Appendix - IV

Section B –Basic Sciences (Common to All streams) **30Marks**

ENGINEERING MATHEMTICS 10 Marks (Ten Questions 1 Mark Each)

Linear Algebra: Matrix algebra, systems of linear equations, eigen values and eigen vectors.

Calculus: Functions of single variable, limit, continuity and differentiability, mean value theorems, evaluation of definite and improper integrals, partial derivatives, total derivative, maxima and minima, gradient, divergence and curl, vector identities, directional derivatives, line, surface and volume integrals. Theorems of Stokes, Gauss and Green.

Differential Equations: First order linear and nonlinear equations, higher order linear ODEs with constant coefficients, Cauchy and Euler equations, initial and boundary value problems, Laplace transforms. Partial differential equations and separation of variables methods.

Numerical methods: Numerical solution of linear and nonlinear algebraic equations, integration by trapezoidal and Simpson rule, single and multi-step methods for differential equations.

Probability*:* Conditional Probability; Mean, Median, Mode and Standard Deviation; Random Variables; Distributions; uniform, normal, exponential, Poisson, Binomial.

COMPUTING 10 Marks (Ten Questions 1 Mark Each)

Introduction to C language, Operators and Expressions, Managing Input and Output Operations, Decision making and branching, Decision making and looping, Arrays, Character Arrays and Strings, User defined Functions, Structures, Pointers.

PHYSICS 05 Marks (Five Questions 1 Mark Each)

Dynamics of Rigid Bodies and Elasticity: Rotational motion--Review of M.I., Radius of gyration, parallel and perpendicular axes theorems—Expressions for moments of inertia of a rectangular plate and circular plate about different axes—Kinetic energy of rotation. Stress, strain and Hooke's law---Relation between K ,α and β--Relation between n, α and β—Relation between Y and α – Relation between Y, k, n and σ—Twisting of a cylinder and expression for couple per unit twist—torsion pendulum—Bending of beams –bending moment of a beam—cantilever loaded at free end.

Lasers and Optical fibers: Review of general principle of Laser, Expression for Energy density of radiation in terms of Einstein coefficients. Three and four level lasers--Principle and operation of Carbon Dioxide and semiconductor Laser—. Applications - Laser cooling, Laser fusion and Industrial applications.
Propagation mechanisms in optical fibers, Angle of acceptance and Numerical aperture of step and graded index optical fibers. Attenuation in optical fibers. Optical fiber sensors and applications

Concepts of Modern Physics : De Broglie principle and matter waves—phase velocity and group velocity of matter waves –Expression for group velocity and its equivalence to velocity of particle—Heisenberg's uncertainty relationships. Wave function and it's attributes—One dimensional time independent Schrodinger's wave equation—Solving of wave equation for a particle in an infinite one dimensional potential well and extension to three dimensional case---Step potential—Expression for reflection and transmission coefficients for the cases of (i) E < V and (ii) E > V—Potential barrier and tunnel effect—Scanning tunnelling microscope.

Electrical conduction in solids: Metals: Review of classical free electron theory and its drawbacks—Quantum free electron theory—Fermi –Dirac distribution function—Expressions for density of states in a metal and Fermi energy at 0 K. Qualitative discussion of periodic potential, energy band formation and distinction between metals, semiconductors and insulators. Effective mass of an electron and concept of a hole from E-k curve.

Semiconductors: density of states in conduction and valence bands and expressions for electron and hole concentrations—law of mass action—position of intrinsic Fermi level in semiconductors. Hall Effect and its applications.

CHEMISTRY 05 Marks (Five Questions 1 Mark Each)

Electrochemical Cells: Basic concepts of electrochemistry – electrode potential, Origin of single electrode potential, Derivation of Nernst equation, Galvanic cells, Classification of galvanic cells, Reference electrodes – calomel electrode, Ag|AgCl electrode. Measurement of single electrode potential. Ion-selective electrode-Glass electrode- Determination of pH using glass electrode. Concentration cells. Numerical problems on electrode potential EMF of cells and concentration cells.

Batteries and Fuel Cells:
Batteries: Basic concepts, Mechanism f battery operation, battery characteristics. Classification of batteries – Primary, secondary and reserve batteries. Classical batteries – construction, working Ni-Cd batteries. Modern batteries- construction, working and applications of Zn-air, Nickel-metal hydride and Lithium-MnO_2 batteries.

Fuel Cells: Introduction, Definition, differences between a battery and a fuel cell, advantages. Types of fuel cells –Alkaline fuel cell, Phosphoric acid, Molten carbonate Solid polymer electrolyte fuel cell. Description and working of H2-O2 and MeOH-O2 fuel cells.

Corrosion Science: Metallic corrosion - Definition, Electrochemical theory of corrosion. Types of corrosion - Differential metal corrosion, differential aeration corrosion -pitting and waterline corrosion. Stress corrosion. Factors affecting the rate of corrosion. Corrosion control: metal coating- Anodic and cathodic metal coatings with examples. Inorganic coatings- anodizing and phosphating. Corrosion inhibitors. Cathodic Protection-sacrificial anode method.

Water Technology

Hardness – definition, types of hardness and its determination by EDTA method – numerical problems; Alkalinity– Definition and its determination by phenolphthalein and Methyl orange indicator. Biological Oxygen Demand– definition, determination and numerical problems. Chemical Oxygen Demand – Definition, determination and numerical problems. Determination of Nitrate by phenol disulphide (spectrophotometric). Sulphate by gravimetric, Chloride by argentometric. Fluoride content, hazards, deflourination. Determination of dissolved (DO) oxygen by Winklers method. Sewage treatment – Primary treatment, Secondary treatment by activated sludge treatment and tertiary treatment. Potable water – Definition, purification of water by reverse osmosis. Purification of water for industries-Ion exchange method.

Energy Sources: Introduction to energy; conventional sources: calorific value– Definition, net and gross calorific values, units (SI), determination of calorific value of a solid fuel by bomb calorimeter. Numerical problems, Liquid fuels: Petroleum cracking - fluidized bed catalytic cracking, Reformation of petrol. Knocking – mechanism, octane number, cetane number, prevention of knocking, unleaded petrol. Bio energy-bio fuels.