(B) SYLLABUS

(I) COMPULSORY PAPERS

(a) General English: 100 Marks Time 3 Hrs.

1. Essay, preferably related to Tripura Forest and wildlife 20 marks.
2. Prose 20 "
3. Comprehension Test 20 "
4. Official Correspondence 20 "
5. Grammar 20 "

(Locating errors & Sentences, vocabulary test, Reorganisation of sentences, filling up of blanks with appropriate prepositions).

(b) General Knowledge: 100 marks Time 2 Hrs.

This paper will include general knowledge including knowledge of current events and of such matters of every day observations and experience in their scientific aspects as may be expected of educated person who has not made a special study of any scientific subjects. The paper will also include questions on History of India and Geography of nature which a candidate should be able to answer without special study. Questions on Tripura, its History & Geography will also be included.

(c) বাংলা

1. প্রবন্ধ রচনা 100 মার্কস সময় ৩ ঘণ্টা ২৫ মিনিট
2. পুস্তক রচনা ২৫ মিনিট
3. সারসংক্ষেপ ২০ মিনিট
4. ভাব সন্ধান ২০ মিনিট
5. কোন বিশেষ প্রণয়ন প্রধান প্রশ্নের প্রতিক্রিয়া ২০ মিনিট

(d) Alternative English: 100 marks. Time 3 Hrs.

1. Paragraph Writing 20 marks.
2. Report Writing on Certain Incident 20 "
3. Letter Writing 15 "
4. Reconstruction of a story out of a skeleton 15 "
5. Amplification 15 "
6. Summarising a prose passage 15 "
II. OPTIONAL PAPERS.
AGRICULTURAL SCIENCE
PAPER—I

Full marks---100

Time---3 Hours.

1. General: Physico-climatic situation as prevailing in Tripura and scope of raising various crops under it.

2. Soil science and soil conservation: Soil genesis and its composition, soil profile, soils structure & texture, physical properties of soil, soil-water relationship, soil-plant relationship, soil fertility and plant growth, essential elements for plant growth and role of macro, micro and trace elements in plant nutrition, effect of green manure, organic manure and fertilizers on soil properties, properties of common nitrogenous, phosphatic and potassic fertilizers, soil organic matter and its effect on soil, acid and alkali, their formation and reclamation, microbiology.

Soil erosion, factors effecting soil erosion, soil and water conservation, planning and programme, land use classification.

3. Irrigation and drainage:
Sources of irrigation water, systems and methods of irrigation-advantages and limitations of each method, Water requirements of crops, measurement of irrigation water, soil moisture, different forms and their importance.

Drainage and its necessity, cases of water logging, harmful effects of excessive water, methods of drainage.

4. Weed and weed control:
Injurious effects and losses caused weeds, chief agencies of weed dissemination, cultural, biological and chemical control of common weeds of the State.

5. Entomology & Plant Pathology:
Insect pests of crops and various methods of their control, various forms of insecticides, their classification, precaution in the use of insecticides, economic insects and methods of their rearing.

Diseases of crops-nature and causets of crops disease; reproduction and dissemination of disease-causing organisms-methods of their prevention and control, various forms of fungicides and their use. Diseases caused by plant viruses, bacteria & nematodes and their control.

7. Layout of orchards—its importance & various methods; plant propagation—various methods and advantages and disadvantages of each; Training and pruning and their importance in fruit production; botanical classification of vegetables and classification bases on edible parts used.

8. Studies on Agro forestry & Social Forestry & their importance.

AGRICULTURE SCIENCE
PAPER—I

Full Marks—100 Time—3 Hours.

1. Role of Horticulture with special reference to the health building of the nation.

2. Farm management—its meaning and importance, basic principles of farm management; types and systems of farming, farm records and accounts, problems and prospects of agricultural marketing; role of co-operatives in agricultural economy.

   Importance of fruits and vegetable processing, different methods of fruits and vegetable processing.

3. Studies of field crops:

   Detailed studies of the following crops with reference to their scientific introductions, soil and climatic requirement, seedbed preparation, seedrate, sowing/transplanting, land preparation inter culture, fertiliser and manurial requirement and application; improved varities, plant protection, harvesting & storing:

   (a) Cereals and millets like paddy, wheat Maize.
   (b) Oilseeds & pulses like mustard, sesamum and groundnut; black gram, gram, cowpea, fieldpea & pigeonpea.
   (c) Fibre crops like jute/mesta & cotton.
   (d) Plantation crops like sugarcane.

Detailed studies of the following crops with reference to soil & climate requirements, spacing, layout, requirement or planting material like seeds & seedlings, grafts & gooties etc. seedbed preparation & sowing, pit size, pitmating, refilling, planting, varieties, manure, fertilizer requirement & application interculture, harvesting & yield, postharvest handling.

(a) Fruits-crops like citrus, banana, pineapple, papaya, jackfruit, guava, litchi.

(b) Condiment & spice crops like betelvine, black papper, ginger, termeric, coriander, chilli.

(c) Plantation crops like coconut, cashewnut, coffee, cacao acrecanut & tea.

(d) Winter vegetables like cole crops. brinjal, carrot, beet, garden pea, potato, lettuce, onion, radish, spinach & tamato.

(e) Summer & rainy season vegetables like parwal, bhindi kakrol, ashgourd, sweet gourd, bitter gourd, ridge gourd, brinjal, bettle gourd, cowpea, cucumber, snake gourd.

BOTANY

PART-I

Full Marks-100

Cryptogams:

Morphology: Inflorescence, Flower, Pollination, Seeds and Fruits including dispersal.

Anatomy: Tissue, Tissue system, internal structures of root, stem and leaf, normal secondary growth in stem.

Taxonomy: Principles of nomenclature and classification of angiosperm, distinctive features and economic importance of the families: Gramineae, Zingiberaceae, Orchidaceae, Palmae, Magnoliaceae, Leguminosae, Cucurbitaceae, Rubiaceae, Eup Euphorbiaceae, Dipterocarpaceae, Verbenaceae, Myrtaceae, Compositae, Labiatae.

BOTANY
PAPER-II

Full Marks-100

Plant Pathology: Causes and of cure plant diseases, disease organisms, deficiency diseases, physiology of parasitism.

Physiology: Intake of water and minerals, transpiration, photosynthesis, respiration, growth hormone, photoperiodism.

Ecology: Ecological factor, ecosystem, forest ecosystem, method of studying plant community, man and biosphere resources including their conservation, pollution.

Plant Geography: Botanical regions of India.

Economic Botany: Economic uses of flowering Plants—particularly medicinal plants, timber yielding plants, food and fibre yielding plants, beverage yielding plants.

Cytology & Plant breeding: Mitotic and meiotic division, chromosome structure, Mendelism, mutation, polyploidy, plant breeding methods and hybrid vigour.

Time-3 Hours.
ZOOGOLOGY.
Paper-I.

Full Marks-100. Time- 3 Hours.

1. Classification of the animal kingdom into principle groups-distinguishing features of the various phyla.
2. Classification upto subclass in Nonchordates and upto order in chordates.
3. The structure, habits, and Life-history of the following non-chordate types:
   - Amoeba, a sponge, Obelia, roundworm, earthworm, Leech, Slorsion, Pila and starfish.
5. Beneficial insects : Lac-insect, honey bee and silk motho
6. Insect pests of forest trees and their control measures.
7. The structure and comparative anatomy of the following chordate types Branchiostoma, Petromyzon, Lates, toad, Calotes, pigeon and guineapig.
8. Elementary knowledge of the histology and physiology of the various organs of the animal body with reference to toad, guineapig, Endocrine glands and their functions.

ZOOGOLOGY
PAPER-II

Full Marks—100 Time—3 Hours.

2. Ecology :—Ecological factors (biotic and antibiotic factors), Ecosystem—Components, food chains and food weds, Forest ecosystem and pond ecosystem—structure and function.
3. Adaptation:—Aquatic, volant and arboreal adaptation, Colouration
and mimicry.


5. Cytogenetics:—Chromosome structure, DNA as genetic material,
Mendelism, Linkage and crossing over; Sex linked inheritance; Sex
determination; Congenital abnormalities in man; Colour blindness, Down’s
syndrome.

6. Evolution:—Evidences of evolution; Darwinism; Modern synthetic
theory of evolution; Mutation theory of de Vires.

7. Embryology:—Account of gametogenesis and fertilization Cleavage
and formation of tree germinal layers in chick structure and functions of
the mammalian placenta.

8. Zoogeography:—Zoogeographical realms.

9. Distribution of animals:—Type of distribution, Geological distribution
of animals with special reference to the Indian fauna.

10. Wild Life:—Purpose of wild life study; Elementary knowledge of
life of India with special reference to the endangered species; Principles
of Conservation and management.


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FORESTRY
PAPER-I.

Full Marks-100. Time-3 Hours.

1. Environment and ecology of forests:
Forest as living entity—its effect on environment inclusion in
concurrent list of constitution; ecosystem; ecological succession and climax;
nutrient cycling and water relations; physiology in stress environment (drou-
ght, water-logging, alkalinity and salinity etc); distribution of different types
of forest; principles and concepts of tree improvement.
2. Forest Economic, Policies & Legislation:

Fundamental principals of forest economics; cost benefit analysis; forest biometry; estimation of demand and supply; assessment and projection of market structures; role and mode of corporate functioning, socio-economic analysis of forestry productivity and its dynamics.

3. History of forest development in India:


5. Forest Botany:

PLANT MORPHOLOGY:

Type of leaves-phyllotaxy, different types of inflorescence, flowers, floral structure, floral formulae and floral diagram, dispersal of fruits and seeds, germination of seed.

Taxonomy and systematic botany.

Nomenclature, principles of classification, Bentham and Hooker system of (classification), different herbarium plants and herbaria, I.C.B.N. and Vienna Code.

Plant Anatomy or Forest Anatomy:

Root, stem and leaf anatomy, wood and bast tissues, annual rings, sapwood and hardwood, cambium, wounds and leaf abscession.

6. Soil & Water Conservation:

Soil formation, extent and causes of erosion in India, histological cycle, genesis of wasteland, land capability classification and utilization.
Soil conservation measures in varied topography, afforestation and protection of sensitive areas, closure, fire protection, contour trancheing, check dams, gulley plugging, wing breaks, shelter belts etc, adaption of different engineering measures for soil and water conservation, soil conservation in agricultural land-terracing, contour bunding, crop protection, stip cropxing, green manuring, mulching, soil conservation in catchment areas and watershed management.

7. Wildlife:

Definition, values, food chain, biomes, concept of habitat, bio-diversity, population control, major wildlife species, management of protected areas.

8. Social Forestry:

Genesis, scope, necessity, agro-forestry, extension forestry, recreational forestry, involvement of people and people's participation.

9. Application of remote sensing technique in Forestry:

Aerial photographs, interpretation of satellite imagery.

10. Tribal Welfare:

Constitutional provisions and general legislation for tribal welfare, symbiotic relationship with forests, tribal economy in relation to forests, tribal development schemes.

FORESTRY
PAPER-II.

Full Marks-100. Time-3 Hours.

1. Silviculture,

General silvicultural principles ecological and physiological factors influencing vegetation, natural and artificial generation of forests, nurseryseed technology-collection, storage, pretreatment and germination, establishment and tendings. Silvicultural system-clear felling, uniform, shelterwood, selection, coppice and conversion systems.

FOREST MENSURATION AND MANAGEMENT:

22. **Forest Mensuration and Management**

Methods of measuring—diameter, girth, height and volume of trees, form-factor, volume estimation of stand, sampling methods, yield calculation, current annual increment, mean annual increment, sample plots, yield and stand tables, scope and objectives of forest inventory.

Forest management: Objectives and principles, techniques, sustained yield, rotation, normal forest, growing stock, regulation of yield-methods and application.

3. **Forest Utilisation**

Logging and extraction techniques and principles, transport, storage and sale. Minor forest produces-definition and scope, gums, resins, oleoresins, fibres, oilseeds, nuts, rubber canes, bamboo medicinal plant, charcoal, apiary, sericulture, lac and shellac, tassar, silk, katha and bidi Leafs. Collection, processing and disposal of minor forest products.

Wood technology, anatomical, physical and mechanical properties of wood, defects and abnormalities, composite and other wood products, pulp, paper and rayon. Saw milling wood seasoning and preservation.

4. **Forest Protection**

Injuries to forests—abiotic and biotic, insects, pests and diseases, General forest protection against fire, insect and diseases, biological and chemical controls.
5. **Forest Surveying and Engineering**

   Different methods of surveying-chain, prismatic compass, pliantable and topographic surveys, area calculation, maps and map reading.

   Basic principles of forest engineering. Building materials, and construction. Roads-objects and classification, general principles, construction, Bridges-general principles, objects, types, simple design and construction of timber bridges.

6. **Forest Accounts**

   Accounts Code Vol-III, service agency, basic principles in maintenance of Cash Book on forest accounts.

7. **Forest Working or Management Plans**

   Necessity, aspects covered, evaluation, monitoring of prescriptions, feasibility studies.

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**PHYSICS**

**PAPER---I**

Full Marks--100

1. **Mechanics and general properties of matter.**

   Units and dimensions, scaler and vector quantities. Moment of inertia in simple cases like uniform rod, disc, ring sphere, uniform lamina. Rotational motion under constant angular acceleration, gravitation, escape velocity, geostationary satellites, simple harmonic motion, simple and compound pendulum, elasticity, surface tension, viscosity of liquids, rotary pump, Mcleod gauge.

2. **Sound.**

   Differential equation of waves, energy of sound waves, stationery waves, velocity of longitudinal waves in solids and gases. Acoustics in architecture, Elements of ultrasonics, Elementary principle of gramophones, Talkies and Loudspeakers.

3. **Heat and Thermodynamics.**

PHYSICS.
PAPER-II

Full Marks--100. Time-3 Hours.

1. Light.

Geometrical Optics-Refraction of light at spherical surface, thin lenses and their combination, separated lenses, chromatic abberation and spherical abberation. Ramsden and Hyghen eyepiece, optical instruments-telescope, compound microscope, magnifying power.


2. Electricity and Magnetism.

Magnetic potential and field due to short magnet magnetic shall, couple on magnet, work done in deflecting a magnet, Earth’s magnetic field. Magnetic properties of matt, Hysterisis permeability and susceptibility. Electrostatics-Gausses theorm and simple applications, condensers, Attracted dises electrometer.


Transistor, Semiconductors, Characteristics curves different configurations, cathode ray oscilloscope, measurement of specific charge of electron. Measurement of charge of Electron Radioactivity-Mean life, half life of age of rocks, radio is otopes G.M. Counters Elements of Bohr’s theory, X rays.
CHEMISTRY
PAPER-I

Full Marks-100

Organic Chemistry:


Elementary ideas of: Petrochemicals, vitamins, Hormones, Antibiotics Alkaloid, Protein and Pesticide.

Inorganic Chemistry:
Chemistry of the common ('S' and 'P' block) elements (both metals and nonmetals) including their isolation/extraction and their compounds.

Structure of hydrogen peroxide, diborane, aluminium chloride and the important oxy acids of nitrogen, phosphorus, chlorine and sulphur.


Principles of Inorganic qualitative and quantitative analysis.

CHEMISTRY
PAPER-II

Full Marks-100

General Chemistry:
Electronic configuration of elements, Aufbau Principle, Periodic classification of elements, atomic and ionic radii, ionisation potential, electron affinity, electronegativity. Natural and artificial radioactivity, nuclear fission & fusion reactions.
Electronic theory of valency, modern concepts of covalent bonding, elementary ideas of sigma and Pi-bonds, hybridisation and directional nature of covalent bonds, inductive, mesomerie and hyperconjugative effect resonance oxidisation and reducing agents, balancing equations by ion-election method. Modern concept of acid base-Arrhenius, Lewis, Bronsted, Lowry, Usanovich, Soft and hard acid-base.

Laws of thermodynamics-Zeroth, first and Second laws, isothermdl, adiabatic, cyclic, reversible, irreversible processes, enthalpy, entropy, free energy, Criteria of chemical equilibrium and spontaneity of a process.

Carnot cycle, mathematical derivation of second law of thermodynamics. Thermochemistry-head of reaction, formation, combustion, Solution, Heu' law, bond energy, flame temperature, kirchoff effination.

Physical Chemistry:


Osmotic presure, relative lowering of vapour pressure, elevation of boiling point, depression of freezing point, determination of molecular weight insolution, association and disociation of solutes.

Low of mas action and its application to homogeneous and simple heterogeneous equilibrium, Lechatelier Principle, influence of temperature and pressure on chemical equilibrium.

Molecularity and order of a reaction, first and second order reaction determination of order of a reaction, elementary ideas of theory of reaction ratescollision theory and activited complex theory.

Phase rule equation phase, component, dergree of freedom, application to one component and simple two component systems distribution law.

Conductance-equivalent, molecular and ionic Conductance, Kohlrausch’s law of independent migration of ions, transport number, absolute velocity of ions, Conductometric titrations, Ostwald’s dilution law, hydrogen ion concentration-PH, buffer reaction, indicators, theory of indicators (elementary ideas) Solubility product, hydrolysis of salts.

Reversible and irreversible cells, HE (Standard hydrogen electrode) and Quinhydrone, calomel electrodes, redox potential determination of PH by different methods, potentiometric titrations.

**MATHEMATICS, PAPER-I**

Full Marks-100. Time-3 Hours.

1. **Classical Algebra:**


   (c) Determinants and Matrices: Simple properties of product of determinants. Solution of Linear equations with not more than three variables by Cramer’s rule. Algebra of matrices. Adjoint of a matrix, inversion of matrices, Rank of matrix. Consistency and solution of linear equations (in three unknowns.)

2. **Vector Algebra:**

   Addition of vectors. Multiplication of a vector by a scalar. Scalar and vector products of two and three variables. Simple applications to (i)
Geometrical problems (ii) Mechanics (work done and torque).

3. Differential Calculus:

Concept of limit, continuity and differentiability of a function of one variable. Derivative of standard functions. Successive differentiation. Statement of Leibnitz theorem and its applications. Statement of Rolle's theorem and its applications. Mean value theorem of Lagrang and Cauchy. Statement of Taylor's and Maclaurin's theorem with Lagrange's form of remainders. Taylor's and Maclaurin's series for functions like \( \mathrm{e}^x \), \( \sin x \), \( \cos x \), \((1+x)^n\), \(\log(1+x)n\). Indeterminate forms. L. Hospital rule (proof not needed) applications. Maxima and minima of a function of a single variable. Geometrical application such as tangent, normal, rectilinear asymptotes (Cartesian only). Curvature of plane curves. Envelope of family of straight lines (Problems only). Partial differentiations. Euler's theorem on homogeneous function of two variables.

Convergence of sequence and series. Test of convergence of series of positive terms. Statement of Comparison test, Ratio test, Cauchy's nth root test and Raabe's test and applications.

4. Integral Calculus:

Standard methods of integration. Definition of definite integral of continuous functions. Fundamental theorem of Integral Calculus. Reduction formula of \( \tan \theta \times \frac{d \theta}{x} \), \( \sin m \times \cos n \times \frac{d x}{x} \) and connected problems (m, n are non-negative integers). Definition of improper integrals. Use of Beta and Gamma functions (Convergence and important relations being assumed). Quadrature, Rectification, Volume and surface areas of solids of revolution of plane curves and areas by X-axis and Y-axis. Problems only.

5. Differential equations:

1. Analytical Geometry of two and three dimensions:
   (a) Two dimensions: Pair of straight lines. Condition that the general equation of second degree in X and Y may represent two straight lines. Angle between two straight lines. Equation of bisectors of the angle between pair of straight lines. General equation of second degree in x and y. Reduction to canonical forms. Classification of conics.
   Polar equations of straight lines, circles. Polar equation of a conic referred to focus as pole. Equations of tangents and normals.
   (b) Three Dimensions:
   Rectangular cartesian coordinates. Distance between two points. Direction cosines and direction ratios of a straight line. Production of a line segment on another straight line. Angle between two straight lines.
   Equations of a straight line: General form and symmetrical form. Complanarity of two lines. Shortest distance between two skew lines.
   Sphere and its tangent plane.

2. Linear Algebra:
   Concept of vector space/Linear space over a field. Examples from different branches of Mathematics.
   Line combination, linear dependence, independence of finite set of vectors. Basis of a finite dimensional vector space.

3. Linear Programming:
4. **Dynamics of Particle**:

Kinematics, -- displacement, speed, velocity and acceleration of a Particle, relative velocity. Motion in a straight line under (i) Constant forces (ii) Variable forces (Simple Harmonic motion, Inverse square law), Damped oscillation. Forced and damped forced oscillation.

Motion in two dimensions: Projectile in vacum and in a medium with resistance varying linearly as velocity. Motion under forces varying as distance from a fixed point.

Impact of elastic bodies. Direct impact. Loss of Kinetic energy, indirect impact.

Motion in plane. Velocity and acceleration in cartesian coordinates. Angular velocity and angular acceleration. Tangential and normal acceleration. Radial and Transverse component of velocity and acceleration.


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**STATISTICS**

**PAPER - I**

Mathematical Statistics

Full Marks - 100

Time - 3 Hours.

I. Classical definition of probability and principal theorems on probability along with their applications in solving problems, expectation of random variables and principal theorems, joint distribution of discrete random variables and their independence, chebychev's Inequality and weaklaw of large number with applications.
2. Types of statistical data and their representation by means of charts and diagrams, frequency distributions and their graphical representations, measures of central tendency and dispersion, correlation and regression involving two variables, rank correlation ratio, partial and multiple correlation and regression involving three variables.

3. Standard theoretical distributions like binomial, Poisson and Normal, derivation of these distributions and discussion of their properties, concept of sampling distribution of a statistic and derivation of sampling distribution of mean and of variance independent normal variates and of K2 (Chi-square). characteristics of T and F distributions, large sample and small sample tests of significance, definition and uses of Pearsonian K2 (chi-square).

4. Criteria of a good estimator, minimum likelihood estimators and their properties (without proof), derivation of maximum likelihood estimates for parameters of binomial, Poisson and normal distributions, meaning of interpolation, and E operator's, Newton's forward, backward and divided difference formula, Lagrange's interpolation formula, meaning of numerical integration, general integration formula and derivation of trapezoidal and Simpson's one-third rules from its problems on numerical integration, numerical solution of equations in one unknown by method of false position method of interaction and Newton-Raphson method, convergence of interaction method,

STATISTICS
PAPER - II

APPLIED STATISTICS

Full Marks - 100

1. Advantages of sampling method over complete enumeration steps involved in a sampling enquiry and requirements of a good sample, simple random sampling with and without replacement, stratifies random sampling procedures (with estimates & their standard errors), preparation of forms and schedules for enquiry, basic principles of design of experiments, completely randomised arrangement, randomised block arrangement and latin square arrangement of treatments, technique of analysis of the above designs.

2. Price index number and various steps in the construction of a price index number, important price index number formula with their derivation, quantity index, numbers, tests of index number formula; chain index, number construction of consumer price index number, wholesale price index number and its construction with reference to All India wholesale price index number errors in index numbers. contents of important statistical publications of Govt. of India and Govt. of Tripura, methods of compilation of statistics relating to census, agriculture and prices particularly with reference to Tripura.
3. Time series and its components, trend determination by free-hand smoothing, method of moving average and fitting a mathematical curve, determination of seasonal indices by methods to trend-ratios and ratios to moving averages, statistical quality control (SQC) and its meaning, advantages of SQC, rational subgroups, control charts for variables and attributes, construction of control charts for mean, range, fraction defective, number of defectives and number of defects.

4. Sources of vital statistics, rates and ratios of vital statistics measurement of mortality by crude, specific and standardised death rates, general description of a complete Life table and its construction, measurement of fertility by crude birth rate, general, specific and total fertility rates, gross and net reproduction rates. Analysis of variance in one way and two-way classified data with one observation in each cell, numerical problems relating to one-way classified data.

AGRICULTURAL ENGINEERING
PAPER-I

Pull Marks - 100


2. IRRIGATION AND DRAINAGE :- Soil, Water, plant relationship. Sources and types of irrigations, planning and design of minor irrigation schemes, measurement of soil moisture.

   Duty of water consumptive use. Water requirements of crops. Benefit cost ratio of irrigation systems. Measurement of irrigation water orifices wires and flumes, command area development with construction of channels, pipe lines, head gates, diversion boxes structures and cross drainage works.

   Study of ground water hydrology. Hydraulics of various type of wells Drilling methods, development and testing of wells.

   DRAINAGE :- Definition-causes of water logging : Methods of drainage of irrigated and non-irrigated water logged areas. Design of surface and sub-surface drainage systems.
AGRICULTURAL ENGINEERING

PAPER — II

Full Marks — 100

FARM STRUCTURE/ BUILDING:— Study of the various types of building materials and their properties, Timber bracwork and R. C. works study on the construction and ansehenig of columns, beams, roof trusses, joints project preparation, planning of small and big farms houses, farm steed, animal shelters and storage structures. Rural water supply and sanitation.

Farm machinery and power:— Study on the construction of different types of internal combustion engines. Ignition, fuel, Lubricating, cooling and governing systems of IC engines. Different types of tractors, Chassis transmission and steering.


3. RURAL ELECTRIFICATION:— Problems and maintenance of Electrical Systems in rural areas. A.C. and D.C. circuits. Maintenance and development of Electrical System in agricultural and allied farms. Electrical motor used in agriculture, their types, selection, installation and maintenance.

CHEMICAL ENGINEERING

PAPER — I

Full Marks — 100.

1. Transport phenomena : (Under steady State Conditions)

   (a) Momentum transfer:—
     (i) Different patterns of flow and their criteria;
     (ii) Velocity Profile;
     (iii) Filtration; Sedimentation; Centrifuge.
     (iv) Flow of solids through fluids.

   (b) Heat transfer; Different modes of heat transfer; conduction—calculation for single and composite walls of Flat, cylindrical, spherical shapes.
   Convection-different diamentionless groups used in forced and free convection, Equivalent diameter, Determination of individual and overall heat transfer coeff.
   Evaporation—Radiation-Stefan Boltzmen law.
   Emissivity and absorptivity, Geometrical shape factor, Heat load of furnaces—calcultion.

   (c) Mass transfer: Diffusion in gases and liquids.

   Absorption, desorption, humidification, dehumidification drying and distillation Analogy between momentum, heat and mass and transfer.
2. Thermodynamics:
   (a) 1st, 2nd and 3rd Laws of thermodynamics.
   (b) Determination of internal energy, entropy, enthalpy and free energy-Determination of chemical equilibrium constants for homogeneous and heterogeneous systems. Use of thermodynamics in combustion, distillation and heat transfer. Mechanism and theory of mixing, various mixers for liquid-liquid, soil-liquid and solid-solid.

CHEMICAL ENGINEERING
PAPER — II

Full Marks — 100.
Time — 3 Hours.

1. Reaction Engineering:
   (i) Kinetics: Homogeneous and heterogeneous reactions. 1st and 2nd order reactions.
   Batch and flows-Reactors and their design.
   (ii) Catalysis-Choice of catalysis; Preparations; Mechanics of catalysis based upon mechanism.

2. Transportation:
   Storage and transport of materials and in particular, powders, resins, volatile and non-volatile liquids, emulsions and dispersions, pumps, compressors and blowers, Mixer-Mechanisms and theory of mixing, various mixers for liquid-liquid, soil; solid-liquid.

3. Materials:
   Factors that determine choice of materials for construction in chemical industries;
   Metals and alloys, ceramics, plastics and rubbers, Timber and timber products, plywood laminates.
   Fabrication of equipment with particular reference to production of vats, barrals, filter presses etc.

4. Instrumentation and process control.
   Mechanical, hydraulic, pneumatic, thermal, optical, magnetic, electrical and electronic instruments, controls and control systems, automation.

CIVIL ENGINEERING
PAPER — I

Full Marks — 100
Time — 3 Hours.

1. Engineering Materials—their properties and strength;
   Materials—Timber, stone, brick, lime, cement, tile, sand, surkhi, mortar and concrete, metal and glass-structural proportion of metals and alloys used in engineering practice. Stresses and strains—Hook’s Law, Bending. Torsion and direct stresses, Elastic
of bending of beams, maximum and minimum stresses due to eccentric loading. Bending moment and shear force diagrams and deflection of beams under static and live loads.

2. Structural Engineering:

Steel Structures—Permissible stresses, Design of beams, simple and built-up columns and simple roof trusses and girders, column bases and griffages for axially and eccentrically loaded columns; bolted, riveted and welded connections.

R. C. C. structures—Specifications of materials used-proportioning, workability and strength requirement—I. S. I. standards for design loads, permissible stresses in R. C. C. members subject to direct and bending stress—Design of simply supported, overhanging and cantilever beams, rectangular and Tee-beams in floors and lintels; axially loaded columns and their bases.

CIVIL ENGINEERING
PAPER — II

Full Marks — 100

1. Civil Engineering construction and environmental Engineering:

Construction—Brick and stone masonry walls, floors and roof, staircases, carpentry in wooden floors, roofs ceiling, doors and windows; finishes (plastering, pointing, painting and varnishing etc.) Principles of design of highways-width of foundation and pavement, camber, gradient. Curves and super-elevation; retaining walls. Construction of earth roads, stabilized and water bound macadam roads, bituminus surfaces and concrete roads; draining of roads. Water supply-Sources of water, standards of purity, methods of purification, layout of distribution system, pumps and beesters. Sanitation—Sewers, storm water overflows, house drainage requirements and apportunities, septic tanks, imhoff tanks, sewage treatment and dispersion trenches—Activated sludge process.

2. Surveying, estimating and Bridge Engineering:

Surveying—Chain and Compass Surveying-instruments and their uses; plane levelling; theodolite.

Estimating—Principles and units of measurements, taking out quantities for buildings; and preparation of abstract of costs; specifications and data sheets for important items; estimating earthwork for roads and canals.

Bridges—Types, economical spans, IRC loading, designing superstructure of small span bridges; Principles of designing foundation of abutments and piers of bridges, pile and well foundations, Soil Mechanics—Soils and their investigation, bearing capacity.

ELECTRICAL ENGINEERING
PAPER — I

Full Marks — 100

Electrical Fields:—Coulomb's law, Gauss theorem, Capacitance, charging current and stowed energy.

Magnetic Field:—Biav Savart's law flux density, relative peremeability, magnetic saturation, stored energy, self and Mutual induction.
Net Work's:— Networks elements, KCL,KVL, Star/Delta connections, Thevenin's Theorem, Maximum Power Transfer theorem.

A.C. :— Single phase and three phase, active and reactive power, power factor and its improvement.

Transient and steady state response, Laplace and Fourier's transform, Resonance and coupled circuits.

Lead acid storage battery, charging and discharging. Care and maintenance of battery.

Measurements.—

Basic methods of measurements, general features of Indicating, Moving coil, Moving iron, Dynamometer Rectifier type of instruments. Production of deflecting, controlling and damping torques. C. I. and P. I. measurement of active and reactive power in single phase and three phase with wattmeter. Electro-static instruments and measurement of high Voltage. Induction type instruments, Principles of energy meter, power factor meter, frequency meter and use of synchronoscope.

Electrical Machines:—

Principals of electro mechanical energy conversion, field excitation in electrical machine, steady d. e. pulsating and rotating and retating magnetic fields, voltage due to steady d. c., rotating magnetised field, concentrated and distributed windings, Magnetic saturation. No load characteristics of electrical machines.

Transformer.

Basic Principles of transformer, e. m. f. equation, phasor diagram, equivalent circuit, regulation, losses and efficiency, testing of transformer, Auto transformer, three phase connection, paralleled operation of 3-phase transformer.

D. C. Machines.

D. C. Generators, excitation systems and characteristics, Principals of D. C. motors, starting and speed control of D. C. motors, losses and efficiency. Heating, cooling and ventilations of electrical machines.

ELECTRICAL ENGINEERING

PAPER — II.

Full Marks — 100.

Time — 3 Hours.

Power systems and High Voltage:— Line conductors. Insulators and their uses. Calculation of over head line pera meters-Resistance, Inductance, Capacitance for 3 phase line, sag and Tension Calculation including effect of wind, ice, etc.

Underground cables and their uses, Calculation of cable parameters, grading, equalisation of potential gradients.

Electrical design of over head lines—Performance of Short and medium transmission lines. Control of Reactive power, use of shunt and series capacitors and synchronous Condensers.

Fault calculation and protective:— Relays, Corona, measurements of High Voltage. Protection against over Voltages.

Methods of forecasting electrical loads, Estimation of connected load, Maxm. demand, average load, Load factor and Energy consumption Calculations of simple flat rate, two parts and three par Us traffs.
Fields and A.C. Machines: Vector Analysis, Divergence theorem (Gauss-Theorem), Maxwell's equation, Electromagnetic wave propagation, Synchronous machines—Generator and Motor characteristics, synchronous impedance, parallel operation of synchronous generators. Induction machines—Three phase motor characteristics, starting and speed control, single phase Induction motor.

Electronics and Computer: Semi conductor devices, Equivalent circuits, transistor parameters determination of current and voltage gain input and output impedances, biasing techniques, single and multistage audio and radio small signals large signals amplifier's and their analysis, Feed back amplifiers and Oscillators.


Control System: Transfer functions, Block diagrams and signal flow graphs steady state error. stability Routh and Nyquish Criteria, Bodeplots, Root Loci.

MECHANICAL ENGINEERING.

PAPER — I

Full Marks — 100.


Stress and strains—Hooke's Law. Bending Moment, Shear force and deflection in simply supported, over-hanging and cantilever beams for simple loading. Torsion in round bars—transmission of power by shafts. Simple cases of combined and torsion.


3. Production Engineering.


Metrology—Linear and angular measurement. Measurement of screws and gears. Surface finish. Limits and Fits. Optical and pneumatic instruments. Measurement of other physical quantities like temperature, pressure, force and speed etc.

MECHANICAL ENGINEERING.

PAPER — II

Full Marks — 100.

1. Applied Thermodynamics.

Uses of temperature-entropy, heat-entropy, pressure-Volume Charts and diagrams. Simple
steam turbines and internal combustion engine. Indicator Diagrams. Mechanical, thermal,
air standard and actual efficiencies. General construction of engines, performance
tests and heat balance.

2. Fluid Mechanics and Hydrodulic Machines.

Bernoulli's equation. Fluid flows-laminar and turbulent flow, flow through chavinels
and pipes, moving pates and vanes. Measurement of flow. Pumps and turbines-design
principles, application and characteristic curves, principles of gindlarity and governing.
Hydroulic accumulators, presses, lifts and cranes. Surgo tanks and Storage roservois.

3. Industrial Engineering.

Industrial plant location and layout. duction planning and control. Methods of
time study and work measurement-Motion-time date, Work sampling. Job evaluation and
merit rating. Wages and Incentives.

[Signature]
29/6/07

( R. L. BAR )
Under Secretary to GOVERNMENT OF TRIPURA.