1. **Mathematics- I**

   UNIT - I: Trigonometry

   Concept of angles, measurement of angles in degrees, grades and radians and their conversions, T-Ratios of Allied angles (without proof), Sum, difference formulae and their applications (without proof). Product formulae (Transformation of product to sum, difference and vice versa). T- Ratios of multiple angles, sub-multiple angles (2A, 3A, A/2). Graphs of sin x, cos x, tan x and e^x .

   Differential Calculus

   Definition of function; Concept of limits. Four standard limits

   $$\lim_{x \to a} \frac{x^n - a^n}{x-a}, \quad \lim_{x \to 0} \frac{\sin x}{x},$$

   $$\lim_{x \to a} \left(\frac{a^x - 1}{x}\right) \text{ and } (1+x)^{\frac{1}{x}} \quad .$$

   Differentiation by definition of $x^n, \sin x \cos x, \tan x$, e^x and $\log_a x$.
   Differentiation of sum, product and quotient of functions. Differentiation of function of a function. Differentiation of trigonometric and inverse trigonometric functions, Logarithmic differentiation, Exponential functions.

   UNIT - III: Algebra

   Complex Numbers: Definition, real and imaginary parts of a Complex number, polar and Cartesian, representation of a complex number and its conversion from one form to other, conjugate of a com- plex number, modulus and amplitude of a complex number Addition, Subtraction, Multiplication and Division of a complex number. Demovier's theorem, its application.

   Partial fractions: Definition of polynomial fraction proper & improper fractions and definition of partial fractions. To resolve proper fraction into partial fraction with denominator containing non-repeated linear factors, repeated linear factors and irreducible non-repeated quadratic factors. To resolve improper fraction into partial fraction.

   Permutations and Combinations: Value of ^nP_r and ^nC_r.

   Binomial theorem: Binomial theorem (without proof) for positive integral index (expansion and general form); binomial theorem for any index (expansion without proof) first and second binomial approximation with applications to engineering problems.

2. **Applied Physics –I**

   Unit 1: Physical world, Units and Measurements

   Physical quantities; fundamental and derived, Units and systems of units (FPS, CGS and SI units),

Dimensions and dimensional formulae of physical quantities, Principle of homogeneity of dimensions, Dimensional equations and their applications (conversion from one system of units to other, checking of dimensional equations and derivation of simple equations), Limitations of dimensional analysis. Measurements: Need, measuring instruments, least count, types of measurement (direct, indirect), Errors in measurements (systematic and random), absolute error, relative error, error propagation, error estimation and significant figures.

Unit 2: Force and Motion

Scalar and Vector quantities – examples, representation of vector, types of vectors. Addition and Subtraction of Vectors, Triangle and Parallelogram law (Statement only), Scalar and Vec- tor Product, Resolution of a Vector and its application to inclined plane and lawn roller.

Force, Momentum, Statement and derivation of conservation of linear momentum, its applications such as recoil of gun, rockets, Impulse and its applications.

Circular motion, definition of angular displacement, angular velocity, angular acceleration, frequency, time period, Relation between linear and angular velocity, linear acceleration and angular acceleration (related numerical), Centripetal and Centrifugal forces with live examples, Expression and applications such as banking of roads and bending of cyclist.

Unit 3: Work, Power and Energy

Work: Concept and units, examples of zero work, positive work and negative work
Friction: concept, types, laws of limiting friction, coefficient of friction, reducing friction and its engineering applications, Work done in moving an object on horizontal and inclined plane for rough and plane surfaces and related applications.

Energy and its units, kinetic energy, gravitational potential energy with examples and derivations, mechanical energy, conservation of mechanical energy for freely falling bodies, trans- formation of energy (examples).

Power and its units, power and work relationship, calculation of power (numerical problems).

Unit 4: Rotational Motion

Translational and rotational motions with examples, Definition of torque and angular momentum and their examples, Conservation of angular momentum (quantitative) and its ap- plications.

Moment of inertia and its physical significance, radius of gyration for rigid body, Theorems of parallel and perpendicular axes (statements only), Moment of inertia of rod, disc, ring and sphere (hollow and solid); (Formulae only).

Unit 5: Properties of Matter

Elasticity: definition of stress and strain, moduli of elasticity, Hooke's law, significance of

stress-strain curve.

Pressure: definition, units, atmospheric pressure, gauge pressure, absolute pressure, Fortin's
Barometer and its applications.

Surface tension: concept, units, cohesive and adhesive forces, angle of contact, Ascent Formula (No derivation), applications of surface tension, effect of temperature and impurity on surface tension.
Viscosity and coefficient of viscosity: Terminal velocity, Stoke's law and effect of temperature
on viscosity, application in hydraulic systems.

Hydrodynamics: Fluid motion, stream line and turbulent flow, Reynold's number Equation of
continuity, Bernoulli's Theorem (only formula and numericals) and its applications.

Unit 6: Heat and Thermometry
Concept of heat and temperature, modes of heat transfer (conduction, convection and radiation with examples), specific heats, scales of temperature and their relationship, Types of Thermometer (Mercury thermometer, Bimetallic thermometer, Platinum resistance thermometer, Pyrometer) and their uses.

Expansion of solids, liquids and gases, coefficient of linear, surface and cubical expansions and relation amongst them, Co-efficient of thermal conductivity, engineering applications.

3.   **Applied Chemistry**

Unit 1: Atomic Structure, Chemical Bonding and Solutions

Rutherford model of atom, Bohr's theory (expression of energy and radius to be omitted), and hydrogen spectrum explanation based on Bohr's model of atom, Heisenberg uncertainty principle, Quantum numbers – orbital concept. Shapes of s, p and d orbitals, Pauli's exclusion principle, Hund's rule of maximum multiplicity Aufbau rule, electronic configuration.

Concept of chemical bonding – cause of chemical bonding, types of bonds: ionic bonding (NaCl example), covalent bond (H_2, F_2, HF hybridization in Be Cl_2, BF_3, CH_4, NH_3, H_2O), coordination bond in NH_4^+, and

anomalous properties of NH_3, H_2O due to hydrogen bonding, and metallic bonding.

Solution – idea of solute, solvent and solution, methods to express the concentration of solution molarity (M = mole per liter), ppm, mass percentage, volume percentage and mole fraction.

Unit 2: Water

Graphical presentation of water distribution on Earth (pie or bar diagram). Classification of soft and hard water based on soap test, salts causing water hardness, unit of hardness and simple numerical on water hardness.

Cause of poor lathering of soap in hard water, problems caused by the use of hard water in boiler (scale and sludge, foaming and priming, corrosion etc), and

quantitative measurement of water hardness by ETDA method, total dissolved solids (TDS) alkalinity estimation.

i).   Water softening techniques – soda lime process, zeolite process and ion exchange process.

ii).   Municipal water treatment (in brief only) – sedimentation, coagulation, filtration, sterilization.

Water for human consumption for drinking and cooking purposes from any water sources and enlist Indian standard specification of drinking water (collect data and understand standards).

Unit 3: Engineering Materials

Natural occurrence of metals – minerals, ores of iron, aluminium and copper, gangue (matrix), flux, slag, metallurgy – brief account of general principles of metallurgy.

Extraction of - iron from haematite ore using blast furnace, aluminium from bauxite along with reactions. Alloys – definition, purposes of alloying, ferrous alloys and non-ferrous with suitable examples, properties and applications.

General chemical composition, composition based applications (elementary idea only details omitted):

Port land cement and hardening, Glasses Refractory and Composite materials.

Polymers – monomer, homo and co polymers, degree of polymerization, simple reactions involved in preparation and their application of thermoplastics and thermosetting plastics (using PVC, PS, PTFE, nylon – 6, nylon-6,6 and Bakelite), rubber and vulcanization of rubber.

Unit 4: Chemistry of Fuels and Lubricants

Definition of fuel and combustion of fuel, classification of fuels, calorific values (HCV and
LCV), calculation of HCV and LCV using Dulong's formula.

Proximate analysis of coal solid fuel

petrol and diesel - fuel rating (octane and cetane numbers),

Chemical composition, calorific values and applications of LPG, CNG, water gas, coal gas, producer gas and biogas.

Lubrication – function and characteristic properties of good lubricant, classification with examples, lubrication mechanism – hydrodynamic and boundary lubrication, physical properties (viscosity and viscosity index, oiliness, flash and fire point, could and pour point only) and chemical properties (coke number, total acid number saponification value) of lubricants.

Unit 5: Electro Chemistry

Electronic concept of oxidation, reduction and redox reactions.
Definition of terms: electrolytes, non-electrolytes with suitable examples, Faradays laws of
electrolysis and simple numerical problems. Industrial Application of Electrolysis –
- Electrometallurgy

- Electroplating
- Electrolytic refining.

Application of redox reactions in electrochemical cells –
- Primary cells – dry cell,

- Secondary cell - commercially used lead storage battery, fuel and Solar cells. Introduction to Corrosion of metals –
- definition, types of corrosion (chemical and electrochemical), H_2 liberation and O_2 absorption mechanism of electrochemical corrosion, factors affecting rate of corrosion.

Internal corrosion preventive measures –
- Purification, alloying and heat treatment and

External corrosion preventive measures: a) metal (anodic, cathodic) coatings, b) organic
inhibitors.

4. **Communication Skills in English**
   Unit-1 Communication: Theory and Practice
   - Basics of communication: Introduction, meaning and definition, process of communication etc.

   - Types of communication: formal and informal, verbal, non-verbal and written Barriers to effective communication.

   - **7** Cs for effective communication (considerate, concrete, concise, clear, complete, correct, courteous).

   - Art of Effective communication,

     o Choosing words
     o Voice
     o Modulation
     o Clarity
     o Time
     o Simplification of words

   - Technical Communication.

   Unit-2 Soft Skills for Professional Excellence
   - Introduction: Soft Skills and Hard Skills.
   - Importance of soft skills.
   - Life skills: Self-awareness and Self-analysis, adaptability, resilience, emotional intelligence and empathy etc.
   - Applying soft skills across cultures.
   - Case Studies.

   Unit-3: Reading Comprehension
   Comprehension, vocabulary enhancement and grammar exercises based on reading of the following texts:
   Section-1
   Malgudi Days: R.K. Narayan
   The Room on Roof: Ruskin Bond "The Gift of the Magi" by O. Henry
   "Uncle Podger Hangs a Picture" Jerome K. Jerome

Section-2
Night of the Scorpion by Nissim Ezekiel,
Stopping by Woods on a Snowy Evening by Robert Frost, Where the Mind is
Without Fear by Rabindranath Tagore, Ode to Tomatoes by Pablo Neruda,

Unit-4: Professional Writing
The art of
précis writing,
Letters:
business and
personnel,
Drafting e-mail, notices, minutes of a meeting etc.
Filling-up different forms such as banks and on-line forms for placement etc.

Unit-5: Vocabulary and Grammar
Vocabulary of commonly used words
Glossary of administrative
terms (English and Hindi)
One-word substitution,
Idioms and phrases etc.
Parts of speech, active and passive voice, tenses etc., Punctuation

5. **Engineering Graphics**
   Unit – I Basic elements of Drawing
   Drawing Instruments and supporting materials: method to use them with

   applications. Convention of lines and their applications.

   Representative Fractions – reduced, enlarged and full size scales;
   Engineering Scales such as plain and diagonal scale.

   Dimensioning techniques as per SP-46:2003 – types and applications of chain,
   parallel and coordinate dimensioning.

   Geometrical and Tangency constructions. (Redraw the figure)

   Unit – II Orthographic projections
   Introduction of projections-orthographic, perspective, isometric and oblique:
   concept and
   applications. (No question to be asked in examination).

   Introduction to orthographic projection, First angle and Third angle method,
   their symbols.

   Conversion of pictorial view into Orthographic Views – object containing
   plain surfaces, slanting surfaces, slots, ribs, cylindrical surfaces. (use First Angle
   Projection method only)

   Unit – III Isometric Projections
   Introduction to isometric projections. Isometric scale and Natural scale.

   Isometric view and isometric projection.

   Illustrative problems related to objects containing lines, circles and arcs shape

only. Conversion of orthographic views into isometric view/projection.

Unit – IV Free Hand Sketches of engineering elements

Free hand sketches of machine elements: Thread profiles, nuts, bolts, studs, set screws, wash- er, Locking arrangements. (For branches other than mechanical Engineering, the teacher should select branch specific elements for free hand sketching)

Free hand sketches of orthographic view (on squared graph paper) and isometric view (on isometric grid paper)

Unit – V Computer aided drafting interface

Computer Aided Drafting: concept.

Hardware and various CAD software available.

System requirements and Understanding the interface.

Components of AutoCAD software window: Title bar, standard tool bar, menu bar, object properties tool bar, draw tool bar, modify tool bar, cursor cross hair. Command window, status bar, drawing area, UCS icon.

File features: New file, Saving the file, Opening an existing drawing file, Creating templates, Quit.

Setting up new drawing: Units, Limits, Grid, Snap. Undoing and redoing

action.

Unit – VI Computer aided drafting

Draw basic entities like Line, Circle, Arc, Polygon, Ellipse, Rectangle, Multiline, Poly Line.

Method of Specifying points: Absolute coordinates, Relative Cartesian and Polar coordinates.

Modify and edit commands like trim, extend, delete, copy, offset, array, block, layers.

Dimensioning: Linear, Horizontal Vertical, Aligned, Rotated, Baseline, Continuous, Diameter, Radius, Angular Dimensions.

Dim scale variable. Editing dimensions.

Text: Single line Text, Multiline text.

Standard sizes of sheet. Selecting Various plotting parameters such as Paper size, paper units, Drawing orientation, plot scale, plot offset, plot area, print preview.

6.   **Engineering Workshop Practice**

S.No.	Details Of Practical Content
I	**Carpentry:** i) Demonstration of different wood working tools / machines. ii) Demonstration of different wood working processes, like plaining, marking, chiseling, grooving, turning of wood etc. iii) One simple job involving any one joint like mortise and tenon dovetail, bridle, half lap etc.

II	**Fitting:** i) Demonstration of different fitting tools and drilling machines and power tools ii) Demonstration of different operations like chipping, filing, drilling, tapping, sawing, cutting etc. iii) One simple fitting job involving practice of chipping, filing, drilling, tapping, cutting etc
III	**Welding:** i) Demonstration of different welding tools / machines. ii) Demonstration on Arc Welding, Gas Welding, MIG, MAG welding, gas cutting and rebuilding of broken parts with welding. iii) One simple job involving butt and lap joint
IV	**Sheet Metal Working:** i) Demonstration of different sheet metal tools / machines. ii) Demonstration of different sheet metal operations like sheet cutting, bending, edging, end curling, lancing, soldering, brazing, and riveting. iii) One simple job involving sheet metal operations and soldering and riveting.
V	**Electrical House Wiring:** Practice on simple lamp circuits (i) one lamp controlled by one switch by surface conduit wiring, (ii) Lamp circuits-connection of lamp and socket by separate switches, (iii) Connection of Fluorescent lamp/tube light, (iv) simple lamp circuits-in- stall bedroom lighting. And (v) Simple lamp circuits- install stair case wiring.
VI	**Demonstration:** i) Demonstration of measurement of Current, Voltage, Power and Energy. ii) Demonstration of advance power tools, pneumatic tools, electrical wiring tools and accessories. iii) Tools for Cutting and drilling

7. **Applied Physics-I Labs**

1. To measure length, radius of a given cylinder, a test tube and a beaker using a Vernier
   caliper and find volume of each object.
2. To determine diameter of a wire, a solid ball and thickness of cardboard using a screw gauge.
3. To determine radius of curvature of a convex and a concave mirror/surface using a spherometer.
4. To verify triangle and parallelogram law of forces.
5. To find the co-efficient of friction between wood and glass using a horizontal board.
6. To determine force constant of a spring using Hook's Law.
7. To verify law of conservation of mechanical energy (PE to KE).
8. To find the moment of inertia of a flywheel.
9. To find the viscosity of a given liquid (Glycerin) by Stoke's law.
10. To find the coefficient of linear expansion of the material of a rod.
11. To determine atmospheric pressure at a place using Fortin's barometer.
12. To measure room temperature and temperature of a hot bath using mercury thermometer and convert it into different scales.

8. **Applied Chemistry Lab**

Volumetric and Gravimetric analysis:

1 Preparation of standard solution of oxalic acid or potassium permanganate.
2 To determine strength of given sodium hydroxide solution by titrating

against standard oxalic
acid solution using phenolphthalein indicator.

3   Standardization of $KMnO_4$ solution using standard oxalic acid and Determine the percentage of
iron present in given Hematite ore by $KMnO_4$ solution.

4   Iodometric estimation of copper in the copper pyrite ore.

5   Volumetric estimation of total acid number (TAN) of given oil.

6   Volumetric estimation of

a)   Total hardness of given water sample using standard EDTA solution.

b)   Alkalinity of given water sample using 0.01M sulphuric acid

7   Proximate analysis of coal

a)   Gravimetric estimation moisture in given coal sample

b)   Gravimetric estimation ash in given coal sample

Instrumental analysis

8.   Determine the conductivity of given water sample.

9.   Determination of the Iron content in given cement sample using colorimeter.

10. Determination of calorific value of solid or liquid fuel using bomb calorimeter.

11. Determination of viscosity of lubricating oil using Redwood viscometer.

12. Determination of flash and fire point of lubricating oil using Able's flash point apparatus.

13. To verify the first law of electrolysis of copper sulfate using copper electrode.

14. Construction and measurement of emf of elector chemical cell (Daniel cell).

15. To study the effect of dissimilar metal combination.

9.   **Sports and Yoga**
   - **Introduction to Physical Education**

     o   Meaning & definition of Physical Education

     o   Aims & Objectives of Physical Education

     o   Changing trends in Physical Education

   - **Olympic Movement**

     o   Ancient & Modern Olympics (Summer & Winter)

     o   Olympic Symbols, Ideals, Objectives & Values

     o   Awards and Honours in the field of Sports in India (Dronacharya Award, Arjuna Award, Dhayanchand Award, Rajiv Gandhi Khel Ratna Award etc.)

   - **Physical Fitness, Wellness & Lifestyle**

     o   Meaning & Importance of Physical Fitness & Wellness

     o   Components of Physical fitness

     o   Components of Health related fitness

- Components of wellness
- Preventing Health Threats through Lifestyle Change
- Concept of Positive Lifestyle

- **Fundamentals of Anatomy & Physiology in Physical Education, Sports and Yoga**
  - Define Anatomy, Physiology & Its Importance
  - Effect of exercise on the functioning of Various Body Systems. (Circulatory System, Respiratory System, Neuro-Muscular System etc.)

- **Kinesiology, Biomechanics & Sports**
  - Meaning & Importance of Kinesiology & Biomechanics in Physical Edu. & Sports
  - Newton's Law of Motion & its application in sports.
  - Friction and its effects in Sports.

- **Postures**
  - Meaning and Concept of Postures.
  - Causes of Bad Posture.
  - Advantages & disadvantages of weight training.
  - Concept & advantages of Correct Posture.
  - Common Postural Deformities – Knock Knee; Flat Foot; Round Shoulders; Lordosis, Kyphosis, Bow Legs and Scoliosis.
  - Corrective Measures for Postural Deformities

- **Yoga**
  - Meaning & Importance of Yoga
  - Elements of Yoga
  - Introduction - Asanas, Pranayama, Meditation & Yogic Kriyas
  - Yoga for concentration & related Asanas (Sukhasana; Tadasana; Padmasana & Sha-shankasana)
  - Relaxation Techniques for improving concentration - Yognidra

- **Yoga & Lifestyle**
  - Asanas as preventive measures.
  - Hypertension: Tadasana, Vajrasana, Pavan Muktasana, Ardha Chakrasana, Bhujangasana, Sharasana.
  - Obesity: Procedure, Benefits & contraindications for Vajrasana, Hastasana, Trikonasana, Ardh Matsyendrasana.

- Back Pain: Tadasana, Ardh Matsyendrasana, Vakrasana, Shalabhasana, Bhujangasana.

- Diabetes: Procedure, Benefits & contraindications for Bhujangasana, Paschimottasana, Pavan Muktasana, Ardh Matsyendrasana.

- Asthema: Procedure, Benefits & contraindications for Sukhasana, Chakrasana, Gomukhasana, Parvatasana, Bhujangasana, Paschimottasana, Matsyasana.

- **Training and Planning in Sports**

  - Meaning of Training

  - Warming up and limbering down

  - Skill, Technique & Style

  - Meaning and Objectives of Planning.

  - Tournament – Knock-Out, League/Round Robin & Combination.

- **Psychology & Sports**

  - Definition & Importance of Psychology in Physical Edu. & Sports

  - Define & Differentiate Between Growth & Development

  - Adolescent Problems & Their Management

  - Emotion: Concept, Type & Controlling of emotions

  - Meaning, Concept & Types of Aggressions in Sports.

  - Psychological benefits of exercise.

  - Anxiety & Fear and its effects on Sports Performance.

  - Motivation, its type & techniques.

  - Understanding Stress & Coping Strategies.

- **Doping**

  - Meaning and Concept of Doping

  - Prohibited Substances & Methods

  - Side Effects of Prohibited Substances

- **Sports Medicine**

  - First Aid – Definition, Aims & Objectives.

  - Sports injuries: Classification, Causes & Prevention.

  - Management of Injuries: Soft Tissue Injuries and Bone & Joint Injuries

- **Sports / Games**

   Following sub topics related to any one Game/Sport of choice of student out of: Athletics, Badminton, Basketball, Chess, Cricket, Kabaddi, Lawn Tennis, Swimming, Table Tennis, Volleyball, Yoga etc.

   - History of the Game/Sport.
   - Latest General Rules of the Game/Sport.
   - Specifications of Play Fields and Related Sports Equipment.
   - Important Tournaments and Venues.
   - Sports Personalities.
   - Proper Sports Gear and its Importance.

10. **Communication Skills in English - Lab**
    Unit 1 Listening Skills
    Listening Process and Practice: Introduction to recorded lectures, poems, interviews and speeches, listening tests.

    Unit II Introduction to Phonetics
    Sounds: consonant, vowel, diphthongs, etc. transcription of words (IPA), weak forms, syllable division, word stress, intonation, voice etc.

    Unit III Speaking Skills
    Standard and formal speech: Group discussion, oral presentations, public speaking, business presentations etc. Conversation practice and role playing, mock interviews etc.

    Unit IV Building vocabulary
    Etymological study of words and construction of words, phrasal verbs, foreign phrases, idioms and phrases. Jargon/ Register related to organizational set up, word exercises and word games to en- hance self-expression and vocabulary of participants.

11. **Mathematics - II**

    UNIT - I: Determinants and Matrices

    Elementary properties of determinants up to 3rd order, consistency of equations, Crammer's rule. Algebra of matrices, Inverse of a matrix, matrix inverse method to solve a system of linear equations in 3 variables.

    UNIT - II: Integral Calculus

    Integration as inverse operation of differentiation. Simple integration by substitution, by parts

    and by partial fractions (for linear factors only). Use of formulas $\int_0^{\frac{\pi}{2}} \sin^n x \, dx$, $\int_0^{\frac{\pi}{2}} \cos^n x \, dx$ and $\int_0^{\frac{\pi}{2}} \sin^m x \cos^n x \, dx$ for solving problems Where m and n are positive integers.

Applications of integration for i. Simple problem on evaluation of area bounded by a curve and axes.
ii. Calculation of Volume of a solid formed by revolution of an area about axes. (Simple problems).

UNIT - III: Co-Ordinate Geometry

Equation of straight line in various standard forms (without proof), inter section of two straight lines, angle between two lines. Parallel and perpendicular lines, perpendicular distance formula.

General equation of a circle and its characteristics. To find the equation of a circle, given:

i.   Centre and radius,

ii.   Three points lying on it and

iii. Coordinates of end points of a diameter;

Definition of conics (Parabola, Ellipse, Hyperbola) their standard equations without proof. Problems
on conics when their foci, directories or vertices are given.

UNIT - IV: Vector Algebra

Definition notation and rectangular resolution of a vector. Addition and subtraction of vectors. Scalar
and vector products of 2 vectors. Simple problems related to work, moment and angular velocity.

UNIT-V: Differential Equations

Solution of first order and first degree differential equation by variable separation method (simple
problems). MATLAB – Simple Introduction.

12. **Applied Physics -II**

UNIT - 1: Wave motion and its applications

Wave motion, transverse and longitudinal waves with examples, definitions of wave velocity, frequency and wave length and their relationship, Sound and light waves and their properties, wave equation ($y = r \sin\omega t$) amplitude, phase, phase difference, principle of superposition of waves and beat formation.

Simple Harmonic Motion (SHM): definition, expression for displacement, velocity,

acceleration, time period, frequency etc. Simple harmonic progressive wave and energy transfer, study of vibration of cantilever and determination of its time period, Free, forced and resonant vibrations with examples.

Acoustics of buildings – reverberation, reverberation time, echo, noise, coefficient of absorption of sound, methods to control reverberation time and their applications, Ultrasonic waves – Introduction and properties, engineering and medical applications of ultrasonic.

UNIT - 2: Optics

Basic optical laws; reflection and refraction, refractive index, Images and image formation by mirrors, lens and thin lenses, lens formula, power of lens, magnification and defects. Total internal reflection, Critical angle and conditions for total internal reflection, applications of total internal reflection in optical fiber.

Optical Instruments; simple and compound microscope, astronomical telescope in normal adjustment, magnifying power, resolving power, uses of microscope and telescope, optical projection systems.

UNIT - 3: Electrostatics

Coulombs law, unit of charge, Electric field, Electric lines of force and their properties, Electric flux, Electric potential and potential difference, Gauss law: Application of Gauss law to find electric field intensity of straight charged conductor, plane charged sheet and charged sphere.

Capacitor and its working, Types of capacitors, Capacitance and its units. Capacitance of a parallel plate capacitor, Series and parallel combination of capacitors (related numerical), dielectric and its effect on capacitance, dielectric break down.

UNIT - 4: Current Electricity

Electric Current and its units, Direct and alternating current, Resistance and its units, Specific resistance, Conductance, Specific conductance, Series and parallel combination of resistances. Factors affecting resistance of a wire, carbon resistances and colour coding.

Ohm's law and its verification, Kirchhoff's laws, Wheatstone bridge and its applications (slide wire
bridge only), Concept of terminal potential difference and Electro motive force (EMF)

Heating effect of current, Electric power, Electric energy and its units (related numerical problems), Advantages of Electric Energy over other forms of energy.

UNIT - 5: Electromagnetism

Types of magnetic materials; dia, para and ferromagnetic with their properties, Magnetic field and its units, magnetic intensity, magnetic lines of force, magnetic flux and units, magnetization.

Concept of electromagnetic induction, Faraday's Laws, Lorentz force (force on moving charge in magnetic field). Force on current carrying conductor, force on rectangular coil placed in magnetic field.

Moving coil galvanometer; principle, construction and working, Conversion of a galvanometer into ammeter and voltmeter.

UNIT - 6: Semiconductor Physics

Energy bands in solids, Types of materials (insulator, semi-conductor, conductor), intrinsic and extrinsic semiconductors, p-n junction, junction diode

and V-I characteristics, types of junction diodes. Diode as rectifier – half wave and full wave rectifier (centre taped).

Transistor; description and three terminals, Types- pnp and npn, some electronic applications (list only).

Photocells, Solar cells; working principle and engineering applications.

UNIT - 7: Modern Physics

Lasers: Energy levels, ionization and excitation potentials; spontaneous and stimulated emission; population inversion, pumping methods, optical feedback, Types of lasers; Ruby, He-Ne and semiconductor, laser characteristics, engineering and medical applications of lasers.

Fiber Optics: Introduction to optical fibers, light propagation, acceptance angle and numerical aperture, fiber types, applications in; telecommunication, medical and sensors.

Nanoscience and Nanotechnology: Introduction, nanoparticles and nanomaterials, properties at nanoscale, nanotechnology, nanotechnology based devices and applications.

13. Introduction to IT Systems

UNIT 1:

Basic Internet skills: Understanding browser, efficient use of search engines, awareness about Digital
India portals (state and national portals) and college portals.

General understanding of various computer hardware components – CPU, Memory, Display, Key- board, Mouse, HDD and other Peripheral Devices.

UNIT 2:

OS Installation (Linux and MS Windows), Unix Shell and Commands, vi editor.

UNIT 3:

HTML4, CSS, making basic personal webpage.

UNIT 4:

Office Tools: OpenOffice Writer, OpenOffice Spreadsheet (Calc), OpenOffice Impress.

UNIT 5: Information security best practices.

Class lectures will only introduce the topic or demonstrate the tool, actual learning will take place in the Lab by practicing regularly.

14. Fundamentals of Electrical and Electronics Engineering

UNIT I Overview of Electronic Components & Signals:

Passive Active Components: Resistances, Capacitors, Inductors, Diodes, Transistors, FET, MOS and CMOS and their Applications. Signals: DC/AC, voltage/current, periodic/non-periodic signals, aver- age, rms, peak values, different types of signal waveforms, Ideal/non-ideal voltage/current sources, independent/dependent voltage current sources.

UNIT II Overview of Analog Circuits:

Operational Amplifiers-Ideal Op-Amp, Practical op amp, Open loop and closed loop configurations, Application of Op-Amp as amplifier, adder, differentiator and integrator.

UNIT III Overview of Digital Electronics: Introduction to Boolean Algebra, Electronic Implementation of Boolean Operations, Gates-Functional Block Approach, Storage elements-Flip Flops-A Functional block approach, Counters: Ripple, Up/down and decade, Introduction to digital IC Gates (of TTL Type).

Unit IV Electric and Magnetic Circuits:

EMF, Current, Potential Difference, Power and Energy; M.M.F, magnetic force, permeability, hysteresis loop, reluctance, leakage factor and BH curve; Electromagnetic induction, Faraday's laws of electromagnetic induction, Lenz's law; Dynamically induced emf; Statically induced emf; Equations of self and mutual inductance; Analogy between electric and magnetic circuits.

Unit V A.C. Circuits:

Cycle, Frequency, Periodic time, Amplitude, Angular velocity, RMS value, Average value, Form Factor Peak Factor, impedance, phase angle, and power factor; Mathematical and phasor representation of alternating emf and current; Voltage and Current relationship in Star and Delta connections; A.C in resistors, inductors and capacitors; A.C in R-L series, R-C series, R-L-C series and parallel circuits; Power in A. C. Circuits, power triangle.

Unit VI Transformer and Machines: General construction and principle of different type of trans- formers; Emf equation and transformation ratio of transformers; Auto transformers; Construction and Working principle of motors; Basic equations and characteristic of motors.

15. **Engineering Mechanics**

Unit – I Basics of mechanics and force system

Significance and relevance of Mechanics, Applied mechanics, Statics, Dynamics.

Space, time, mass, particle, flexible body and rigid body.

Scalar and vector quantity, Units of measurement (SI units) - Fundamental units and derived units.

Force – unit, representation as a vector and by Bow's notation, characteristics and effects of a
force, Principle of transmissibility of force, Force system and its classification.

Resolution of a force - Orthogonal components of a force, moment of a force, Varignon's Theorem.

Composition of forces – Resultant, analytical method for determination of resultant for concur- rent, non-concurrent and parallel co-planar force systems – Law of triangle, parallelogram and polygon of forces.

Unit– II Equilibrium

Equilibrium and Equilibrant, Free body and Free body diagram, Analytical and graphical methods of analysing equilibrium

Lami's Theorem – statement and explanation, Application for various engineering problems. Types of beam, supports (simple, hinged, roller and fixed) and loads acting on beam (vertical and inclined point load, uniformly distributed load, couple),

Beam reaction for cantilever, simply supported beam with or without overhang – subjected to combination of Point load and uniformly distributed load.

Beam reaction graphically for simply supported beam subjected to vertical point loads only.

Unit– III Friction

Friction and its relevance in engineering, types and laws of friction, limiting equilibrium, limiting friction, co-efficient of friction, angle of friction, angle of repose, relation between co-efficient of friction and angle of friction.

Equilibrium of bodies on level surface subjected to force parallel and inclined to plane. Equilibrium of bodies on inclined plane subjected to force parallel to the plane only.

Unit– IV Centroid and centre of gravity

Centroid of geometrical plane figures (square, rectangle, triangle, circle, semi-circle, quarter circle) Centroid of composite figures composed of not more than three geometrical figures

Centre of Gravity of simple solids (Cube, cuboid, cone, cylinder, sphere, hemisphere) Centre of Gravity of composite solids composed of not more than two simple solids.

Unit – V Simple lifting machine

Simple lifting machine, load, effort, mechanical advantage, applications and advantages. Velocity ratio, efficiency of machines, law of machine.

Ideal machine, friction in machine, maximum Mechanical advantage and efficiency, reversible and non-reversible machines, conditions for reversibility

Velocity ratios of Simple axle and wheel, Differential axle and wheel, Worm and worm wheel, Single purchase and double purchase crab winch, Simple screw jack, Weston's differential pulley block, geared pulley block.

16. **Applied Physics II Lab**
    1. To determine and verify the time period of a cantilever.
    2. To determine velocity of ultrasonic in different liquids using ultrasonic interferometer.
    3. To verify laws of reflection from a plane mirror/ interface.
    4. To verify laws of refraction (Snell's law) using a glass slab.
    5. To determine focal length and magnifying power of a convex lens.
    6. To verify Ohm's law by plotting graph between current and potential difference.
    7. To verify laws of resistances in series and parallel combination.
    8. To find the frequency of AC main using electrical vibrator.

9. To verify Kirchhoff's law using electric circuits.
10. To study the dependence of capacitance of a parallel plate capacitor on various factors and determines permittivity of air at a place.
11. To find resistance of a galvanometer by half deflection method.
12. To convert a galvanometer into an ammeter.
13. To convert a galvanometer into a voltmeter.
14. To draw V-I characteristics of a semiconductor diode (Ge, Si) and determine its knee voltage.
15. To verify inverse square law of radiations using a photo-electric cell.
16. To measure wavelength of a He-Ne/diode laser using a diffraction grating.
17. To measure numerical aperture (NA) of an optical fiber.

17. Introduction to IT Systems Lab

S.No.	Topics for Practice
1	Browser features, browsing, using various search engines, writing search queries
2	Visit various e-governance/Digital India portals, understand their features, services of- fered
3	Read Wikipedia pages on computer hardware components, look at those components in lab, identify them, recognise various ports/interfaces and related cables, etc.
4	Install Linux and Windows operating system on identified lab machines, explore various options, do it multiple times
5	Connect various peripherals (printer, scanner, etc.) to computer, explore various features of peripheral and their device driver software.
6	Practice HTML commands, try them with various values, make your own Webpage
7	Explore features of Open Office tools, create documents using these features, do it multiple times
8	Explore security features of Operating Systems and Tools, try using them and see what happens.

18. Fundamentals of Electrical and Electronics Engineering Lab

S. No.	Practical Outcomes (PrOs)
1.	Determine the permeability of magnetic material by plotting its B-H curve.
2.	Measure voltage, current and power in 1-phase circuit with resistive load.
3.	Measure voltage, current and power in R-L series circuit.
4.	Determine the transformation ratio (K) of 1-phase transformer.
5.	Connect single phase transformer and measure input and output quantities.
6.	Make Star and Delta connection in induction motor starters and measure the line and phase values.
7.	Identify various passive electronic components in the given circuit

8.	Connect resistors in series and parallel combination on bread board and measure its value using digital multimeter.
9.	Connect capacitors in series and parallel combination on bread board and measure its value using multimeter.
10.	Identify various active electronic components in the given circuit.
11.	Use multimeter to measure the value of given resistor.
12.	Use LCR-Q tester to measure the value of given capacitor and inductor.
13.	Determine the value of given resistor using digital multimeter to confirm with colour code.
14.	Test the PN-junction diodes using digital multimeter.
15.	Test the performance of PN-junction diode.
16.	Test the performance of Zener diode.
17.	Test the performance of LED.
18.	Identify three terminals of a transistor using digital multimeter.
19.	Test the performance of NPN transistor.
20.	Determine the current gain of CE transistor configuration.
21.	Test the performance of transistor switch circuit.
22.	Test the performance of transistor amplifier circuit.
23.	Test Op-Amp as amplifier and Integrator

19. **Engineering Mechanics Lab.**
   1. To study various equipments related to Engineering Mechanics.
   2. To find the M.A., V.R., Efficiency and law of machine for Differential Axle and Wheel.
   3. To find the M.A., V.R., Efficiency and law of machine for Simple Screw Jack.
   4. Derive Law of machine using Worm and worm wheel.
   5. Derive Law of machine using Single purchase crab.
   6. Derive Law of machine using double purchase crab.
   7. Derive Law of machine using Weston's differential or wormed geared pulley block.
   8. Determine resultant of concurrent force system applying Law of Polygon of forces using force table.
   9. Determine resultant of concurrent force system graphically.
   10. Determine resultant of parallel force system graphically.
   11. Verify Lami's theorem.
   12. Study forces in various members of Jib crane.
   13. Determine support reactions for simply supported beam.
   14. Obtain support reactions of beam using graphical method.

15. Determine coefficient of friction for motion on horizontal and inclined plane.
16. Determine centroid of geometrical plane figures.

20. Environmental Science

Pre requisite: - High School Chemistry

Unit-1 Ecosystem

Structure of ecosystem, Biotic & Abiotic components Food chain and food web

Aquatic (Lentic and Lotic) and terrestrial ecosystem Carbon, Nitrogen, Sulphur, Phosphorus cycle.

Global warming -Causes, effects, process, Green House Effect, Ozone depletion

Unit– 2 Air and, Noise Pollution

Definition of pollution and pollutant, Natural and manmade sources of air pollution (Refriger- ants, I.C., Boiler) Air Pollutants: Types, Particulate Pollutants: Effects and control (Bag filter, Cyclone separator, Electrostatic Precipitator)

Gaseous Pollution Control: Absorber, Catalytic Converter, Effects of air pollution due to Refrig- erants, I.C., Boiler

Noise pollution: sources of pollution, measurement of pollution level, Effects of Noise pollu- tion, Noise pollution (Regulation and Control) Rules, 2000

Unit- 3 Water and Soil Pollution

Sources of water pollution, Types of water pollutants, Characteristics of water pollutants Tur-
bidity, pH, total suspended solids, total solids BOD and COD: Definition, calculation

Waste Water Treatment: Primary methods: sedimentation, froth floatation, Secondary meth- ods: Activated sludge treatment, Trickling filter, Bioreactor, Tertiary Method: Membrane sepa- ration technology, RO (reverse osmosis).

Causes, Effects and Preventive measures of Soil Pollution: Causes-Excessive use of Fertilizers, Pesticides and Insecticides, Irrigation, E-Waste.

Unit– 4 Renewable sources of Energy

Solar Energy: Basics of Solar energy. Flat plate collector (Liquid & Air). Theory of flat plate col- lector. Importance of coating. Advanced collector. Solar pond. Solar water heater, solar dryer. Solar stills.

Biomass: Overview of biomass as energy source. Thermal characteristics of biomass as fuel. Anaerobic digestion. Biogas production mechanism. Utilization and storage of biogas.

Wind energy: Current status and future prospects of wind energy. Wind energy in India. Environmental benefits and problem of wind energy.

New Energy Sources: Need of new sources. Different types new energy sources. Applications of (Hydrogen energy, Ocean energy resources, Tidal energy conversion.) Concept, origin and power plants of geothermal energy

Unit-5 Solid Waste Management, ISO 14000 & Environmental Management   06 hours

Solid waste generation- Sources and characteristics of : Municipal solid waste, E- waste, bio- medical waste.

Metallic wastes and Non-Metallic wastes (lubricants, plastics, rubber) from industries.

Collection and disposal: MSW (3R, principles, energy recovery, sanitary landfill), Hazardous waste

Air quality act 2004, air pollution control act 1981 and water pollution and control act1996. Structure and role of Central and state pollution control board. Concept of Carbon Credit, Carbon Footprint. Environmental management in fabrication industry. ISO14000: Implementation in industries, Benefits.

21. Principles of Electronic Communication

- **ANALOG MODULATION**: Concept of frequency translation. Amplitude Modulation: Description of full AM, DSBSC, SSB and VSB in time and frequency domains, methods of generation & demodulation, descriptions of FM signal in time and frequency domains
- **PULSE ANALOG MODULATION**: Ideal sampling, Sampling theorem, aliasing, interpolation, natural and flat top sampling in time and frequency domains
- **PULSE ANALOG MODULATION**: Ideal sampling, Sampling theorem, aliasing, interpolation, natural and flat top sampling in time and frequency domains
- **DIGITAL MODULATION**: Baseband transmission: Line coding (RZ, NRZ), inter symbol interference (ISI), pulse shaping, Nyquist criterion for distortion free base band transmission, raised cosine spectrum. Pass band transmission: Geometric interpretation of signals, orthogonalization

SPREAD-SPECTRUM MODULATION: Introduction, Pseudo-Noise sequences, direct sequence spread spectrum (DSSS) with coherent BPSK, processing gain, probability of error, frequency-hop spread spectrum (FHSS). Application of spread spectrum: CDMA

22. Principles of Electronic Communications Lab

1. Harmonic analysis of a square wave of modulated waveform: measures modulation index.
2. To modulate a high frequency carrier with sinusoidal signal to obtain FM

signal.

3. To study and observe the operation of a super heterodyne receiver
4. To modulate a pulse carrier with sinusoidal signal to obtain PWM signal and demodulate it.
5. To modulate a pulse carrier with sinusoidal signal to obtain PPM signal and demodulate it.
6. To observe pulse amplitude modulated waveform and its demodulation.
7. To observe the operation of a PCM encoder and decoder. To consider reason for using digital signal x-missions of analog signals.
8. To study & observe the amplitude response of automatic gain controller (AGC).

Practical Outcomes (PrOs)

1. Understanding the different techniques of signal modulation and demodulation.

Understanding the variation in amplitude of controllers.

23. Electronics Devices and Circuits

Unit 1 – Semiconductor and Diodes

Definition, Extrinsic/Intrinsic, N-type & p-type

PN Junction Diode – Forward and Reverse Bias Characteristics Zener Diode – Principle, characteristics, construction, working Diode Rectifiers – Half Wave and Full Wave

Filters – C, LC and PI Filters

Unit 2 – Bipolar Junction Transistor (BJT)

NPN and PNP Transistor – Operation and characteristics Common Base Configuration – characteristics and working Common Emitter Configuration – characteristics and working Common Base Configuration – characteristics and working High frequency model of BJT

Classification of amplifiers, negative feedback

Unit 3 – Field Effect Transistors

FET – Working Principle, Classification

MOSFET Small Signal model

N-Channel/ P-Channel MOSFETs – characteristics, enhancement and depletion mode, MOS-FET as a Switch

Common Source Amplifiers

Uni-Junction Transistor – equivalent circuit and operation

Unit 4 – SCR DIAC & TRIAC

SCR – Construction, operation, working, characteristics DIAC - Construction,

operation, working, characteristics TRIAC - Construction, operation, working, characteristics SCR and MOSFET as a Switch, DIAC as bidirectional switch Comparison of SCR, DIAC, TRIAC, MOSFET

Unit 5 – Amplifiers and Oscillators

Feedback Amplifiers – Properties of negative Feedback, impact of feedback on different pa-rameters

Basic Feedback Amplifier Topologies: Voltage Series, Voltage Shunt Current Series, Current Shunt

Oscillator – Basic Principles, Crystal Oscillator, Non-linear/ Pulse Oscillator

24. Electronic Devices and Circuits Lab

SUGGESTED PRACTICALS/ EXERCISES

The practical in this section are PrOs (i.e. sub-components of the COs) to be developed and assessedin the student for the attainment of the competency.

S. No.	Practical Outcomes (PrOs)	Unit No.
1.	Construct the circuit and plot the VI characteristics of the PN Junction Diode , find the cut in voltage	1
2.	Construct the circuit and plot the characteristics of a Zener Diode. Find the breakdown voltage	1
3.	Construct a Half Wave Rectifier and obtain regulation characteristics – Without Filters and with FiltersCompare the results	1
4.	Construct a Full Wave Rectifier and obtain regulation characteristics – Without Filters and with FiltersCompare the results	1
5.	Construct a Bridge Rectifier and obtain regulation characteristics – Without Filters and with Filters	1
6.	Obtain the characteristics of DIAC and TRIAC	3
7.	Simulate half wave, full wave and bridge rectifier using simulation tool like PSpice/ Orcad/ Multisim.	3
8.	Develop a simulation model for Voltage Series and Voltage Shunt Feedback Amplifiers	5
9.	Develop circuits for Voltage Series and Voltage Shunt Feedback Amplifiers and obtain output plots. Compare the results with the simulation model.	5
10.	Develop a simulation model for Current Series and Current Shunt Feedback Amplifiers	5
11.	Develop circuits for Current Series and Current Shunt Feedback Amplifiers and obtain output plots. Compare the results with the simulation model.	

25. Digital Electronics

Unit 1 – Number Systems & Boolean Algebra

Introduction to different number systems – Binary, Octal, Decimal, Hexadecimal

Conversion from one number system to another. Boolean variables – Rules and laws of Boolean AlgebraDe-Morgan's Theorem

Karnaugh Maps and their use for simplification of Boolean expressions

Unit 2 – Logic Gates

Logic Gates – AND, OR, NOT, NAND, NOR , XOR, XNOR: Symbolic representation and truth
table
Implementation of Boolean expressions and Logic Functions using gates
Simplification of expressions

Unit 3 – Combinational Logic Circuits

Arithmetic Circuits – Addition, Subtraction, 1's 2's Complement, Half Adder, Full Adder, HalfSubtractor, Full Subtractor, Parallel and Series Adders

Encoder, Decoder

Multiplexer – 2 to 1 MUX, 4 to 1 MUX, 8 to 1 MUX. Applications

Demultiplexer – 1 to 2 DEMUX, 1- 4 DEMUX, 1- 8 DEMUX

Unit 4 – Sequential Logic Circuits

Flip Flops – SR,JK, T, D, FF, JK-MS, Triggering

Counters – 4 bit Up – Down Counters, Asynchronous/ Ripple Counter, Decade Counter- Mod3, Mod 7 Counter, Johnson Counter, Ring Counter

Registers – 4bit Shift Register: Serial In Serial Out, Serial in Parallel Out, Parallel In Serial Out, Parallel In Parallel Out

Unit 5 – Memory Devices

Classification of Memories – RAM Organization, Address Lines and Memory Sixe,

Static RAM, Bipolar RAM, cell Dynamic RAM, D RAM, DDR RAM

Read Only memory – ROM organization, Expanding memory, PROM, EPROM, EEPROM, Flash
memory

Data Converters – Digital to Analog converters, Analog to Digital Converters

26. Digital Electronics Lab

The practical in this section are PrOs (i.e. sub-components of the COs) to be developed and assessedin the student for the attainment of the competency.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	To verify the truth tables for all logic fates – NOT OR AND NAND NOR XOR XNOR using CMOS Logic gates and TTL Logic Gates	1	02
2.	Implement and realize Boolean Expressions with Logic Gates	2	02

3.	Implement Half Adder, Full Adder, Half Subtractor, Full subtractor us-ing ICs	3	02
4.	Implement parallel and serial full-adder using ICs	3	02
5.	Design and development of Multiplexer and De-multiplexer using mul-tiplexer ICs	3	02
6.	Verification of the function of SR,D, JK and T Flip Flops	4	02
7.	Design controlled shift registers	4	02
8.	Construct a Single digit Decade Counter (0-9) with 7 segment display	4	03
9.	To design a programmable Up-Down Counter with a 7 segment display.	4	03
10.	Study of different memory ICs	5	02
11.	Study Digital- to – Analog and Analog to Digital Converters	5	02
12.	Simulate in Software (such as PSpice) an Analog to Digital Converter	5	03
13.	Simulate in Software (such as PSpice) an Analog to Digital Converter	5	03

27. Electronic Measurement and Instrumentation

Unit – I Basics of Measurements and Bridges
Accuracy & precision, ResolutionTypes of Errors

DC Bridges – Wheatstone and Kelvin Double Bridge

AC Bridges - Maxwell's Bridge, Hay's Bridge, Anderson Bridge, De-Sauty's Bridge

Unit- II Potentiometer
Basic DC slide wire PotentiometerCrompton's DC Potentiometer Applications of DC Potentiometer AC Potentiometers

Applications of AC Potentiometers

Unit– III Measuring Instruments
Permanent Magnet Moving Coil Instruments (PMMC) Moving Iron type Instruments (MI) Electro Dynamo Type InstrumentsSingle Phase Energy Meter

Unit– IV Electronic Instruments
Electronic Voltmeter and Digital VoltmeterElectronic Multimeters Q – Meter Vector Impedance Meter

Unit– V Oscilloscopes
Cathode ray tube: construction, operation, screens, graticules

Vertical deflection system, Horizontal deflection system, Delay line,

Measurement of frequency, time delay, phase angle and modulation index (trapezoidal meth-od) Oscilloscope probe: Structure of 1:1 and 10:1 probe Multiple Trace CRO

Unit- VI Transducers
Classification, Selection Criteria, Characteristics, Construction, Working Principles and Ap-plication of following Transducers: RTD, Thermocouple, ThermistorLVDT, Strain Gauge Load Cell Piezoelectric Transducers

28. Electronic Measurements and Instrumentation Lab

SUGGESTED PRACTICALS/ EXERCISES

The practical in this section are PrOs (i.e. sub-components of the COs) to be developed and assessedin the student for the attainment of the competency.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx Hrs. Required
1.	Measure unknown inductance using following bridges (a) Ander-son Bridge (b) Maxwell Bridge	I	4
2.	Measure Low resistance by Kelvin's Double Bridge	I	2
3.	Calibrate an ammeter using DC slide wire potentiometer	II	2
4.	Calibrate a voltmeter using Crompton potentiometer	II	2
5.	Measure low resistance by Crompton potentiometer	II	2
6.	Calibrate a single-phase energy meter by phantom loading	III	2
7.	Study the working of Q-meter and measure Q of coils	IV	2
8.	Study working and applications of (i) C.R.O. (ii) Digital Storage C.R.O. & (ii) C.R.O. Probes	V	2
9.	Measurement of displacement with the help of LVDT	VI	2
10.	Draw the characteristics of the following temperature transduc- ers (a) RTD (Pt-100) (b) Thermistor	VI	2
11.	Measurement of strain/force with the help of strain gauge load cell	VI	2

29. Electric Circuits & Network

Unit – 1 Basics of Network and Network Theorem

Node and Mesh Analysis Superposition Theorem Thevenin Theorem Norton Theorem Maximum Power transfer theorem Reciprocity Theorem

Unit– 2 Graph Theory

Graph of network, tree, incidence matrix

F- Tie Set Analysis

F-Cut Set Analysis

Analysis of resistive network using cut-set and tie-setDuality

Unit– 3 Time Domain and Frequency Domain Analysis

Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C
circuits

Initial and Final conditions in network elementsForced and Free response,

time constants Steady State and Transient State Response

Analysis of electrical circuits using Laplace Transform for standard inputs (unit, Ramp, Step)

Unit– 4 Trigonometric and exponential Fourier series

Discrete spectra and symmetry of waveform

Steady state response of a network to non-sinusoidal periodic inputs, power factor, effectivevalues

Fourier transform and continuous spectra

Unit- 5 Two Port Network

Two Port Network Open Circuit Impedance Parameters Short Circuit Admittance ParametersTransmission Parameters Hybrid Parameters

Interrelationship of Two Port Network Inter Connection of Two Port Network

30.Microcontroller and Applications

Unit I Introduction:-Introduction to Microprocessors and Microcontrollers, Architectures [8085,8086] Intel MCS- 51 family features – 8051 - organization and architecture

Unit II Programming with 8051

10 8051 instruction set, addressing modes, conditional instructions, I/O Programming, Arithmetic logic instructions, single bit instructions, interrupt handling, programming counters, timers and Stack

Unit III

MCS51 and external Interfaces 8 User interface – keyboard, LCD, LED, Real world interface -ADC, DAC, SENSORS Communication interface.

Unit IV C programming with 8051

8 I/O Programming, Timers/counters, Serial Communication, Interrupt, User Interfaces-LCD, Keypad, LED and communication interfaces [RS232].

Unit V ARM processor core based microcontrollers 14 Need for RISC Processor-ARM processor fun-
damentals, ARM core based controller [LPC214X], IO ports, ADC/DAC, Timers.

31. Microcontroller and Applications Lab

1. Programming 8051 Micro controller using ASM and C, and implementation in flash 8051
   microcontroller.
2. Programming with Arithmetic logic instructions [Assembly]
3. Program using constructs (Sorting an array) [Assembly]
4. Programming using Ports [Assembly and C]
5. Delay generation using Timer [Assembly and C]
6. Programming Interrupts [Assembly and C]
7. Implementation of standard UART communication (using hyper terminal) [Assembly and C].
8. Interfacing LCD Display. [Assembly and C]
9. Interfacing with Keypad [Assembly and C]
10. Programming ADC/DAC [Assembly and C]

11. Interfacing with stepper motor. [Assembly and C]
12. Pulse Width Modulation. [Assembly and C] Programming ARM Micro controller using ASMand C using simulator. 11.Programming with Arithmetic logic instructions[Assembly]
13. GPIO programming in ARM microcontroller. [C Programming].
14. Timers programing in ARM Microcontroller. [C Programming].

32. Consumer Electronics

UNIT-I Audio Fundamentals and Devices

Basic characteristics of sound signal, Audio level metering, decibel level in acoustic measurement,Microphone & Types, speaker types & working principle, Sound recording principle & types

UNIT-II Audio Systems, CD player, home theatre sound system, surround sound, Digital console block diagram, working prin-ciple, applications, FM tuner , ICs used in FM tuner TDA 7021T , PA address system.

UNIT-III Television Systems-Monochrome TV standards, scanning process, aspect ratio, persistence of vision and flicker, interlace scanning, picture resolution, Composite video signal, Colour TV standards, colour theory, hue, bright-ness, saturation, luminance and chrominance, Different types of TV camera, Transmission standards

UNIT-IV Television Receivers and Video Systems-PAL-D colour TV receiver, Digital TVs:- LCD, LED , PLASMA, HDTV, 3-D TV, projection TV, DTH receiv-er, Video interface, Digital Video, SDI, HDMI Multimedia Interface , Digital Video Interface, CD and DVD player

UNIT-V Home / Office Appliances Diagrams, operating principles and controller for FAX and Photocopier, Microwave Oven, Washing Machine, Air conditioner and Refrigerators, Digital camera and cam coder.

33. Digital Communication Systems

UNIT1 Block diagram and sub-system description of a digital communication system. Sampling of low-passand band-pass signals, PAM , PCM, signal to quantization noise ratio analysis of linear and nonlin- ear quantizers, Line codes and bandwidth considerations; PCM TDM hierarchies, frame structures, frame synchronization and bit stuffing.

UNIT 2 Quantization noise analysis of DM and ADM; DPCM and ADPCM; Low bit rate coding of speech and video signals. Baseband transmission, matched filter, performance in additive Gaussian noise; In- tersymbol interference (ISI), Nyquist criterion for zero ISI, sinusoidal roll-off filtering, correlative coding, equalizers and adaptive equalizers; Digital subscriber lines.

UNIT 3 Geometric representation of signals, maximum likelihood decoding; Correlation receiver, equiva- lence with matched filter.Generation, detection and probability of error analysis of OOK, BPSK, co- herent and non-coherent FSK, QPSK and DPSK; QAM, MSK and multicarrier modulation; Comparison of bandwidth and bit rate of digital modulation schemes.

UNIT 4 Introduction to Information and Coding Theories: Information Theory: information measures, Shan- non entropy, differential entropy, mutual information, capacity theorem for point-to-point channels with discrete

and continuous alphabets. Coding Theory: linear block codes – definitions, properties, bounds on minimum distance (singleton, Hamming, GV, MRRW), soft versus hard decision decoding, some specific codes (Hamming, RS, Concatenated); Convolutional codes – structure, decoding (the Viterbi and BCJR algorithms); Turbo codes, LDPC codes.

34. Digital Communication Systems Lab

1. Pulse Code Modulation and Differential Pulse Code Modulation.
2. Delta Modulation and Adaptive Delta modulation.
3. Simulation of Band Pass Signal Transmission and Reception • Amplitude Shift Keying • Fre- quency Shift Keying • Phase Shift Keying.
4. Performance Analysis of Band Pass Signal Transmission and Reception • Amplitude Shift Keying • Frequency Shift Keying • Phase Shift Keying.
5. Implementation of Amplitude Shift Keying
6. Implementation of Frequency Shift Keying
7. Implementation of Phase Shift Keying.
8. Time Division Multiplexing: PLL (CD 4046) based synch, clock and data extraction

35. Electronic Equipment Maintenance

Unit 1 : Fundamental Troubleshooting Procedures Inside An Electronic Equipment: Reading Draw-ings And Diagrams – Block Diagram, Circuit Diagram, Wiring Diagram; Dis-assembly and re-assembly of equipment, Equipment Failures and causes such as poor design, production deficiencies, carelessstorage and transport, inappropriate operating conditions, Nature of faults, Fault location procedure, Fault finding aids – Service and maintenance manuals and instruction manuals, Test and Measuring instruments, special tools Troubleshooting techniques, Approaching components for tests, Grounding systems in Electronic Equipment, Temperature sensitive Intermittent problems Corrective actions, Situations where repairs should not be attempted.

Unit 2 : Passive Components and Their Testing Passive Components- Resistors, Capacitors, Induc- tors Failures in fixed resistors, testing of resistors, variable resistors, variable resistors as potenti- ometers, failures in potentiometers, testing of potentiometers, servicing potentiometers, LDRs and Thermistors Types of capacitors and their performance, Failures in capacitors, testing of capacitors and precautions therein, variable capacitor types, Testing of inductors and inductance measurement

Unit 3 : Testing of Semiconductor Devices Types of semiconductor devices, Causes of failure in Semiconductor Devices, Types of failure Test procedures for Diodes, special types of Diodes, Bipolar Junction Transistors, Field Effect Transistors, Thyristors Operational Amplifiers, Fault diagnosis in op-amp circuits

Unit 4: Logic IC families, Packages in Digital ICs, IC identification, IC pin-outs, Handling ICs, Digital troubleshooting methods – typical faults, testing digital ICs with pulse generators Logic clip, Logic Probe, Logic Pulser, Logic Current Tracer, Logic Comparator Special consideration for fault diagnosis in digital circuits Handling precautions for ICs sensitive to static electricity Testing flip-

flops, count-ers, registers, multiplexers and de-multiplexers, encoders and decoders; Tri-state logic.

Unit 5: Rework and Repair of Surface Mount Assemblies Surface Mount Technology and surface mount devices Surface Mount Semiconductor packages – SOIC, SOT, LCCC, LGA, BGA, COB, Flatpacks and Quad Packs, Cylindrical Diode Packages, Packaging of Passive Components as SMDs Repairing Surface Mount PCBs, Rework Stations.

36. Linear Integrated Circuits

UNIT I - IC Fabrication and Circuit Configuration for Linear IC

Advantages of ICs over discrete components – Manufacturing process of monolithic Ics Construction of monolithic bipolar transistor – Monolithic diodes – Integrated Resistors Monolithic Capacitors Inductors. Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, BJT Differential amplifier with active loads, General operational amplifier stages and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations.

UNIT II Applications Of Operational Amplifiers Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder,subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarith- mic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters.

UNIT III Analog Multiplier and PLL Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable transcon- ductance technique, analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detec- tion, FM detection, FSK modulation and demodulation and Frequency synthesizing.

UNIT IV Analog to digital and digital to analog converters Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R2R Ladder types switches for D/A converters, high speed sample-and-hold circuits, A/D Converters specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type - A/D Converter using Voltage-to-Time Conversion - Over-sampling A/D Converters.

UNIT V Waveform generators and special function ICs Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555, IC Voltage regulators – Three terminal fixed and adjust- able voltage regulators - IC 723 general purpose regulator Monolithic switching regulator, Switched capacitor filter IC MF10, Frequency to Voltage and Voltage to Frequency converters, Audio Power amplifier, Video Amplifier, Isolation Amplifier, Opto-couplers and fiberoptic IC.

37. Electronic Devices and Circuits Practical

1. Operational Amplifiers (IC741)-Characteristics and Application.
2. Waveform Generation using Op-Amp (IC741).

3. Applications of Timer IC555.
4. Design of Active filters.
5. Study and application of PLL IC's
6. Design of binary adder and subtractor.
7. Design of counters.
8. Study of multiplexer and demultiplexer /decoders.
9. Implementation of combinational logic circuits.
10. Study of DAC and ADC 11. Op-Amp voltage Regulator- IC 723

38. Embedded Systems

Unit I -Embedded C basics operators for Arduino Familiarizing with the Arduino IDE. Sketch designing for Arduino Communication interface using serial port

Basic understanding of the code with boolean operations, pointer access operations, bitwise operations, compounded operations.

Unit II - Embedded C control structure blocks Looping mechanism – for, do and while. The branching operations based on conditions expression

Unit III Introduction to Arduino Mega Arduino Mega specifications including power ratings, digital and analog peripherals. Difference between the C language and Embedded C languageArduino Mega Ports, Pins, Digital and Analog Peripherals

Unit IV Communication with Arduino Different communication modules available with their real-life applicationCommunication interface

39. Embedded Systems Lab

The practical in this section are PrOs (i.e. sub-components of the COs) to be developed and assessedin the student for the attainment of the competency.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	Built-in LED state control by push button sketch implementation	I	02*
2.	Built-in LED blinking sketch implementation	I	02
3.	Built-in LED blinking by toggling states based on binary operation	I	02
4.	Built-in LED state control by user interface through serial port	I	02*
5.	User interface for boolean operation and bit wise operation through se-rial port	I	02
6.	User interface for compounded operation through serial port	I	02
7.	Looping mechanism to check the state of pin and if change print its sta-tus on serial port	II	02
8.	Controlling multiple LEDs with a loop and an array	II	02
9.	Use a potentiometer to control the blinking of an LED	III	02*

10.	Uses an analog output (PWM pin) to fade an LED.	III	02
11.	Servo Motor Control using PWM	III	02
12.	Temperature sensor interfacing and sending its reading over serial port	IV	04
13.	I2C light sensor interfacing and sending its reading over serial port	IV	04*

40. Mobile and Wireless Communication

Unit I - Overview of Cellular SystemsEvolution 2g/3G/4G/5G Cellular Concepts – Frequency reuse, Cochannel and Adjacent channel Interference

Unit II - Wireless propagation Link budget, Free-space path loss, Noise figure of receiver Multipath fading, Shadowing, Fading margin, Shadowing margin

Unit III Antenna diversity, wireless channel capacity and MIMO

Unit IV Overview of CDMA , OFDM and LTE

41. Mobile and Wireless Communication Lab

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	To understand the cellular frequency reuse concept to find the co-channel cells for a particular cell.	I	04
2.	To understand the path loss	II	04
3.	Understand the path loss with shadowing	II	04
4.	Understanding the Flat fading	II	04
5.	Understanding the Frequency selective fading	II	04
6.	Understanding the Multipath channel for the following objectives 1. No Fading 2. Flat Fading 3. Dispersive Fading	II	04
7.	To simulate a dipole antenna (λ, $\lambda/4$, $\lambda/2$, $3\lambda/2$) for a particular fre- quency using 4NEC2	III	04
8.	Perform following experiments using CDMA trainer kit 1. PSK modulation and demodulation experiment 2. Bit synchronization extraction experiment 3. Error correction encoding experiment	IV	04

42. Industrial Automation

Unit I - Industrial automation overview and data acquisition Architecture of Industrial Automation Systems. Measurement Systems Characteristics Data Acquisition Systems

Unit II - Control Generation Introduction to Automatic Control P-I-D Control Feedforward Control Ratio Control The branching operations based on

conditions expression

Unit III Sequential control and PLC Introduction to Sequence Control, PLC , RLL, PLC Hardware Environment

Unit IV Industrial control application Hydraulic Control Systems Pneumatic Control Systems Energy Savings with Variable Speed Drives Introduction To CNC Machines

43. Industrial Automation lab

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	Develop a data acquisition system using arduino	I	04
2.	Temperature control system using PID	II	04
3.	Level control system based on error feedback	II	04
4.	PLC programming using Relay ladder Logic for AND , OR XOR and NOR gate	III	04
5.	PLC, RLL programming using CASCADE method	III	04
6.	PLC timer, counter, registers and analog input/output functions	III	04
7.	Variable Speed drive of an induction motor	IV	04
8.	PLC/ microcontroller based computer numerical control machinejob completion	IV	04

44. Microwave and Radar

Unit I - Introduction to Microwaves History and applications of Microwaves

Mathematical Model of Microwave Transmission Microwave transmission modes, wave- guides and transmission lines, Impedance Matching Microwave Network Analysis

Unit II - Passive and Active Microwave Devices Directional Coupler, Power Divider, Attenuator, Resonator. Microwave active components: Diodes, Transistors, Microwave Tubes

Unit III -Microwave Design Principles- Microwave Filter Design, Microwave Amplifier Design,Microwave Mixer Design, Microwave Oscillator Design. Microwave Antennas

Unit IV - Microwave Measurements, Microwave Systems, Effect of Microwaves on human body.

45. Microwave and RADAR Lab

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	To study wave guide components.	I	04
2.	To study the characteristics of Gunn oscillator Gun diode as mod-ulated source.	I	04
3.	Introduction to Smith chart and its application for the unknownimpedance measurement.	I	04

4.	Study the behavior of impedance matching for passive networksusing Smith chart.	II	04
5.	To study loss and attenuation measurement of attenuator	II	04
6.	Construct a cavity resonator in waveguide and study its character-istics using the network analyzer and a frequency counter.	III	04
7.	To determine the frequency and wavelength in a rectangular wave-guide working in TE10 mode	IV	04

46. Computer Networking and Data Communication

Unit 1 - Introduction to data communication. Concept of analog and digital signals. Bandwidth. Network architecture. Basics of OSI and TCP/IP reference models. Types of Computer Networks – Personal Area Network, Local Area Network, MetropolitanArea Network, Wide Area Network, Internetwork. Computer Network Topologies – Point to Point, Bus topology, Star topology, ring topology,mesh topology, tree topology, Daisy Chain, Hybrid Topology, Computer Network Model. Transmission media. Wired and wireless connectivity.

Unit 2 – Digital & Analog Transmission. Digital Transmission – Digital to Digital Conversion, Line Coding, Unipolar Encoding, Polar Encoding, Bipolar Encoding, block Coding Analog Transmission - Analog-to-Digital Conversion, Digital to analog Conversion, Analog toAnalog Conversion.

Sampling, Quantization, Encoding, Transmission Modes.

Unit 3 – Wireless Communication. Radio, Microwave, Infra-red, Light Transmission. Wireless Communication Standards, Characterization of the Wireless Channel, Receiver Techniques for Fading Dispersive Channels, Mobility Management in Wireless Networks, Mobile IP, Mobile Ad hoc Networks, Ad hocRouting Protocols, Performance Analysis of DSR and CBRP, Cluster Techniques, Incremental Cluster Maintenance Scheme, Space time Coding for Wire-less Communication.

Unit 4 – Data Link Layer Technologies. Types of Network Routing, Network Layer Protocols. FDM, TDM and CDMA. Circuit and packet switching. Frame relay and ATM switching. ISDN. Local area network pro- tocols. Fibre optic networks. Satellite networks. Data link layer design issues: its functions and protocols. Internet protocol. Routing algo- rithms. Congestion control algorithms. IP addressing schemes. Internetworking and sub-net- ting. Error Detection and Correction - Types of Errors, Detection, Correction Switching and Data link layer, data link control and protocols

Unit 5 - Transmission Media & Transmission Control protocol Magnetic Media, Twisted Pair Cable, Coaxial Cable, Power Lines, Fiber Optics. Protocol–Features, Header, Addressing, Connection Management, Error Control and Flow Control, Multiplexing, Congestion Control, Timer Management, Crash Recover

47. Computer Networking and Data Communication Lab

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	To study the different physical equipment used for networking		02*
2.	Study the different internetworking devices in a computer network		02*
3.	Study the working of basic networking commands		02*
4.	To study PC to PC communication using parallel port		02
5.	Study of LAN in Star Topology		02
6.	Study of LAN in Bus Topology		02
7.	Study of LAN in Tree Topology		02
8.	Study and configuration of modem of computer		02
9.	Study of wireless communication		02*
10.	Studying PC Communication using LAN		02