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PANJAB UNIVERSITY

PULEET SYLLABUS 2020

Physics

Mechanics

Linear kinematics and its equations of motion, projectile motion, circular motion.

Newton's laws of motion, principle of conservation of momentum applications to linear and planar motion, concept of friction and its laws, motion on smooth and rough inclined planes, simple and complex Atwood's machines.

Concept of work, energy and power, work-energy principle, principle of conservation of energy.

Rotational motion, equations of rotational kinematics, moment of inertia and radius of gyration of a rotating body; torque and angular momentum; work, power and energy in rotational motion, conservation of angular momentum.

Simple harmonic motion and its characteristics, energetics of simple harmonic motion, idea of damped and forced oscillations, resonance and its applications.

Wave motion and its characteristics, theory of sound propagation, velocity of sound and factors influencing the velocity of sound, Doppler effect in sound, superposition of sound in space (stationary waves) and time (beats), vibrations of air columns and stretched strings.

Optics

Geometrical optics, reflection and refraction of light, reflections by spherical mirrors, refraction through lenses, spherical and chromatic aberrations, dispersion and deviation of light through prism, optical microscopes and telescopes.

Wave nature of light; interference, Young's double slit experiment, Lloyd's mirror and Fresenel's biprism techniques for producing interference pattern, interference through thin film, colouring of thin films ; diffraction of light through a single slit, Rayleigh's criteria of resolution, resolving power of optical instruments ; concept of polarization, methods of producing polarized light, analysis of polarized light, Doppler effect in light.

Laser, its principle, characteristics and applications.

HEAT

Thermometry, idea of specific heat and heat capacity, latent heats of fusion and vaporization, variation of specific heats of solids, liquids and gases with temperature, concept of degree of freedom, law of equipartition of energy.

Modes of heat transfer (conduction, convection and radiation); linear, surface and volume expansion of matter on heating.

Electrodynamics

Electric field and electric potential, electric dipole and its field, Gauss' law and its applications; concept of capacitance, energy stored in a capacitor, effect of introducing dielectric and conducting slabs between plates of a capacitor, dielectric constant of material.
Current electricity, Kirchoff's laws and applications, thermal and chemical effects of current, slide wire bridge, potentiometer, ammeter and voltmeter.

Magnetic effects of current, Biot-Savert law and its applications, Lorentz force, moving coil galvanometers ; laws of electromagnetic induction, eddy currents and its applications, self and mutual inductance.

Modern Physics

Black body radiation distribution, photoelectric effect, idea of x-ray production, wave-matter duality and de-Broglie waves, position- momentum uncertainty principle.

Crystalline and amorphous solids, basic idea of crystal structures (simple cubic, body- centered cubic, face-centered cubic) and their characteristics, close packing morphologies, Schottkey and Frenkel defects in crystals.

Rutherford scattering experiment, Bohr's model and hydrogen spectrum. Nucleus and its properties (mass, size, binding energy, magnetic and quadruple moments), nuclear forces and its properties, phenomenon of radioactivity and its laws, modes of radioactive decays (α, β and γ), nuclear fission and fusion.

Chemistry

Atomic Structure and Periodic Table

Constituents of the Atom, Bohr's Model of the Atom,Quantum Number and Electronic Energy Levels, Aufbau's Principle, Pauli's ExclusionPrinciple, Hund's Rule, n + l Rule, Electronic Configuration of Elements (s, p, d BlockElements), Development of Periodic Table- Modern Periodic Law, Long form of Periodic Table,Study of Periodicity in Physical and Chemical Properties with\ special reference to – Atomic andIonic Radii, Ionisation Potential. Electron Affinity, Electronegativity, Variation of EffectiveNuclear Charge in a Period, Metallic Character.

Fuels

Definition, Classification, Calorific Value (HCV and LCV) and Numerical Problems onCalorific Value, Combustion of Fuels, Numerical Problems on Combustion, Solid Fuels – Coaland Coke, Liquid Fuels- Petroleum and its Distillation, Cracking, Octane and Cetane Values ofLiquid Fuels, Synthetic Petrol, Power Alcohol, Bio-Gas, Nuclear Fuels – Introduction to Fissionand Fusion Reactions.

Water

Demonstration of water resources on Earth using pie chart., Classification of water – soft water and hard water, action of soap on hard, water, types of hardness, causes of hardness, units of hardness – mg perliter (mgL-1) and part per million (ppm) and simple numericals., Disadvantages caused by the use of hard water in domestic and boiler feedwater. Removal of hardness – Permutit process and Ion-exchange process. Chemical analysis of water for estimation of Total dissolved solids (TDS), Alkalinity of water. Drinking water and characteristics of drinking water. Natural water sterilization by chlorine and UV radiation and reverseosmosis (elementary idea).

Environmental Chemistry

Classification of pollutants, the greenhouse effect, toxic heavy metals, organic compounds as environmental pollutants, ozone layer depletion.

Corrosion

Types of corrosion, dry and wet corrosion and their mechanisms, types of electrochemical corrosion(galvanic, pitting, waterline, differential aeration, soil, microbiological, inter-granular, stress corrosion), factors influencing corrosion, prevention of corrosion.

Mathematics

Algebra

Quadratic Equations, equations reducible to quadratic form, relation between roots and coefficients, Arithmetic Progression, Geometric Progression, Arithmetico-Geometric Progression, Harmonic Progression, Series of Natural Numbers.

Matrices

Concept of linear independence and dependence, Rank of a matrix: Row – Echelon form, System of linear equations: Condition for consistency of system of linear equations, Inverse of a matrix.

Trigonometry

Trigonometric ratios and their relations, ratios of some standard angles, solution of trigonometric equations, sum and difference formulae, product formulae, multiple and sub-multiple angles, solution of triangles.

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Coordinate Geometry

Cartesian coordinates, equations of straight line in various forms, intersection of two straight lines, angle between two lines, distance formula. Equation of circle in various forms, tangent and normal to circle.

Differential Calculus of Functions of one variable

Successive Differentiation, Leibnitz Theorem, Expansions of functions: Taylor's and Maclaurin's Series, Formulae for remainder term in Taylor and Maclaurin series, Angle of contingence, Curvature, Radius of curvature, Centre of curvature for curves in Cartesian form. Curvature at the origin: Newton's formulas.

Differential Calculus of Functions of two variables

Concept of limit and continuity of a function of two variables, Partial derivatives, total differential, differentiation of an implicit function, chain rule, change of variables, Jacobian, Taylor's and Maclaurin's series. Maxima and minima of a function of two variables: Lagrange's method of multipliers.

Ordinary Differential Equations

Review of geometrical meaning of the differential equation y' = f (x, y), directional fields, Exact differential equations, Integrating factors.

Integral Calculus

Reduction formula for $\int \sin^n x\,dx$, $\int \cos^n x\,dx$, $\int \sin^m x \cos^n x\,dx$, $\int x^m (\log x)^n\,dx$, $\int x^n e^{ax}\,dx$, $\int x^n \sin mx\,dx$, $\int x^n \cos mx\,dx$, Areas of curves, Length of curves, Volume and surface areas of revolution, Double integrals, Change of order of integration, Areas enclosed by plane curves.

Vector Differential Calculus

Vectors and scalar functions and fields, derivatives. Curves, tangents, arc lengths, Curvature and torsion of a curve, Gradient of a Scalar field, Directional Derivative, Divergence of a vector field, Curl of a vector field.

Vector Integral Calculus

Line integrals, Line integrals independent of path, Green's theorem in the plane, Surface Integrals, Triple integrals, Gauss Divergence Theorem, Stoke's Theorem.

General Aptitude & Communication Skills

General Aptitude

Coding- Decoding , Directions, Reasoning

Writing Skills

Basics of Grammar – Word Order, Sentence Construction, Placing of Subject and Verbs, Parts of Speech – Nouns, Pronouns, Adjectives, Verbs, Adverbs, Use of Tenses, Articles, Active-Passive, Verbal Analogies.

General Engineering

Basic Electrical Engineering

1. DC circuits: Voltage and current sources, Kirchhoff‟s laws and network solution, network analysis by mesh and node analysis, superposition theorem, Thevenin‟s theorem, Norton‟s theorem, delta-star transformation and vice-versa, maximumpower transfer theorem, energy storage elements, step response of RL, RC and RLC circuits.
2. Single Phase AC Fundamentals: Alternating current systems, waveform terms and definitions, average and r.m.s. values of alternating, quantities, phasor notation, solution and phasor diagram of single phase ac circuits with sinusoidal source excitation.
3. Three Phase AC Fundamentals: Disadvantages of single phase system, three phase voltages and currents, voltages and currents in star and delta connected systems, power in a three phase system, solution of three phase balanced circuits, power and power factor measurement by two watt-meter method.
4. Magnetic Circuit: Introduction to magnetic circuit, magneto motive force and magnetic field strength, permeability of free space, relative permeability, reluctance, comparison of electric and magnetic circuits, B/H curve, magnetic circuits calculations, self and mutual inductance.
5. Transformers: Introduction, Basic Principle, EMF equation, approximate equivalent circuit, phasor diagram, losses, efficiency and condition for maximum efficiency, voltage regulation, open circuit and short circuit tests.
6. Electric Machines: Operating principle and application of DC machine as generator and motor, EMF and Torque equations, methods of excitation.
Operating principle and applications of 3 phase squirrel cage and slip ring induction motors, equivalent circuit and torque speed characteristics (qualitative treatment)

Operating principle of single phase induction motor (split Phase and capacitor motors), torque-speed characteristics (qualitative treatment)

Principle of operation and applications of variable reluctance, permanent magnet and hybrid stepper motors, speed torque characteristics (qualitative approach)

Basic Electronics

1. Semiconductor Diode: PN-Junction, Junction Theory, V-I characteristics of a PN-Junction Diode, Ideal Diode, Use of Diode in Rectifiers: Half Wave Rectifiers, Full Wave Rectifiers, Zener Diode, Varacter Diode, Light Emitting Diodes.
2. Bipolar Junction Transistor: Introduction, Junction Transistor Structure, Operation, Transistor amplifying action, CB, CC and CE Configuration, characteristics, application of transistor as an amplifier.
3. Field Effect Transistor: Introduction, Types of FET's, JFET's, MOSFET's, CMOS, characteristics, working, applications.
4. Operational Amplifiers: Block Diagram, Characteristics of an ideal OP-AMP, Application of OP-AMP as an Inverting amplifier, Phase Shifter, Scale Changer, Non-inverting amplifier, Adder or Summing amplifier, differential or difference amplifier, integrator.
5. Oscillators: Block Diagram of feedback circuit used as an oscillator, Barkhausen criterion, types of oscillators.
6. Boolean Algebra and Logic Gates: Binary and Hexadecimal number system, BCD and weighted codes, Binary arithmetic, Logic- positive and negative logic, basic and universal logic gates. Boolean algebra and postulates, reduction of Boolean expression.
7. Flip Flops: Concept of flip-flops, RS, D, JK and T types, triggered and clocked, master slave, Shift Register, concept of synchronous and asynchronous counters. Half and full adder, subtractor, Seven Segment display, Concept of Mux, deMux, decoder and encoder.

8. Test and Measuring Instruments: Block diagram, concept of digital electronic voltmeters, ammeter and wattmeter, CRO, Signal Generators, Sensors and Transducers and their classification. Working principle of resistive, capacitive, photosensitive and temperature transducers. Block diagram and working principle of analog and digital data acquisition system.
9. Communication: Basic Concepts, Modulation, Need for modulation, introduction to AM, FM, PM.

Programming Fundamentals

1. Introduction: Computer Basic, Block Diagram of Computer, Memory Hierarchy, Types of RAM, Secondary Memory Introduction to Operating Systems, Programming Languages, Program Structure, Linux Shell Commands, Bourne Shell, C Shell, Korn Shell
2. Basic Constructs of C: Keywords, Identifiers, Variables, Symbolic Constants, Data Types and their storage, Operands, Arithmetic Operators, Relational Operators, Logical Operators, Bitwise Operators, Increment & Decrement Operators, Expressions, Conditional Expressions, Assignment Operators and Expressions, Type Conversions, Precedence and Order of Evaluation, External Variables and Scope of Variables. Basic Input Output, Formatted I/O.
3. Program Control Flow: Statements and Blocks, Conditional Statements, IF, ELSE-IF, Switch Case statements, Control Loops, For, While and Do-While, Go to and Labels.
4. Arrays & Functions: Pointers and Addresses, Arrays, Multi dimensional arrays, strings, pointer arrays, Functions, Function Prototyping, Scope of functions, Arguments, Call by value and call by references, static variables, recursion, C-Preprocessor and Macros, Command line arguments.
5. Structures: Structures, Array of Structures, pointer to structures, Typedef, Unions, Bit fields, passing structures as an argument to functions

6. Input and Output: Standard and Formatted Input and Output, File Access & its types, Line Input and Output, Types of Files, Binary & ASCII Files, Error handling, stderr and Exit functions
7. Introduction to Object Oriented Programming: Classes and Objects, Structures vs Classes, Abstraction, Encapsulation, Polymorphism, Inheritance.

Fundamentals of Mechanical Engineering

1. Laws Of Thermodynamics: First law of thermodynamics, Steady flow energy equation and its applications (nozzle, throttling device, turbine, compressor, heat exchanger). Limitations of first law, statements of second law by Max-planck and Clausis, equivalence between the two statements. Reversible and irreversible processes, Carnot's theorem. Energy analysis of a heat engine, refrigerator and heat pump.
2. Steam and Its Formation: P-V, P-T, T-S, H-S diagrams of water. Dryness fraction and its measurement by calorimeter. Uses of steam tables and mollier chart (H-S chart)
3. Power Cycles: Carnot and Rankine steam power cycles. Effect of mean temperature of heat addition on Ranking cycle efficiency. Otto, Diesel and Dual combustion cycles for reciprocating I.C. engines.
4. Kinematics Of Fluid Flow: Types of flow, acceleration in fluid flow, stream lines, stream tubes, irrotational flow, stream function, velocity potential, flow nets.

5. Fluid Dynamics: Equation of continuity, Euler's Equation, Bernoulli's equation, simple applications to one dimensional flow problems.

6. Flow Measurement: Pilot tube, Venturimeter, Orificemeter, Notches (Rectangular & Triangular) and weirs, Rotameter.

7. Simple Stress and Strains: Concept of stress and strain. Stress and strains in bars subjected to tension and compression, stress- strain diagrams, mechanical properties, factor of safety, Extension of Uniform bar under its own weight, stress produced in compound bars (two or three) due to axial loads.
8. Bending moment (B.M.) and Shear force (S.F.): Diagrams for cantilevers, simply supported beams with or without overhang and calculation of maximum B.M. and S.F. and the point of contra flexture under the following loads. Concentrated loads, Uniformly distributed loads over whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads.
9. Bending and Torsion: Stress in beams due to bending, proof of formulae $M/I = f/y = E/R$ and its application to beams of rectangular and circular section. Application of torsion equation to hollow and solid circular shaft.

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Fundamentals of Civil Engineering

1. **Construction Material and Building Construction:** rock, Bricks & Tiles, Cement, Lime Timber and paints, Excavation of foundation, Brick Masonry, Stone Mesonry, Wall, Mortal & Concrete, Damp-proofing, Doors-windows, Roof, Floors, Stairs and Building planning.
2. **Hydraulics :** Fluids and Properties of fluids, Hydrostatic Pressure, fluid flow and measurement through pipe and open channel
3. **Concrete and Structures:** Concrete and Properties of Concrete, Formwork, ordinary and special concrete, Concrete Operation. Stress & strain, Bending Moment & Shear Force, Slope and Deflection, Columns and trusses.
4. **Reinforced Concrete Structures**: Reinforcement, Theory of RCC Beams, Bonds in RCC Beams, Singly & Doubly RCC Beams, RCC Slabs, Reinforced Brick Works and Columns.
5. **Steel Structure:** Structural Steel Section and Connections, Tension, Compression and Beam Members.
6. **Surveying:** Chain & Compass Surveying, Leveling using Dumping and IOP Level.
7. **Irrigation Engineering:** Rainfall and Run off, Crops water requirement, Irrigation and types of irrigation, Canal Works, Water logging and Drainage, Dams.
8. **Transportation Engineering**: Road Geometrics, Highway Surveying, Road Material and Pavement, Road Drainage and Maintenance.
9. **Soil Mechanics:** Physical Properties of soil and Soil classification, Water flow through soil and Soil Deformation, Strength Characteristics of soil and soil Compaction, Bearing Capacity and Site Exploration
10. **Estimation and Costing** : Estimation and Types of estimation, Analysis of Rates, Irrigation Work Estimation, Road Work Estimation and Valuation.

Fundamentals of Chemical Engineering

1. **Introduction to Engineering Calculations:** Units and dimensions, conversion of units, systems of units, dimensional homogeneity and dimensionless quantities, Conversions involving process variables like pressure, temperature, density/specific gravity, mass, volume, flow rate and chemical composition. Chemical equations and stoichiometry.
2. **Systematic analysis of chemical processes:** Unit operations and unit processes, material and energy balances, thermodynamics, chemical reaction engineering, Introduction to material balances without chemical reactions. Limiting and excess reactants. Recycle, Bypass and Purge calculations.
3. **Gas laws and humidity calculations :** P-V-T relations for gas and gas mixtures, calculations using ideal gas law, Use of compressibility charts and equations of state (Van der Waals') to predict real gas properties from experimental data. Vapour pressure calculations, Clausius Clapeyron equation, saturation vapour pressure, vapour-liquid equilibrium calculations using Raoult's law and Henry's law, relative humidity, partial saturation and humidity.