वनक्षेत्राधिकारी परीक्षा पाठ्यक्रम

परीक्षा की योजनाः– प्रतियोगिता परीक्षा में क्रमवार निम्नलिखित स्तर सम्मिलित है यथाः (1) प्रारम्भिक परीक्षा सामान्य अध्ययन एवं सामान्य बुद्धि परीक्षण (वस्तुनिष्ठ प्रकार की), (2) मुख्य परीक्षा (विस्तृत लिखित प्रकार के होंगे), (3) मौखिक परीक्षा (व्यक्तित्व परीक्षा)।

नोट– मुख्य परीक्षा हेतु निर्धारित वैकल्पिक विषयों के मूल्यांकन में स्कैलिंग प्रणाली (Scaling Method) लागू रहेगी।

प्रारम्भिक परीक्षा हेतु निर्धारित विषय

(अनिवार्य विषय) : सामान्य अध्ययन

प्रारम्भिक परीक्षा में एक वस्तुनिष्ठ प्रश्न–पत्र (सामान्य अध्ययन एवं सामान्य बुद्धि परीक्षण) 150 अंक का होगा। प्रश्न–पत्र हेतु निर्धारित समय 02 धंटे है। प्रश्न–पत्र के उत्तर पत्रक ओ.एम.आर. के रूप में होंगे। पाठ्यक्रम इस विज्ञापन के ''**परिशिष्ट–4''** में उल्लिखित है।

मुख्य (लिखित) परीक्षा के लिए निर्धारित विषय

मुख्य परीक्षा में निम्नलिखित अनिवार्य तथा वैकल्पिक विषय होंगे जिनका पाठ्यक्रम इस विज्ञापन के ''**परिशिष्ट–5**'' में उल्लिखित है। अभ्यर्थियों को मुख्य परीक्षा हेतु वैकल्पिक विषयों की सूची में से कोई दो विषय चुनने होंगे। प्रत्येक वैकल्पिक विषय का एक प्रश्न–पत्र होगा। मुख्य लिखित परीक्षा कुल 700 अंकों की होगी।

(अ) अनिवार्य विषय :–

1. सामान्य ज्ञान	100 अंक
2. सामान्य अंग्रेजी (निबन्ध व सार लेखन आदि)	100 अंक
3. सामान्य हिन्दी	100 अंक

समस्त अनिवार्य तथा वैकल्पिक विषयों के प्रश्न–पत्रों हेतु 03 घंटे का समय निर्धारित है। वैकल्पिक विषयों का प्रत्येक प्रश्न पत्र 200 अंकों का होगा।

नोट :– अभ्यर्थी से सामान्य हिन्दी के अनिवार्य प्रश्न पत्र में न्यूनतम 35% अंक प्राप्त करना अनिवार्य होगा।

(ब) वैकल्पिक विषय (कोड सहित) :–

अभ्यर्थी नीचे उल्लिखित विषयों में कोई दो विषय वैकल्पिक विषय के रूप में चुनें। वैकल्पिक विषय का पाठ्यक्रम **परिशिष्ट–5** में दिया गया है। प्रत्येक वैकल्पिक विषय का प्रश्न पत्र 200 अंकों का होगा।

1. कृषि (कोड 01)	13. वानिकी (कोड 13)
2. वनस्पति विज्ञान (कोड 02)	14. भू–विज्ञान (कोड 14)
3. रसायन शास्त्र (कोड 03)	15. उद्यान विज्ञान (कोड 15)
4. कम्प्यूटर एप्लीकेशन/कम्प्यूटर विज्ञान (कोड 04)	16. गणित (कोड 16)

5. कृषि इंजीनियरिंग (कोड 05)
6. रसायन इंजीनियरिंग (कोड 06)
7. सिविल इंजीनियरिंग (कोड 07)
8. कम्प्यूटर इंजीनियरिंग (कोड 08)
9. इलेक्ट्रिकल इंजीनियरिंग (कोड 09)
10. इलेक्ट्रॉनिक्स इंजीनियरिंग (कोड 10)
11. मैकेनिकल इंजीनियरिंग (कोड 11)
12. पर्यावरणीय विज्ञान (कोड 12)
17. भौतिकी (कोड 17)
18. सांख्यिकी (कोड 18)
19. पशु चिकित्सा विज्ञान (कोड 19)
20. प्राणी विज्ञान (कोड 20)

नोटः अभ्यर्थी निम्नलिखित विषय समूहों में से केवल एक ही विषय ले सकेंगेः–

समूह–क	**समूह–ख**	**समूह–ग**
1. कृषि	1. रसायन शास्त्र	1. कम्प्यूटर एप्लीकेशन/कम्प्यूटर साईन्स
2. कृषि अभियांत्रिकी	2. रसायन अभियांत्रिकी	2. कम्प्यूटर अभियांत्रिकी
3. पशु चिकित्सा विज्ञान		

समूह–घ	**समूह–ड.**
1. इलैक्ट्रिकल इंजीनियरिंग	1. गणित
2. इलेक्ट्रॉनिक्स इंजीरियरिंग	2. सांख्यिकी

(3) व्यक्तित्व परीक्षा/मौखिक परीक्षाः (कुल अंक– 75)

यह परीक्षा अभ्यर्थियों की सामान्य जागरूकता, बुद्धि, अभिव्यक्ति की क्षमता, व्यक्तित्व एवं सेवा के लिये सामान्य उपयुक्तता को दृष्टि में रखते हुये सामान्य अभिरूचि के विषयों से सम्बन्धित होगी।

परिशिष्ट–4

Preliminary Examination

(प्रारम्भिक परीक्षा का पाठ्यक्रम हिन्दी व अंग्रेजी दोनों भाषाओं में आयोग की वेबसाइट पर उपलब्ध है)

General Studies and General Aptitude Test (Objective Type)

Time : 2 Hours **Maximum Marks : 150**

Part -1 : General Studies

Maximum Marks-100 **Total Questions-100**

1 **General Science and Knowledge of Computer Operation:** Questions on General Science and Computer operation will cover general understating and application of science and Computers including matters of day to day observation and experience as may be expected from an educated person who has not made a special study of any scientific or computer discipline.

2 **History of India and Indian National Movement:** Questions on history of India and Indian National Movement will be based on broad understanding of ancient, mediaeval and modern India's political, social, economic, and cultural aspects and India's Freedom movement, growth of nationalism and attainment of Independence.

3 **Indian polity and Economy:** Questions on Indian polity and economy will be based on Indian polity, Constitution, Panchayati raj and Community development, broad features of Indian economy and planning.

4 **Geography and Demography of India:** Questions will be based on a broad understanding of geographical, ecological and socio-economic aspects and demography of India.

5 **Current Events:** Questions will be based on important Uttarakhand State, National and International current events including games.

6 **History of Uttarakhand:** Historical background of Uttarakhand: Ancient period (from earliest to 1200 AD) ; Mediaeval period (from 1200 to 1815 AD): Important dynasties and their achievements; Gorkha invasion and administration, British rule, Tehri State and its administration, role of Uttarakhand in the Freedom Movement of India and related eminent personalities, historical sites and monuments; movements for the formation of Uttarakhand, contribution of people of Uttarakhand in National and International fields, especially in Armed forces; different social reform movements, and different welfare programmes of Uttarakhand for SC, ST, children, minorities and women.

7 **Culture of Uttarakhand:** Castes and tribes, religious and folk beliefs, literature and folk literature, traditions and customs, costumes and ornaments; Fairs and Festivals, food habits, art and Crafts, dances, songs, musical instruments, major tourist places, important sports, tournaments and awards, famous authors and poets of Uttarakhand and their contribution in the field of Hindi literature and folk literature, State steps taken by Uttarakhand for the development of culture.

8 **Geography and Demography of Uttarakhand :** Geographical Setup. Salient features of Uttarakhand Himalaya. Rivers and streams, mountains, climate, forest resources and horticulture. Major crops and crop rotation. Means of irrigation. Agricultural holdings. Natural and man-made calamities and Disaster management. Water crises and watershed management. Problems of remote areas. Environment and environmental movements. Biodiversity and its preservation. Population of Uttarakhand: Classification, density, sex ratio, literacy and out-migration.

9 **Economic, Political and Administrative Background of Uttarakhand :**

Political and Administrative Background- Elected governments in Uttarakhand and their policies, different services in the State, the political and administrative systems, Panchayati raj,Community development and Co-operatives.

The historical background of the administrative system in Uttarakhand- Land management system under Gorkhas rule and British rule, district land management (Thokdari, van panchayat, civil and soyam forest, Kesar-i-hind(benap land)Nazul, nayabad settlements) Modern period Uttar Pradesh and Uttarakhand-Kumaun land reforms, changes in land tenures and collection of land revenue after the enforcement of Zamidari Abolition Act, revenue police system.

Economic background – Indo-Tibetan trade from border districts, the present position, local agriculture and animal husbandry, the uneconomic condition of land holdings and need for consolidation of holdings, Begar and Dadwar systems.

10 **Economic and natural resources :** Human resources, Education system of the State and important educational institutes; forest, water, herbs, agriculture, animals, hydro electricity, minerals, tourism, industries (Small and Village), the position of utilisation of resources.

Various schemes being implemented in Uttarakhand for the eradication of poverty and unemployment and for economic development. Economic activities and their contribution in the State GDP. The priorities of development in Uttarakhand and new strategies of planning and its problems. Marketing facilities in Uttarakhand and agriculture mandis. The salient features of the budget of Uttarakhand State.

Part -2 : General Aptitude Test

Maximum Marks-50 **Total Questions-50**

1 **General Intelligence:** The questions on general intelligence will cover, both, verbal and non verbal types, including questions on analogies, similarities, differences, space visualization, problem solving, analysis, judgement, decision making, visual memory, discrimination, observation, relationship concepts, arithmetical reasoning, verbal and figure classification and arithmetical number series. The test will also include questions designed to test the candidate's ability to deal with abstract ideas, symbols and their relationships, arithmetical computations and other analytical functions.

परिशिष्ट–5

SYLLABUS FOR MAIN WRITTEN EXAMINATION

(मुख्य परीक्षा का पाठ्यक्रम हिन्दी व अंग्रेजी दोनों भाषाओं में आयोग की वेबसाइट पर उपलब्ध है)

(A)The written examination shall be held in the following manner

COMPULSORY SUBJECTS

1. GENERAL KNOWLEDGE – 100 Marks (Time - 3.00 hrs)

The paper on General knowledge will include questions covering current events of National and International importance, History of India - Indian Freedom Movement, Constitution of India, General appreciation and understanding of Science including everyday matter of observation and experience as may be expected of a well-educated person.

Geography of nature, political system including local self government in Uttarakhand, Indian economy.

Note- This paper carries 10 questions. Each question 10 marks. All questions are compulsory.

2. GENERAL ENGLISH – 100 Marks (Time - 3.00 hrs)

Essay, Precis writing, Letter writing, Usages, Vocabulary and Application of Grammar.

1- Write an essay in approximately 400 words on any one of the following topics – (20 Marks)
- (A) Science, Technology and Environment
- (B) Literature and Culture
- (C) Economic Development and Planning
- (D) Social and Political sphere of Uttarakhand
- (E) National and International Issues
- (F) Natural Calamities

2- Précis Writing - (5+10 Marks)

3- Letter writing - (10+ 10 Marks)
- (A) Official letters
- (B) Semi Government letters
- (C) Telegram
- (D) Official orders
- (E) Notice
- (F) Circular/Official Memorandum

4- Vocabulary – (5+5+5 Marks)
- (A) Synonyms
- (B) Antonyms
- (C) One-word Substitute

5- Usages – (5 Marks)
Idioms and Phrases

6- Application of Grammar- (10+10+5 Marks)
- (A) Parts of Speech
- (B) Transformation and Synthesis
- (C) Punctuation

3. GENERAL HINDI – 100 Marks (Time - 3.00 hrs)

(1) प्रश्न–पत्र में दिये गये गद्यखण्ड का अवबोध एवं प्रश्नोत्तर। 10 + 5 = 15

(2) संक्षेपण। 5 +10 = 15

(3) सरकारी एवं अर्द्धसरकारी पत्र लेखन, तार, कार्यालय आदेश, अधिसूचना, परिपत्र। 10 +10 = 20

(4) शब्द ज्ञान एवं प्रयोग– (अ) उपसर्ग एवं प्रत्यय 05

(आ) विलोम शब्द 05

(इ) वाक्यांश के लिए एक शब्द 05

(ई) वर्तनी एवं वाक्यशुद्धि। 05

(5) लोकोक्ति एवं मुहावरे। 20

(6) कम्प्यूटर और हिन्दी। (सरकारी कामकाज में हिन्दी क्षेत्र में कम्प्यूटर की उपयोगिता एवं आवश्यकता) 10

नोटः– अनिवार्य विषय सामान्य हिन्दी प्रश्न–पत्र में **न्यूनतम 35 % अंक** प्राप्त करना अनिवार्य होगा।

4. OPTIONAL SUBJECTS

Any 2 (two) Subjects out of the following carrying 200 Marks each.

1. Agriculture
2. Botany
3. Chemistry
4. Computer Applications/Computer Science
5. Agriculture Engineering
6. Chemical Engineering
7. Civil Engineering
8. Computer Engineering
9. Electrical Engineering
10. Electronics Engineering
11. Mechanical Engineering
12. Environmental Science
13. Forestry
14. Geology
15. Horticulture
16. Mathematics
17. Physics
18. Statistics
19. Veterinary Science
20. Zoology

Each optional subject will have one question paper of 3.00 hour duration carrying 200 marks. Each question paper shall have two parts containing four questions in each part. Candidates will be required to answer five questions in all. It shall be compulsory to answer at least two questions from each part. The standard and syllabus of each subject will in general be equivalent to that of the University Degree Course Examination. A candidate is required to select any two of the above optional subjects but will not be allowed to offer the following combination of subjects.
(a) Agriculture, Agricultural Engineering and Veterinary Science.
(b) Chemistry and Chemical Engineering.
(c) Computer Application/Computer Science and Computer Engineering.
(d) Electrical Engineering and Electronics Engineering.
(e) Mathematics and Statistics

(B) Interview – 75 Marks

1. AGRICULTURE

SECTION – A

Ecology and its relevance to man, natural resources, their management and conservation. Environmental factors of crop distribution and production. Climatic elements as factor of crop growth, impact of changing environment on cropping pattern. Environmental pollution and associated hazards to crops, animals and humans.
Cropping patterns in different agro-climatic zones of the state. Impact of high yielding and short duration varieties on shifts in cropping patterns. Concepts of multiple cropping, multistory, relay and inter-cropping and their importance in relation to sustainable crops production. Package of practices for production of important cereals, pulses, oilseeds, fibre, sugar and cash crops grown during Kharif and Rabi seasons in different regions of the state. Important features, scope and propagation of various types of forestry plants with reference to agro-forestry and social forestry.

Weeds, their characteristics, dissemination and association with various field crops; their multiplications; cultural, biological and chemical control of weeds. Processes and factors of soil formation, classification of Indian soils including modern concepts. Mineral and organic constituents of soils and their role in maintaining soil productivity. Problem soils, extent and distribution in India and their reclamation. Essential plant nutrients and other beneficial elements in soils and plants, their occurrence, factors affecting their distribution, functions and cycling in soil. Symbiotic and non-symbiotic nitrogen fixation. Principles of soil fertility and its evaluation for judicial fertilizer use. Soil conservation planning on water shed basis, Erosion and runoff management in hilly foothills and valley lands; processes and factors affecting them. Dry land agriculture and its problems. Technology for stabilising agriculture production in rainfed agriculture area.

Water use efficiency in relation to crop production, criteria for scheduling irrigations, ways and means of reducing run-off losses of irrigation water. Drainage of water-logged soils. Farm management, scope, importance and characteristics, farm planning and budgeting. Economics of different types of farming systems. Marketing and pricing of agriculture inputs and outputs, price fluctuations and their cost, role of co-operatives in agricultural economy, types and systems of farming and factors affecting them. Agricultural extension, its importance and role, methods of evaluation of extension programmes, diffusion, communication and adoption of innovations people's participation and motivation. Farm mechanization and its role in agricultural production and rural employment. Training programmes for extension workers and farmers. Extension systems and programmes : Training & Visits, NATP and IVLP.

SECTION - B

Heredity and variation. Mendels law of inheritance, Chromosomal theory of inheritance. Cytoplasmic inheritance. Sex linked, sex influenced and sex limited characters. Spontaneous and induced mutations. Role of chemicals in mutation. Origin and domestication of field crop. Morphological patterns of variations in varieties and related species of important field crops. Cause and utilization of variation in crop improvement. Application of the principles of plant breeding to the improvement of major field crops, methods of breeding of self and cross-pollinated crops. Introduction, selection, hybridization. Male sterility and self-incompatibility, utilization of mutation of polypoidy in breeding. Seed technology and its importance, production, processing, storage and testing of seeds. Role of national and state seed organization in production. Processing and marketing of improved seeds. Physiology and its significance in agriculture, physical properties and chemical constitution of protoplasm, inhibition, surface tension, diffusion and osmosis, absorption and translocation of water, transpiration and water economy.

Enzymes and plant pigments. Photosynthesis – modern concepts and factors affecting the process, aerobic and anaerobic respiration. Growth and development, Photoperiodism and vernalization. Plant growth regulators and their mechanism of action and importance in crop production. Climatic requirements and cultivation of major fruits and vegetable crops; package of practices and the scientific basis for the same. Pre and post harvest physiology of fruits and vegetables. Principal methods of preservation of fruits and vegetables. Processing techniques and equipment. Landscape and Floriculture including raising of ornamental plants. Design and layout of lawns and gardens. Diseases and pests of vegetables, fruits and plantation crops of the state, and

measures to control plant diseases. Integrated management of pests and diseases Pesticides and their formulations, plant protection equipment, their care and maintenance.

Storage pests of cereals and pulses, hygiene of storage godowns; preservation and remedial measures.

2. BOTANY

SECTION – A

Microbiology,Plant pathology, Plant diversity and Morphogenesis.

1. Microbiology: – Microbial diversity, elementary idea of microbiology of air, water and soil, a general account of microbial infection and immunity, application of microbiology with reference to agriculture, industry, medicine and environment.

2. Plant Pathology – Important plant diseases caused by viruses, bacteria, algae, fungi and nematodes with special reference to root blot of crucifers, tobacco mosaic, leaf curl of papaya, citrus canker, leaf blight of paddy, rust of tea, rust of wheat, smut of barley, late blight of potato, red rot of sugarcane and wilt of arhar.

3.Plant Diversity – Classification, structure, reproduction, life cycles and economic importance of viruses, bacteria, algae, fungi, bryophytes, pteridophytes and gymnosperms including fossils, morphology of root, stem, leaf, flower and seed, secondary growth; embryology-microsporogenesis and male gametophyte, megasporogenesis and female gametophyte, fertilization, embryo and endosperm development principles of taxonomy, modern systems of classification of angiosperms, rules of botanical nomenclature, biosystematics, distinguishing features of the families – Renunculaceae, Magnoliaceae, Brassicaceae, malvaceae, Fabaceae, Rosaceae, Apiaceae, Cucurbitaceae, Solanaceae, Asclepiadaceae, Verbenaceae, Lamiaceae, Asteraceae, Apocyanaceae, Euphorbiaceae, Arecaceae, Poaceae and Orchidaceae.

4.**Morphogenesis** – Correlation, polarity, symmetry, totipotency, differentiation and regeneration of tissues and organs; morphogenetic factors, methods and applications of cell, tissue, organ and protoplast cultures, somaclonal variations, somatic hybrids and cybrids.

SECTION – B

1. **Cell Biology** – Cell as structural and functional unit of life; ultrastructure of eukaryotic and prokaryotic cells, structure and function of plasma membrane, endoplasmic reticulum, chloroplasts, mitochondria, ribosomes, golgi bodies and nucleus; cell cycle, mitosis and meiosis, chromosomal morphology and chemistry, numerical and structural changes in chromosomes and their cytological and genetical effects.

2. Genetics – Mendal's law of inheritance, interaction of genes, linkage and crossing over, genetic recombination in fungi, cyanobacteria, bacteria and viruses, gene mapping, sex linkage, determination of sex, cytoplasmic inheritance of plastids; development of genetics and gene concept, genetic code; molecular genetics – DNA as genetic material, structure and replication of DNA, role of nucleic acids in protein synthesis (transcription and translation) and regulation of gene expression, mutation and evolution; DNA damage and repair, gene amplification, gene rearrangement, oncogene; genetic engineering-restriction enzyme, cloning vectors (pBR 322, pTi, lambda phage), gene transfer, recombinant DNA, genomic libraries, application of genetic engineering in human welfare.

3. **Physiology and Biochemistry** – Water relation of plants – absorption, conduction of water and transpiration; mineral nutrition and ion transport, translocation of photosynthates, essential micro and macroelements and their function; chemistry and classification of carbohydrates; photosynthesis – mechanism and importance, factors affecting photosynthesis, C3 and C4 carbon fixation cycle, photorespiration; plant respiration and fermentation, Kreb's cycle; enzymes and co-enzymes, mechanism of enzyme action; secondary metabolites (alkaloids, steroids, terpenes, lipids), nitrogen fixation and nitrogen metabolism, structure of protein and its synthesis; plant growth – growth movements and senescence, growth hormones and growth regulators – their structure, role and importance in agriculture and horticulture; physiology of flowering, sexual incompatibility, seed germination and dormancy.

4. **Ecology** – Scope of ecology, ecological factors, plant communities and plant succession; concept of biosphere; ecosystem – structure and function, abiotic and biotic components, flow of energy in the ecosystem, applied aspects of ecology – natural resources and their conservation, endangered, threatened and endemic taxa; pollution and its control. 5. **Economic Botany** – Origin of cultivated plants study of plants as sources of food, fibre, timber, drugs, rubber, beverage, spices, resin and gums, dyes, essential oils, pesticides and biofertilizers, ornamental plants, energy plantation and petrocrops.

3. CHEMISTRY

SECTION – A

Atomic Structure – Bohr's model and its limitations, de Broglie equation, Heisenberg uncertainty principle, quantum mechanical operators and the Schrodinger wave equation, physical significance of wave function and its characteristics (normalized, orthogonal), radial distribution and shapes of s, p, d and f-orbitals, particle in a one-dimensional box, quantization of electronic energies (qualitative treatment of hydrogen atom). Pauli's exclusion principle, Hund's rule of maximum multiplicity, Aufbau principle. Electronic configuration of atoms, Long form of Periodic table including translawrencium elements. Periodicity in properties of the elements such as atomic and ionic radii, ionization potential, electron affinity, electronegativity and hydration energy.

Nuclear and Radiation Chemistry – Structure of nucleus (shell model), nuclear forces, nuclear stability N/P ratio, nuclear binding energy. Kinetics, detection and measurement of radioactivity, Artificial transmutation of elements and nuclear reactions, nuclear fission & fusion, radioactive isotopes and their applications. Radio carbon dating, Elementary ideas of radiation chemistry, radiolysis of water and aqueous solutions, unit of radiation chemical yield (G-value), Fricke's dosimetry.

Chemical Bonding – Valence bond theory (Heitler-London and Pauling-Slater theories), hybridization VSEPR theory and shapes of simple inorganic molecules. Molecular orbital theory, bonding, non-bonding and anti-bonding molecular orbitals, molecular orbital energy level diagrams for homo and hetro nuclear diatomic molecules, bond order, bond length and bond strength, sigma and pi-bonds, hydrogen bond, characteristics of covalent bond.

Chemistry of s- and p-Block Elements – General properties of s- and p-block elements, chemical reactivity of elements and group trends, chemical behaviour with respect to their hybrids, halides and oxides.

Chemistry of Transition Elements – General characteristics, variable oxidation states, complex formation, colour, magnetic and catalytic properties. Comparative study of 4d and 5d transition elements with their 3d analogues with respect to their ionic radii, oxidation state and magnetic properties.

Chemistry of Lanthanides and Actinides – Lanthanide contraction, oxidation states, Principles of separation of lanthanides and actinides. Magnetic and spectral properties of their compounds.

Coordination Chemistry – Werner's theory of coordination compounds, IUPAC system of nomenclature, effective atomic number (EAN) Isomerism in coordination compounds. Valence bond theory and its limitations, Crystal field theory, Crystal field splitting of d-orbitals in octahedral, tetrahedral and square planar complexes. Dq and factors affecting its magnitude, calculation of Crystal field stabilization energies

(CFSE) for d^1 to d^9 week and strong field octahedral complexes, spectrochemical series. Electronic spectra of 3d-transition metal complexes, types of electronic transitions, selection rules for electronic transitions, spectroscopic ground states for d^1 to d^{10} systems.

Bio-inorganic Chemistry – Essential and trace elements in biological processes, Metalloporphyrins with special reference to haemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Ca^{2+}.

Preparation, Properties and Uses of the following Inorganic Compounds – Heavy water, boric acid, diborane, hydrazine, hydroxylamine, potassium dichromate, potassium permanganate, (Ce(IV) sulphate and titanium (III) sulphate.

Polymers – Number average and weight average, sedimentation, light scattering, viscosity and osmotic pressure methods. Finding molecular weight of polymers.

SECTION – B

General Organic Chemistry – Electronic displacement – inductive, electromeric and messomeric effects, Conjugation and hyperconjugation. Resonance and its application to organic compounds. Electrophiles, mucleophiles, carbocations, carbanions and free radicals. Organic acids and bases. Effects of structure on the strength of organic acids and bases. Hydrogen bond and its effect on the properties of organic compounds.

Concepts of Organic Reaction Mechanism – Mechanism of addition, substitution, elimination reactions and molecular re-arrangements. Mechanism of electrophilic and nucleophilic aromatic substitution. Mechanism of the following reactions; Aldol condensation, Claisen condensation, Beckmann re-arrangement, Perkin reaction, Reimer-Tiemann reaction, Cannizzaro's reaction, Friedel-Craft's reaction, Reformatisky's reaction and Wagner-Meerwein re-arrangement.

Aliphatic Compounds – Chemistry of simple organic compounds belonging to following classes with special reference to the mechanisms of the reactions involved therein ; alkanes, alkenes, alkynes, alkyl halides, alcohols, ethers, thiols, aldehydes, ketones, α, β-unsaturated carbonyl compounds, acids and their derivatives, amines, aminoacids, hydroxyl acids, unsaturated acids and dibasic acids. Synthetic uses of malonic ester, acetoacetic ester, Grignard's reagent, carbine, diazomethane and phosphoranes.

Carbohydrates – Classification, configuration and general reaction of simple monosaccharides. Osazone formation, mutarotation, pyranose and furanose structures. Chain lengthening and chain shortening in aldoses and ketoses. Interconversion of glucose and fructose.

Stereochemistry and Conformations – Elements of symmetry, optical and geometrical isomerism in simple organic compounds. Absolute configuration (R & S), Configurations of geometrical isomers, E & Z notations. Conformations of mono and disubstituted cyclohexanes. Boat and chair forms.

Aromatic Compounds – Modern structure of benzene ; concept of aromaticity, Huckel rule and its simple application to non-benzenoid aromatic compounds. Activating and deactivating effect of substituent groups, directive influence.

Study of the compounds containing following groups attached to the alkyl and benzene ring – Halogen, hydroxyl, nitro and amino groups. Sulphonic acids, benzaldehyde, salicyldehyde, acetophenone, Benzoic, salicylic, phthalic, cinnamic and mandelic acids.

Naphthalene and Pyridine – Synthesis, structure and important reactions.

Alkaloids – General methods of structure elucidation of alkaloids, chemistry of nicotine.

Organic Polymers – Mechanism of polymerization, polymers of industrial importance, synthetic fibres.

Chemistry of Living Cells – A brief introduction, chemical constituents, cell membrance, acid-base balance. Diffusion and active transport. Donnan membrance equilibria.

Enzymes and Coenzymes – Nomenclature and characteristics, factors which affect enzyme activity.

NMR Spectroscopy – Principle of PMR, chemical shift, spin-spin coupling, interpretation of PMR spectra of simple organic molecules.

Evaluation of Analytical Data – Errors, accuracy and precision, Relative and standard deviation, rejection of doubtful observations, t-test, Q-test.

Solvent Extraction – Distribution law, Craigs concept of counter – current distribution, important solvent extraction systems.
Chromatography – Classification of chromatographic techniques, general principles of adsorption, partition ion exchange, paper and thin layer chromatography.
Environmental Chemistry – Air pollutants and their toxic effects, depletion of ozone layer Effects of oxides of nitrogen fluorochlorocarbons and their effect on ozone layer, Greenhouse effect, Acid rain.

4. COMPUTER SCIENCE/COMPUTER APPLICATION

SECTION – A

Basic Mathematics Element of probability, matrix, algebra, integration, differentiation.

Basic Concepts Analog Vs digital, accuracy, reliability, fastness, character and number representations, decimal, binary, octal, hexadecimal numbers, floating point representation, batch processing, time sharing, multiprogramming, programming language, machine language and high level language, compiler and interpreter, study of commonly used peripherals.

Switching Theory and Digital Design Logic functions, Boolean algebra, simplifications, Gates, implementation of logical functions, design of combinational and sequential circuits, flip-flops, registers, encoder, decoder, code converters, counters, design with integrated circuits including ROM, PLA and multiplexers, microprocessor architecture, programming study of 8085/8086.

Programming and Data structures - Concepts of OOP's , C++ data types, control statements, procedures, Scope rules, arrays and records, enumerated data types, sets, pointers, recursion. File-sequential, indexed files, sorting and merging report generations. Arrays, queues, linked lists, stacks, tree traversal, evaluation of expressions using postfix notation, sorting algorithms, bubble sort, quick sort, heap sort, complexity of algorithms

SECTION – B

Computer Organization Function organization, machine instructions, addressing modes, introduction to microprocessors, study of 8085/8086 communication between processor and I/O via DMA and interrupt priority, I/O processors, problems associated with bus scheduling. Micro computer memory, virtual memory, basic concepts, problems of virtual memory, page replacements algorithms, cache memory, associative memory. Fundamentals of parallel processing and its necessity pipelined processors and multiprocessors.

Systems Programming Editors, loaders, linkers, assemblers, phases of a compiler and their function, lexical analysers and parsers, parsing techniques, symbol table, code generation.

Operating Systems Batch, Multi-programming and time sharing systems, processor memory, device and file management, virtual memory, process scheduling, inter process communication, I/O redirection, process synchronization and concurrency, deadlocks, prevention, avoidance, detection and recovery, auxiliary storage management, file system functions and its hierarchy.

Data Processing Concepts File organisation techniques: indexing, relational and network data models, study of relational DBMS. Data dictionary, normal forms and query languages.

Computer Networks Data communication concepts, concepts of LAN, evolution of LAN, OSI - 7 layer

reference model and design issues. Physical layer-transmission media, packet and circuit switching, topologies, Data link layer, token passing, sliding window protocols, protocols specification and verification, network layer, routing, congestion control, transport layer, session and presentation layers, design issues, application layer, file transfer, electronic mail.

Software Engineering and Applications Systems analysis, detailed analysis, feasibility study, tools for system designer, input and output design, program definition, module design and design review, structured programming and conversion, testing, training and documentation, systems life cycle, role of System Analyst. Tools for office Automation, word processing Spreadsheets, , Multimedia systems, Application of computers .

5. AGRICULTURAL ENGINEERING

SECTION –A

1. Soil and Water Conservation : Scope of soil and water conservation. Mechanics and types of erosion, their causes. Rainfall, runoff and sedimentation relationships and their measurement. Soil erosion control measures - biological and engineering including stream bank protection-vegetative barriers, contour bunds, contour trenches, contour stone walls, contour ditches, terraces, outlets and grassed waterways. Gully control structures - temporary and permanent - design of permanent soil conservation structures such as chute, drop and drop inlet spillways. Design of farm ponds and percolation ponds. Principles of flood control-flood routing. Watershed Management - investigation, planning and implementation - selection of priority areas and water shed work plan, water harvesting and moisture conservation. Land development - levelling, estimation of earth volumes and costing. Wind Erosion process - design of shelter belts and wind brakes and their management. Forest (Conservation) Act,

2. Aerial Photography and Remote Sensing : Basic characteristics of photographic images, interpretation keys, equipment for interpretation, imagery interpretation for land use, geology, soil and forestry.

Remote sensing - merits and demerits of conventional and remote sensing approaches. Types of satellite images, fundamentals of satellite image interpretation, techniques of visual and digital interpretations for soil, water and land use management. Use of GIS in planning and development of watersheds, forests including forest cover, water resources etc.

3. Irrigation and Drainage : Sources of water for irrigation. Planning and design of minor irrigation projects. Techniques of measuring soil moisture - laboratory and in situ, Soil-water plant relationships. Water requirement of crops. Planning conjunctive use of surface and ground water. Measurement of irrigation water, measuring devices - orifices, weirs and flumes. Methods of irrigation - surface, sprinkler and drip, fertigation. Irrigation efficiencies and their estimation. Design and construction of canals, field channels, underground pipelines, head-gates, diversion boxes and structures for road crossing.

Occurrence of ground water, hydraulics of wells, types of wells (tube wells and open wells) and their construction. Well development and testing. Pumps-types, selection and installation. Rehabilitation of sick and failed wells.

Drainage causes of waterlogging and salt problem. Methods of drainage— drainage of irrigated and unirrigated lands, design of surface, sub-surface and vertical drainage systems. Improvement and utilization of poor quality water. Reclamation of saline and alkali soils. Economics of irrigation and drainage systems.

Use of waste water for irrigation — standards of waste water for sustained irrigation, feasibility and economics.

4. Agricultural Structures : Site selection, design and construction of farmstead - farm house, cattle shed, dairy bam, poultry shed, hog housing, machinery and implement shed, storage structures for food grains, feed and forage. Design and construction of fences and farm roads. Structures for plant environment - green houses, poly houses and shade houses. Common building materials used in construction - timber, brick, stone, tiles, concrete etc and their properties. Water supply, drainage and sanitation system.

SECTION – B

1. Farm Power and Machinery : Agricultural mechanization and its scope. Sources of farm power - animate and electro-mechanical. Thermodynamics, construction and working of internal combustion engines. Fuel, ignition, lubrication, cooling and governing system of IC engines. Different types of tractors and power tillers. Power transmission, ground drive, power take off (p.t.o.) and control systems. Operation and maintenance of farm machinery for primary and secondary tillage. Traction theory. Sowing transplanting and interculture implements and tools. Plant protection equipment - spraying and dusting. Harvesting, threshing and combining equipment. Machinery for earth moving and land development - methods and cost estimation. Ergonomics of man-machine system. Machinery for horticulture and agro-forestry, feeds and forages. Haulage of agricultural and forest produce.

2. Agro-energy : Energy requirements of agricultural operations and agro-processing. Selection, installation, safety and maintenance of electric motors for agricultural applications. Solar (thermal and photovoltic), wind and bio-gas energy and their utilization in agriculture. Gasification of biomass for running IC engines and for electric power generation. Energy efficient cooking stoves and alternate cooking fuels. Distribution of electricity for agricultural and agro-industrial applications.

3. Agricultural Process Engineering : Post harvest technology of crops and its scope. Engineering properties of agricultural produces and by-products. Unit operations - clearning grading, size reduction, densification, concentration, drying/dehydration, evaporation, filtration, freezing and packaging of agricultural produces and by-products. Material handling equipment - belt and screw conveyors, bucket elevators, their capacity and power requirement.

Processing of milk and dairy products - homogenization, cream separation, pasteurization, sterilization, spray and roller drying, butter making, ice cream, cheese and shrikhand manufacture. Waste and by-product utilization - rice husk, rice bran, sugarcane bagasse, plant residues and coir pith.

4. Instrumentation and computer applications in Agricultural Engineering : Electronic devices and their characteristics - rectifiers, amplifiers, oscillators, multivibrators. Digital circuits — sequential and combinational system. Application of microprocessors in data acquisition and control of agricultural engineering processes- measurement systems for level, flow, strain, force, torque, power, pressure, vaccum and temperature. Computers — introduction, input/output devices, central processing unit, memory devices, operating systems, processors, keyboards and printers. Algorithms, flowchart specification, programme translation and problem analysis in Agricultural Engineering. Multimedia and Audio-Visual aids.

6. CHEMICAL ENGINEERING

SECTION – A

(a) Fluid and Particle Dynamics -Viscosity of fluids. Laminar and turbulent flows. Equation of continuity and Navier-Stokes equition-Bernoulli's theorem. Flow meters. Fluid drag and pressure drop due to friction, Reynold's Number and friction factor - effect of pipe roughness. Economic pipe diameter. Pumps, water, air/steam jet ejectors, compressors, blowers and fans. Agitation and mixing of liquids. Mixing of solids and pastes. Crushing and Grinding - principles and equipment. Rittinger's and Bond's laws. Filtration and filtration equipment. Fluid-particle mechanics - free and hindered settling. Fluidisation and minimum fluidization velocity, concepts of compressible and incompressible flow. Transport of Solids.

(b) Mass Transfer --Molecular diffusion coefficients, First and second law and diffusion, mass transfer coefficients, film and penetration theories of mass transfer. Distillation, simple distillation, relative volatility, fractional distillation, plate and packed columns for distillation. Calculation of theoretical number of plates. Liquid-liquid equilibria. Extraction - theory and practice; Design of gas-absorption columns. Drying. Humidification, dehumidification. Crystallisation. Design of equipment.

(c) Heat Transfer --Conduction, thermal conductivity, extended surface heat transfer. Convection - free and forced. Heat transfer coefficients - Nusselt Number. LMTD and effectiveness. NTU methods for the design of Double Pipe and Shell & Tube Heat Exchangers. Analogy between heat and momentum transfer. Boiling and condensation heat transfer. Single and multiple-effect evaporators. Radiation - Stefan-Boltzman Law, emissivity and absorptivity. Calculation of heat load of a furnace. Solar heaters.

(d) Noval Separation Processes --Equilibrium separation processes - ion-exchange, osmosis, electro-dialysis, reverse osmosis, ultra-filtration and other membrane processes. Molecular distillation. super critical fluid extraction.

(e) Process Equipment Design --Fractors affecting vessel design criteria - Cost considerations. Design of storage vessels-vertical, horizontal spherical, underground tanks for atmospheric and higher pressure. Design of closures flat and eliptical head. Design of supports. Materials of construction-characteristics and selection.

(f) Process Dynamics and Control --Measuring instruments for process variables like level, pressure, flow, temperature pH and concentration with indication in visual/pneumatic/analog/digital signal forms. Control variable, manipulative variable and load variables. Linear control theory-Laplace, transforms. PID controllers. Block diagram representation transient and frequency response, stability of closed loop system. Advanced control strategies. Computer based process control.

SECTION – B

(a) Material and Energy Balances --Material and energy balance calculations in processes with recycle/bypass/purge. Combustion of solid/liquid/gaseous fuels, stoichiometric relationships and excess air requirements. Adiabatic flame temperature.

(b) Chemical Engineering Thermodynamics --Laws of thermodynamics. PVT relationships for pure components and mixtures. Energy functions and inter-relationships - Maxwell's relations. Fugacity, activity and chemical potential. Vapour-liquid equilibria, for ideal/non-ideal, single and multi component systems. criteria for chemical reaction equilibrium, equilibrium constant and equillibrium conversions. Thermodynamic cycles - refrigeration and power.

(c) Chemical Reaction Engineering : --Batch reactors - kinetics of homogeneous reactions and interpretation of kinetic data. Ideal flow reactors - CSTR, plug flow reactors and their performance equations. Temperature effects and run-away reactions. Heterogeneous reactions - catalytic and non-catalytic and gas-solid and gas-liquid reactions. Intrinsic kinetics and global rate concept. Importance of interphase and intraparticle mass transfer on performance. Effectiveness factor. Isothermal and non-isothermal reactors and reactor stability.

(d) Chemical Technology --Natural organic products - Wood and wood-based chemicals, pulp and paper, Agro industries - sugar, Edible oils extraction (including tree based seeds), Soaps and detergents. Essential oils - Biomass gasification (including biogas). Coal and coal chemical. Petroleum and Natural gas-Petroleum refining (Atomospheric distillation/cracking/reforming) - Petrochemical industries - Polyethylenes (LDPE/HDPE/LLDPE), Polyvinyl Chloride, Polystyrene. Ammonia manufacture. Cement and lime industries. Paints and varnishes. Glass and ceramics. Fermentation - alcohol and antibiotics.

(e) Environmental Engineering and Safety --Ecology and Environment. Sources of pollutants in air and water. Green house effect, ozone layer depletion, acid rain. Micrometeorology and dispersion of pollutants in environment. Measurement techniques of pollutant levels and their control strategies. Solid wastes, their hazards and their disposal techniques. Design and performance analysis of pollution control equipment. Fire and explosion hazards rating - HAZOP and HAZAN. Emergency planning, disaster management. Environmental legislations - water, air environment protection Acts. Forest (Conservation) Act.

(f) Process Engineering Economics : --Fixed and working capital requirement for a process industry and estimation methods. Cost estimation and comparison of alternatives. Net present value by discounted cash flow. Pay back analysis. IRR, Depreciation, taxes and insurance. Break-even point analysis. Project scheduling - PERT and CPM. Profit and loss account, balance sheet and financial statement. Plant location and plant layout including piping.

7. CIVIL ENGINEERING

SECTION – A

Engineering Mechanics, Strength of Materials and Structural Analysis.

Engineering Mechanics : Units and Dimensions, SI Units, Vectors, Concept of Force, Concept of particle and rigid body. Concurrent, Non Concurrent and parallel forces in a plane, moment of force and Varignon's theorem, free body diagram, conditions of equilibrium, Principle of virtual work, equivalent force system.

First and Second Moment of area, Mass moment of Inertia.

Static Friction, Inclined Plane and bearings.

Kinematics and Kinetics : Kinematics in Cartesian and Polar Co-ordinates, motion under uniform and nonuniform acceleration, motion under gravity. Kinetics of particle : Momentum and Energy principles, D'

Alembert's Principle, Collision of elastic bodies, rotation of rigid bodies, simple harmonic motion, Flywheel.

Strength of Materials : Simple Stress and Strain, Elastic constants, axially loaded compression members, Shear force and bending moment, theory of simple bending, Shear Stress distribution across cross sections, Beams of uniform strength, Leaf spring. Strain Energy in direct stress, bending & shear.

Deflection of beams : Mecaulay's method, Mohr's Moment area method, Conjugate beam method, unit load method. Torsion of Shafts, Transmission of power, close coiled helical springs, Elastic stability of columns, Euler's Rankine's and Secant formulae. Principal Stresses and Strains in two dimensions, Mohr's Circle, Theories of Elastic Failure, Thin and Thick cylinder : Stresses due to internal and external pressure–Lame's equations.

Structural Analysis : Castiglianio's theorems I and II, unit load method, method of consistent deformation applied to beams and pin jointed trusses. Slope-deflection, moment distribution, Kani's method of analysis and column Analogy method applied to indeterminate beams and rigid frames.

Rolling loads and Influences lines : Influences lines for Shear Force and Bending moment at a section of a beam. Criteria for maximum shear force and bending Moment in beams traversed by a system of moving loads. Influences lines for simply supported plane pin jointed trusses.

Arches : Three hinged, two hinged and fixed arches, rib shortening and temperature effects, influence lines in arches.

Matrix methods of analysis : Force method and displacement method of analysis of indeterminate beams and rigid frames.

Plastic Analysis of beams and frames : Theory of plastic bending, plastic analysis, statical method, Mechanism method.

Unsymmetrical bending : Moment of inertia, product of inertia, position of Neutral Axis and Principle axes, calculation of bending stresses.

Design of Structures : Steel, Concrete and Masonry Structures.

Structural Steel Design :

Structural Steel : Factors of safety and load factors. Rivetted, bolted and welded joints and connections. Design of tension and compression members, beams of built up section, rivetted and welded plate girders, gantry girders, stancheons with battens and lacings, slab and gussetted column bases.

Design of highway and railway bridges : Through and deck type plate girder, Warren girder, Pratt truss.

Design of Concrete and Masonry Structures : Concept of mix design. Reinforced Concrete : Working Stress and Limit State method of design–Recommendations of I.S. codes design of one way and two way slabs, stair-case slabs, simple and continuous beams of rectangular, T and L sections. Compression members under direct load with or without eccentricity, Isolated and combined footings.

Cantilever and Counterfort type retaining walls.

Water tanks : Design requirements for Rectangular and circular tanks resting on ground.

Prestressed concrete : Methods and systems of prestressing, anchorages, Analysis and design of sections for flexure based on working stress, loss of prestress.

Design of brick masonry as per I.S. Codes

Design of masonry retaining walls.

Fluid Mechanics, Open Channel Flow and Hydraulic Machines

Fluid Mechanics : Fluid properties and their role in fluid motion, fluid statics including forces acting on plane and curve surfaces.

Kinematics and Dynamics of Fluid flow : Velocity and accelerations, stream lines, equation of continuity, irrotational and rotational flow, velocity potential and stream functions, flownet, methods of drawing flownet, sources and sinks, flow separation, free and forced vortices.

Control volume equation, continuity, momentum, energy and moment of momentum equations from control volume equation, Navier-Stokes equation, Euler's equation of motion, application to fluid flow problems, pipe flow, plane, curved, stationary and moving vanes, sluice gates, weirs, orifice meters and Venturi meters.

Dimensional Analysis and Similitude : Buckingham's Pi-theorem, dimensionless parameters, similitude theory, model laws, undistorted and distorted models.

Laminar Flow : Laminar flow between parallel, stationary and moving plates, flow through tube.

Boundary layer : Laminar and turbulent boundary layer on a flat plate, laminar sublayer, smooth and rough boundaries, drag and lift.

Turbulent flow through pipes : Characteristics of turbulent flow, velocity distribution and variation of pipe friction factor, hydraulic grade line and total energy line, siphons, expansion and contractions in pipes, pipe networks, water hammer in pipes and surge tanks.

Open channel flow : Uniform and non-uniform flows, momentum and energy correction factors, specific energy and specific force, critical depth, resistance equations and variation of roughness coefficient, rapidly varied flow, flow in contractions, flow at sudden drop, hydraulic jump and its applications surges and waves, gradually varied flow, classification of surface profiles, control section, step method of integration of varied flow equation, moving surges and hydraulic bore.

Hydraulic Machines and Hydropower :

Centrifugal pumps–Types, characteristics, Net Positive Suction Height (NPSH), specific speed. Pumps in parallel.

Reciprocating pumps, Airvessels, Hydraulic ram, efficiency parameters, Rotary and positive displacement pumps, diaphragm and jet pumps.

Hydraulic turbines, types classification, Choice of turbines, performance parameters, controls, characteristics, specific speed.

Principles of hydropower development. Type, layouts and Component works. Surge tanks, types and choice. Flow duration curves and dependable flow. Storage an pondage. Pumped storage plants. Special features of mini, micro-hydel plants.

Geo Technical Engineering

Types of soil, phase relationships, consistency limits particles size distribution, classifications of soil, structure and clay mineralogy.

Capillary water and structural water, effective stress and pore water pressure, Darcy's Law, factors affecting permeability, determination of permeability, permeability of stratified soil deposits.

Seepage pressure, quick sand condition, compressibility and consolidation, Terzaghi's theory of one dimensional consolidation, consolidation test.

Compaction of soil, field control of compaction. Total stress and effective stress parameters, pore pressure coefficients.

Shear strength of soils, Mohr Coulomb failure theory, Shear tests.

Earth pressure at rest, active and passive pressures, Rankine's theory, Coulomb's wedge theory, earth pressure on retaining wall, sheetpile walls, Braced excavation.

Bearing capacity, Terzaghi and other important theories, net and gross bearing pressure.

Immediate and consolidation settlement.

Stability of slope, Total Stress and Effective Stress methods, Conventional methods of slices, stability number.

Subsurface exploration, methods of boring, sampling, penetration tests, pressure meter tests.

Essential features of foundation, types of foundation, design criteria, choice of type of foundation, stress distribution in soils, Boussinessq's theory, Newmarks's chart, pressure bulb, contact pressure, applicability of different bearing capacity theories, evaluation of bearing capacity from field tests, allowable bearing capacity, Settlement analysis, allowable settlement.

Proportioning of footing, isolated and combined footings, rafts, buoyancy rafts, Pile foundation, types of piles, pile capacity, static and dynamic analysis, design of pile groups, pile load test, settlement of piles, lateral capacity. Foundation for Bridges. Ground improvement techniques–preloading, sand drains, stone column, grouting, soil stabilisation.

SECTION – B

Construction Technology, Equipment, Planning and Management

1. Construction Technology :

Engineering Materiels : Physical properties of construction materials : Stones, Bricks and Tiles; Lime, Cement and Surkhi Mortars; Lime Concrete and Cement Concrete, Properties of freshly mixed and hardened concrete, Flooring Tiles, use of ferro-cement, fibre-reinforced and polymer concrete, high strength concrete and light weight concrete. Timber : Properties and uses; defects in timber; seasoning and preservation of timber. Plastics, rubber and damp-proofing materials, termite proofing, Materials, for Low cost housing.

Construction : Building components and their functions; Brick masonry : Bonds, jointing. Stone masonry. Design of Brick masonry walls as per I.S. codes, factors of safety, serviceability and strength requirements; plastering, pointing. Types of Floors & Roofs. Ventilators, Repairs in buildings.

Functional planning of building : Building orientation, circulation, grouping of areas, privacy concept and design of energy efficient building; provisions of National Building Code. Building estimates and specifications; Cost of works; valuation.

2. Construction Equipment : Standard and special types of equipment, Preventive maintenance and repair, factors affecting the selection of equipment, economical life, time and motion study, capital and maintenance cost. Concreting equipments ,Earth-work equipment

3. Construction Planning and Management : Construction activity, schedules, job layout, bar charts, organization of contracting firms, project control and supervision. Cost reduction measures.

Newwork analysis : CPM and PERT analysis, Float Times, cashing of activities, contraction of network for cost optimization, up dating, Cost analysis and resource allocation.

Survey and Transportation Engineering

Survey : Common methods of distance and angle measurements, plane table survey, levelling traverse survey, triangulation survey, corrections, and adjustments, contouring, topographical map. Surveying instruments for above purposes. Tacheometry. Circular and transition curves. Principles of photogrammetry.

Railways : Permanent way, sleepers, rail fastenings, ballast, points and crossings, design of turn outs, stations and yards, turntables, signals, and interlocking, level-crossing. Construction and maintenance of permanent ways : Superelevation, creep of rail, ruling gradient, track resistance, tractive effort, relaying of track.

Highway Engineering : Principles of highway planning, Highway alignments. Geometrical design : Cross section, camber, superelevation, horizontal and vertical curves. Classification of roads : low cost roads, flexible pavements, rigid pavements. Design of pavements and their construction, evaluation of pavement failure and strengthening. .

Traffic Engineering : Forecasting techniques, origin and destination survey, highway capacity. Channelised and unchannelised intersections, rotary design elements, markings, sign, signals, street lighting; Traffic surveys. Principle of highway financing.

Hydrology, Water Resources and Engineering :

Hydrology : Hydrological cycle, precipitation, evaporation, transpiration, depression storage, infiltration, overland flow, hydrograph, flood frequency analysis, flood estimation, flood routing through a reservoir, channel flow routing-Muskingam method.

Ground water flow : Specific yield, storage coefficient, coefficient of permeability, confined and unconfined aquifers, aquitards, radial flow into a well under confined and unconfined conditions, tube wells, pumping and recuperation tests, ground water potential.

Water Resources Engineering : Ground and surface water resource, single and multipurpose projects, storage capacity of reservoirs, reservoir losses, reservoir sedimentation, economics of water resources projects.

Irrigation Engineering : Water requirements of crops : consumptive use, quality of water for irrigation, duty and delta, irrigation methods and their efficiencies.

Canals : Distribution systems for canal irrigation, canal capacity, canal losses, alignment of main and distributory canals, most efficient section, lined canals, their design, regime theory, critical shear stress, bed load, local and suspended load transport, cost analysis of lined and unlined canals, drainage behind lining.

Water logging : causes and control, drainage system design, salinity.

Canal structures : Design of cross regulators, head regulators, canal falls, aqueducts, metering flumes and canal outlets.

Diversion head work : Principles and design of weirs of permeable and impermeable foundation, Khosla's theory, energy dissipation, stilling basin, sediment excluders.

Storage works : Types of dams, design, principles of rigid gravity and earth dams, stability analysis, foundation treatment, joints and galleries, control of seepage.

Spillways : Spillway types, crest gates, energy dissipation.

River training : Objectives of river training, methods of river training.

Environmental Engineering

Water Supply : Estimation of surface and subsurface water resources, predicting demand for water, impurities, of water and their significance, physical, chemical and bacteriological analysis, waterborne diseases, standards for potable water.

Intake of water : pumping and gravity schemes. Water treatment : principles of coagulation, flocculation and sedimentation; slow-; rapid-, pressure-, filters; chlorination, softening, removal of taste, odour and salinity.

Water storage and distribution : storage and balancing reservoirs : types, location and capacity. Distribution system : layout, hydraulics of pipe lines, pipe fittings, valves including check and pressure reducing valves, meters, analysis of distribution systems, leak detection, maintenance of distribution systems, pumping stations and their operations.

Sewage systems : Domestic and industrial wastes, storm sewage–separate and combined systems, flow through sewers, design of sewers, sewer appurtenances, manholes, inlets, junctions, siphon. Plumbing in public buildings.

Sewage characterisation : BOD, COD, solids, dissolved oxygen, nitrogen and TOC. Standards of disposal in normal water course and on land.

Sewage treatment : Working principles, units, chambers, sedimentation tanks, trickling filters, oxidation ponds, activated sludge process, septic tank, disposal of sludge, recycling of waste water.

Environmental pollution : Sustainable development. Radioactive wastes and disposal. Environmental impact assessment for thermal power plants, mines, river valley projects. Air pollution. Pollution control acts.

8. Computer Engineering

SECTION – A

1. Software Engineering

   Software development process: Software life cycle models, specification design tools, software design objectives, documentation, configuration management, S/W reliability, safety, risk assessment and maintenance.

   Software estimation techniques, loc and FP estimation. Empirical models like COCOMO. Project tracking and scheduling. Reverse engineering.

   Software requirements and specifications, requirement analysis models.

   Software design and implementation (OOD,JSD), implementation strategies (top-down, bottom-up, team) and issues, reuse, performance improvement, debugging and antibugging.

   Verification, validation, testing and maintenance: Verification and validation techniques (pre/post - conditions, invariant, proof of correctness), code and design reading, structured walk through, testing (test plan, white/black box testing, unit and integration testing, regression testing, test case design and acceptance testing) and maintenance activities.

   Code sharing, software components, rapid prototyping, specialization, construction, class extensions, intelligent software agents.

   Introduction to CASE tools.

   Social, legal and ethical implications of computing.

2. Advanced computer architecture

   Introduction to parallel processing, Pipelined and vector processors, SIMD and MIMD computers, Multi processor architecture, Data driven coupling, data flow computer architecture.Parallel algorithms, detection of parallelism, local balancing, communication and synchronization, features of typical ,parallel languages, monitors and operating systems.

   Introduction to hybrid computers.

   Compiler Construction

   Lexical analysis: Some sophisticated pattern matching algorithms and their optimization, use of LEX.

   Error recovery: Detection, reporting, recovery and repair of errors in the compilation process.

   Syntax analysis: Canonical LR prasers, handling of ambiguous grammars, error reporting in LL (1), operator precedence and LR parsing, efficient generation of LALR (1) sets, optimization of LR parsers, optimization of transformations.

   Run time storage: Activation records, handling recursive calls, management of variable length blocks, garbage collection and
   compaction, allocation strategies for arrays, structures, class.

   Type checking: Overloading of functions and operators, polymorphic functions, unification algorithm.

   Code generation and semantic analysis: Semantic stacks, attributed translation, analysis of syntax, directed translation,
   evaluation of expressions, control structures, procedure calls.

   Code optimization: Basic blocks and folding, optimization within iterative loops, global optimization through flow graph analysis, code-improving transformations, machine dependent optimization.

Compiler-Compilers: Parser generators, YACC attributed LL (1) parser generator, machine independent code generation.
Other topics: Compilers for parallel machines, compilers for functional languages.

3. Data communication

Elements Of Communication Systems: Communication channel and their characteristics.
Elements of Signals: Classification of systems, LTI systems and reconstruction method, Review of probability and random variables, probability density function, description of random processes in the frequency domain, Gaussian and White processes.
Modeling of Information sources: Measure of information, source coding techniques like Huffman code, Lempel – Ziv Code, Block Code & Cyclic codes, Quantisation, Pulse Code, DPCM, Multiplexers and multiplexing PCM signals, Delta Modulation and
adaptive delta modulation, Frequency division multiplexing, synchronous TDM and statistical TDM.
Modulation: its need, basic PAM techniques, Binary PSK, DPSK, QPSK< frequency shift keying, M-ary FSK.
Broadband Signal Receiver: Probability of error, filtering, correlation type demodulator, matched filter demodulator, coherent detector, correlation, errors in binary & M-ary modulation, PAM with ISI.
Noise calculations in digital communication systems.,Introduction to equalizations,
Introduction to data compression techniques. ,Relay and Cell relay techniques.

4. Digital signal Processing

Discrete Time Signals and Systems: Discrete time signal sequences, Linear Shift Invariant system, Stability, Linear Constant
Coefficient difference equations, Frequency domain representation of discrete time systems and signals, symmetry properties of Fourier Transform, Sampling of continuous time signal, Two dimensional sequences and system.
Z Transform: Z-transform, Inverse z transform theorem and properties, System functions, Two-dimensional transforms.
The Discrete Fourier Transform: Representation of periodic sequences, The Discrete Fourier Series, Properties of the discrete Fourier series, Sampling the z-transform, Fourier representation of finite deviation sequences, the discrete fourier transform, properties of the DFT, Linear convolution using the DFT, two dimensional DFT.
Flow Graph and Matrix Representation of Digital Filters: Signal flow graph representation of digital networks, Matrix
representation of digital networks, Basic network structures for IIR, Transposed forms, Basic network structures for FIR systems,
Parameter Quantization effects, Tellegen's theorem for digital filters and its applications.
Digital Filter Design Techniques: Design of IIR digital filters from analog filters, Properties of FIR digital filters, Design of FIR
filters using windows, Comparison of IIR and FIR filters.
Computation of The Discrete Fourier Transform: Goertzel's Algorithm, Decimation in time algorithms, Decimation in frequency algorithms, FFT algorithms for a N composite number, General computational considerations in FFT algorithms, Chirps Z transform algorithm.
Discrete Hilbert Transform: Real and Imaginary part sufficiency for causal sequences, Minimum phase condition, Hilbert Transform relation for the DFT and the complex sequences.

5. Operating Systems

Introduction to history of operating systems : Processes and Interprocess communication:,Memory management ,File systems.
Deadlocks : Conditions, modeling, detection and recovery, deadlock avoidance, deadlock presentation.

Case studies : Unix : Implementation of processes, memory model, file systems, deadlock handling, Strategies, scheduling, IPC, system calls.
WINDOWS 2000 Server Technology: Layered structure, interopretability.
Distributed Systems : Introduction to H/W and S/W concepts in distributed systems, network operating systems and NFS, NFS, architecture and protocol, client-server model, distributed file systems,

6. Database Management System

Basic Concepts, Database system architecture.
Entity Relationship Model ,Relational Model.
Crash Recovery: Failure verification, storage hierarchy, transaction model, log-based recovery, buffer management, and checkpoints.
Concurrency Control: Schedules, serializability, log based protocols.
Transaction Recovery: Storage model, recovery from transaction failure, deadlock handling.
Security & Integrity: Security & integrity violation, authorization & views, security systems in SQL, encryption.
Heiracheal Model: Architecture, data structure, external level, data manipulation, internal level, and logical databases.
Network Model: Architecture, data structure, external level, and data manipulation.
Selection of DBMS, Introduction to OODB, distributed DB, temporal DB, and active DB**.**

7. Computer organization

General organization of a digital computer, functional blocks, data representation, fixed and floating point decimal arithmetic, bit slice microprocessor (introduction), full adders, ripple carry adders, look ahead carry generators, multiplication and division circuits, an arithmetic unit.
Instruction cycle, instruction sequencing, formats and its interpretation, microprogram concepts and control unit design.
Semiconductor memory and memory organization, virtual memory, segments, pages, paged segments, cache memory and interleaved memory.
Concepts of I/O organization, data transfer methods, programmed I/O, DMA, interrupt-based transfer, I/O channels, I/O processors, serial transmission and synchronization.
Introduction to assembly level programming - concepts of assemblers, macros, linkers, and loaders, linking loaders.
Multiprogramming and time-sharing, introduction to advanced computer architecture (pipelining, array processors & multiprocessors).
Introduction to operating systems. Case study (comparative) of DOS & UNIX.

SECTION – B

1. Computer Networks & Communication*: OSI and DOD model* Seven layers model, LAN, MAN ,WAN,Routing,Switching, ISDN,X.25, Frame Realy
2. Object oriented programming methodology

Introduction to object oriented programming, it's need and requirements, general object oriented philosophy, software usability, code sharing, rapid prototyping, information hiding.
Classes, attributes and methods, encapsulation, constructor, destuctors, iterator classes, class interface.
Function overloading, inline, functions, operators & operator overloading, iterators.
Inheritance base class, derived classes, friend class, static class, type checking, class scopes.
Multiple inheritance & polymorphism, abstract classes, virtual function, virtual base class, static & dynamic binding,
overloading, overriding type conversions.

Object oriented design, class identification, defining inheritance, visibility & dependency coupling & cohesion.
Case study of classes like ADT class, I/O class, string class, editor class.
Language study: C++, object Pascal.

3. Discrete Structure

Introduction to sets: Review only.
Logic : Propositions and logical operations, Truth tables, Equivalence and implication, Laws of logic, Mathematical induction and quantifiers.
Set theory : Method of proof for set, Venn diagram, set membership tables, definitions, Laws of set theory, Partition of sets.
Permutations, combinations and discrete probability :
Introduction to permutations and combinations, Generation of permutation and combination, Discrete probability, Conditional probability.
Relations and Diagraphs :
Relations and diagraphs., Paths and the relations and diagraphs, Properties of relations, Equivalence relations, Computer representation of relations and diagraphs, Manipulation of relations, Transitive closure, Warshall's algorithm.
Function and pigeon hole principle :
Definition, Types of functions: injective, surjective, bijective, Composition, identity and inverse, Pigeon hole principle.
Graphs , Posets, Hasse Diagram, Lattices,Finite Boolean Algebra, Groups & their Applications, Introduction to Rings & Fields.

4. Computer Graphics

Introduction: Application areas, display devices and hard copy devices, interactive input devices, display processors, co-ordinate systems, vector generation.
Raster Algorithms: Line drawing algorithms -- DDA and Bresenham's algorithm, and aliasing techniques, circle generation algorithm, ellipses and other curves generation, style primitives and display processor interface, area filling-scan line algo, boundary fill and flood fill techniques, text generation and display processor interface.
Geometric transformations in 2D : basic transformations, world, NDC, device and homogeneous co-ordinate systems, composite transformations.
Windowing and clipping: Windowing concepts, window view part transformation algorithms, line clipping algorithms like Cohen-Sutherland and Liang and Barsky, area chipping methods like Sutherland and Holgman.
Segmentation: Segments, segment files, segmented display processor, segment attributes.
Graphics hardware: Display controller, use of DAC and buffer organization.
Introduction to 3-D: 3D co-ordinate system, 3D display techniques, and 3D transformations.
Three-dimensional representations: Modeling polygon and curved surfaces, sweep representations, CSG and B- rep techniques.
3D viewing: Projection methods, viewing transformations, chipping in 3D.
Image synthesis: Hidden line and hidden surface removed techniques like back-face depth buffer method, scan line method, arc subdivision method, ochre methods.
Light and shading: Illumination theory, reflections, textures and surface patterns, shadows, half toning surface shading methods, Gounand shading, Phang shading, Ray tracing.
User interfaces: Interactive input techniques, physical device classification, interactive picture contraction techniques, positioning methods, constraints, grids and field input functions, event handle, design of user interface command language, mean design, output formats.

5. Principles of Communication Engineering

Signals and their representations: Fourier series, Fourier transform, continuous spectra, frequency selective networks and transformers.

Basic Information Theory: Information , entropy of discrete systems, rate of transmission, redundancy, efficiency and channel capacity.

Amplitude Modulation: Frequency spectrum, power relations, basic requirements and description of various modulators, comparison. DSB, DSBSC, SSB,VSB, spectrum modulators and detectors.

Frequency Modulation: Frequency spectrum of FM, phase modulation, effect of noise, generation of FM and demodulators.

Pulse Modulation: Sampling theorem, low pass and band pass signals, elements of PAM, PWM, PPM, PCM and Delta, Modulation. FDM,TDM.A.M. and FM radio transmitters and receivers. Characteristics, block diagrams.

6. Logic Circuits

Number systems and codes: Binary, Octal and Hexadecimal number systems. Conversion from any base to another base number system. Binary, BCD, Excess-3, Alphanumeric, EBCDIC, Hollerith, ASCII codes, code conversion, error detecting and correcting codes, parity and Hamming codes.

Binary Arithmetic: Basic rules for addition and multiplication. Sign magnitude notation, One's complement notation. Two's complement notation. Addition and multiplication using binary, octal and hexadecimal number systems.

Boolean Algebra and Logic Gates: Boolean algebra theorems, reduction of logic expressions using boolean algebra, truth tables,minterms, maxterms, SOP and POS forms. Standard SOP and POS forms. Basic and universal logic gates, control aspect of gates, enabling and disabling of gates. K map representation of logical functions, simplification of logic functions using K-maps upto 6 variables. Quine McCluskey method and Veitch diagrams used for logic function reduction.

Combinational Logic Circuits: Concepts of combinational and sequential logic circuits. Realisation of following circuits using gates.:

(a) Systems implementing combinational logic.

(b) Arithmetic circuits, half and full adders, subtractors, multipliers, code converters, parity generators, parity checkers, comparators.

(c) Multiplexers, demultiplexers, encoder, decoder.,(d) Concept of mode control

(e) Application of MSI devices for multiplexer, demultiplexer/decoder, parity generator/checker, concept of capacity, expansion using gates. Use of MSI devices for adders, Sequential adder, BCD adder / subtractor, carry look ahead adder,multiplier, fast multipliers, Arithmetic Logic Unit

Sequential Circuits: Concept of Synchronous and Asynchronous operation, Flip Flops :

triggering and edge triggering , flip flop excitation tables, triggering and timing of flip flops.

(b) Registers: (c) Analysis of clocked sequential circuits,(d) Asynchronous counters: up-down counters, modulo N counter, glitch problem.,(e) Synchronous counters: Use of K- maps for synchronous counters, ring counters, twisted ring counters, counters using

shift registers, sequence generators using flip flops.

7. C Programming Features of C, ANSI C, structure of a C program.

Control structures and looping, Functions, Function Scope

Arrays, Pointers, Structures and Unions.

Memory Management and **File Management :** Low level and high level file access. Sequential and random access files, error handling.

Pre processor : macro substitution, header file inclusion, study of standard libraries

8. Computer methodology and algorithms

SORTING ,Searching

Stacks and Queues and Linked Lists, Trees :
Graph : Representation, Transitive Closure or path matrix, Graph Traversal, Shortest path problem, minimal cost spanning tree, Backtracking and greedy algorithms.
Matrix Operations: Strassen's Matrix Multiplication, LU decomposition matrix, Sparse matrices.
Algorithms and its Efficiency
Hash functions, collision handling techniques, array representation, evaluation of expression in Postfix form, Infix to Postfix conversion.

9. ELECTRICAL ENGINEERING

SECTION – A

Circuit Theory: Circuit components; network graphs; KCL, KVL; circuit analysis methods: nodal analysis, mesh analysis; basic network theorems and applications; transient analysis: RL, RC and RLC circuits; sinusoidal steady state analysis; resonant circuits; coupled circuits; balanced 3-phase circuits; Two-port networks.

Signals & Systems: Representation of continuous–time and discrete-time signals & systems; LTI systems; convolution; impulse response; time-domain analysis of LTI systems based on convolution and differential/difference equations. Fourier transform, Laplace transform, Z-transform, Transfer function. Sampling and recovery of signals DFT, FFT Processing of analog signals through discrete-time systems.

E.M. Theory: Maxwell's equations, wave propagation in bounded media. Boundary conditions, reflection and refraction of plane waves. Transmission line: travelling and standing waves, impedance matching, Smith chart.

Analog Electronics: Characteristics and equivalent circuits (large and small-signal) of Diode, BJT, JFET and MOSFET. Diode circuits: clipping, clamping, rectifier. Biasing and bias stability. FET amplifiers. Current mirror; Amplifiers: single and multi-stage, differential, operational, feedback and power. Analysis of amplifiers; frequency-response of amplifiers. OPAMP circuits. Filters; sinusoidal oscillators: criterion for oscillation; single-transistor and OPAMP configurations. Function generators and wave-shaping circuits. Linear and switching power supplies.

Digital Electronics: Boolean algebra; minimization of Boolean functions; logic gates; digital IC families (DTL, TTL, ECL, MOS, CMOS). Combinational circuits: arithmetic circuits, code converters, multiplexers and decoders. Sequential circuits: latches and flip-flops, counters and shift-registers. Comparators, timers, multivibrators. Sample and hold circuits, ADCs and DACs. Semiconductor memories. Logic implementation using programmable devices (ROM, PLA, FPGA).

Energy Conversion: Principles of electromechanical energy conversion: Torque and emf in rotating machines. DC machines: characteristics and performance analysis; starting and speed control of motors; Transformers: principles of operation and analysis; regulation, efficiency; 3-phase transformers. 3-phase induction machines and synchronous machines: characteristics and performance analysis; speed control.

Power Electronics and Electric Drives: Semiconductor power devices: diode, transistor, thyristor, triac, GTO and MOSFET–static characteristics and principles of operation; triggering circuits; phase control rectifiers; bridge converters: fully-controlled and half-controlled; principles of thyristor choppers and inverters; DC-DC converters; Switch mode inverter; basic concepts of speed control of dc and ac motor drives applications of variable-speed drives.

Analog Communication: Random variables: continuous, discrete; probability, probability functions. Statistical averages; probability models; Random signals and noise: white noise, noise equivalent bandwidth; signal transmission with noise; signal to noise ratio. Linear CW modulation: Amplitude modulation: DSB, DSB-SC and SSB. Modulators and Demodulators; Phase and Frequency modulation: PM & FM signals; narrowband FM; generation & detection of FM and PM, Deemphasis, Preemphasis. CW modulation system: Superhetrodyne receivers, AM receivers, communication receivers, FM receivers, phase locked loop, SSB receiver Signal to noise ratio calculation for AM and FM receivers.

SECTION – B

Control Systems: Elements of control systems; block-diagram representation; open-loop & closed-loop systems; principles and applications of feed-back. Control system components. LTI systems: time-domain and transform-domain analysis. Stability: Routh Hurwitz criterion, root-loci, Bode-plots and polar plots, Nyquist's criterion; Design of lead-lad compensators. Proportional, PI, PID controllers. State-variable representation and analysis of control systems.

Microprocessors and Microcomputers: PC organisation; CPU, instruction set, register set, timing diagram, programming, interrupts, memory interfacing, I/O interfacing, programmable peripheral devices.

Measurement and Instrumentation: Error analysis; measurement of current, voltage, power, energy, power-factor, resistance, inductance, capacitance and frequency; bridge measurement. Signal conditioning circuit; Electronic measuring instruments: multimeter, CRO, digital voltmeter, frequency counter, Q-meter, spectrum-analyzer, distortion-meter. Transducers: thermocouple, thermistor, LVDT, strain-gauge, piezo-electric crystal.

Power Systems: Analysis and Control: Steady-state performance of overhead transmission lines and cables; principles of active and reactive power transfer and distribution; per-unit quantities; bus admittance and impedance matrices; load flow; voltage control and power factor correction; economic operation; symmetrical components, analysis of symmetrical and unsymmetrical faults. Concept of system stability: swing curves and equal area criterion. Static VAR system. Basic concepts of HVDC transmission.

Power System Protection: Principles of overcurrent, differential and distance protection. Concept of solid state relays. Circuit breakers. Computer aided protection: Introduction; line bus, generator, transformer protection; numeric relays and application of DSP to protection.

Digital Communication: Pulse code modulation (PCM), differential pulse code modulation (DPCM), delta modulation (DM), Digital modulation and demodulation schemes: amplitude, phase and frequency keying schemes (ASK, PSK, FSK). Error control coding: error detection and correction, linear block codes, convolution codes. Information measure and source coding. Data networks, 7-layer architecture.

10. ELECTRONICS ENGINEERING

SECTION – A

Materials and Components : Structure and properties of Electrical Engineering materials; Conductors, Semiconductors and Insulators, magnetic, Ferroelectric, Piezoelectric, Ceramic, Optical and Super-conducting materials. Passive components and characteristics Resistors, Capacitors and Inductors; Ferrites, Quartz crystal Ceramic resonators, Electromagnetic and Electromechanical components.

Physical Electronics, Electron Devices and ICs: Electrons and holes in semiconductors, Carrier Statistics, Mechanism of current flow in a semiconductor, Hall effect; Junction theory; Different types of diodes and their characteristics; Bipolar Junction transistor; Field effect transistors; Power switching devices like SCRs,

GTOs, power MOSFETS; Basics of ICs - bipolar, MOS and CMOS types; basic of Opto Electronics.

Signals and Systems Classification of signals and systems: System modelling in terms of differential and difference equations; State variable representation; Fourier series; Fourier transforms and their application to system analysis; Laplace transforms and their application to system analysis; Convolution and superposition integrals and their applications; Z-transforms and their applications to the analysis and characterisation of discrete time systems; Random signals and probability, Correlation functions; Spectral density; Response of linear system to random inputs.

Network theory Network analysis techniques; Network theorems, transient response, steady state sinusoidal response; Network graphs and their applications in network analysis; Tellegen's theorem. Two port networks; Z, Y, h and transmission parameters. Combination of two ports, analysis of common two ports. Network functions : parts of network functions, obtaining a network function from a given part. Transmission criteria : delay and rise time, Elmore's and other definitions effect of cascading. Elements of network synthesis.

Electromagnetic Theory -Analysis of electrostatic and magnetostatic fields; Laplace's and Poisson's equations; Boundary value problems and their solutions; Maxwell's equations; application to wave propagation in bounded and unbounded media; Transmission lines : basic theory, standing waves, matching applications, microstrip lines; Basics of wave guides and resonators; Elements of antenna theory.

Electronic Measurements and instrumentation -Basic concepts, standards and error analysis; Measurements of basic electrical quantities and parameters; Electronic measuring instruments and their principles of working : analog and digital, comparison, characteristics, application. Transducers; Electronic measurements of non electrical quantities like temperature, pressure, humidity etc; basics of telemetry for industrial use.

SECTION – B

Analog Electronic Circuits : Transistor biasing and stabilization. Small signal analysis. Power amplifiers. Frequency response. Wide banding techniques. Feedback amplifiers. Tuned amplifiers. Oscillators. Rectifiers and power supplies. Op Amp, PLL, other linear integrated circuits and applications. Pulse shaping circuits and waveform generators.

Digital Electronic Circuits : Transistor as a switching element; Boolean algebra, simplification of Boolean functions, Karnaguh map and applications; IC Logic gates and their characteristics; IC logic families : DTL, TTL, ECL, NMOS, PMOS and CMOS gates and their comparison; Combinational logic Circuits; Half adder, Full adder; Digital comparator; Multiplexer Demulti-plexer; ROM an their applications. Flip flops. R-S, J-K, D and T flip-flops; Different types of counters and registers Waveform generators. A/D and D/A converters. Semiconductor memories.

Control Systems : Transient and steady state response of control systems; Effect of feedback on stability and sensitivity; Root locus techniques; Frequency response analysis. Concepts of gain and phase margins: Constant-M and Constant-N Nichol's Chart; Approximation of transient response from Constant-N Nichol's Chart; Approximation of transient response from closed loop frequency response; Design of Control Systems, Compensators; Industrial controllers.

Communication Systems:

Basic information theory; Modulation and detection in analogue and digital systems; Sampling and data reconstructions; Quantization & coding; Time division and frequency division multiplexing; Equalization; Optical Communication : in free space & fiber optic; Propagation of signals at HF, VHF, UHF and microwave frequency; Satellite Communication.

Microwave Engineering : Microwave Tubes and solid state devices, Microwave generation and amplifiers, Waveguides and other Microwave Components and Circuits, Microstrip circuits, Microwave Antennas, Microwave Measurements, Masers, lasers; Microwave propagation. Microwave Communication Systems terrestrial and Satellite based.

Computer Engineering : Number Systems. Data representation; Programming; Elements of a high level programming language PASCAL/C; Use of basic data structures; Fundamentals of computer architecture;

Processor design; Control unit design; Memory organisation, I/o System Organisation. Microprocessors : Architecture and instruction set of Microprocessors 8085 and 8086, Assembly language Programming. Microprocessor Based system design : typical examples. Personal computers and their typical uses.

11. Mechanical Engineering

SECTION – A

1. Theory of Machines --Kinematic and dynamic analysis of planar mechanisms. Cams, Gears and gear trains, Flywheels, Governors, Balancing of rigid rotors, Balancing of single and multicylinder engines, Linear vibration analysis of mechanical systems (single degree and two degrees of freedom), Critical speeds and whirling of shafts, Automatic Controls, Belts and chain drives. Hydrodynamic bearings.

2. Mechanics of Solids : Stress and strain in two dimensions. Principal stresses and strains, Mohr's construction, linear elastic materials, isotropy and an isotropy, Stress-strain relations, unlaxial loading, thermal stresses. Beams : Banding moment and shear force diagrams, bending stresses and deflection of beams, Shear stress distribution. Torsion of shafts, helical springs. Combined stresses, Thick and thin walled pressure vessels. Struls and columns, Strain energy concepts and theories of failure. Rotation discs. Shrink fits.

3. Engineering Materials : Basic concepts on structure of solids, Crystalline materials, Defects in crystalline materials, Alloys and binary phase diagrams, structure and properties of common engineering materials. Heat treatment of steels. Plastics, Ceramics and composite Materials, common applications of various materials.

4. Manufacturing Science : Marchant's force analysis, Taylor's tool life equation, machinability and machining economics, Rigid, small and flexible automation, NC, CNC. Recent machining methods- EDM, ECM and ultrasonics. Application of lasers and plasmas, analysis of forming processes. High energy rate forming. Jigs, fixtures, tools and gauges, Inspection of length, position, profile and surface finish.

5. Manufacturing management : Production Planning and Control, Forecasting-Moving average, exponential smoothing, Operations scheduling; assembly line balancing. Product development. Breakeven analysis, Capacity planning. PERT and CPM.

Control Operations : Inventory control-ABC analysis. EOQ model. Materials requirement planning. Job design, Job standards, work measurement, Quality management-Quality control. Operations Research : Linear programming-Graphical and Simplex methods. Transportation and assignment models.

Value Engineering : Value analysis, for cost/value. Total quality management and forecasting techniques. Project management.

6. Elements Of Computation : Computer Organisation, Flow charting. Features of Common Computer Languages-FORTRAN d Base III, Lotus 1-2-3 C and elementary programming.

SECTION – B

1. Thermodynamics : Basic concept. Open and closed systems, Applications of Thermodynamic Laws, Gas equations, Clapeyron equation, Availability, Irreversibility and Tds relations.

2. I.C. Engines, Fuels and Combustion : Spark Ignition and compression ignition engines, Four stroke engine and Two stroke engines, mechanical, thermal and volumetric efficiency, Heat balance.

Combustion process in S.I. and C.I. engines, preignition detonation in S.I. engine Diesel knock in C.I. engine. Choice of engine fuels, Octance and Cetane retings. Alternate fuels Carburration and Fuel injection, Engine emissions and control. Solid, liquid and gaseous fuels, stoichometric air requirements and excess air factor, fuel gas analysis, higher and lower calorific values and their measurements.

3. Heat Transfer, Refrigeration And Air Conditioning : One and two dimensional heat conduction. Heat transfer from extended surfaces, heat transfer by forced and free convection. Heat exchangers. Fundamentals for diffusive and connective mass transfer, Radiation laws, heat exchange between black and non balck surfaces, Network Analysis. Heat pump refrigeration cycles and systems, Condensers, evaporators and expansion devices and controls. Properties and choice of refrigerant, Refrigeration Systems and components, psychometrics, comfort indices, cooling loading calculations, solar refrigeration.

4. Turbo-Machines And Power Plants : Continuity, momentum and Energy Equations. Adiabatic and Isentropic flow, fanno lines, Raylegh lines. Theory and design of axial flow turbines and compressors, Flow through turbo-machine blade, cascades, centrifugal compressor. Dimensional analysis and modelling. Selection of site for steam, hydro, nuclear and stand-by power plants, selection base and peak load power plants Modern High pressure, High duty boilers, Draft and dust removal equipment, Fuel and cooling water systems, heat balance, station and plant heat rates, operation and maintenance of various power plants, preventive maintenance, economics of power generation.

12. ENVIRONMENTAL SCIENCE

SECTION – A

Life Sciences (Basic Biology and Natural Resources)

Introduction to biology, branches, scope and importance from environmental point of view. What is life? The evolution of life on earth: Origin of life - Microbes, Plants andAnimals, fossils and sediments, distribution and pattern of life in past, Paleontological evidences, Mass extinction,Life forms on Earth (all forms of plants and animals), Life in Water,Life on Land, Microbial life in air, water and soils, microbes and diseases, decomposing soil microbes, marine biology

Taxonomic principles: History, aims, objectives, hierarchy and kingdoms, identification and nomenclature.Classification of plants and animals based on form-relationship, species concept, organization of living things, microbial classification, Ecological Classification Systems, Collection and Herbarium, Preservation, flora, fauna, preservation of insects

Ecological adaptation under various environmental conditions,Hydrophytes, Xerophytes, Halophytes, Mesophytes, Epiphytes.Distribution of life on earth and factors responsible for present day distribution. Continental drift,

Introduction, scope and importance of natural resources, biotic and abiotic resources Renewable resources: Forest and wildlife resources, forest wealth of India, animal resources, livestock and fisheries, Food Resources: World food problems, agricultural resources, agricultural potential of India, effects of modern agriculture

Non-renewable resources: Fossil fuels – coal, oil and natural gas, Consequences of rapid consumption of fossil fuels.

Fresh and marine Water resources: global distribution of freshwater and its limits, The sources of fresh water for terrestrial life, fresh water resources of India
Soil and Mineral resources: global status, mineral resources of India, metals and minerals.
Energy resources: Global energy consumption, energy needs, conventional and non-conventional energy sources, alternative energy sources, energy resources of India

SECTION – B

Earth Sciences (Environmental Chemistry and Basic Geosciences)

Chemistry of atmosphere, Chemical reactions involved in atmosphere, chemistry in ozone depletion, chemical reactions of global warming, Chemistry of water, unusual physical properties, changes in water properties by addition of solute, hydrogen bonding, gases present in water, basic reversible and irreversible reactions in water, sources of cations and anions in water, changes in water properties by addition of solute. Stichiometry, Gibb's energy, chemical potential, chemical equilibria, acid-base reactions, solubility product, carbonate system. Chemistry of carcinogenic compounds and their effects on human body Surfactants, Pesticides, Hydrocarbons Atmosphere: Evolution, structure and chemical composition of atmosphere.
Temperature measurement and controls, Environmental lapse rate, dry and wet adiabatic lapse rate, inversion of temperature and atmospheric stability.
Atmospheric pressure and winds, factors affecting on wind, Forms of condensation, precipitation, hydrological cycle.
Internal structure of earth, Geological evolution, plate tectonic, formation of lithosphere. Continental and oceanic crust formation. , Types of rocks, Rock cycle, basic minerals of rock, clay minerals, mineral chemistry, Soil and its formation, weathering processes, soil profiles, physical and chemical properties of soil, composition of soil. Macro and micro plant nutrients in soil, Soil classification, Soils of India.

13. FORESTRY

SECTION – A

General Silviculture

Biotic and abiotic components of forest ecology. Forest community concepts, Nutrient cycling and water relations, Ecological succession and climax. Composition of forest types in India, species identification, composition and association, principles of establishment of herbs and trees. General principles of Silviculture, local factors influencing vegetation. Natural and artificial regeneration of forests, propagation techniques, forest nursery technique – nursery beds, poly bags and their maintenance, grading and hardening of seedlings, establishment and tending, felling climber, cutting.

Silviculture systems and forest Silviculture

Clear felling, shelter, wood selection, coppice and conversion systems. Choice of species, establishment and management of standards enrichment methods, technical constraints, intensive mechanized methods. Traditional and recent advancement in dry tropical forest, forest Silviculture research. Silviculture of some of the economically important species in India such as Acacia nilotica, Auriculiformis, Albizzia, lebbeck, Anogeissus latifolia, Azadira chat indica, Bambocaceae, Dandrocalamus strictus, Bombex ava casurina, Ecucitifolia, Dalbergia, Lautifolia, Emblica Officindils, Eucalyptus hybrid, Malaina arboria, Hardwickia binta, Largerstroemia, Lanceolata, Pterocarpus marsupium, Prosopis julifora, Santalum album, Tectona grandis, Terminabis tomentosa Terminalis arjuna, Terminalis paneculai, Tamurindus indica, Zialia jialocorpa.

Agroforestry and social forestry and requirements, interbehaviour of tree crops, selection of species, classification of agroforestry systems. Agro-forestry systems under different agro-ecological zones of Uttarakhand, role of multipurpose trees and NTFP's, techniques, food, fodder and fuel security. Urban social forestry extension and necessity, people's participation, agrofield forestry. Agrofield wood group and dry and water logged land forestry.

Soil Conservation and Watershed Management

Forest soil, classification of soil formation, physical, chemical and biological properties. Soil conservation – definition, causes for erosion, types – wind and water erosion, problems of soil protection and improvement, role of forests in conserving of soil. Maintenance and buildup of soil organic matter, role of micro-organisms in ameliorating soils, watershed management, concepts of watershed – watershed development in respect of torrent control, river channel stabiliszation, avalanche and landslide controls, rehabilitation of degraded areas; hilly and mountain areas, integrated watershed management, water-harvesting and conservation, groundwater recharge and watershed management.

Tree Improvement

General concept of tree improvement, methods and techniques, natural standards and variance in its use. Seed production and seed orchards, establishment, evaluation, maintenance and usefulness. Progeny tests, use of tree improvement and stand improvement, forest genetic resources and gene conservation in situ and ex-situ. Modern propagation techniques, seed certification.

SECTION - B

Forest Management

Objectives, principles and techniques of forest management, units of administration and management, forest stands, structure and dynamics, principles of sustained yield, normal forests, rotation, analysis of ideal tree wealth, yield regulation, management of forest plantations, commercial forests, working plans and their role in scientific management, nature conservation, bio-diversity and other dimensions annual plan and its operation, principles of joint forest management, methodology, usefulness and its role, village forest committee arrangement/construction.

Forest Mensuration and Remote Sensing

Methods and use of tools, diamemtre, girth, height, age, growth and volume of trees, tree multiplier, current annual and average annual increment, sampling methods and sample plots, yield calculation and stand table, creating yield mechanism and its use. Field quality analysis/remote/distant sensing principles, schemes and contingencies, forest cover monitoringn through remote sensing. Geogtraphical information system for forest management.

Forest Economics and Legislation

Forest economics, fundamental principles, cost benefit analysis, estimation of demand and supply, role of private sector, cooperatives of forestry and corporate financing, valuation of forest products and service, commercial control. Legislation : History of forest development. National forest policies of 1894, 1952 and 1988. Forest policies and issues related to land use. Timber and non-timber products. Institutional and structural changes. Forest laws, necessity and general principles. Indian Forest Act, 1927. Indian Forest (Uttaranchal Amendment) 2001, U.P.

forest conservation Act, 1976. Forest (Conservation) Act, 1980. Wild Life (Conservation) Act, 1972 and Amendment, Environment (Protection) Act, 1986.

Forest Resources and Utilization
Environmentally sound forest harvesting principles, logging and extraction techniques and principles, transportation system and sale of forest products, definition and scope, collection of gums, resins, oleoresins, fibres, oil seeds, nuts, rubber, canes, bamboos, medicinal plants, charcoal, lac and shellac, Bidi leaves. Importance of wood seasoning, necessity and protection. General principles of seasoning methods, properties and uses of wood, Present position of supply of raw material to pulp, paper and rayon industry. Wood plantation, substitution, wood use.

Forest Conservation
Needs and limitations, agencies responsible for destruction of forests – Man, pet animals, wild animals and environmental factors, prohibitory and protective measures, responsible factors for destruction of forests for human development, Substitutional tenancy, mining, forest fire, illegal hunting, bad management, encroachment, illegal felling and control over them, types of forest fire, damage, speed control. Important insects and diseases of nursery and plantation fields, insects and disease management.

Environment and Bio-diversity change
Environment : Components and importance, impact of deforestation, forest fires and various human activities like mining, construction, development projects. Population growth, types, impact and controlling standards for pollution. Global warming, green house effects, ozone layer depletion, acid rain, impact and control measures. Role of trees and forests in environmental conservation. Control and prevention of air, water and noise, environment test, environment effect analysis, protection, biology, rational methods of protection of bio-diversity with special reference to protected regions. Protection of forest ecology and sustained development.

14. GEOLOGY

SECTION – A

1. **General Geology** – Energy in relation to geodynamic activities. Origin and interior of the Earth. Dating of rocks by various methods and age of Earth. Radio-activity and its application to geological problems. Volcanoes – causes and products, volcanic belts. Earthquakes – causes, effects, distribution and its relation to volcanic belts. Geosynclines and their classification, island arcs, deep sea trenches and midoceanic ridges, sea-floor spreading and plate tectonics; isostasy, Mountains – types and origin. Origin of continents and oceans. An outline of continental drift.

2. **Geomorphology** – Basic concepts and significance. Geomorphic processes and parameters. Geomorphic cycles and their interpretation, Relief features, topography and its relation to structures and lithology. Major landforms, Drainage systems, Geomorphic features of Indian subcontinent.

3. **Structural Geology** – Stress and strain ellipsoid, and rock deformation. Mechanics of folding and faulting. Linear and planar structures and their genetic significance. Petrofobric analysis, its graphic representation and application to geological problems. Tectonic framework of India.

4. **Palaeontology** - Micro and macro-fossils. Modes of preservation and utility of fossils. General idea about classification and nomenclature. Organic evolution and the bearing of palaeontological studies on it. Morphology, classification and geological history including evolutionary trends of brachiopods, bivalves, gastropods, ammonoids, trilobites, echinoids and corals. Principle groups of vertebrates and their main morphological characters. Vertebrate life through ages. Dinosaurs, Detailed study of evolution of horses, elephants and man. Gondwana flora and its importance. Types of microfossils and their significance with reference to petroleum exploration.

2. **Stratigraphy** – Principles of stratigraphy, stratigraphic classification and nomenclature. Standard stratigraphical scale. Detailed study of various geological system of Indian subcontinent. Boundary problems in stratigraphy, Pre-Cambrian and Cambrian, Permian Triassic, cretaceous Tertiary and Neogene – Quarternary Correlation of the major Indian formations with their world equivalents. An outline of the stratigraphy of various geological systems. Brief study of climates and igneous activities in Indian subcontinent during geological past. Palaeogeographic reconstructions.

SECTION – B

1. **Crystallography** – Crystalline and non-crystalline substances, space groups. Lattice symmetry, Classification of crystals into 32 classes of symmetry, International system of crystallographic notation. Use of stereographic projections to represent crystal syhmmetry, Twinning and twin laws. Crystal irregularities, Applications of X-rays for crystal studies.

2. **Optical Mineralogy** – General principles of optics, isotropism and anisotropism, concepts of optical indicatrix. Pleochroism, Birefringence and interference colours, and extinction, Optical orientation in crystals, Dispersion optical accessories.

3. **Mineralogy** – Elements of crystal chemistry, types of bondings, ionic radii, coordination number, isomorphism, polymorphism and pseudomorphism. Structural classification of silicates. Detailed study of rock forming minerals, their physical, chemical and optical properties and uses, if any. Study of the alternation products of these minerals.

4. **Petrology** – Magma, its generation, nature and composition. Simple phase diagrams of binary and ternary systems and their significance. Bowen's Reaction Principle. Magmatic differentiation and assimilation. Texture and structure and their petrogenetic significance. Classification of igneous rocks. Petrography and petrogenesis of import rock types of India; granites, alkaline rocks, charnockites, anorthosite and Deccan basalts. Processes of formation of sedimentary rock. Diagenesis and lithification. Textures and structures and their petrogenetic significance. Classification of sedimentary rocks, clastic and non-clastic. Heavy minerals and their significance. Elementary concept of depositional environments, sedimentary, facies and provenance. Petrography of common rock types. Metamorphic processes and types of metamorphism. Metamorphic grades, zones and facies. ACF, AKF and AFM diagrams. Textures, structures and nomenclature of metamorphic rock. Petrography and petrogenesis of important rock types.

5. **Economic Geology** – Ore, Ore mineral and gangue, tenor of ores. Processes of formation of mineral deposits. Common forms and structures of ore deposits. Classification of ore deposits. Control of ore deposition. Metallogenetic epocks. Study of important metalliferous and non-metalliferous deposits in oil and natural gas fields, and coal fields of India, Mineral wealth of India. Mineral economics. National mineral policy. Conservation and utilization of minerals.

6. **Applied Geology** – Essentials of prospecting and exploration techniques. Principal methods of mining. Sampling, ore dressing and mineral beneficiation. Geological considerations in Engineering works; Dams, Tunnels, Bridges and Roads. Elements of soil and groundwater geology and geochemistry. Use of aerial photographs and satellite imageries in geological investigations.

15. HORTICULTURE

SECTION –A

Principles Of Horticulture

Scope and importance of horticulture in the economy of India and Tamil Nadu - Horticultural geography (regions and zones)-Role of climate, Soil and water in relation to horticultural crop production - Integrated nutrient management (INM), Integrated, management of pests and diseases, Management of water, weeds, mulches, pruning and training.

Crop systems - protected cultivation - off season production - crop manipulation - Hydropoinics - Nutrient Film Technique - Crop forcing - use of growth regulators.
Environmental Horticulture - Commercial Horticulture - organic Horticulture.
Advances in conventional plant propagation - Mist propagation - Micro propagation.
Role of bio-technology in crop improvement and rapid clonal propagation in horticultural crops.

Breeding systems and methods in Vegetatively and Sexually propagated crops - Breeding for hybrid vigour, processing and resistance to biotic and abiotic stresses - Mutation and polyploidy breeding - somaclonal variation and its application - development of haploids - protoplast fusion - somatic cell fusion - in vitro mutation - transgenic plants.

Landscaping designs for house gardens, institutional and industrial gardens - Bioaesthetic planning of rural gardens, recreational grounds, avenue planting in highways and near railway lines, establishment and maintenance of lawns and different types of gardens - Interior plant scaping – Bonsai

Pre-and Post - Harvest losses in horticultural crops - Maturity indices - ripening - storage methods of storage - Extending the storage life - use of chemicals, growth regulators and skin coatings in regulating ripening and storage life - control of spoilage - Handling, packaging, packing and Methods of transport.

Processing and preservation - Different horticultural products - Establishment of horticulture based industries –

SECTION – B

Production Technology of Horticultural Crops

Present status and prospects - climatic and Soil requirements in different zones - Propagation techniques and nursery technologies - cropping systems - Planting systems - varieties and crop improvement - Nutrient uptake, requirement and Management - Irrigation methods, water requirement and Management - pruning and training - Mulching - weed management - use of plant growth regulators - Maturity indices - harvesting - grading - packaging methods and packing - storage - ripening methods - Industrial and Export potential - seed production techniques including F1 seed production.

Fruit Crops : Mango, Banana, Citrus, grapes, Papaya, guava, Sapota, Pine apple, pomegranate, anonas, ber, amla, tamarind - apple, pear, plum, peach, strawberry, jack, mangosteen, avocado, other minor fruits.

Vegetable Crops : Tomato, brinjal, hot and sweet, Peppers, Bhendi, Leguminous vegetables (Beans, Peas,

cluster beans - cowpea, soya beans - dolichos bean); bulbous vegetables (Onion, garlic) Tuber crops - (Tapioca, sweet potato, yams); cucurbitaceous vegetables (cucumber, musk melon, water melon, gourds, coccinea, pumpkin and squashes, chow-chow), cruciferous vegetables (Cabbage, Cauliflower, minor crucifers), root vegetables (Carrot, radish, beet root, turnip, knol-kohl); Leafy vegetables (Spinach, chekurmanis, palak, amaranthus), Drumstick, asparagus, Potato, Curry leaf.

Flower Crops : Jasmines, roses, tube rose, chrysanthemum, dahlia, marigold, crossandra, cut flowers (cut roses, orchids, carnations, gladioli, chrysanthomum, Gerbera, anthurium, aster, lilies, dry flowers).

Spice crops : Pepper, cardamom, turmeric, ginger, Tree spices (clove, nutmeg, cinnamon, All spice, coriander, fenugreek, fennel, cumin, herbal spices).

Plantation crops : Tea, Coffee, Rubber, Cocoa, Coconut, Oilpalm, Cashew, Palmyrah, Arecanut, Oilpalm and nut crops.

Medicinal Plants : Catharanthus, Senna, dioscorea, Solanum, gloriosa, coleus, pyrethrum, digitalis, atropa, Ipecac, Isabgol, withania, Rowolfia

Aromatic Plants : Geranium, Mentha, Ocimum, aromatic grasses (Cymbopogons, citronella, palma rosa, vettiver), patchouli.

16. MATHEMATICS

SECTION – A

Linear Algebra – Vector space, bases, dimension of a finitely generated space, Linear transformations, Rank and nullity of a linear transformation, Cayley Hamiliton theorem, Eigen values and Eigen vectors. Matrix of a linear transformation, Row and column reduction. Echelon form. Equivalence, Congruence and similarity. Reduction to canonical forms. Orthogonal, symmetrical, skew-symmetrical, unitary, Hermitian and skew-Hermitian matrices – their eigen values, orthogonal and unitary reduction of quadratic and Hermitian forms. Positive definite quadratic forms. Simultaneous reduction. **Calculus** – Real numbers, limits, continuity, differentiability, Mean value theorems, Taylor's theorem, indeterminate forms, Maxima and Minima. Curve Tracing, Asymptotes. Functions of several variables, partial derivatives, maxima and minima, Jacobian, Definite and indefinite integrals, Double and triple integrals (techniques only), Application to Beta and Gamma Functions. Areas, Volumes, Centre of gravity. **Analytical Geometry of two and three dimensions** – First and second degree equations in two dimensions in Cartesian and polar coordinates, Plane, sphere, paraboloid, Ellipsoid, hyperboloid of one and two sheets and their elementary properties, Curves in space Curvature and torsion. Frenet's formulae.

Differential Equations – Order and Degree of a differential equation, differential equation of first order and first degree, variables separable. Homogeneous, linear and exact differential equations. Differential equations with constant coefficients. The complementary function and the particular integral of e^{ax}, cos ax, sin ax, x^m, e^{ax}, cos bx, e^{ax}, sin bx. **Vector Analysis** – Vector Algebra, Differentiation of vector function of a scalar variable, Gradient, divergence and curl in Cartesian, cylindrical and spherical coordinates and their physical interpretation. Higher order derivatives. Vector identities and vector equations, Gauss and Stokes Theorems. **Tensor Analysis** – Definition of a Tensor, Transformation of coordinates, contravariant and convariant tensors. Addition and multiplication of tensors, contraction of tensors. Inner product, fundamental tensors, Christoffel symbols, convariant differentiation, Gradient, curl and

divergence in tensor notation. **Statistics** – Equilibrium of a system of particles, work and potential energy. Friction. Common Catenary. Principle of Virtual work. Stability of equilibrium. Equilibrium of forces in three dimensions. **Dynamics** – Degree of freedom and constraints, Rectilinear motion. Simple Harmonic motion in a plane. Projectiles, Constrained motion, work and energy. Motion under impulsive forces. Kepler's laws. Orbits under central forces. Motion of varying mass. Motion under resisting medium. **Hydrostatics** – Pressure of heavy fluids. Equilibrium of fluids under given system of forces. Centre of pressure. Thrust on curved surfaces. Equilibrium of Floating bodies, stability of equilibrium and pressure of gases, problems relating to atmosphere.

SECTION – B

Algebra – Groups, subgroups, normal subgroups homomorphism of groups, quotient groups, Basic isomorphism theorems. Sylow theorems. Permutation Groups. Cayley's theorem. Rings and ideals, Principal ideal domains, unique factorization domains and Euclidean domains, Field Extensions, Finite fields. **Real analysis** – Metric spaces, their topology with special reference to R^n sequence in metric space. Cauchy sequence completeness. Completion, continuous functions, Uniform continuity, Properties of continuous functions on Compact sets. Riemann stieltjes Integral, Improper integrals and their conditions of existence. Differentiations of functions of several variables. Implicit function theorem, maxima and minima. Absolute and Conditional Convergence of series of real and Complex terms, Rearrangement of series, Uniform convergence, infinite products. Continuity, differentiability and integrability for series, Multiple integrals. **Complex Analysis** – Analytic functions, Cauchy's theorem, Cauchy's integral formula, power series, Taylor's series, Singularities, Cauchy's Residue theorem and Contour integration. **Partial Differential Equations** – Formation of partial differential equations. Types of integrals of partial differential equations of first order, Charpits method, Partial differential equation with constant coefficients. **Mechanics** – Generalised Coordinates, constraints, holonomic and non-holonomic systems, D 'Alembert's Principle and Langranges' equations, Moment of inertia, Motion of rigid bodies in two dimensions. **Hydrodynamics** – Equation of continuity, momentum and energy, inviscid flow theory – Two dimensional motion, streaming motion, Sources and Sinks. **Numerical Analysis** – Transcendental and polynomial Equations – Methods of tabulation, bisection, regula-falsi, secants and Newton-Rephson and order of its convergence, Interpolation and Numerical Differentiation.

17. PHYSICS

SECTION – A

Mechanics, Thermal Physics and Waves and Oscillations

1. **Mechanics** – Conservation law. Collisions, impact parameter, scattering cross-section, centre of mass and lab systems with transformation of physical quantities, Rutherford Scattering. Motion of a rocket under constant force field. Rotating frames of reference, Coriolis force. Motion of rigid bodies, Dynamics of rotating bodies, Moment of inertia, Theorem of parallel and perpendicular axes. Moment of inertia of sphere, ring, cylinder, disc. Angular momentum. Torque and precession of a top, Gyroscope. Central forces. Motion under inverse square law, Kepler's Laws, Motion of Satellites (including geostationary). Galileann Relativity, Special Theory of Relativity, Michelson-Morley Experiment, Lorentz Transformations – addition theorem of velocities. Variation of mass with velocity. Mass-Energy equivalence. Fluid

dynamics, streamlines, Reynold number, Viscosity, Poiseulle's formula for the flow of liquid through narrow tubes, turbulence, Bernoulli's Equation with simple applications.

2. **Thermal Physics** – Law's of thermodynamics, Entropy, Carnot's cycle, Isothermal and Adiabatic changes, Thermodynamic Potentials, Helmboltz and Gibbs functions, Maxwell's relations. The clausius-clapeyron equation, reversible cell, Joule-Kelvin effect, Stefan-Boltzmann Law. Kinetic Theory of Gases, Maxwell's Distribution Law of Velocities, Equipartition of energy, specific heats of gases, mean Free path, Brownian Motion. Black Body radiation, specific heat of solids Einstein and Debye theories, Wein's Law, Planck's Law, solar constant. Saha's theory of thermolionization and Stellar spectra. Production of low temperatures using adiabatic demagnetization and dilution refrigeration. Concept of negative temperature.

3. Waves and Oscillations – Oscillations, simple harmonic motion. Examples of simple harmonic motion : mass, spring and LC circuits. Stationary and traveling waves, Damped harmonic motion, Forced oscillation and Resonance. Sharpness of resonance. Wave equation, Harmonic solutions, Plane and Spherical waves, Superpositions of waves, Two perpendicular simple harmonic motions – Lissajous figures, Fourier analysis of periodic waves – square and triangular waves. Phase and Group velocities, Beats, Huygen's principle, Division of amplitude and wavefront, Fresnel Biprism, Newton's rings, Michelson interferometer, Fabry-Perot interferometer.Diffraction-Fresnel and Fraunhofer. Diffraction as a Fourier Transformation. Fresnel and Fraunhofer diffraction by rectangular and circular apertures. Diffraction by straight edge, Single and multiple slits. Resolving power of grating and Optical Instruments. Rayleigh criterion. Polarization, production and Detection of polarized light (linear, circular and elliptical). Brewster's law, Huyghen's theory of double refraction, optical rotation, Polarimeters. Laser sources (Helium-Neon, Ruby, and semi-conductor diode). Concept of spatial and temporal coherence. Holography, theory and applications.

SECTION – B

1. Electricity and Magnetism – Coulomb's law, Electric Field. Gauss's Law, Electric potential. Poission and Laplace equations for homogeneous dielectric, uncharged conducting sphere in a uniform field, point charge and infinite conducting plane. Current electricity : Kirchoff's laws and its applications : Wheatstone bridge, Kelvin's double bridge, Carey-Foster's bridge. Bio-Savart law andn applications, Ampere's circuital law and its applications, Magnetic induction and field strength, magnetic shell. Magnetic field on the axis of a circular coil. Helmboltz coil. Electromagnetic induction, Faraday's and Lenz's law, Self and Mutual inductances, Alternating currents. L.C.R. circuits, series and parallel resonance circuits, quality factor. Maxwell's equations and electromagnetic waves, Transverse nature of electromagnetic waves, Poynting vector. Magnetic fields in matter : Dia, Para, Ferro Antiferro and Ferrimagnetism (Qualitative approach only), Hysteresis.

2. Modern Physics – Bohr's theory of hydrogen atom. Electron spin, Optical and X-ray Spectra. Stern-Gerlach experiment and spatial quantization. Vector model of the atom, spectral terms and fine structure of spectral lines. J-J and L-S coupling. Zeeman effect, Pauli's exclusion principle spectral terms of two equivalent and non-equivalent electrons. Gross and fine structure of electronic band spectra. Raman effect, Photoelectric effect, Compton effect DeBroglie waves. Wave-Particle duality, uncertainty principle, postulates of quantum mechanics. Schrodinger wave equation with application to (i) particle in a box, (ii) motion across a step potential. One dimensional harmonic oscillator eigen values and eigen functions. Radioactivity, Alpha, beta and gamma radiations. Elementary theory of the alpha decay. Nuclear binding energy. Mass spectroscopy, Semi empirical mass formula. Nuclear binding energy. Mass spectroscopy, Semi empirical mass formula. Nuclear fission and fusion. Elementary Reactor Physics, Elementary

particles and their classification, strong and weak Electromagnetic interactions. Particle accelerators, cyclotron. Linear accelerators. Elementary ideas of Superconductivity.

3. Electronics – Band theory of solids, conductors, insulators and semiconductors. Intrinsic and extrinsic semiconductors, P.N. Junction. Thermistor, Zener diodes, reverse and forward biased P.N. junction, solar cell. Use of diodes and transistors for rectification, amplification, oscillation, modulation and detection of r.f. waves. Transistor receiver. Television. Logic Gates and their truth table, some applications.

18 . STATISTICS

SECTION – A

- Uses, Scope and lidmitation of Statistics, Collection Classification and tabulation of data, Diagramatic and Graphical representation, Measures of location, dispersion, Skewness and Kurtosis.

- Probability - Addition, multiplication and Bay's Theorems and their application. Tchebychev's inequality. Random variables - Univariate and Bivariate - probability distributions - Marginal and conditional distributions - Expectations - Moments and cumulants genevating functions Discrete distributions - Binomial, poisson, Geometric and Hypergeometric. Continuos distributions - Uniform, exponential and normal.

- Curve Fitting - Linear and Quadratic equation by the method of least squares. Correlation and regression.

- Population and sample - Parameter and statistic, sampling distributions and standard error, student's 't' Chi-square and F statistic - distributions and their applications.

- Estimation - Point estimation - properties of estimates Neyman - Fisher Factorization theorem(without proof) Cramer - Rao inequality, Rao - Blackwell theorem - MLE and method of Moments estimation - Interval estimation - for population mean and variance based on small and large samples.

- Tests of Hypothesis - Null and Alternative - Types of errors _ Power of test, Neyman - Pearson lemma, UMP and Likelihood ratio tests, Test procedures for large and small samples - Independence of attributes, Chi-square test - Goodness of fit.

SECTION – B

- Simple random sample - stratified, systematic, Cluster (Single stage) Estimation of mean and variance in SKS - Sample Survey - Organisation - CSO and NSSO - Sampling and Non-Sampling errors.

- Analysis of Variance - Principles of design CRD, Rbd and LSD - Factorial experiments 22, 23 and 32 (Without confounding) Missing plot techniques.

- Concept of SQC - Control Charts - X,R, p and C-Charts Acceptance sampling plan - single and double - oc curves Attributes and Variables plan, Reliability.

- Time series - Different Components - Trend and Seasonal Variations - Determination and elimination.

- Index Numbers - Construction and uses - Different kinds of simple and weighted index numbers - Reversal tests - construction and use of cost of living index numbers.

- OR Models - Linear Programming problems - Simples method Dual - Primal, Assignment problems, Net work - CPM and PERT.

- Basic programming - variables, constants and strings, flow charts - Basic expression and control statements, standard Library functions, subscripted variables DIM and DATA statements simple programming problems. Birth and death rates - Crude and standard death rates, Fertility rates - Life table construction and uses.

19. VETERINARY SCIENCE

SECTION – A

Animal Nutrition

1. **Energy nutrition** – Energy sources, energy metabolism. Requirements of energy for maintenance and production of milk, meat, eggs and pork, energy evaluation of foods.
2. **Protein nutritions –** Sources of protein, digestion and metabolism of protein, Protein evaluation. Requirement of protein for maintenance and production, Energy, protein ratio in a ration.
3. **Mineral nutrition** – Sources, function, deficiency symptoms, requirements for animals and their relationship with vitamins.
4. **Vitamins, Hormones and Feed additives** – Sources, function, deficiency symptoms, requirements and interrelationship with minerals.
5. **Applied nutrition** – Evaluation of feeding experiments, digestibility and balance studies, Feeding standards and measures of feed energy, Nutrient requirement for growth, maintenance and production. Balanced ration.
6. **Ruminant nutrition** – Nutrient and their metamolism with reference to milk production and its composition. Nutrient requirements and feed formulation for calves, heifers dry and milking cows and buffaloes.
7. **Non-ruminants nutrition** – Nutrient and their metabolism and special reference to meat and egg production. Nutrient requirements and feed formulation for layer, broiler and pig.

Animal Physiology

1. **Growth and animal production** – Parental and Post natal growth, maturation, growth curves, measures of growth, factors affecting growth, body composition and meat quality.
2. **Milk production** – Hormonal control of mammary development. Milk secretion amd milk ejection, composition of milk of cows and buffaloes.
3. **Animal Reproduction** – Male and female reproductive organs, their components and functions.
4. **Digestive physiology** – Organs of digestion and their functions. Digestion of carbohydrates, protein and fat in ruminants and non-ruminants.
5. **Environment Physiology** – Physiology relations and their regulation mechanism of adaptation, environmental factors and regulatory mechanism involved in animal behaviour. Method of controlling climatic stress.
6. **Semen quality, preservation and artificial inseminations** – Components of semen, composition of spermatozoa, physical and chemical properties of ejaculated semen, semen preservation, composition of diluents, sperm concentration, transport of diluted semen, deep freezing techniques.

Livestock Production and Management

1. **Commercial dairy farming** – Comparison of dairy farming in India with advanced countries. Dairying under mixed farming and as specialized farming, economic dairy farming, starting of dairy farm, capital and land requirement, organisation of dairy farms, procurement of goods, opportunities in dairy farming, factors determining the efficiency of dairy animals, herd recording, budgeting, cost of milk production, pricing policy, personnel management.
2. **General Management** – Management of livestock (pregnant, and milking cows, newly born calves), livestock records, principles of clean milk production, economics of livestock farming. Housing for livestock and poultry, General problems of sheep, goat, pigs and poultry management.
3. **Feeding management** – Developing practical and economic ration for dairy cattle, supply of green fodder throughout the year, Land and fodder requirement of dairy farms, Feeding regimes for dry, young stock, bulls, heifers and breeding animals.
4. **Management of animals under drought condition** – Feeding and management of animals under drought, flood and other natural climatics.
5. **Milk and milk products technology**

. **Milk Technology** – Organization of rural milk procurement, collection and transport of raw milk. Quality, testing and grading of raw milk, Quality storage grade of whole milk, skimmed milk and cream. Processing, packing, storing, distributing, marketing defects and their control and nutritive properties of the following milks: Pasteurized, standardized, Toned, double toned, sterilized, homogenized, reconstituted, recombined and flavoured milk. Culture and their management, Yoghurt, Dahi, Lassi, Srikhand, legal standards, sanitation, Requirement for clean and safe milk and for the milk plant equipments.

Milk product technology.

SECTION B

Genetics and Animal Breeding

1. **Animal Genetics** – Mitosis and meiosis, Mendelian inheritance, deviations to Mendalian genetics, Expression of genes, Linkage and crossing over, sex determination, sex influenced and sex limited characters, Blood groups and polymorphism, chromosomal aberrations, Gene and its structure DNA as a genetic material, genetic code and protein synthesis, Recombinant DNA technology, Mutations, types of mutations, methods for detecting mutations and mutation role.
2. **Population Genetics applied to animal breeding** – Quantitative Vs Qualitative traits, Hardy Weinbery law, Population Vs Individual, Gene and genotype frequency, Forces changing gene frequency, Random drift and small populations, Inbreeding, methods of estimating inbreeding co-efficient, system of inbreeding. Effective population size, Breeding value, estimation of breeding value, dominance and epistatic deviation, partitioning of variation genotype environment correlation and genotype environment interaction.
3. **Breeding system** - Heritability, repeatability and genetic and phenotypic correlations, their methods of estimation and precision of estimates, Aids to selection and their relative merits, individual pedigree, family within family selection, progeny testing, methods of selection, basis of selection. Response to selection and its measure, selection differential, siroindex, selection index, recurrent and reciprocal recurrent selection, establishment of new breed, inbreeding, out breeding, upgrading, hybridization, crossbreeding, out crossing.

Health and Hygiene

1. Anatomy of ox and fowl.Histological techniques, freezing paraffin embedding etc. preparation and staining of blood film.
2. Common histological stain and embryology of cow.
3. Physiology of blood and its circulation, digestion, respiration, excretion, endocrine gland in health and diseases.
4. General knowledge of pharmacology and therapetics of drugs.
5. Veterinary-hygiene with respect of water, air and habitation. 6. Milk hygiene.

Animal diseases

1. **Immunity and Vaccination** – Principles and methods of immunization of animals against specific diseases, herd immunity, disease free zones, zero disease concept, chemoprohylaxis.
2. **Diseases of cattle, buffalo, sheep and goats** – Etiology symptoms, diagnosis, prevention and control and treatment of the following diseases : Anthrax, haemorrhagic septicaemia, Black quarter, mastitis, tuberculosis, johns disease, Foot and mouth disease, Rinder pest rabies, Piroplosmosis, Trypnasomiasis Faciolisis, Milk fever and Tympanitis.
3. **Disease of poultry** – Etiology, symptoms, diagonosis, prevention, control and treatments of Ranikeht disease, Fowl pox, Avian leucosis complex Marek's disease and gumboro disease.
4. **Disease of Swine** – Swine fever, hogcholera.
5. **Disease of Dog** – Canine distemper, Parvo disease, Rabies in pets in relation to human health.

Veterinary Public health

1. **Zoonoses** – Classification, definition, role of animals and birds in prevalence and transmission of Zoonotic disease.
2. **Veterinary Jurisprudence** – Rules and regulations for improvement of animals' quality and prevention of animal diseases. Materials and methods for collection of samples for veterolegal investigations.
3. Duties and role of veterinian in slaughter house to provide meat that is produced under ideal hygienic conditions.
4. By-products from slaughter houses and their economic utilization.
5. Method of collection, preservation and processing of hormonal glands for medicinal use.

Extension

Basic philosophy, objectives, concept and principles of extension, different methods adopted to educate farmers under rural conditions. Generation of technology, its transfer and feed back. Problems and constraints in transfer of technology, Animal husbandry programmes for rural development.

20. ZOOLOGY

SECTION – A

Non-Chordata and Chordata

1. General survey, Classification and Interrelationship of various Phyla. 2. **Protozoa** – Locomotion, Nutrition, Reproduction and Human Parasite. 3. **Porifera** – Canal system : Skeleton and Reproduction. 4. **Cnidaria** – Polymorphism : Coral reefs; Metagenesis. 5. **Helminthes** – Parasitic adaptations and host-parasite relationships. 6. **Annelida** – Adaptive radiation in Polychaeta. 7. **Arthropoda** – Larval forms and parasitism in crustacean;

Appendages of prawn; Vision and respiration in Arthropoda; Social life and metamorphosis in insects. 8. **Mollusca** – Respiration ; Pearl formation. 9. **Echinodermata** – General organisation, larval forma and affinities. 10. **Chordata** – Origin; Lung fishes; Origin of tetrapods. 11. **Amphibia** – Neoteny and parental care. 12. **Reptilia** – Skull types (Anapsid; Diapsid; Prapsid and Synapsid); Dinosaurs. 13. **Aves** – Origin, aerial adaptations and migration; Flightless birds. 14. **Mammalia** – Prototheria and Metatheria; Skin derivatives of Eutheria.

Ecology – Abiotic and biotic factors; Inter and intraspecific relations, ecological succession; Different types of biomes; Biogeochemical cycles; Food web; Ozone layer and Biosphere; Pollution of air, water and land. 2. **Ethology** – Types of animal behaviour; Role of hormones and pheromones in behaviour; Methods of studying animal behaviour; Biological rhythms. 3. **Biostatistics** – Sampling methods, frequency distribution and measures of central tendency, standard deviation, standard error, correlation and regression, Chi-square and t-test. 4. **Economic Zoology** – Insect pests of crops (Paddy, Gram and Sugarcane) and stored grains; Apiculture, Sericulture, Lac culture, Pisciculture and Oyster culture.

SECTION -B

Cell Biology, genetics and evolution and systematics – Cell membrane, Active transport and Sodium-potassium ATPase Pump; Mitochondria, Golgibodies; endoplasmic reticulum; ribosomes and lysosomes; cell division; mitotic spinal and chromosome movements and meiosis; Chromosome mapping Gene concept and function – Watson-Crick model of DNA, Genetic code, Protein synthesis, Sex chromosomes and sex determination. 2. **Genetics** – Mendelian laws of inheritance; recombination linkage and linkage maps, multiple alleles, mutation (natural and induced), mutation and evolution, chromosome number and form, structural rearrangements, polyploidy; regulation of gene expression in prokaryotes and eukaryotes; Human chromosomal abnormalities, gene and diseases; Eugenics; Genetic engineering; recombinant DNA technology and gene cloning. 3. **Evolution and Systematics** – Theories of evolution; sources and nature of organic variation; natural selection; Hardy-Weinberg law; cryptic and sematic colouration; mimicry; isolating mechanisms and their role; insular fauna; concept of species and sub-species; principles of taxonomy; Zoological nomenclature and International code; Fossils; Geological eras; Phylogeny of horse and elephant; origin and evolution of man; principles and theories of continental distribution of animals; Zoogeographical realms of the world.

Biochemistry – Structure of carbohydrates, lipids (including saturated and unsaturated fatty acids), amino acids, proteins and nucleic acids; Glocolysis, Kreb's cycle, Oxidation and reduction, oxidative phosphory-lation, Energy conservation and release, ATP, C-AMP, Types of enzymes, mechanism of enzymes action; Immunoglobulins and immunity; vitamins. 2. **Physiology (with special reference to mammals)** – Composition of blood, blood groups in man, agglutination; oxygen and carbon dioxide transport, haemoglobin, breathing and its regulation; Thermo-regulation in Man; Nerve impulse conduction and transmission across synapse, neurotransmitters; Vision, hearing and olfaction; Types of muscles; Digestion and absorption of protein, carbohydrate, fat and nucleic acid, control of secretion of digestive juices; Balanced diet of man. Steroid, protein, peptide and amino-acid derived hormones, role of hypothalamus, pituitary, thyroid, parathyroid, pancreas, adrenal, gonads and pineal organ and their relationships; Physiology of human reproduction, hormonal control of development in man; Pheromopnes in mammals. 3. **Developmental Biology** – Gametogenesis, fertilisation, types of eggs, cleavage and gastrulation in Branchiostoma, frog and chick; Fate maps of frog and chick; metamorphosis in frog; formation and fate of extra embryonic membrane in chick;

Formation of amnion, allantois and types of placenta in mammals, organiser phenomenon, regeneration, genetic control of development, organogenesis of brain, eye and heart, Aging. Harmonic control of metamorphosis.