilling ,G Saha , *Principles of Communication*; 3/e,2007.
4. Martin S.Roden, *Analog and Digital Communication System*; 3rd Edition, PHI.
5. G. S. N. Raju, *Electromagnetic Field Theory & Transmission Lines*; Pearson Education.

Course Outcomes:

After the completion of the course students will be able to

1. Distinguish among different analog modulation techniques with their advantages, disadvantages and applications
2. Interpret Maxwell's equations physically and explain wave properties in lossy, lossless and distortion less medium
3. Compare the merits and short comings of the basic digital modulation techniques
4. Apply sampling theorem to sample analog signal properly and Differentiate among pulse modulation & demodulation techniques and signal multiplexing for engineering solutions
5. Describe and determine the performance of coding schemes for the reliable transmission of digital representation of signals & information over the channel and methods to mitigate inter symbol interference
6. Compare modern multiple access schemes, explain the concept of frequency reuse, channel assignment strategies and make use of wireless communication tools

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| Course Name : Microprocessors- Architecture And Applications | | | | | |
| Course Code: AEIE3102 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | 1 | - | 4 | 4 |

Module I - [12L]

Introduction of microcomputer system.

Introduction to 8 bit Microprocessor: History of microprocessor, 8085A microprocessor internal architecture, buses, 8085 pin description.

Software instruction set, addressing modes and assembly language programming.

Module II - [10L]

Instruction cycle, machine cycle, timing diagrams.

Interrupts: Introduction, interrupt vector table, interrupt service routine, programs using interrupts, DMA operation.

Stack and stack handling, call and subroutine, counter and time delay generation.

Module III - [6L]

Interfacing of memory chip and input / output devices: Absolute and partial address decoding, interfacing of different size of memory chips with 8085A, Memory mapped I/O and I/O mapped I/O, interfacing of input/output devices with 8085A.

Module IV - [12L]

Programmable peripherals and applications: Block diagram, pin description and interfacing of 8255(PPI) with 8085A microprocessor. Interfacing of LEDs, switches, stepper motor, ADC and DAC using 8255.

Block diagram, pin description and interfacing of 8259, 8254 and 8251 USART with 8085A microprocessor.

References:

1. Ramesh S. Gaonkar, *Microprocessor architecture, programming and applications with 8085/8085A*; Wiley eastern Ltd.
2. B. Ram, *Fundamental of Microprocessor and Microcontrollers*; Dhanpat Rai Publications.
3. N. Senthil Kumar, M. Saravanan, S. Jeevanathan, *Microprocessors and Microcontrollers*; Oxford Publications.
4. A. Nagoor Kani, *8085 Microprocessor and its Applications*; Third Edition, TMH Education Pvt. Ltd.

Course outcome:

After the completion of the course the students will be able to:

1. Understand the architecture of 8 bit microprocessor (8085A).
2. Describe the importance and function of each pin of 8085A Microprocessor.
3. Develop the skill in program writing for 8085A microprocessor.
4. Describe different types of memory and I/O interfacing with 8085A microprocessor.
5. Describe the architecture of different types of programmable peripheral devices and their interfacing with 8085A microprocessor.
6. Develop the skill to interface different types of I/O devices with 8085A microprocessor using programmable peripheral device.

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| Course Name : Industrial Instrumentation | | | | | |
| Course Code: AEIE3103 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | 1 | - | 4 | 4 |

Module I – [10L]

Measurement of Pressure and Vacuum: Introduction, manometers, diaphragm, capsule, bellows, bourdon tube, pressure switch, differential pressure gauge, dead weight tester; Flapper nozzle assembly, pneumatic relay, pneumatic transmitter - force balance and motion balance system; Electronic Pr / DP transmitters – capacitive, piezoresistive and resonating wire type; installation of pressure measuring instruments with accessories like seals, snubbers, valve manifolds and installation of DP measuring instruments; Mcleod gauge, thermal conductivity gauge, ionization gauge.

Module II – [12L]

Flow rate Measurement: General concepts – Reynolds’s number, laminar flow, newtonian & non-newtonian fluids; head type flow meters – orifice, venturi, pitot tube, multiport averaging pitot, flow nozzle; variable area flow meters – glass and metal tube rotameters; electromagnetic flow meters; ultrasonic flow meters; vortex flow meters; positive displacement flow meters; turbine flow meters; Coriolis flow meters; open channel flow measurement - different shapes of weirs and corresponding flow relations, solid flow measurement.

Module III – [8L]

Level Measurement: Sight glass, float and displacers type instruments – gauges and switches, interface level measurement; resistive and capacitive type level instrument; D/P type sensors and boiler drum level measurement; ultrasonic and microwave type level instruments, radioactive level measurement, solid level measurement.

Module IV – [10L]

Temperature Measurement: filled in systems – liquid, gas and vapour, ranges, media, errors, construction details and comparison, classification; bimetal elements, thermostats; RTD – working principle, different wired configuration, characteristics, typical industrial application; thermocouples – working principle, cold junction compensation, different types of thermocouples and their application in industry and laboratory, thermopiles; thermowells, thermistor; total radiation pyrometer, optical pyrometers; hazardous area instrumentation: basic concepts, classification based on site, material and temperature – IEC and North American system; methods of protection – explosion proof, intrinsic safety, zener barrier, purging and pressurization, non-incendiary; IEC equipment protection level (EPL); NEMA and IP codes.

References:

1. B. G. Liptak, *Instrument Engineers Handbook, vol-I and vol-II*; Chilton Book Co. Philadelphia.
2. D. Patranabis, *Principles of industrial Instrumentation*; TMH, New Delhi, 2nd Ed.
3. Eckman, *Industrial Instrumentation*; Wiley Eastern Ltd.
4. D. M. Considine and G. D. Considine (Eds.) *Process Instruments and controls Handbook*; Mc Graw Hill, New York.
5. Ernest O. Doebelin, *Measurement Systems – Application and Design*; Tata-McGraw Hill.
6. K Krishnaswamy, *Industrial Instrumentation*; New Age International.
7. S. K. Singh, *Industrial Instrumentation & Control*; Tata McGraw-Hill.

Course Outcome:

After the completion of the course students will be able to

1. Learn the working principle of measuring devices for pressure and apply their knowledge for selection and installation of proper sensing instruments applicable to the process in hand.
2. Design different flow measuring devices towards the choice of proper sensing instruments required in industry
3. Analyze level measuring devices with necessary accessories for industry and societal needs
4. Demonstrate working knowledge of temperature measuring devices as well as safety practices used in the measurement and control of industrial processes
5. Design electronic instrumentation system for the acquisition of measurement data produced by measuring instruments for flow, level, temperature and pressure
6. Formulates industrial process parameters towards the analysis of process data

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| Course Name : Control Systems | | | | | |
| Course Code: AEIE3104 | | | | | |
| Contact hrs per | L | T | P | Total | Credit Points |
| week: | 3 | 1 | - | 4 | 4 |

Module I – [10L]

Elementary control concept - control system terminology and examples, basic structure of open loop, feedback and feed forward control system; mathematical model of physical system - importance, differential equation representation of physical systems, transfer function models, block diagram models, signal flow graphs models, model of standard test signals, concept of system sensitivity.

State space analysis - concepts of state, state variables and state model, state space representation of linear continuous-time systems, solution of linear time invariant state equation, concept on controllability and observability, illustrative examples.

Module II – [11L]

Developments of models for industrial control devices and systems - dc servomotors, ac servomotors, dc motor speed and position control;

Time domain analysis -time domain performance criterion, transient response of first order and second order with standard test signals, steady state error coefficient, effect of pole-zero addition in system response.

Basic control action- introduction to conventional controller (P, PI, PD, PID), effect of control action, basic knowledge for implementing of controller.

Module III – [7L]

Stability analysis - concept of stability necessary and sufficient condition for stability, Routh stability criterion, concept of relative stability; root locus technique - introduction, the root locus concept, root locus construction rules, stability analysis from the root locus plot.

Module IV – [12L]

Frequency domain analysis techniques -introduction, polar plot: guideline for sketching polar plot, stability analysis; Nyquist plot- introduction, mapping of close contour and principle of arguments, development of Nyquist stability criterion; Bode plot - minimum and non minimum phase system, concept of phase margin and gain margin, procedure for drawing Bode plots. Assessment of relative stability-gain margin and phase margin.

Compensation techniques - the design problems, lead compensation, lag compensation, lead-lag compensation.

Reference

1. Nagrath I. J. and Gopal M., “Control System Engineering”, 5th Ed., New Age International Private Ltd. Publishers.
2. Kuo B. C., “Automatic Control Systems”, 8th Ed., Wiley India
3. Ogata K., “Modern Control Engineering”, 4th Ed., Pearson Education.
4. Dorf R. C. and Bishop R. H., “Modern Control Systems” Pearson Education.
5. Norman S. N., “Control Systems Engineering”, 4th Ed., Wiley India.

Course Outcomes:

After the completion of this course students will be able to:

1. Develop mathematical model of physical and simulated systems in forms of transfer function.
2. Represent the block diagram and signal flow graph of the systems.
3. Investigate the time response of systems and calculate performance indices.

4. Analyze frequency response and stability of linear systems using different methods.
5. Understand the concept of state variable representation and design principle.
6. Check the observability and controllability of the systems.

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| Course Name : Sensors and Transducers Lab | | | | | |
| Course Code: AEIE3111 | | | | | |
| Contact hrs per | L | T | P | Total | Credit Points |
| week: | - | - | 3 | 3 | 2 |

List of Experiments:

1. Comparative studies of some temperature measuring sensors like AD590 IC sensor, RTD and thermistor.
2. Study of capacitive transducer.
3. Study of I/O characteristics of LVDT and hence measure Pressure and displacement through it.
4. Study of a load cell with tensile and compressive load.
5. Rotational speed measurement using magnetic proximity sensor.
6. Measurement of rotational speed measurement using a stroboscopic principle.
7. Comparative studies of some optical sensors like LDR, photo diode and photo transistor.
8. Design a suitable signal conditioning circuit for a given sensor.

Course Outcome:

After the completion of the assignments, the students will be able to

1. Explain working principles of sensors and transducers.
2. Study the working principle of displacement transducers and their applications.
3. Understand principle of working of various transducers used to measure Temperature, comparative study of various transducers.
4. Learn the various types of level measurement transducers and their applications, basic principle of working.
5. Understand applications of various transducers in industry
6. Understand applications of miscellaneous other sensors.

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| Course Name : Microprocessor Lab | | | | | |
| Course Code: AEIE3112 | | | | | |
| Contact hrs per | L | T | P | Total | Credit Points |
| week: | - | - | 3 | 3 | 2 |

List of Experiments:

1. Familiarization with 8085A trainer kit components with the process of storing and viewing the contents of memory as well as registers. Repeat the above using 8085A simulator.
2. Study of prewritten programs using basic instruction set (data transfer, load/store, arithmetic, logical) on the simulator and related assignments.
3. Programming using kit/simulator for:
 - a. Look up table
 - b. Copying and shifting block of memory
 - c. Packing and unpacking of BCD numbers
 - d. Addition/subtraction of two 8-bit unsigned/signed hex numbers,
 - e. Addition of 16-bit unsigned hex numbers.
 - f. BCD addition.
 - g. Multiplication of two 8-bit unsigned numbers using sequential shift - add method.
 - h. Division of two 8-bit numbers.
 - i. Factorial calculation.
 - j. Binary to ASCII conversion
 - k. String matching
 - l. String sorting
4. Interfacing with switches and LEDs through PPI 8255A with 8085A trainer kit and glowing LEDs according to read switch status, scrolling, blinking of LEDs using delay subroutines.
5. Interfacing with seven segment displays through 8-bit latch (e.g., 74LS373) using a trainer kit and 8255A PPI employing absolute and partial decoding concept as a peripheral mapped output port with absolute address decoding.
6. ADC, DAC, stepper motor interfacing with 8085A trainer kit and their programming.
7. Programming with hardware interrupts of 8085A microprocessor.
8. Familiarization with EEPROM programming and erasing.

Course Outcome:

After the completion of the course the students will be able to:

1. Select proper instructions and build different assembly language program for 8085 microprocessor.
2. Understand the assembly language programming concept of microprocessor.
3. Design the interfacing of input/output devices with 8085 microprocessor using partial and absolute address decoding.
4. Build assembly language program to control input/output devices for various applications.
5. Analyze the processing of analog signal and generation of various analog signals using interfacing circuit.
6. Realize the programming concept of hardware interrupts in 8085 microprocessor.

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| Course Name : Industrial Instrumentation Laboratory | | | | | |
| Course Code: AEIE3113 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | - | - | 3 | 3 | 2 |

List of Experiments:

1. Familiarization of/with diaphragm, capsule, bellow, Bourdon tube, orifice plate, pitot tube, etc.
2. Calibration of pressure gauges using dead weight tester.
3. Study the characteristics of thermocouple.
4. Study the characteristics of RTD.
5. Fluid flow rate measurement using orifice meter.
6. Measurement of fluid flow rate using rotameter.
7. Level measurement using capacitive/ultrasonic type level transducer.
8. Moisture measurement using moisture analyzer.
9. Measurement of kinematic viscosity using Ostwald viscometer.

Course Outcome:

After completion of this course students will be able to

1. Build a knowledge selecting particular sensing elements for the measurement of physical parameters.
2. Demonstrate the calibration process of pressure measuring devices using dead weight taster.
3. Measure process parameters like flow and level using different measuring devices.
4. Select particular temperature sensing elements for the measurement of temperature.
5. Determine the measurement of viscosity of a specific solution.
6. Formulate moisture percentage of a given sample.

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| Course Name : Control Engineering Lab | | | | | |
| Course Code: AEIE3114 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | - | - | 3 | 3 | 2 |

List of Experiments:

1. Familiarization with MATLAB control system toolbox, MATLAB-SIMULINK toolbox.
2. Block diagram reduction techniques using MATLAB.
3. Transient response of first order and second order system with standard test signals, and study of system parameter using MATLAB .
4. Design and study of the response of first and second order electrical circuits using RC and RLC circuits in hardware.
5. Study of system stability root-locus, Bode plot, Nyquist plot using MATLAB toolbox for any given transfer function with P-Z mapping.
6. Familiarization with state space representation of models using MATLAB toolbox.
7. Study the effect of P, I, D actions on first order / second order simulated processes.
8. Position control of DC servo motor.
9. Speed control of Servo motor or DC motor.

Course Outcomes:

After the completion of this course students will be able to:

1. Understand the concept of pole-zero and transfer function.
2. Derive the overall transfer function from block diagram.
3. Analyze the time response of first order and second order system for different standard input signals and calculate the transient response parameters.
4. Check the stability of a system using root locus method.
5. Find the frequency response of a system using Bode plot and Nyquist plot method.
6. Control the speed of dc motor using different controllers.

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| Course Name : Principles of Management | | | | | |
| Course Code: HMTS3201 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |

Module I – [4L]

Management: Definition, nature, purpose and scope of management, Skills and roles of a Manager, functions, principles; Evolution of Management Thought: Taylor Scientific Management, Behavioral Management, Administrative Management, Fayol’s Principles of Management, Hawthorne Studies.

Module II – [8L]

- a) **Planning:** Types of plans, planning process, Characteristics of planning, Traditional objective setting, Strategic Management, premising and forecasting.
- b) **Organizing:** Organizational design and structure, Coordination, differentiation and integration.
- c) **Staffing:** Human Resource Management and Selection, Performance appraisal and Career strategy, Managing Change.
- d) **Decision-Making:** Process, Simon’s model of decision making, creative problem solving, group decision-making.
- e) **Coordinating:** Concepts, issues and techniques.
- f) **Controlling:** Concept, planning-control relationship, process of control, Types of Control, Control Techniques

Module III – [4L]

Span of management, centralization and de-centralization Delegation, Authority & power – Concept & distinction, Line and staff organizations.

Module IV – [8L]

Organization Behaviour: Motivation, Leadership, Communication, Teams and Team Work. [6L]

Management by Objectives (MBO): Management by exception; Styles of management: (American, Japanese and Indian), McKinsey’s 7-S Approach, Self Management. [2L]

References:

1. Harold Koontz & Heinz Weihrich, Essentials of Management, TMH.
2. Stoner, Freeman, Gilbert Jr., Management, PHI.
3. Bhatt & Kumar, Principles of Management, OUP.

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| Course Name : Process Control | | | | | |
| Course Code: AEIE3201 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | 1 | - | 4 | 4 |

Module I – [6L]

Process control system: process control and automation, basic process control loop block diagram, terms and objectives, piping and instrumentation diagram, servo and regulatory control, classification of variables; process characteristic: process equation, degrees of freedom, process quantity, process potential, process resistance, process capacitance, process lag, process dead time, self-regulating processes, interacting and non- interacting processes; modeling of simple systems: liquid, thermal and gas systems.

Module II – [14L]

Theory of controllers: basic control action, two position, multi-position, floating control modes; continuous controller modes: proportional, integral, derivative; composite controller modes: P-I, P-D, P-I-D, integral wind-up and prevention, auto/manual transfer, bump less transfer, position and velocity algorithm; response of controllers with different test inputs; closed loop response of 1st & 2nd order systems with and without valve, measuring element dynamics; selection of control modes for processes like: level, pressure, temperature and flow; design of electronic/pneumatic controllers; controller tuning methods: evaluation criteria - IAE, ISE, ITAE, process reaction curve method, continuous oscillation method, damped oscillation method, auto tuning.

Module III – [10L]

Final control elements: final control element: actuators (pneumatic actuators, electrical actuators) and control valves (globe, ball, butterfly, gate, pinch), different parts, single & double seated valves, fail-safe operation, valve characteristics, inherent and installed valve characteristics, valve sizing, valve selection, cavitations, flashing, noise, instrument air supply specifications; control valve accessories: air filter regulator, I/P converter, pneumatic positioner, electro-pneumatic positioner, limit switches, motion transmitters; brief study of safety and solenoid valves.

Module IV – [10L]

Complex control system: cascade control, ratio control, feed forward control, override, split range and selective control, multivariable process control, interaction of control loops; case studies: boiler drum level control, combustion control and ph control; introduction to programmable logic controllers (PLC): basic architecture and functions; input-output modules and interfacing; CPU and memory; relays, timers, counters and their uses; PLC programming and applications; introduction to DCS and SCADA; introduction to digital control; automation hierarchy.

References:

1. Surekha Bhanot, *Process Control: Principles and Applications*, Oxford University Press, 1st Edition, 2008.
2. G.Stefanopoulos, *Chemical Process Control-An Introduction to Theory and Practice* Prentice Hall of India, New Delhi, 2nd Edition, 2005.
3. B.W. Bequette, *Process Control Modeling, Design and Simulation*, Prentice Hall of India, New Delhi, 2004.
4. Curtis D.Johnson, *Process Control: Instrumentation Technology*, Prentice Hall College Div; Custom edition, 2008.

5. C.L.Smith and A.B Corripio., *Principles and Practice of Automatic Process Control*, John Wiley and Sons, New York, 2nd Edition 1998.
6. Paul W. Murril, *Fundamentals of Process Control Theory*, 3rd Edition, ISA press, New York, 2000.
7. Bela G. Liptak, *Instrument Engineers' Handbook,: Process Control*, CRC Press; 3rd edition, 1995.

Course Outcomes:

After the completion of this course students will be able to:

1. Develop the mathematical model for the liquid, thermal and gas systems by their knowledge of Mathematics, Science and engineering.
2. Design and simulate the ON-OFF, P, PI, PID etc. controllers both in hardware and software using electronic components, simulink, MatLab, LabVIEW etc.
3. Identify; analyze the process and accordingly able to choose the modes of controller best suited for the control of the process.
4. Apply their contextual knowledge of control valve to provide engineering solutions of various societal, professional & environmental responsibilities if imposed.
5. Design and develop the ladder logic program in PLC towards the solution of the sequential events performed in industry.
6. Identify, formulate/model, analyze the process and provide solution using knowledge of complex control systems like cascade control, ratio control, feed forward control, override, split range and selective control, multivariable process control.

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|-----------------------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Electronic Instrumentation and Measurement | | | | | |
| Course Code: AEIE3202 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | 1 | - | 4 | 4 |

Module I – [12L]

Analogue electronic instruments: introduction, emitter follower voltmeter, D.C. and A.C. voltmeters with operational amplifiers, true R.M.S voltmeter, peak response voltmeter, current-to-voltage converter type electronic ammeters, chopper stabilized amplifiers for measurement of very low voltage and current, electronic multimeter; voltage controlled oscillator, phase locked loop, applications; current mirror, programmable gain amplifier, charge amplifier; voltage to frequency and frequency to voltage converters.

Module II – [10L]

Cathode ray oscilloscopes and its applications: cathode ray tube, deflection amplifiers, sweep generator, oscilloscope automatic time base, dual-trace oscilloscopes, oscilloscope controls, oscilloscope probes, delayed time base oscilloscope, analog storage oscilloscope, sampling oscilloscope, digital storage oscilloscope, applications of oscilloscope.

Module III – [9L]

Digital instruments: introduction, digital voltmeters: characteristics, types- ramp type, dual slope integrating type, successive approximation type, voltage to frequency converter type, microprocessor based ramp type; basic digital displays, LED and LCD panels, display drivers and latches, time base generation with crystal oscillators and dividers; design and implementation of a simple digital frequency meter, errors in frequency measurement–possible remedies, time period and frequency ratio measurement.

Module IV – [9L]

Q meter: basic circuit, series connection method, parallel connection method, sources of errors; electronic ohmmeter; spectrum analyzers; interference and noises; introduction to virtual instrumentation.

References:

1. David Bell, *Electronic Instrumentation & Measurement*; Reston Publishers.
2. H.S. Kalsi, *Electronic Instrumentation*; Tata McGraw Hill.
3. A.D. Helfrick & W.D. Cooper , *Modern Electronic Instrumentation & Measuring Instruments*; Wheeler.
4. D.C. Patranabis, *Principles of Electronic Instrumentation*; PHI.
5. Oliver, Cage, *Electronic Measurements and Instrumentation*; Mc Graw Hill

Course Outcome:

After completion of this course students will be able to

1. Select electronic voltmeters and ammeters suitable for typical measurements.
2. Use electronic instruments like VCO, PLL, current mirror, charge amplifier, voltage to frequency and frequency to voltage converter.
3. Explain the circuit operation of CRO, dual trace oscilloscope, delayed time base oscilloscope.
4. Familiar about digital storage oscilloscope, spectrum analyzer.
5. Explain the working of different types of digital voltmeters, digital frequency meter and digital display unit.
6. Check the quality of a coil, capacitor using Q meter.

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|--------------------------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Advanced Microprocessors and Microcontrollers | | | | | |
| Course Code: AEIE3203 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | 1 | - | 4 | 4 |

Module I - [10L]

Introduction to 8086/8088 architecture: architecture, memory segmentation, signal descriptions, clock generator, resetting the microprocessor, wait state inserting, bus buffering, interrupts; instruction set, addressing modes and assembly language programming of 8086/8088.

Module II - [6L]

Interfacing memory: interfacing static ram (6116–2K, 6264–8K), interfacing EPROM (2764 – 8K, 27256 – 32K), designing memory modules (higher capacity say 512K) using memory chips (say 8K); interfacing I/O devices.

Module III - [12L]

Introduction to microcontrollers: Intel MCS-51 family features, 8051 architecture, pin configuration, I/O ports and memory organization; instruction set and basic assembly language programming; interrupts, timer/counter and serial communication; MCS-51 applications: square wave generation, LED, A/D converter and D/A converter interfacing with 8051.

Module IV - [12L]

PIC microcontroller: introduction, architectural overview, memory organization, data memory and flash memory, interrupts and reset, timer, analog and digital I/O; programming concepts and embedded programming in C; PIC applications: temperature monitoring and control, stepper motor control.

References:

1. Douglas V. Hall, *Microprocessors & Interfacing*, Tata McGraw-Hill.
2. Ray & Bhurchandi, *Advanced Microprocessors & Peripherals*, Tata McGraw-Hill.
3. Barry B. Brey, *The Intel Microprocessors*, PHI/Pearson Ed. Asia.
4. Muhammed Ali Mazidi and Janice Gillispie Mazidi, *The 8051 Microcontroller and Embedded Systems*, Pearson Education Inc.
5. Ajay V Deshmukh, *Microcontrollers Theory and Applications*, Tata McGraw-Hill.
6. Muhammed Ali Mazidi, Rolin D. McKinlay, Danny Causey, *PIC Microcontroller and Embedded Systems*, Pearson Education Inc.
7. Raj Kamal, *Embedded systems- Architecture, Programming and Design*, McGraw Hill Education (India) Pvt. Ltd.

Course outcome:

After the completion of the course the students will be able to:

1. Describe the architecture of 16 bit microprocessor (8086/8088), 8051 and PIC (PIC16F877) microcontroller
2. Develop the skill in program writing for 8086 microprocessor, 8051 and PIC microcontroller.
3. Understand and realize the interfacing of memory, input/output devices with 8086 microprocessor.
4. Understand the interrupts of 8086 microprocessor, 8051 and PIC microcontroller.
5. Understand the use of timer/counter and serial data communication process in 8051 microcontroller.
6. Apply the knowledge to interface different type of I/O devices with 8051 and PIC microcontroller.

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|----------------------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Fundamentals of Digital Signal Processing | | | | | |
| Course Code: AEIE3231 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | - | - | 3 | 3 |

Module I – [10L]

Discrete-time signals and systems: discrete time signals- generation of discrete and digital signals, sampling of continuous time signals and aliasing, classification of discrete time signals, mathematical operations on discrete time signals- time shifting, scaling, folding, addition and multiplication; correlation of discrete time signals; discrete time systems: description, block diagram representation, classification of discrete time systems- static and dynamic, time invariant and time variant, linear and nonlinear, stable and unstable, FIR and IIR and recursive and non-recursive systems; response of LTI discrete time system; linear and circular convolution.

Module II - [6L]

Z-transform and its applications: z-transform –direct z-transform, inverse z-transform, properties of z-transform, rational z-transforms- poles and zeros, pole location and time domain behavior for causal signals; system function of linear time invariant system; inverse z-transform; one-sided z-transform; analysis of Linear Time Invariant (LTI) systems in z-domain.

Module III-[10L]

Signal transforms: Fourier Transform of Discrete-Time signals (DTFT)- definition, frequency spectrum of discrete time signal, inverse discrete time Fourier transform; Discrete Fourier Transform (DFT) – definition of forward and inverse DFT, frequency spectrum using DFT, properties and limitations of DFT; Fast Fourier Transform (FFT) – algorithm, 8-point DFT using Decimation in Time (DIT) radix-2 FFT; drawbacks of Fourier transform; introduction to time-frequency analysis- Short Time Fourier Transform (STFT), Continuous and Discrete Wavelet Transform (CWT and DWT) and their applications in signal processing.

Module IV- [10L]

Digital filter design and realizations: design of FIR filters- Fourier series method, frequency sampling method and window technique; design of IIR filters- approximation of derivatives, impulse invariance technique and bilinear transformation; structures for realization of FIR and IIR filters- direct form-I, direct form-II, cascade, parallel and linear phase structure of FIR filters; finite word length effect in digital filters.

References:

1. John G. Proakis, Dimitris G. Manolakis, *Digital Signal Processing: Principles, Algorithms and Applications*, 3rd ed., Pearson Education Inc., New Delhi, India.
2. Sanjit K. Mitra, *Digital Signal Processing- A computer based Approach*, McGraw-Hill.
3. S. Salivahanan, A. Vallavaraj, C. Gnanapriya, *Digital Signal Processing*, TMH, 2nd Edition, 2010.
4. A.V. Oppenheim, R.W. Schaffer and John R. Buck, *Discrete Time Signal Processing*, 3rd Edition, Prentice-Hall Signal Processing Series, 2009.
5. Nagoor Kani, *Signals and Systems*, McGraw Hill Education (India) Privet Limited, New Delhi, 2013.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Characterize, analyze and perform mathematical operations on discrete time signals
2. Characterize and analyze the properties of discrete time systems
3. Analyze a discrete linear time invariant system using Z-transform
4. Perform Fourier Transform of Discrete-Time signals and their properties and Fast Fourier Transform algorithms
5. Design algorithms of digital FIR and IIR filters according to the given specification
6. Realize structure of a digital filter for given transfer function

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|-------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Mobile Communication | | | | | |
| Course Code: AEIE3232 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | - | - | 3 | 3 |

Module I – [8L]

Cellular concept and system design fundamentals: introduction to wireless communication- evolution of mobile communication, mobile radio systems- examples, trends in cellular radio and personal communications; cellular concept- frequency reuse, channel assignment strategies, handoff strategies, interference and system capacity, trunking and grade of service, improving coverage and capacity of cellular systems.

Module II – [9L]

Mobile radio propagation: reflection, ground reflection model (2 ray model), diffraction, practical link budget design using path loss models, small-scale multipath propagation, parameter of multi-path channels, types of small scale fading, Rayleigh and Ricean distribution, diversity, rake receiver; instrumentation for multiple access technique in wireless communications: review of frequency division multiple access (FDMA) and time division multiple access (TDMA), spread spectrum multiple access (SSMA), space division multiple access (SDMA).

Module III – [10L]

Introduction to modern technologies: GSM network architecture, signaling protocol architecture, identifiers, channels, introduction frame structure, speech coder RPE-LTP, authentication and security, call procedure, handoff procedure, services and features; GPRS and EDGE: architecture and services offered; IS-95 A & B (CDMA-1): frequency and channel specifications of forward and reverse CDMA channel, packet and frame formats, mobility and radio resource management.

Module IV – [9L]

Wireless network & access protocols: wireless LAN – IEEE 802.11 standards – architecture – services – wireless local loop (WLL), WAP model mobile, location based services, WAP gateway, WAP protocols, WAP user agent profile-caching model and wireless bearers for WAP; 3G Technology: IMT-2000/UMTS: network architecture, air interface specification, forward and reverse channels in W-CDMA and CDMA 2000.

References:

7. Schiller, *Mobile Communication*; Pearson Ed.
8. C.Y Lee, *Mobile Communication*; Wiley.
9. Rappaport. T.S., *Wireless communications*; Pearson Education, 2003.
10. Simon Haykin & Michael Moher, *Modern Wireless Communications*; Pearson Education, 2007.
11. Gordon L. Stuber, *Principles of Mobile Communication*; Springer International Ltd., 2001.

Course Outcomes:

After the completion of the course students will be able to

1. Explain cellular concept and the strategies associated with cellular communication
2. Analyze mobile radio propagation models considering losses and fading
3. Compare multiple access techniques used for mobile communications
4. Evaluate GSM and CDMA technologies with their architecture, frame structure, system capacity as well as services provided by them
5. Design wireless local area networks utilizing the wireless access protocols
6. Determine the merits and limitations of 3G technology

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|--------------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Opto Electronics and Fibre Optics | | | | | |
| Course Code: AEIE3233 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | - | - | 3 | 3 |

Module I – [8L]

Optoelectronics: characteristics of optical emission, electro-luminescence, photo electric effect, photo conducting effect, photo voltaic effect.

Module II – [8L]

Photo diode: PIN photodiode, hetero junction diode, avalanche photo diode, phototransistor, LDR, photo voltaic cell. LED: power and efficiency calculation, structure of LED and its characteristics, hetero-junction LED.

Module III - [10L]

LASER fundamentals: fundamental characteristics of lasers, three level and four level lasers, properties of lasers, laser modes, resonator configuration-Q switching and mode locking, cavity damping, types of lasers- gas lasers, liquid laser, solid lasers, semi-conductor lasers: double hetero-junction broad area laser, stripe geometry DH laser; industrial applications of LASER: laser for measurement of distance, length, velocity, acceleration and atmospheric effect; material processing: laser heating, welding, melting and trimming of material-removal and vaporization.

Module IV - [10L]

Optical fibers and their performances : principle of light propagation through fiber, different types of fibers and their properties, fiber characteristics, absorption losses, scattering losses, dispersions, connectors; industrial applications of optical fiber; fiber optic sensors, fiber optic instrumentation system; different types of modulators, infer metric method of measurement of length, Moire fringes, birefringence fringes, measurement of pressure, temperature, current, voltage, liquid level and strain.

References:

1. J.M. Senior, *Optical Fibre Communication, Principles and Practice*; Prentice Hall of India, 1985.
2. J. Wilson and J.F.B. Hawkes, *Introduction to Opto Electronics*; Prentice Hall of India, 2001.
3. Donald J. Sterling Jr, *Technicians Guide to Fibre Optics*; 3rd Edition, Vikas Publishing House, 2000.
4. M. Arumugam, *Optical Fibre Communication and Sensor*; Anuradha Agencies, 2002.
5. John F. Read, *Industrial Applications of Lasers*; Academic Press, 1978.
6. Monte Ross, *Laser Applications*; McGraw Hill, 1968.
7. G. Keiser, *Optical Fibre Communication*; McGraw Hill, 1995.
8. S.M. Zse, *Physics of Semiconductor Devices*; Wiley; Third edition , 2008
9. Ajay Ghatak, *Optics*; TMH, 2012.

Course Outcomes:

After the completion of the syllabus, students will be able to:

1. Learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
2. Learn the various optical source materials, LED structures, quantum efficiency, Laser diodes.

3. Learn the fiber optical receivers such as PIN APD diodes, noise performance in photo detector, receiver operation and configuration
4. Specify and analyze optical optoelectronic devices in optical fiber communication.
5. Specify the different kind of losses, signal distortion in optical wave guides and other signal degradation factors
6. Gain the basic concepts of optoelectronics, properties and industrial applications.

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|-------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Biomedical Instrumentation | | | | | |
| Course Code: AEIE3241 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | - | - | 3 | 3 |

Module I- [7L]

Introduction to the physiology of cardiac, nervous, muscular and respiratory systems; basic medical instrumentation system; origin of bioelectric signals: resting and action potentials; electrode theory, electrode tissue interface, polarizable and non-polarizable, different types of electrodes- hydrogen, calomel, Ag-AgCl, pH, pO₂, pCO₂ electrodes, selection criteria of electrodes.

Module II – [6L]

Biomedical transducers: different physiological variables: blood pressure, pulse rate, cardiac output, body temperature, blood pH etc.; different types of transducers: piezoelectric, strain-gauge, LVDT, magnetic induction, thermocouple, thermistor, diaphragm etc. and their selection for biomedical applications.

Module III-[9L]

Cardiovascular measurement: the heart and other cardiac systems, measurement of blood pressure & blood flow, heart sounds, cardiac output and cardiac rate; ECG : amplifiers and leads, cardiac pace-maker, defibrillator.

Module IV-[8L]

Measurement of electrical activities in muscles and brain: EMG, EEG, and their interpretations; medical imaging: ultrasound imaging, radiography, CT Scan, MRI and applications; philosophy of biotelemetry: transmission and reception aspects of biological signals via long distances; electrical safety of patients.

References:

1. L Cromwell, *Biomedical Instrumentation and Measurements*; Pearson Education.
2. R. S. Khandpur, *Handbook of Biomedical Instrumentation*; TMH.
3. J. S. Webster, *Medical Instrumentation Application and Design*; Wiley India Pvt. Limited.
4. J. J. Carr & J. M. Brown, *Introduction to Biomedical Equipment Technology*; Pearson Education.
5. B. R. Astor, *Introduction to Biomedical Instrumentation and Measurement*; McMillan.
6. S. Chatterjee & A. Miller, *Biomedical Instrumentation*; Delmar Cengage Learning.

Course Outcomes:

After the completion of the course, the students will be able to

1. Describe the origin of biopotentials and explain the role of biopotential electrodes and to design and operate biopotential amplifiers.
2. Inspect common bioelectrical and biochemical signals and sensors with distinguish characteristic features.
3. Correlate working principle of different sensors used to measure process variables with that of cardiac variables like- blood flow rate, blood pressure, heart sound, cardiac outputs etc.
4. Explain the design of cardiac pacemaker, Defibrillator or other therapeutic instruments.
5. Understand the various method of medical imaging systems like-MRI, X-Rays, Ultrasounds along with the concept of bio-telemetry.
6. Understand the patient safety issues related to biomedical Instrumentation.

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|---------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Advanced Sensors | | | | | |
| Course Code: AEIE3242 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | - | 0 | 3 | 3 |

Module I – [9L]

Overview of micro-sensors: principle of transduction; classification of micro-sensors; chemical, thermal, pressure, acoustic, optical, electrical, mechanical, biological sensors, their calibration and determination of characteristics; materials for micro-sensors: substrates and wafers, silicon as substrate material; silicon compounds: silicon dioxide, silicon carbide, silicon nitride and polycrystalline silicon, silicon piezo-resistors, gallium arsenide, quartz, piezoelectric crystals, polymers.

Module II - [10L]

Micro-fabrication process: IC technology used in micro sensor system; crystal growth and wafer making, different techniques of deposition; physical vapor deposition - evaporation, thermal oxidation, sputtering, epitaxy, ion implantation and diffusion; chemical vapor deposition- LPCVD, APCVD, PECVD, spin coating, electrochemical deposition; pattern generation and transfer- masking, photolithography, photoresists and applications, light sources, photo resist development and removal; different types of etching: chemical and plasma; overview of micro-manufacturing techniques: bulk micro-machining, surface micro-machining, LIGA.

Module III - [9L]

Testing and packaging: partitioning, layout, technology constraints, scaling, compatibility study; scaling laws in miniaturization; examples of selected micro sensors.

Module IV - [9L]

Smart sensors: introduction; nature of semiconductor sensor output, information coding, integrated sensor principles, sensor networking, present trends.

References:

1. J. W Gardner, V. K. Varadan, *Microsensors, MEMS And Smart Devices*, Wiley, 2001.
2. Stephen Beedy, *MEMS Mechanical Sensors*, Artech House, 2004
3. N. P. Mahalik, *MEMS*, McGraw Hill, 2007
4. Jon Wilson, *Sensor Technology Handbook*, Elseiver, 2005.
5. Leondes, Cornelius T. (Ed.), *Mems/Nems Handbook Techniques and Applications*, Springer, 2006
6. Mohamed Gad-el-Hak, *The MEMS Handbook*, CRC Press; 2nd edition, 2005.
7. G. Steetman and Sanjay Banerjee, *Solid State Electronic Devices*, Prentice Hall; 6th edition, 2005.

Course Outcomes:

After the completion of the syllabus, students will be able to:

1. Know the concepts of micro sensors.
2. Know the basic concepts of sensors, selection criteria and industrial applications.
3. Acquaint the fundamentals of sensing materials, properties and industrial applications.
4. Understand microfabrication techniques.
5. Explain the need for smart sensors
6. Tell the importance of choice of materials in microfabrication techniques.

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|------------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Non Conventional Energy Sources | | | | | |
| Course Code: AEIE3243 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | - | - | 3 | 3 |

Module I – [8L]

Introduction: fossil fuel based systems, impact of fossil fuel based systems, non conventional energy – seasonal variations and availability, renewable energy – sources and features, hybrid energy systems, distributed energy systems and dispersed generation (DG); solar thermal systems: solar radiation spectrum, radiation measurement, conversion technologies, applications- heating, cooling, drying, distillation, power generation.

Module II – [9L]

Solar photovoltaic systems: operating principle, photovoltaic cell concepts - cell, module, array, series and parallel connections, maximum power point tracking, applications - battery charging, pumping, lighting, solar cell power plant, limitations; wind energy: wind patterns and wind data, site selection, types of wind mills, characteristics of wind generators, performance and limitations of energy conversion systems, load matching, recent developments.

Module III – [8L]

Energy from bio-mass: resources and conversion process: bio gas conversion, bio gas plant, bio mass gasifier, cogeneration, bio-diesel; fuel cells: principle of working of various types of fuel cells - working, performance and limitations, advantages of fuel cell power plants, future potential of fuel cells; geothermal energy: resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations.

Module IV – [11L]

Energy from the ocean: ocean thermal electric conversion (OTEC) systems like open cycle, closed cycle, hybrid cycle, prospects of OTEC in India; energy from tides: basic principle of tidal power, single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy; energy power from wave: wave energy conversion devices, advantages and disadvantages of wave energy; concept of energy management and audit.

References:

1. G.D. Rai, *Non-conventional energy sources*; Khanna Publishers.
2. H.P. Garg & Jai Prakash, *Solar Energy: Fundamentals and Applications*; Tata McGraw Hill.
3. Bansal, Kleeman & Melisa, *Renewable Energy Sources & Conversion Technology*; Tata McGraw Hill New Delhi.
4. Twidell & Weir, *Renewable Energy Resources*; ELBS
5. D.S. Chauhan, *Non-conventional Energy Resources*; New Age International.
6. C.S. Solanki, *Renewal Energy Technologies: A Practical Guide for Beginners*; PHI Learning.
7. Peter Auer, *Advances in Energy System and Technology- Vol. 1 & II*; Edited by Academic Press.

Course Outcomes:

After the completion of the course students will be able to

1. Discuss the issue of fuel availability and analyze the supply and demand of fuel in the world
2. Illustrate solar energy conversion techniques
3. Compare the working principle and environmental impacts of a biomass based power plant with a coal-fired power plant
4. Estimate the scope of wind energy for electricity generation
5. Explain the process to harness energy from nonconventional energy sources like geothermal, tidal, ocean-thermal and wave
6. Evaluate the economical use of renewable energy resources compared to conventional energy sources

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|------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Process Control Lab | | | | | |
| Course Code: AEIE3211 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | - | - | 3 | 3 | 2 |

List of Experiments:

1. Study of flow, level and pressure processes and construction of P&I diagram in accordance with ISA guidelines /Standards.
2. Study of typical pressure control loop having pressure source, pressure transmitter, control valve and conventional PID controller.
3. Study of a typical level control loop having level transmitter, control valve and conventional PID controller.
4. Study of a typical air duct flow monitoring and control.
5. Study of a furnace temperature control loop.
6. PLC programming through PC.
7. Study of single element & three element control of boiler drum level and burner management system using boiler simulation software.

Course Outcomes:

After completion of this course students will be able to

1. Draw and explain P&I diagram of flow, pressure, level and temperature control loop from their engineering knowledge.
2. Analyze the process responses with respect to various process parameter values.
3. Use software tool to study the close loop process responses.
4. Create ladder logic diagram for various sequential operations commonly used in industrial environment.
5. Conduct experiments either in group or by individual means.
6. Provide engineering solutions of various societal, professional & environmental responsibilities.

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|---------------------------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Electronic Instrumentation and Measurement Lab | | | | | |
| Course Code: AEIE3212 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | - | - | 3 | 3 | 2 |

List of Experiments:

1. Study of static and dynamic characteristics of a measuring instrument.
2. Acquaintance with basic structure of DMM and measurement of different electrical parameters.
3. Realization of data acquisition system.
4. Spectrum analysis using spectrum analyzer.
5. Realization of a V-to-I & I-to-V converter.
6. Study of VCO (voltage controlled oscillator) & PLL (phase locked loop).
7. Study of analog to digital converter.
8. Study of digital to analog converter.
9. Statistical analysis of errors in measurement using MATLAB.

Course Outcomes:

After completion of this course students will be able to

1. Use data acquisition system to gather output data from transducer.
2. Able to make statistical analysis on large number of data.
3. Implement analog to digital and digital to analog converter.
4. Get hands on experience on voltage controlled oscillator, phase locked loop and spectrum analyzer.
5. Design voltage to current converter, current to voltage converter and digital multimeter.
6. Study static and dynamic characteristics of measuring instruments.

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|------------------------------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Advanced Microprocessors and Microcontrollers Lab | | | | | |
| Course Code: AEIE3213 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | - | - | 3 | 3 | 2 |

Experiments with 8086 microprocessor:

1. Familiarization of 8086 microprocessor kit/simulator, its operation along with prewritten programs on it using data transfer, load/store, arithmetic and logical instructions.
2. Write assembly language programs (ALP) using 8086 microprocessor/simulator on the following:
 - i) Finding the largest/ smallest number from an array
 - ii) Arranging numbers in ascending/descending order
 - iii) Shifting a block of data from one memory location to another
 - iv) Addition of a series of BCD numbers
 - v) String matching

Experiments with 8051/ PIC 16F or 18F series microcontroller:

3. Write a program using microcontroller to read a digital input from a push button switch and toggle a LED ON and OFF every time the switch is pressed.
4. Write a program using microcontroller to develop a 4-bit binary counter and display the counts using seven segment displays.
5. Write a program using microcontroller to interface LCD and display characters.
6. Write a program using microcontroller to generate square wave, saw tooth wave and triangular wave of specified frequency.
7. Write a program to develop a temperature monitoring system using temperature sensor, LCD and microcontroller.
8. Write a program to perform pulse width modulation of a voltage signal using a microcontroller.
9. Write a program to control a stepper motor/servo motor and control its rotational direction, speed and number of steps using microcontroller.
10. Write a program to transmit data through serial port between microcontroller and PC.
11. Write a program to interface a matrix keypad with microcontroller and display the pressed key information on a character LCD.

Course Outcomes:

After the completion of the course the students will be able to:

1. Understand the assembly language programming concept of 8086 microprocessor.
2. Develop 8051/ PIC 16F or 18F series microcontroller based systems to implement various tasks such as switch state read, development of binary counter, data transfer, etc.
3. Design the interfacing of display devices (LED/LCD) with microcontroller and write program using them.
4. Build program to control input/output devices like motor (stepper motor/servo motor), temperature sensor, key board, etc., with microcontrollers for various applications.
5. Build program using microcontroller to generate different waveforms (like square wave, saw tooth wave) and perform pulse width modulation of a voltage signal.
6. Design and implement an embedded system using 8051/ PIC 16F or 18F series microcontrollers.

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|----------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Personality Development | | | | | |
| Course Code: HMTS3221 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 1 | - | - | 1 | 1 |

Module I: Self Growth

- i) Self Growth- Maslow's Hierarchy of Needs Theory
- ii) Anger, Stress & Time Management- Theories and application
- iii) SWOT Analysis

Module II: Stepping Up

- i) Growth & Environment
- ii) Competitive Spirit
- iii) Responsibility Factor

Module III: Professional Communication

- i) Impression Management- theory on social psychology
- ii) Employability Quotient
- iii) Cross-cultural communication

Module IV: Leadership & Team Playing

- i) Leadership & Team Playing: Theories, Styles, Stages
- ii) Motivation, Negotiation Skills, Conflict Management
- iii) Planning & Envisioning: Initiative and Innovation in the Work Environment- De Bono's Six Thinking Hats

Evaluation:

Max.Marks-100(sessional)
25 marks/ module

Methodology: Assignment and project

Suggested Reading

1. Personality Development and Soft Skills by Barun K. Mitra, Oxford University, 2011
2. Soft Skills: An Integrated Approach to Maximize Personality by Gajendra Singh Chauhan and Sangeeta Sharma, Wiley, 2016
3. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success by Gopaldaswamy Ramesh and Mahadevan Ramesh, Pearson, 2010

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|------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Technical Seminar I | | | | | |
| Course Code: AEIE3221 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | - | - | 3 | 3 | 2 |

The seminar should be on any topic having relevance with Instrumentation engineering and related areas of technology. The topic should be decided by the student and concerned teachers. Seminar work shall be in the form of presentation to be delivered by the student regularly throughout the semester. The candidate will deliver a final talk on the topic at the end of the semester and assessment will be made by a group of internal examiners.

Course Outcomes:

After the completion of the course the students will be able to:

1. Explore literature to identify promising new directions of various cutting edge technologies to solve real-world issues.
2. Build up knowledge in the field engineering, with specialization related to Electronics and Instrumentation engineering and the ability to integrate information across disciplines.
3. Prepare quality presentation on a topic with proper organization and demonstrate the content properly with the aid of audio-video, pictures and documents, etc.
4. Communicate effectively by making an oral presentation before an evaluation committee.
5. Interact efficiently with audience.
6. Develop habits of maintaining regularity and punctuality.

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|---------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Telemetry and Remote Control | | | | | |
| Course Code: AEIE4101 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | 1 | - | 4 | 4 |

Module I – [11L]

Introduction to telemetry principles: Basic systems, classifications, non electrical telemetry systems, voltage and current telemetry systems.

Networking protocols for wired system – TCP/IP & P2P protocols.

Basics in Wireless systems – WiMAX, ZigBee and Bluetooth, power line carrier communication.

Module II – [9L]

Review of digital modulation techniques: MPSK, QAM, FDM systems – architecture & standards, TDM systems (architecture), synchronization.

Signaling for instrumentation systems – wireless system, Wireless sensor network, Satellite system.

Module III – [9L]

Satellite telemetry system - general considerations, telemetry and Tele-command, SCADA for communication system.

Optical fiber cable – dispersion, losses, connectors and splices, transmitter and receiving circuits, coherent optical fiber communication system, wavelength division multiplexing, trend in fiber optic device development – examples of an optical telemetry system.

Module IV – [11L]

Remote control and its importance for independent messages and combinatorial message sharing. Telemetry systems in process industries, Power system telemetry.

Introduction to IoT, Basic sensor networks, Architecture of IoT system, MQTT protocol.

Video conferencing systems for Telemedicine, Telemedicine standards (DICOM).

References:

1. D. Patranabis, *Telemetry principles*, TMH, New Delhi
2. E. L. Gruenberg, *Handbook of Telemetry and Remote control*, Mc Graw Hill
3. B. P. Lathi, *Modern Digital and Analog Communication Systems*, Oxford University Press
4. G. Swobada, *Telecontrol Method and Application of Telemetering and Remote Control*, Von Nostrand.
5. Ginz Beng “Fundamentals of Automation and Remote Control”.
6. Feng Zhao and Leonidas. J. Guibas, *Wireless Sensor Networks: An Information Processing Approach*, Morgan Kaufmann.

Course Outcomes:

After the completion of the course students will be able to

1. Design and handle a transmitting and receiving section of a telemetry system.
2. Design biotelemetry system used in critical cases.
3. Handle computerized control wireless telemetry system.
4. Recognize and explain at a basic level fundamental principle of digital communication systems
5. Demonstrate proficiency and conceptual understanding in current and voltage telemetry systems.
6. Use data acquisition and distribution systems for telemetry in process plants

| | | | | | |
|---------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Power Electronics and Drives | | | | | |
| Course Code: AEIE4102 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | 1 | - | 4 | 4 |

Module I – [9L]

Power semiconductor devices: power diodes, power BJT, power MOSFET, SCR, DIAC, TRIAC and IGBT: construction, characteristics, working principles, applications.

Module II - [9L]

Thyristor:

Principle of operation of SCR, specification and rating, static characteristics, two-transistor analogy, SCR construction, gate characteristics of SCR, turn-on methods of SCR, dynamic turn-on switching characteristics, turn-off mechanisms (commutation), thyristor protection with snubbers and inductors.

Module III - [11L]

Phase controlled rectifiers:

Single phase converters: half controlled and full controlled converter, evaluation of input power factor and harmonic factor, continuous and discontinuous load current, single phase dual converters, power factor improvements, extinction angle control, symmetrical angle control, PWM, single phase sinusoidal PWM, single phase series converters, applications.

Three Phase Converters:

Half controlled and full controlled converters, evaluation of input power factor and harmonic factor, continuous and discontinuous load current, three phase dual converters, power factor improvements, three-phase PWM, twelve phase converters, applications.

Inverters:

Single phase and three phase (both 120° mode and 180° mode) inverters - PWM techniques: sinusoidal PWM, modified sinusoidal PWM, multiple PWM, introduction to space vector modulations, voltage and harmonic control, series resonant inverter, current source inverter.

Module IV - [11L]

Choppers:

Step-down and step-up chopper - time ratio control and current limit control – buck, boost, buck- boost converter.

Cycloconverters:

Single phase to single phase cycloconverter, three-phase half wave converters, cycloconverter circuit for three-phase output.

DC drives:

Basic machine equations, schemes for D.C motor speed control, single phase separately excited drives, braking operation of rectifier controlled separately excited drives, D.C chopper drives, phase-locked loop (PLL) controlled D.C drives.

AC drives:

Basic principle of operation, speed control of induction motor, stator voltage control, variable frequency control, rotor resistance control, slip power recovery scheme, synchronous motor drives.

References:

1. Shashi B. Dewan, Alan Straughen, Power Semiconductor Circuits, Wiley-Blackwell.
2. D. Bedford & R. G. Hoft, Principles of Inverter Circuits, John Wiley & Sons.

3. M H Rashid, *Power Electronics*, Pearson Education.
4. P C Sen, *Modern power electronics*, S. Chand.
5. Lander ,*Power Electronics*, McGraw Hill.

Course Outcomes:

After the completion of the syllabus, students will be able to:

1. Gain practical knowledge about power electronic devices.
2. Analyze various single phase power converter circuits and understand their applications.
3. Gain practical knowledge about using simulation software in power electronics.
4. Design and simulate gate firing circuits.
5. Design and simulate rectifier, chopper and AC voltage controller
6. Develop skills to build and troubleshoot power electronics circuits.

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|-----------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Advanced Process Control | | | | | |
| Course Code: AEIE4141 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | - | - | 3 | 3 |

Module I – [10L]

Digital control loop with continuous process and digital controller, advantages & limitations of digital control. Signal discretization - sampling of continuous signal, sampling period considerations, sampling as impulse modulation, sampled spectra & aliasing. Signal reconstruction – zero and first order hold. Z-transform techniques, pulse transfer function, mapping between S-plane and Z-plane. Stability studies: W - plane transforms, Jury stability criterion, effect of sampling period.

Module II – [10L]

Digital Control Algorithms: (a) dead beat control, (b) Dahlin's algorithm, (c) position algorithm and velocity algorithm. Enhanced single loop control strategies: a) cascade control, b) time delay compensation, c) inferential control, d) selective control/override control, e) nonlinear control system: gain scheduling and fuzzy control, f) adaptive Control.

Module III – [8L]

Real-time optimization (RTO): Basic requirements, the formulation and solution of RTO problems, optimization methods. Overview of model predictive control system. Introduction to batch process control.

Module IV – [8L]

Design of automation system architecture: basic components and their functions; concept of different industrial communication: ISO/OSI reference model, data highway and field-bus; Industrial networking: network access protocols – TDMA, CSMA/CD, token passing, master – slave, network transmission media – twisted pair, co-axial, fiber optic, network topology – mesh, ring, star, bus; concept of redundancy and necessity in process plant; design of SCADA system; client server concept and design; different level of automation.

References:

1. Seborg, D., Edgar, T., and Mellichamp, D., Process Dynamics and Control, Wiley & sons, New York, 1989.
2. G.Stephanopoulos, *Chemical Process Control-An Introduction to Theory and Practice* Prentice Hall of India, New Delhi, 2nd Edition, 2005.
3. B.W. Bequette, *Process Control Modeling, Design and Simulation*, Prentice Hall of India, New Delhi, 2004.
4. Luyben, W., Process Modeling, Simulation and Control for Chemical Engineers, McGraw Hill, New York, 1990.
5. Curtis D.Johnson, *Process Control: Instrumentation Technology*, Prentice Hall College Div; Custom edition, 2008.
6. C.L.Smith and A.B Corripio., *Principles and Practice of Automatic Process Control*, John Wiley and Sons, New York, 2nd Edition 1998.
7. Paul W. Murril, *Fundamentals of Process Control Theory*, 3rd Edition, ISA press, New York, 2000.
8. Bela G. Liptak, *Instrument Engineers' Handbook,: Process Control*, CRC Press; 3rd edition, 1995.

Course Outcomes:

After completion of the course students will be able to

1. Apply knowledge of Mathematics, Science and engineering to develop the process models in digital domain
2. Analyze stability of the system in digital domain
3. Able to develop algorithms for design of various controllers
4. Formulate real time optimization (RTO) problems; apply optimization methods for the possible solutions
5. Learn the architecture of automation systems
6. Familiar with the protocols used for designing of automation systems

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|-------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Soft Computing | | | | | |
| Course Code: AEIE4142 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | - | - | 3 | 3 |

Module I – [7L]

Introduction to soft computing- fuzzy computing, neural computing, genetic algorithm and stochastic algorithm; introduction to different hybrid systems: fuzzy-conventional, neuro-fuzzy, neuro-genetic, genetic-fuzzy systems.

Introduction to fuzzy logic: benefits and application scope of fuzzy logic, distinguish fuzzy set and crisp set, fuzzy set theory, membership functions, fuzzy relations.

Module II - [10L]

Fuzzy systems: different fuzzy implications, compositional rule of inference, normalization and de-normalization, fuzzification, fuzzy rule-base design, defuzzification procedures, steps to design fuzzy controllers.

Module III - [10L]

Neural network: biological neuron and evolution of neural network, model of artificial neuron, architectures, single-layer NN Systems, applications.

Back propagation neural network, radial basis function network.

Neuro and neuro fuzzy control: structure, optimization and case studies.

Module IV - [9L]

Genetic algorithm: introduction, encoding, operators of genetic algorithm, basic genetic algorithm.

Hybrid system: integration of neural networks, fuzzy logic and genetic algorithms.

References:

1. J. S. R. Jang, C. T. Sun and E. Mizutani, *Neuro-Fuzzy and Soft Computing*, PHI, 2004, Pearson Education 2004.
2. Dirankov, Hellendoorn and Reinfrank, *An Introduction to Fuzzy Control*, Narosa Publishing House.
3. Davis E. Goldberg, *Genetic Algorithms: Search, Optimization and Machine Learning*, Addison Wesley, N.Y., 1989.
4. S. Rajasekaran and G. A. Vijaylakshmi Pai, *Neural Networks Fuzzy Logic, and Genetic Algorithms*, Prentice Hall of India.
5. J. Yen and R. Langari, *Fuzzy Logic, Intelligence, Control and Information*, Pearson Education.
6. S. Haykin, *Neural Netowrks*, Prentice Hall of India.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Classify the soft-computing into the different computing methods based on their application, knowledge-base, mode of operation, construction, etc.
2. Explain the functions and properties of different fuzzy sets and compare with crisp set, explain different fuzzy relations and implications.
3. Design and analyze the different components of fuzzy controller appropriately to obtain the best possible fuzzy controller that can be applied to any process control systems.
4. Identify different component of biological and artificial neural network, and acquire knowledge of different ANN terminologies to apply in solving control problems.
5. Analyze and design algorithms for different supervised and unsupervised learning networks.
6. Illustrate biological background and give idea about basics of genetic algorithm and its application in optimizing controller parameters.

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| Course Name : Power Plant Instrumentation | | | | | |
| Course Code: AEIE4143 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | - | - | 3 | 3 |

Module I – [6L]

Fundamental of power plant: Introduction, classification of power plants, resources for power generation, review of thermodynamics cycles related to power plants, fuel handling and combustion, steam generators, steam turbines, fans and pumps, components of turbo generators and auxiliaries.

Module II – [12L]

Instrumentation and control: Burner management system, drum level measurement-DP cell type, hydra step, furnace draft control, boiler drum level control, load demand control, combustion control, steam temperature control, steam pressure control, deaerator storage tank and condenser hot-well level control.

Module III – [10L]

Instrumentation for safety interlocks, emergency shutdown conditions, alarm annunciators. Turbine supervisory instrumentation system: measurement of vibration, eccentricity, rotor & casing movement, temperature of metal and lubricating oil, speed etc. Turbine control systems: speed, lube oil pressure/flow, temperature, tank level etc.

Module IV – [8L]

Water treatment plant: water sources, water quality (impurities), effects of impurities, measurement of impurities, feed water treatment, blow down control.

Pollution measurement and environmental regulations: NO_x, SO_x and CO_x and particulate measurement.

Introduction to hydel power plant, Introduction to nuclear power plant.

References:

1. K Krishnaswamy, M Ponni Bala, *Power Plant Instrumentation*, PHI, 2011.
2. Black & Veatch, *Power plant engineering*, Springer Science & Business Media, Inc. 1996.
3. L. L. Grigsby, *Electric Power Engineering Handbook*, CRC Press, 2001.
4. A.K. Raja, A.P. Srivastava, M. Dwivedi, *Power Plant Engineering*, New Age International (P) Ltd., 2006.

Course Outcomes:

After completion of the course students will be able to

1. Analyze and select thermodynamic cycles used for thermal power plant.
2. Design P&I diagrams for different control loops associated with thermal, hydal and Nuclear power plant.
3. Investigate, formulate and analyze the safety requirements during power plant operation and accordingly able to design instrumentation systems for safety interlocks in power plant.
4. Design Turbine supervisory instrumentation system.
5. Apply engineering knowledge towards the treatment of water for industrial use.
6. Apply contextual knowledge for analysis and measure of pollutant produced by thermal power plant.

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|---------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Biosensors | | | | | |
| Course Code: BIOT4181 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | - | - | 3 | 3 |

Module I: Introduction to biological system and Biosensors [10L]

Biosensor: principle, general characteristics; Proteins and enzymes: basic properties, denaturation and renaturation, immobilization of enzymes; Advantages and limitations of biosensors; Classification of biosensors based on bioreceptor; Immobilization and coupling of bioreceptors.

Module II: Bio-recognition based sensors [10L]

Principle, operation and limitation of: Microbial sensor, Immunological sensor, Nucleic acid sensor. Other bioreceptors (e.g. animal, plant tissue); Different types of inhibitors: principles, operations, applications and limitations.

Module III: Biosensor based on transducer [10L]

Classification of biosensor based on transducer; Calorimetric, Electrochemical (potentiometric, amperometric), Optical, Piezoelectric, Semiconductor biosensor: principle, construction, calibration and limitations.

Module IV: Application of biosensor [10L]

Clinical and diagnostics sector, Industrial sector: Food, Environmental, defense sector; Commercially available biosensor.

Reference Books:

1. Biosensors by Tran Minh Canh. London. Chapman and Hall, 1993.
2. Turner, A.P.F, Karube.I.,and Wilson,G.S, Biosensors Fundamentals and applications, Oxford Univ. Press.
3. Engineering biosensors, kinetics and design applications by Ajit Sadana..San Diego, Academic Press, 2002.
4. D.Thomas and J.M. Laval – Enzyme Technology in concepts in Biotechnology by Balasubramaniam et al, Univ. Press, 1996.

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|--------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Big Data and Web Technology | | | | | |
| Course Code: CSEN4182 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | - | - | 3 | 3 |

Module 1: Intelligent Information Retrieval

Learning from user interactions. Rating and voting, emailing and link forwarding, bookmarking, purchasing items, reviews.

Extracting intelligence from tags. Tag related metadata. Tag generation. Leveraging tags: dynamic navigation, using tag clouds, targeted search, recommendations based on tags.

Extracting intelligence from content: Blogs, Wikis, Message boards.

Module 2: Clustering, Classification and Recommendations

Clustering and web intelligence. Overview of clustering algorithms.

Classification and Web Intelligence. Need for classification. Overview. Automatic categorization of emails and spam filtering. Classification and fraud detection. Combining classifiers.

Creating Suggestions and Recommendations. Concepts of distance and similarity. Recommendations based on similar users. Recommendations based on similar items. Recommendations based on content.

Module 3: Introduction to Hadoop

Starting Hadoop. Components of Hadoop. HDFS. Working with files in HDFS. Introduction to MapReduce. Streaming in Hadoop. Advanced MapReduce: Chaining MapReduce jobs, Joining data from different sources. Developing MapReduce programs in local mode and pseudo-distributed mode. Moving data into and out of Hadoop. Data input and output in MapReduce. Applying MapReduce patterns to Big Data. Streamlining HDFS for big data.

Module 4: Algorithms Using MapReduce

Matrix-Vector Multiplication by MapReduce. Relational-Algebra Operations. Computing Selections by MapReduce. Computing Projections by MapReduce. Union, Intersection, and Difference by MapReduce. Computing Natural Join by MapReduce. Grouping and Aggregation by MapReduce. Matrix Multiplication.

Course Outcomes:

1. Web Intelligence is a fast-growing area of research that combines multiple disciplines including artificial intelligence, machine learning, data mining, natural language processing.
2. Making the web intelligent is the art of customizing items in response to the needs of the users. Predicting users' behaviors will expedite and enhance browsing experience, which could be achieved through personalization.
3. The first half of this subject will provide the students a platform which will give them an introduction to the subject and will empower them to find the most appropriate and best information for their interest.
4. Hadoop and MapReduce are useful tools to work with Big Data. Hadoop is a free, Java-based programming framework that supports the processing of large data sets in a distributed computing environment. MapReduce is a core component of the Apache Hadoop software framework.
5. The second half of the course gives students an introduction to the use of Hadoop and MapReduce.

Text Books:

1. Algorithms of the Intelligent Web. H. Marmanis and D. Babenko. Manning Publishers, 2009.
2. Collective Intelligence in Action. S. Alag. Manning Publishers, 2009.
3. Hadoop in Action by Chuck Lam. Manning Publishers. 2011.
4. Hadoop in Practice by Alex Holmes. Manning Publishers. 2012.
5. Mining of Massive Datasets by Jure Leskovec, Anand Rajaraman, Jeff Ullman. Cambridge University Press. 2011.

Reference Books:

1. Mining the Web: Discovering Knowledge from Hypertext Data. S. Chakrabarti, Morgan-Kaufmann Publishers, 2002.
2. Recommender Systems Handbook: Francesco Ricci, Lior Rokach, Bracha Shapira, Paul B. Kantor, Springer, 2011.

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|---------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : VLSI Design Automation | | | | | |
| Course Code: ECEN4181 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | - | - | 3 | 3 |

Module I: VLSI Circuits & Physical Layout: [12L]

Unit1: MOS Transistor Characteristics, MOS as Digital Switch, NMOS Logic Family, CMOS Logic Family, CMOS Inverter Characteristics (VTC), Inverter Delay & Noise, NAND and NOR gates, Complex Logic Circuits, Pass Transistor Logic & Transmission Gate, CMOS Sequential Circuits, CMOS D-Latch and D-Flip-Flop

Unit2: CMOS Cross Section, Layout and Mask layers, Inverter Layout, Lambda Rule vs Micron Rule, Std Cell Layout Topology, Stick Diagram, Euler Path Algorithm, Layout Legging.

Module II: VLSI Design Methodology: [8L]

Unit1: Moore's Law, Scale of Integration (SSI, MSI, LSI, VLSI, ULSI, GSI), Technology growth and process Node,

Unit2: Full Custom Design, Std Cell based Semi Custom Design, Gate Array Design, PLD, FPGA: CLB, LUT, MUX, VLSI Design Cycle, Y-Chart.

Module III: EDA Tools: High level Synthesis and HDL: [8L]

Unit1: High level Synthesis EDA Flow, Control and Data Flow Graph, Scheduling, Allocation, Binding, RTL

Unit2: Why HDL? Frontend Design Flow using HDL (Behavioral, RTL and Gate Level), Verilog Modeling: Behavioral, Data-Flow, Structural and Mixed, Test Bench, FSM Example: Mealy Machine and Moore Machine. Pipeline Example.

Module IV: EDA Tools: Logical Synthesis and Physical Design Automation: [12L]

Unit1: Combinational Logic Optimization: BDD: Binary Decision Diagram, OBDD, ROBDD, Technology Mapping: Pattern DAG, Subject DAG, Sequential Logic Optimization

Unit2: Physical Layout Automation EDA Flow, Partitioning: KL Algorithm, Floor-planning cost function, Placement, Detailed Routing: Channel Routing, Horizontal Constraint Graph, Vertical Constraint Graph, Cyclic Constraint, Left-edge Algorithm, Global Routing: Steiner Tree, Maze Routing.

Text Book:

1. Principles of CMOS VLSI Design, A Systems Perspective, Author: Neil Weste, Kamran Eshraghian, Addison Wesley, 2nd Edition, 2000
2. Algorithms for VLSI Physical Design Automation, Author: N. Sherwani, KLUWER ACADEMIC PUBLISHERS (3rd edition)

Reference Book:

3. CMOS Digital Integrated Circuits, Analysis and Design, Author: Sung-Mo Kang, Yusuf Leblebici, Tata McGraw Hill (3rd Edition), 2006
4. CMOS VLSI Design, A Circuits and Systems Perspective (3rd Edition) Author: Neil Weste, David Harris, Ayan Banerjee. Pearson, 2011
5. Digital Integrated Circuit, Design Perspective, Author: .M. Rabaey, Prentice-Hall
6. VLSI Design and EDA TOOLS, Author: Angsuman Sarkar, Swapnadip De, Chandan Kumar Sarkar, SCITECH PUBLICATIONS (India) Pvt. Ltd., 2011
7. Algorithms for VLSI Design Automation, Author: Gerez, Wiley, 2011

Course Outcomes:

After completing this course, the students will be able to:

1. Relate to different MOS structures and functions in order to apply the knowledge in building CMOS circuits.
2. Determine logic and performance of CMOS combinational as well as sequential logic and apply the lambda based design rules.
3. Construct physical layout design and stick diagram of digital gates.
4. Classify between VLSI design cycle, style and methodology and also build various stages of miniaturization.
5. Make use of various synthesis flow and HDL modeling in ASIC semi custom design.
6. Build different logical synthesis algorithm and also differentiate between different physical design automation algorithms.

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|-------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Linear Algebra | | | | | |
| Course Code: MATH4182 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | - | - | 3 | 3 |

** Prerequisites Good understanding of Matrix Algebra as described in MATH1101

Module I – [9L]

Characteristic Equations, Eigen Values and Eigen Vectors, Diagonalization, Applications to Differential equations, Symmetric Matrices, Positive Definite Matrices, Similar Matrices, Singular Value Decomposition, Generalized Inverses.

Module I – [9L]

Definition of Field, Vector Spaces, Elementary Properties in Vector Spaces, Subspaces, Linear Sum of Subspaces, Spanning Sets, Linear Dependence and Independence, Basis and Dimension. Application to matrices and system of linear equations.

Module III – [9L]

Inner Product Spaces, Concept of Norms, Orthogonality, Projections and subspaces, Orthogonal Complementary Subspaces, Orthogonal Projections, Gram-Schmidt Orthogonalization Process, Least square approximations, QR decomposition.

Module IV – [9L]

Linear Transformations, kernels and images, The Rank-Nullity-Dimension Theorem. Matrix representation of a Linear Transformation, Change of Basis, Linear space of linear mappings.

Suggested Books:

1. Linear Algebra and its Applications: Gilbert Strang (Thomson Brooks/Cole Cengage Learning)
2. Matrix Computations : Gene H. Golub, Charles F. Van Loan (JHU Press)
3. Linear Algebra : Kenneth M. Hoffman, Ray Kunze (Prentice-Hall)
4. Linear Algebra A Geometric Approach: S. Kumaresan (PHI)

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|-------------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Telemetry and Remote Control Lab | | | | | |
| Course Code: AEIE4111 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | - | - | 3 | 3 | 2 |

List of Experiments:

1. Study of voltage telemetry system using a process variable transducer.
2. Study of 4-20 mA current telemetry system: 2 wire and 3 wire systems.
3. Study of a frequency telemetry system using a VCO and a PSD.
4. Study of a FDM and De-multiplexing system using wire transmission for 2 to 4 channels.
5. Study of a PCM system.
6. Study of a Bio-Telemetry System.
7. Study of a (wireless) remote control system.
8. Study of computerized control wireless telemetry system.

Course Outcomes:

After the completion of the syllabus, students will be able to acquire practical knowledge to

1. Design and handle a transmitting and receiving section of a telemetry system.
2. Design biotelemetry system used in critical cases.
3. Handle computerized control wireless telemetry system.
4. Recognize and explain at a basic level fundamental principle of digital communication systems
5. Demonstrate proficiency and conceptual understanding in current and voltage telemetry systems.
6. Use data acquisition and distribution system for telemetry in process plants

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|-------------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Power Electronics and Drives Lab | | | | | |
| Course Code: AEIE4112 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | - | - | 3 | 3 | 2 |

List of Experiments:

1. Study of V-I Characteristics of an SCR.
2. UJT Triggering circuits for SCR.
3. Study of the operation of a single-phase fully controlled bridge converter supplying
 - a) Resistive load
 - b) R-L load with freewheeling diode including generation of triggering pulses for the devices for both continuous and discontinuous modes of conduction.
4. Study of V-I Characteristics of a TRIAC.
5. Simulation of DC to DC step down chopper.
6. Simulation of PWM bridge inverter using MOSFET/IGBT with R and R-L loads.
7. Simulation of single-phase AC regulator.
8. DC motor speed control using chopper.
9. AC motor speed control using DIAC-TRIAC assembly.

Course Outcomes:

After the completion of this course students will be able to:

1. Gain practical knowledge about power electronic devices.
2. Analyze various single phase power converter circuits and understand their applications.
3. Gain practical knowledge about using simulation software in power electronics.
4. Design and simulate gate firing circuits.
5. Design and simulate rectifier, chopper and AC voltage controller
6. Develop skills to build and troubleshoot power electronics circuits.

| | | | | | |
|-----------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Professional Development | | | | | |
| Course Code: HMTS4121 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | - | - | 3 | 3 | 2 |

Module I: Professional Growth

- Goal Setting- Characteristic of goals, Short-term and long-term goals, Goal-achievement timeline
- Skill identification and Skill up gradation- Washington Accord and Skills for engineers (generic and specific), Local and global skills, Knowledge sources such as MOOC, NPTEL
- Career Planning- Vision and mission, Skill mapping to job profile, Basic and add-on qualifications, Career growth, Self-appraisal, Lifelong learning

Assessment - Activity (20 marks)

Module 2: Entrepreneurship

- The start-up ecosystem in India- Why entrepreneurship?, Indian tech start-up landscape, Stand-up India policies, funding agencies, market development, trends and best practices
- E-Commerce- India as a growing E-commerce market, Possibilities of growth, funding, niche retailers
- Make in India- New processes, Investments, Focus sectors, Makers of Make In India, Opportunities, Policies

Assessment-Project (30 marks)

Module 3: Industry specific opportunities

- Industry prospects in India and Beyond
- Industry-specific job opportunities
- Research & Development
- Other opportunities

Assessment---Presentation (30 marks)

Module 4: Working and living happily

- Managing crisis- Organisational and personal crisis, Analysing crisis, Turnaround strategies, Learning from crisis as opportunity
- Work-life balance- Performance-expectation management, Personal and professional goal- mapping
- Understanding happiness- Components, Conflicts, Happiness Index

Assessment: Activity/case (20 marks)

Suggested Reading:

- 1) Basic Managerial Skill for All by E. H. McGrath.SJ. Pub:PHI, New Delhi.
- 2) The Start-up Equation by Steven Fisher and Jae-Nae Duane. Pub: Mc Graw Hill Education (India) Pvt. Ltd. New Delhi.
- 3) Live Happily, Work Happily by Siddhartha Ganguli. Pub: Allied Publishers Pvt.Ltd. New Delhi.
- 4) Crisis Management: Planning for the Inevitable by Steven Fink. Pub: iUniverseInc.USA.
- 5) Influencer:The New Science of Leading Change by Joseph Grenny&Kerey Patterson. Pub:McGraw Hill Education , USA.

| | | | | | |
|-----------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Industrial Training Evaluation | | | | | |
| Course Code: AEIE4131 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | - | - | - | - | 2 |

This course has been designed for the students to gain real life working experience by visiting a Process Plant / Industry for a specified period. Thus, each & every student of AEIE should undergo industrial training for 4 weeks, during 6th – 7th Semester break in reputed Private / Public Sector / Government organization / companies. After completion of this course each student has to submit a report based on their industrial training and give a presentation on the same topic.

Course Outcomes:

After the completion of this course students will be able to:

1. Correlate their theoretical understanding with practical implementation.
2. Communicate effectively with other professional and non-professional groups in an industry/organization.
3. Identify, formulate and model problems; and find engineering solution based on a systems approach.
4. Become a multi-skilled engineer with good technical knowledge, management, leadership and entrepreneurship skills.
5. Aware of the social, cultural, global and environmental responsibility as an engineer.
6. Develop capability and enthusiasm for self-improvement through continuous professional development and life-long learning.

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|--------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Project I | | | | | |
| Course Code: AEIE4191 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | - | - | 6 | 6 | 4 |

Project should be on any topic having relevance with Electronics, Instrumentation, Electrical or inter-disciplinary field of engineering. The same should be decided by the student and concerned supervisor. Project should consist of research work done by the student in the selected topic with comprehensive and significant review of recent developments in the same field.

Course Outcomes:

After the completion of this course students will be able to:

1. Demonstrate ability to identify and formulate real world engineering problems relevant to society needs; study its feasibility and methodology for implementation.
2. Apply knowledge of circuit design, sensor selection, signal processing, control system, embedded system and programming, etc., to implement the project work with proper time frame.
3. Implement hardware model along with its relevant software programming, conduct experiments, analyze and interpret data and explain them.
4. Prepare project report properly and demonstrate presentation confidently.
5. Develop regularity, engage in enduring learning, ability to work in a group and deal with existing project ethically.
6. Develop interpersonal communication skill and demonstrate sound technical knowledge of their project work.

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|----------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Instrumentation and Telemetry | | | | | |
| Course Code: AEIE4181 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | - | - | 3 | 3 |

Module I – [9L]

Measurement of pressure and vacuum: Introduction, diaphragm, capsule, bellows, bourdon tube, DP transmitters – capacitive, McLeod gauge.

Flow rate measurement: head type flow meters – orifice, pitot tube, venturimeter; variable area flow meters – rotameters; electromagnetic flow meters; ultrasonic flow meters.

Module II – [9L]

Level measurement: float and displacers type instruments, resistive and capacitive type level instrument; D/P type sensors; ultrasonic level instruments.

Temperature measurement: RTD – working principle, different wired configuration, characteristics, typical industrial application; thermocouples – working principle, cold junction compensation, different types of thermocouples and their application in industry and laboratory, thermopiles, thermowells, thermistor, pyrometers.

Module III – [9L]

Basic classification of telemetry systems: voltage, current, position, frequency and time components of telemetering and remote control systems, quantization theory, sampling theorem, sample and hold, data conversion, coding, and conversion.

Module IV – [9L]

Multiplexing; time division multiplexers and demultiplexer theory, scanning procedures, frequency division multiplexers with constant and proportional bandwidth, demultiplexers. Fundamentals of radio-telemetry system, RF link system design. Pipeline telemetry; Power system telemetry.

References:

8. B. G. Liptak, *Instrument Engineers Handbook, vol-I and vol-II*; Chilton Book Co. Philadelphia.
9. D. Patranabis, *Principles of industrial Instrumentation*; TMH, New Delhi, 2nd Ed.
10. Eckman, *Industrial Instrumentation*; Wiley Eastern Ltd.
11. D. Patranabis, *Telemetry Principles*, Tata McGraw-Hill Education Pvt. Ltd.
12. Telemetry and Data Transmission”, R. N Baral, S. K. Kataria & Sons.

Course Outcomes:

After the completion of the course students will be able to

1. Select the suitable pressure transducer in industrial pressure measurement.
2. Select the suitable flow transducer in industrial flow measurement.
3. Select the suitable level transducer in industrial level measurement.
4. Select the suitable temperature transducer in industrial temperature measurement.
5. Understand the functional components of voltage, current and frequency telemetry.
6. Familiar with the scheme of transmission of multiple sensor data based on time division multiplexing and frequency division multiplexing.

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|-------------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Introduction to Embedded Systems | | | | | |
| Course Code: AEIE4182 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | - | - | 3 | 3 |

Module I- Introduction to an embedded system– [10L]

Different types of microcontrollers: embedded microcontrollers, introduction to AVR, PIC, ARM and Arduino based systems; processor Architectures: Harvard V/S Princeton, CISC Vs RISC; microcontroller memory types; microcontroller features: clocking, input/output pins, interrupts, timers and peripherals.

Module II- Overview of AVR microcontroller– [10L]

Introduction to AVR (ATmega 328p-pu) microcontrollers, architecture and pipelining, program memory considerations, addressing modes, CPU registers, ADC registers, instruction set, simple operations, basics of communication, overview of RS232, I²C Bus, UART, USB, ATmega 328p-pu connections to RS-232, ATmega 328p-pu serial communication programming, ATmega 328p-pu interrupts, programming of timer interrupts, programming of external hardware interrupts, programming of the serial communication interrupts, interrupt priority in the ATmega 328p-pu.

Module III- Embedded operating systems –[8L]

Operating system basics, types of operating systems, tasks, process and threads, multiprocessing and multitasking, task scheduling; task communication: shared memory, message passing, remote procedure call and sockets, task synchronization: task communication/synchronization issues, task synchronization techniques, device drivers, how to choose an RTOS.

Module IV- Hardware Interfacing and Programming with ATmega 328p–[8L]

Interfacing of LCD, interfacing with analog sensors (i.e LM35, ADXL 335 accelerometer), interfacing of stepper motor, interfacing with a keyboard and MPU6050 (MEMS Accelerometer and Gyroscope) using I²C bus.

References:

1. Elliot Williams, “*AVR Programming: Learning to Write Software for Hardware*”, Maker Media, Incorporated, 2014
2. Raj Kamal, “*Embedded Systems*”, TMH, 2004.
3. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, “*The AVR Microcontroller and Embedded Systems: Using Assembly and C*”; Pearson, 2014.
4. Dhananjay Gadre, “*Programming and Customizing the AVR Microcontroller*”; McGraw Hill Education, 2014.
5. Silberschatz Galvin Gagne, “*Operating System Concepts*”, WILEY, 2014

Course Outcomes:

After the completion of the course students will be able to

1. Define and design different embedded systems with microcontroller of different memory specification or RAM specification.
2. Design single purpose processors and basic architecture and operation, multipurpose controller-architecture, operation, codes and programming.
3. Define and understand timers and counters, Universal Synchronous Asynchronous Receiver and Transmitter and their classification.
4. Understand the application of different RAMs and ROMs and interfacing.
5. Understand different types of Interrupts and their service routine, describe RTOS, task-state, Semaphores. Understand the message queue, mailbox, and pipes.
6. Interface microcontroller and design the hardware and software to control the operation of I/o devices like LCDs, Keyboard, Stepper Motor, A/d converter etc.

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|-----------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Organizational Behaviour | | | | | |
| Course Code: HMTS4201 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 2 | - | - | 2 | 2 |

Module I

Introduction to Organizational Behaviour-Concept, Importance, Challenges and Opportunities (1L)

Personality-Meaning of Personality, Personality Determinants and Traits, Psychoanalytic Theory, Argyris Immaturity to Maturity Continuum Impact on organization.(2L)

Attitude-Concept, Components, Cognitive Dissonance Theory, Attitude Surveys. (2L)

Module II

Perception- Concept, Nature and Importance, Process of Perception, Factors influencing perception, Perceptual Selectivity, Shortcuts to Judge Others: Halo Effect, Stereotyping, Projection and Contrast Effects, Impact on Organization. (2 L)

Motivation-Definition, Theories of Motivation-Maslow's Hierarchy of Needs Theory, McGregor's Theory X&Y, Herzberg's Motivation-Hygiene Theory, Alderfer's ERG Theory, McClelland's Theory of Needs, Vroom's Expectancy Theory.(4L)

Module III

Leadership-Concept, Leadership Styles, Theories-Behavioural Theory: Ohio Studies, Michigan Studies, Blake & Mouton Managerial Grid; Contingency Theory: Fielder Theory. (4L)

Group Behaviour: Definition, Characteristics of Group, Types of Groups: Formal & Informal; Stages of Group Development, Group Decision making, Group Decision Making Vs Individual Decision Making. (4L)

Module IV

Organizational Design-Variou organizational structures and their pros and cons.

Concepts of organizational climate and culture, Organizational Politics-Concept, Factors influencing degree of Politics (2L)

Conflict management- Concept, Sources of conflict, Stages of conflict process, Conflict resolution techniques, Tools-Johari Window to analyse and reduce interpersonal conflict, Impact on organization. (3L)

Evaluation:

Max. Marks-100

Internal Test-30

Semester End Test-70

Suggested Readings:

- 1) Organization Behaviour by Stephen Robbins
- 2) Organization Behaviour by Luthans
- 3) Organization Behaviour by L.M. Prasad
- 4) Organization Behaviour: Text, Cases & Games by Aswathappa K.

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|-------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Analytical Instrumentation | | | | | |
| Course Code: AEIE4241 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | 1 | - | 4 | 4 |

Module I – [10L]

Introduction to analytical instrumentation: classification, types of instrumental methods.

Gas analysis: thermal conductivity method, heat of reaction method.

Oxygen analysis: magneto dynamic instrument (Pauling cell), thermo magnetic type or hot wire type instrument, zirconia oxygen analyzer, NO_x, CO_x analyzer.

Measurement of humidity, moisture, viscosity and density.

Module II - [8L]

Liquid analysis: electrodes-ion selective, molecular selective types- their variations.

pH analysis: pH electrodes, circuit for pH measurement and applications; conductivity cells: standards, circuits and applications; voltametry, polarography: apparatus, circuits and techniques-pulse polarography, applications.

Module III - [12L]

Colorimetry and Spectrophotometry:

Special methods of analysis, Beer-Lambert law, colorimeters, UV-Visible spectrophotometers: single and double beam instruments, sources and detectors. IR spectrophotometers: types, FTIR spectrophotometers, flame photometer, atomic absorption spectrophotometers: sources and detector; atomic emission spectrophotometers: sources and detectors, flame emission photometers, fluorescence spectrophotometer; X-ray diffractometer: working principle and applications; NMR: working principle and applications.

Module IV - [10L]

Separation methods: chromatography, basic definitions, instrumentation, some relations; gas chromatography (GC): basic parts, columns, detectors, techniques; liquid chromatography (LC): types, sources, detectors; high-pressure liquid chromatography (HPLC): sample injection system, column, detectors, applications; electrophoresis: theory, principle, instrumentation of horizontal and vertical electrophoresis; mass spectrometer: working principle and applications; GC-MS and its application area; microscopic techniques: TEM, SEM, STM and AFM.

References:

1. Principles of Instrumental Analysis- Skoog, Holler, Nieman, Publisher: Thomson Brooks/Cole
2. Handbook of Analytical Instruments- R.S. Khandpur, Publisher: Tata McGraw Hill
3. G.W. Ewing, 'Instrumental Methods of Analysis', McGraw Hill, 1992.
4. Introduction to Instrumental Analysis-Robert D. Braun, Publisher: Pharma Book Syndicate.

Course Outcomes:

After the completion of the syllabus, students will be able to:

1. Select the required gas analyzer for the analysis of a particular gaseous component quantitatively.
2. Know the working principle of the instruments for the measurement of humidity, moisture and density.
3. Get ideas of different analytical methods like pH analysis, conductivity analysis etc.for liquid sample.
4. Understand UV-VIS , IR spectroscopic techniques for the liquid analysis.
5. Know X-ray spectroscopy and NMR spectroscopy for the analysis of sample.
6. Familiar with gas chromatography and liquid chromatography for sample analysis.

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|-------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Ultrasonic Instrumentation | | | | | |
| Course Code: AEIE4242 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | 1 | - | 4 | 4 |

Module I – [12L]

Introduction to ultrasonic waves, principle of propagation of various waves; characterization of ultrasonic transmission: reflection, refraction, diffraction, mode conversion, intensity, transmission coefficients and attenuation, sound field; ultrasonic transducers and their characteristics; generation of ultrasonic waves – magnetostriction and piezoelectric effect

Module II – [10L]

Ultrasonic equipments, A, B, M-scan presentation of test indications and interpretation; ultrasonic test methods: echo, transit time, resonance, direct contact and immersion types; interpretations and guidelines for acceptance/rejection; effectiveness and limitations of ultrasonic testing.

Module III – [6L]

Application of ultrasonic instrumentations for industrial application - NDT for flaw detection- pulse-echo method and associated instrumentations, transit time method and associated instrumentations, ultrasonic methods of measuring thickness, depth, flow and level.

Module IV – [12L]

Applications of ultrasonic instrumentation for medical diagnosis: ultrasonic in medical diagnosis and therapy, CT-scan acoustic holography, various parameters affecting ultrasonic testing and measurements, their remedy.

References:

1. J. Krauthsamer and H. Krauthsamer, Ultrasonic Testing of Materials, Springer Verlag, Berlin, New York.
2. N. T. Wells, Biomedical Ultrasonics, Academic Press, London.
3. J. David and N. Cheeke, Fundamentals and Applications of Ultrasonic Waves, CRC Press LLC.
4. J. Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials; TMH, New Delhi, 2nd Ed

Course Outcomes:

After the completion of the course students to

1. Familiar with the fundamental principles of ultrasonic wave generation and propagation.
2. Know about ultrasonic equipments, A, B, and M-scan presentation of test indications and interpretation.
3. Develop knowledge on different ultrasonic methods of applications and their effectiveness and limitations
4. Apply the knowledge of ultrasonic instrumentation for non-destructive testing.
5. Learn ultrasonic methods of measuring thickness, depth, flow and level.
6. Know about the applications of ultrasonic instrumentations in medical sciences.

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|----------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Digital Control Systems | | | | | |
| Course Code: AEIE4243 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | 1 | - | 4 | 4 |

Module I – [10L]

Introduction to digital control, basic elements of discrete data control systems, advantages of discrete data control systems, examples, discrete time system representation, sampling process and its mathematical modeling, signal reconstruction; review of z-transforms, applications of z-transforms to difference equations, mapping of s-plane to z-plane, zero order and first order sample and hold circuits.

Module II - [10L]

Transfer functions, block diagrams, pulse transfer function and z-transfer function, poles and zeros, discrete data system with cascaded elements separated by sampler and not separated by sampler.

Module III - [10L]

Closed loop response and stability of sampled data systems: determination of closed loop transient and steady state responses, stability in z-plane, bilinear transformation, Schur-Cohn stability criterion, Jury stability criterion; root locus method, design of sampled data control systems.

Module IV - [10L]

Design of digital control systems with digital controllers through bilinear transformation; digital PID-controller; different class of digital controllers, general synthesis method, dead beat response design, Dahlin design, ringing and placement of poles.

References:

1. Ogata, *Discrete Time control systems* ; 2nd ed. (PHI)
2. Kuo, *Digital control systems*; (Second Edition) Oxford University Press
3. M. Gopal, *Digital Control Engineering*; New Age Publ.
4. John Dorsey, *Continuous & Discrete Control Systems* ; MGH

Course Outcomes:

After the completion of the syllabus, students will be able to:

1. Acquire knowledge about fundamental concepts and techniques used in digital control system.
2. Understand and formulate the mathematical models of linear discrete time control systems.
3. Explain the concept of pulse transfer function and z-transfer function along with pole-zero.
4. Determine the transient and steady state behavior of process model.
5. Analyze the stability of the process model using different methods
6. Design digital controllers like digital PID.

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|--------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Computational Biology | | | | | |
| Course Code: BIOT4281 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | - | - | 3 | 3 |

Module I – Introduction to Biomolecules [10L]

Introduction to biochemistry and molecular biology; Biomolecules: structure, function and metabolic pathways.

Module-II: Scope of Computational Biology [10L]

Definition of computational biology; origin and development of computational biology; Nature and Types of biological data; Data Structures: Sequences (GENbank files), Secondary structures, Super-secondary structures (Motifs), Tertiary structures (Pubchem and PDB structure files); Interaction Networks, Photographic Data: Fingerprints (DNA and MS), Microarray data; Biological databases.

Module-III: Preferred Algorithms, Programming languages and Operating systems [10L]

Principles of Pattern recognition: Use of Hidden Markov Model and Artificial Neural Networks in computational biology; Significance of Python and C/C++; Operating system: Bio-Linux (Selected Bioinformatics packages)

Module-IV: Applications of Computational biology [10L]

Molecular Modeling and Dynamics: introduction to Open MM library; GROMACS as an example of GUI in the public domain; computer based drug design (public domain and proprietary); Mathematical modeling of cell growth kinetics; Embedded systems for computational biology: High throughput data collection, processing and analysis; LCMS, DNA microarrays and other applications (e.g. mobile microscopy and high throughput micro-PCR); Systems biology and Metabolic Engineering.

Text books:

1. Introduction to Bioinformatics, by Arthur M. Lesk (International Fourth Edition) (2014), Oxford University Press.
2. Essential Bioinformatics, by Jin Xiong, Cambridge University Press (2006).

Reference books:

1. Biochemistry: Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, 7th edition, Academic Press.
2. Introduction to Bioinformatics: T K Attwood, D J Parry-Smith and S. Phukan (2008) Pearson.
3. Fundamentals of Database Systems, 5th Edition, R. Elmasri and S.B. Navathe (2009)
4. Bioinformatics-A Machine Learning Approach- By Baldi and Brunak, 2nd Edition (2006), John Wiley Inc.
5. Dynamics of Proteins and Nucleic Acids: J. Andrew McCammon and Stephen C. Harvey, Cambridge University Press (1998).
6. Molecular Modelling: Principles and Applications-2 nd Edition, Andrew R. LeachPearson (2016)
7. Molecular Modelling and Drug Design-K.Anand Solomon-1 st edition (2011)-MJP Publishers.

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|--------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Fundamentals of RDBMS | | | | | |
| Course Code: CSEN4281 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | - | - | 3 | 3 |

Module I – Introduction

General introduction to database systems; Database - DBMS Definition, approaches to building a database, data models, three-schema architecture of a database, challenges in building a DBMS, various components of a DBMS.

Module-II: Relational Data Model

Concept of relations and its characteristics, schema-instance, integrity constraints, E/R Model - Conceptual data modeling - motivation, entities, entity types, various types of attributes, relationships, relationship types, E/R diagram notation. Extended E/R Model, Converting the database specification in E/R and Extended E/R notation to the relational schema.

Data Storage and Indexes - file organizations, primary, secondary index structures, hash-based indexing, dynamic hashing techniques, multi-level indexes, B+ trees.

Module-III: Relational Query Language

Relational Algebra operators: selection, projection, cross product, various types of joins, division, example queries, tuple relation calculus, domain relational calculus. Introduction to SQL, Data definition in SQL, Table, Key and Foreign key definitions, Data manipulation in SQL. Nested queries, Notion of aggregation, PL/SQL.

Module-IV: Relational Database Design

Dependencies and Normal forms - Importance of a good schema design, problems encountered with bad schema designs, motivation for normal forms, dependency theory - functional dependencies, Armstrong's axioms for FD's, closure of a set of FD's, minimal covers, definitions of 1NF, 2NF, 3NF and BCNF, decompositions and desirable properties of them, algorithms for 3NF and BCNF normalization. basics of multi-valued dependencies and 4NF, join dependencies and definition of 5NF.

Transaction Processing

Concepts of transaction processing, ACID properties, concurrency control, locking based protocols, recovery and logging methods.

Text books:

1. Database System Concepts by Silberschatz, Korth & Sudarshan (McGraw-Hill Education)
2. Fundamentals of Database System By Elmasari & Navathe- Pearson Education

Reference books:

1. Database Management Systems by RamaKrishna & Gehrke (McGraw-Hill Education)
2. Fundamentals of Relational Database management Systems by Sumathi & Esakkirajan, Springer.
3. Date C. J., “Introduction to Database Management”, Vol. I, II, III, Addison Wesley.
4. Ullman JD., “Principles of Database Systems”, Galgottia Publication. Biochemistry: Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, 7th edition, Academic Press.

Course Outcomes:

After the completion of the syllabus, students will be able to:

1. Differentiate database systems from file systems by enumerating the features provided by database systems and describe each in both function and benefit.
2. Master the basic concepts and understand the applications of database systems.
3. Demonstrate an understanding of the relational data model.
4. Construct an Entity-Relationship (E-R) model from specifications and to perform the transformation of the conceptual model into corresponding logical data structures.
5. Understand the basic database storage structures and access techniques.
6. Distinguish between good and bad database design, apply data normalization principles, and be aware of the impact of data redundancy on database integrity and maintainability.
7. Construct queries and maintain a simple database using SQL.
8. Apply database transaction management and database recovery

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|------------------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Cellular and Satellite Communications | | | | | |
| Course Code: ECEN4281 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | - | - | 3 | 3 |

Module I – (8L)

Brief introduction to mobile wireless communication and systems, Description of cellular system, Cellular Structure, Frequency Reuse, Cell clustering, Capacity enhancement techniques for cellular networks, cell splitting, antenna sectoring, Co-channel and Adjacent channel interferences, Channel assignment schemes – Fixed channel, Dynamic channel and Hybrid channel, mobility management – location management and handoff management, handoff process, different types of handoff.

Module II (10L)

Evolution strategies – First Generation (1G) to Fourth Generation (4G), Personal Area Networks: PAN, Low Tier Wireless System: Cordless Telephone, Second Generation (2G), Digital European Cordless Telecommunications (DECT), Public wide-area Wireless Networks: 1 G to 3G cellular networks (4L)

Second generation (2G) Network: Global system for mobile communication (GSM): Architecture and Protocols Air Interface, GSM spectrum, GSM Multiple Access Scheme, GSM Channel Organization (4L)

Overview of CDMA systems: IS-95 Networks and 3G – The Universal Mobile Telecommunication System (UMTS) CDMA based IS-95 Systems, forward link and reverse link for IS-95, handoff process in CDMA based IS 95 network (2L)

Module III: (8L)

Historical background, Basic concepts, Frequency allocation for satellite services, orbital & spacecraft problems, comparison of networks and services, modulation techniques used for satellite communication. Indian satellite Scenario. (4L)

Orbits- Orbital elements, orbital mechanics, geostationary orbit, change in longitude, orbital maneuvers, orbital transfer, orbital perturbations. Launch Vehicles- principles of Rocket propulsion, powered flight, Launch vehicles for communication satellite (4L)

Module IV: (9L)

RF link- noise, the basic RF link, satellite links (up and down) , optimization RF link, inter satellite link, noise temperature, Antenna temperature, overall system temperature, propagation factors, rain attenuation model. Tropospheric and Ionospheric EFFECT. (5L)

Multiple access- FDMA, TDMA, CDMA techniques, comparison of multiple access techniques, error correcting codes. Satellite subsystems and satellite link design- AOC S, TT&C, power system, spacecraft antenna, transponder, Friis Transmission equation, G/T Ratio of Earth stations.(4L)

Books:

1. Wireless Networks: Applications and Protocols, T. S. Rappaport, Pearson Education
2. Wireless Communication and Networks : 3G and Beyond, I. Saha Misra, TMH Education.
3. Satellite communication – D. Roddy (TMH)
4. Satellite Communication: Maini & Agarwal (Wiley)

Course Outcome:

After completing this course, the students will be able to:

1. Apply the previous knowledge of analog and digital communication to appreciate the contents of this paper.

2. Understand elements of cellular network and its various parameters like freq. planning, cell structure etc.
3. Identify GSM and CDMA Cellular architecture and its various parameters.
4. Categorize different multiple access techniques used for Satellite Communication.
5. Understand various orbits, orbital parameters, satellite launch vehicles etc.
6. Design uplink and downlink for satellite networks.

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|---------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Fundamentals of Cryptography | | | | | |
| Course Code: INFO4281 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | - | - | 3 | 3 |

Module I – [7L]

Cryptography- Concepts and Techniques: Introduction to cryptography, Plaintext & Cipher text, Substitution Techniques, Transposition Techniques, Encryption & Decryption, Type of attacks on encrypted text, Symmetric & Asymmetric key Cryptography and Digital envelope.

Module II - [8L]

Symmetric Key Algorithms: Algorithm types & Modes, Overview of Symmetric Key Cryptography, Diffie-Hellman key exchange algorithm, DES (Data Encryption Standard) algorithm & its variant, IDEA(International Data Encryption Algorithm) algorithm.

Module III - [10L]

Asymmetric Key Algorithms, Digital Signature and User Authentication: Overview of Asymmetric key Cryptography, RSA algorithm, Digital Signature, Basic concepts of Message Digest and Hash Function (Algorithms on Message Digest and Hash function not required), HMAC algorithm. Authentication Token, Certificate based Authentication and Biometric Authentication.

Module IV - [8L]

Electronic mail security, SSL and Firewall: PEM, Secure Socket Layer (SSL) protocol. Introduction to Firewall, Types of firewall, Firewall Configurations and DMZ Network.

References:

1. “Cryptography and Network Security”, William Stallings, 2nd Edition, Pearson Education Asia
2. “Network Security private communication in a public world”, C. Kaufman, R. Perlman and M. Speciner, Pearson.
3. Cryptography & Network Security: Atul Kahate, TMH.
4. “Network Security Essentials: Applications and Standards” by William Stallings, Pearson
5. “Designing Network Security”, Merike Kaeo, 2nd Edition, Pearson Books
6. “Building Internet Firewalls”, Elizabeth D. Zwicky, Simon Cooper, D. Brent Chapman, 2nd Edition, Oreilly
5. “Practical Unix & Internet Security”, Simson Garfinkel, Gene Spafford, Alan Schwartz, 3rd Edition, Oreilly

Course Outcomes:

After the completion of the syllabus, students will be able to:

1. Defining the concepts of Network security and identifying different types of attack on Network security. Recall the principles of security.
2. Classify different kinds of Substitution techniques and Transposition techniques and discuss the concepts of Symmetric key cryptography and Asymmetric key cryptography. Explaining in detail DES, RSA, IDEA and RC5 algorithm.
3. Prepare and practice numerical module based on DES and RSA. Illustrating the concept of SSL, PGP, Authentication token, Digital Signature, Message Digest and Hash function in accordance with the prescribed syllabus.
4. Analyze Biometric Authentication and differentiate between different types of Authentication tokens.
5. Concluding with concepts of Firewall (including types of Firewall), DMZ Network and comparing between different Firewall Configurations.

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|--------------------------------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Advanced Computational Mathematics and Graph Theory | | | | | |
| Course Code: MATH4282 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | - | - | 3 | 3 |

Module I – [9L]

Sums: Sums and recurrences, manipulation of sums, multiple sums, general methods, finite and infinite calculus, infinite sums

Module II - [9L]

Binomial coefficients, generating functions and special numbers: Basic identities, generating functions, special numbers: Bernoulli numbers, Euler numbers, harmonic numbers, Fibonacci numbers, recurrences.

Module III - [9L]

Integer functions and arithmetic: Floors and ceilings, the binary operation ‘mod’, divisibility, primes, relative primality, the congruence relation ‘mod’, residues, Euler phi function, Fermat’s Little Theorem, Wilson Theorem, primitive roots, the law of quadratic reciprocity, (Statement only).

Module IV - [9L]

Graph Theory: Trees, spanning trees, shortest paths, vertex connectivity, edge connectivity, cuts, matchings, maximum matchings, independent sets, graph colouring, chromatic numbers, chromatic polynomials

References:

1. Ronald Graham, Donald Knuth, Oren Patashnik, ‘Concrete Mathematics’, Addison-Wesley
2. Douglas B. West, ‘Introduction to Graph Theory’, Pearson

| | | | | | |
|----------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Comprehensive Viva Voce | | | | | |
| Course Code: AEIE4231 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | - | - | - | - | 3 |

Every student should appear before a panel duly constituted by the members of faculties of the department in order to evaluate his/her knowledge in various subjects learned during the four years of study of the B. Tech AEIE course.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Answer questions from all the courses studied.
2. Attain oral presentation skills by answering questions in precise and concise manner.
3. Appear interview elegantly and confidently.
4. Judge themselves about their domain knowledge.
5. Develop habits of learning.
6. Gain confidence and inter-personal skills.

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|-------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Technical Seminar II | | | | | |
| Course Code: AEIE4232 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | - | - | 3 | 3 | 2 |

The main objective of this course work is to encourage self-learning in the field of student's own interest among the emerging areas of technology. The student is expected to do an extensive literature survey in his subjects of interest and present seminar on a research problem, available methods in literature, future trends, etc. to a group of experts.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Explore literature to identify promising new directions of various cutting edge technologies to solve real-world issues.
2. Build up knowledge in the field engineering, with specialization related to Electronics and Instrumentation engineering and the ability to integrate information across disciplines.
3. Prepare quality presentation on a topic with proper organization and demonstrate the content properly with the aid of audio-video, pictures and documents, etc.
4. Communicate effectively by making an oral presentation before an evaluation committee.
5. Interact efficiently with audience.
6. Develop habits of maintaining regularity and punctuality.

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|---------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Project II | | | | | |
| Course Code: AEIE4291 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | - | - | 12 | 12 | 8 |

The student has to continue the project work done in seventh semester. At the end of eighth semester, the student has to appear in examination (viva-voce & demonstration) before the panel of examiners (both external and internal) to defend his/her work done in project. The candidate shall submit the project report in the prescribed format to the Head of the department, duly certified that the work has been satisfactorily completed.

Course Outcomes:

After the completion of this course students will be able to:

1. Demonstrate ability to identify and formulate real world engineering problems relevant to society needs; study its feasibility and methodology for implementation.
2. Apply knowledge of circuit design, sensor selection, signal processing, control system, embedded system and programming, etc., to implement the project work with proper time frame.
3. Implement hardware model along with its relevant software programming, conduct experiments, analyze and interpret data and explain them.
4. Prepare project report properly and demonstrate presentation confidently.
5. Develop regularity, engage in enduring learning, ability to work in a group and deal with existing project ethically.
6. Develop interpersonal communication skill and demonstrate sound technical knowledge of their project work.

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|----------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Sensor Technology | | | | | |
| Course Code: AEIE4281 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | - | - | 3 | 3 |

Module I – [11L]

Overview of Sensors:

Sensor: classification of sensors; mechanical, electrical, thermal, acoustic, optical, chemical, bio- sensors, their calibration and determination of characteristics.

Module II - [11L]

Mechanical Sensors:

Displacement, acceleration, pressure sensing components, components of seismic system.

Electrical Sensors:

Temperature, pressure, flow, level sensing components

Acoustics Sensor:

Piezo electric sensor, microphones, ultrasonic sensors.

Module III - [10L]

Micro-Sensor:

IC technology used in micro sensor system; crystal growth and wafer making, different techniques of deposition; physical vapor deposition - evaporation, thermal oxidation, sputtering, epitaxy, ion implantation and diffusion; chemical vapor deposition- LPCVD, APCVD, PECVD, spin coating, electrochemical deposition; pattern generation and transfer-masking, photolithography: photoresists and application, light sources, photo resist development and removal; different types of etching: chemical and plasma; overview of micro-manufacturing techniques: bulk micro-machining, surface micro-machining, LIGA.

Testing and Packaging:

Partitioning, layout, technology constraints, scaling, compatibility study; scaling laws in miniaturization; examples of selected micro sensors.

Module IV - [4L]

Smart Sensors:

Introduction; present trends, nature of semiconductor sensor output, information coding, integrated sensor principles, sensor networking.

References:

1. J. W Gardner, V. K. Varadan, *Microsensors, MEMS And Smart Devices*, Wiley, 2001.
2. Stephen Beedy, *MEMS Mechanical Sensors*, Artech House, 2004
3. N. P. Mahalik, *MEMS*, McGraw Hill, 2007
4. Jon Wilson, *Sensor Technology Handbook*, Elseiver, 2005.
5. Leondes, Cornelius T. (Ed.), *Mems/Nems Handbook Techniques and Applications*, Springer, 2006
6. Mohamed Gad-el-Hak, *The MEMS Handbook*, CRC Press; 2nd edition, 2005.
7. B. G. Streetman and Sanjay Banerjee, *Solid State Electronic Devices*, Prentice Hall; 6th Edition, 2005.

Course Outcomes:

After the completion of the syllabus, students will be able to:

1. Distinguish different types of sensors.
2. Understand the characteristics of sensors and calibration procedure.
3. Grab the concepts and application of different mechanical, electrical and acoustic sensors.
4. Acquire the fundamental knowledge in micro sensors, sensor materials, properties and industrial applications.
5. Understand the application of IC technology and photolithography technique in micro sensors.
6. Learn the basics of sensor networking, coding and smart sensors.

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|-------------------------------------------------------|----------|----------|----------|--------------|----------------------|
| Course Name : Control Systems and Applications | | | | | |
| Course Code: AEIE4282 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit Points |
| | 3 | - | - | 3 | 3 |

Module-1-[10L]

Concepts of control systems – open loop and closed loop control systems, effect of feedback in control system; mathematical model of physical system - differential equation representation of physical systems, transfer function models, block diagram models, signal flow graphs, standard test signals, concept of system sensitivity.

Module-II-[6L]

Time response analysis - transient response of first order and second order with standard test signals, steady state error coefficients, effect of pole –zero addition in system response; time domain performance criteria.

Module- III-[10L]

Stability analysis - concept of stability, Routh stability criterion, root locus technique - root locus construction rules, stability analysis from root locus plot.

Introduction to frequency domain analysis –Bode plot - minimum and non minimum phase system, concept of phase margin and gain margin, procedure for drawing bode plots, assessment of relative stability –gain margin and phase margin .

Module –IV-[10L]

Models of control devices and systems - dc servomotors, ac servomotors, dc motor speed and position control, synchro.

Basic control actions- Introduction to conventional controllers (P, PI, PD and PID) and application.

References:

1. Nagrath I. J. and Gopal M., *Control System Engineering*, 5th Ed., New Age International Private Ltd. Publishers.
2. Kuo B. C., *Automatic Control Systems*, 8th Ed., Wiley India
3. Ogata K., *Modern Control Engineering*, 4th Ed., Pearson Education.
4. Dorf R. C. and Bishop R. H., *Modern Control Systems*; Pearson Education.
5. Norman S. N., *Control Systems Engineering*, 4th Ed., Wiley India.
6. B.W. Bequette, *Process Control Modeling, Design and Simulation*, Prentice Hall of India, New Delhi.

Course Outcomes:

After the completion of this course students will be able to:

1. Develop mathematical model of physical and simulated systems in forms of transfer function.
2. Represent the block diagram and signal flow graph of the systems.
3. Investigate the time response of systems and calculate performance indices.
4. Check the stability of a system using root locus method.
5. Analyze frequency response and stability of linear systems using Bode plot methods.
6. Understand the concept and utility of control action and its usage.