

## विस्तृत पाठ्यक्रम

सामान्य अध्ययन – प्रथम प्रश्न पत्र (पूर्णांक-200)  
PART-A - (100 Marks)

1. पर्यावरण- परिस्थितिकी तंत्र, जैविक अजैविक कारक, खाद्य श्रृंखला, खाद्य जाल, वन परिस्थितिकी (Forest Eco System) तालाब परिस्थितिकी (Pond Eco System) मरुस्थल परिस्थितिकी (Desert Eco System) घास परिस्थितिकी (Grass Land Eco System) जनसंख्या परिस्थितिकी (Population Eco System) जैव विविधता (Bio Diversity) विलुप्त प्राय प्रजातियां (Endangered Species) वन्य जीवन सुरक्षा अधिनियम-1972 (Wild life Protection act- 1972) राष्ट्रीय उद्यान एवं अभ्यारण्य (National Park and Sanctuaries') वन संरक्षण अधिनियम (Forest Protection Act.)

### PART-B- (100 Marks)

सूचना एवं प्रौद्योगिकी- अभिलक्षण, प्रयोग, शब्दावली, वेबसाइट्स, ऑनलाईन सर्च इंजन, ई-मेल, विडियो मेल, हेकिंग, वायरस, एम एस. ऑफिस अनुप्रयोग।

सामान्य गणित – लाभ-हानि, ब्याज, प्रतिशत, अनुपात समानुपात, समीकरण सिद्धांत, लघुत्तम महत्तम समापवर्तक, वर्गमूल, पर आधारित प्रश्न

सांख्यिकी- केन्द्रीय प्रवृत्ति की माप- माध्य, मध्यिका, भूयिष्ठक, प्रायिकता के सामान्य अनुप्रयोग।

### द्वितीय प्रश्न पत्र

पाठ्यक्रम-सामान्य हिन्दी

125-अंक

इस प्रश्नपत्र का स्तर स्नातक परीक्षा उत्तीर्ण छात्रों के समकक्ष होगा। इसका उद्देश्य उम्मीदवार की पढ़ने, समझने और लेखन की योग्यता एवं हिन्दी में स्पष्ट तथा सही विचार व्यक्त करने की जाँच करना है।

सामान्यतः निम्नलिखित विषयों पर प्रश्न पूछे जायेंगे

(क) पल्लवन, सन्धि व समास

- (1) दिये गए वाक्यों का व्यापक अर्थ (शब्द-सीमा 50 शब्द)
- (2) सन्धि, समास व विराम चिन्ह

(ख) संक्षेपण

(ग) प्रारूप लेखन – शासकीय व अर्धशासकीय पत्र, परिपत्र, प्रपत्र, विज्ञापन, आदेश, पृष्ठांकन, अनुस्मारक (स्मरण पत्र), अधिसूचना, टिप्पण लेखन – (कोई दो)

(घ) प्रयोग, शब्दावली तथा प्रारंभिक व्याकरण

- (1) प्रशासनिक पारिभाषिक शब्दावली (हिन्दी व अंग्रेजी)
- (2) मुहावरे अथवा कहावतें
- (3) विलोम शब्द एवं समानार्थी शब्द
- (4) तत्सम-तद्भव शब्द
- (5) पर्यायवाची शब्द
- (6) शब्द युग्म

(ङ) (1) अपठित गद्यांश

- (2) प्रतिवेदन – (प्रशासनिक, विधि, पत्रकारिता, साहित्य व सामाजिक)

- (च) अनुवाद (वाक्यों का)  
हिन्दी से अंग्रेजी एवं अंग्रेजी से हिन्दी
- (छ) निबंध

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SYLLABUS - ENGLISH LANGUAGE & COMPOSITION  
(PART-B) Marks 75

1. Grammar
  - Voice (Active Passive)
  - Narration (Direct Indirect speech)
  - Degrees & comparison
  - Articles
2. Vocabulary
  - Synonyms and Antonyms
  - Fill-in the blank with suitable words
3. Comprehension- Unseen Passage
4. Précis writing
5. Composition
  - Essay writing (Topics on contemporary and burning issues) (500 words)
  - Letter writing
  - Paragraph writing (200 words)  
(Expansion & Proverbs)

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SYLLABUS - BOTANY

PAPER-FIRST

1. Origin and Evolution of Life  
Basic ideas about the origin of Earth. Origin of life, chemical and biological evolution, Geological time scale, Fossilization, Types of fossils and their formation.
2. Cell Biology  
Cell, structure and functions of cell organelles, chromosomes : Structure and types, Cell division, Amitosis, Mitosis and meiosis, Cell Cycle.
3. Genetics  
Concept of gene, DNA, RNA, laws of inheritance. Cytoplasmic inheritance, mutation and polyploidy. Plant breeding.
4. Plant Diversity

A general account of structure and reproduction of virus, bacteria, cyanobacteria, algae, fungi, lichens, bryophytes, pteridophytes and gymnosperms. Concept of alternation of generations.

5. Angiosperms

Morphology, anatomy of Root and Leaf. Types of tissues and their functions, Modifications of root stem and leaf. Reproduction : Pollination, fertilization and development of seed.

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पाठ्यक्रम – वनस्पति विज्ञान

प्रथम प्रश्न पत्र

1. जीवन का उद्गम एवं विकास  
पृथ्वी के उद्गम की आधारभूत धारणाएँ, जीवन का उद्गम, रासायनिक तथा जैव विकास की अवधारणाएँ। भूगर्भीय समय सारिणी, जीवास्मीकरण, जीवाश्म के प्रकार और उनके बनने के तरीके।
2. कोशिका जैविकी  
कोशिका संरचना तथा कोशिकांगों के कार्य, गुणसूत्र : संरचना एवं प्रकार, कोशिका विभाजन: असूत्री, समसूत्री एवं अर्द्धसूत्री विभाजन, कोशिका चक्र।
3. अनुवांशिकी  
जीन की संकल्पना, डीएनए, आरएनए, वंशागति के नियम, कोशिका द्रव्यीय वंशानुगति, उत्परिवर्तन एवं बहुगुणिता, पादप संकरण।
4. पादप विविधता  
विषाणु, जीवाणु, सायनोजीवाणु, शैवाल, कवक, लायकेन्स, ब्रायोफायटा, टेरीडोफायटा एवं अनावृत्त बीजी पौधों की संरचना, प्रजनन और जीवन चक्र का सामान्य विवरण। पीढ़ी एकान्तरण की संकल्पना।
5. आवृत्तबीजी  
जड़, तना एवं पत्ती की बाह्य आकारिकी एवं आंतरिक रचना। ऊतकों के प्रकार एवं उनके कार्य। जड़, तना एवं पत्तियों के रूपांतरण। प्रजनन – परागण, निषेचन एवं बीज का विकास।

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SYLLABUS - BOTANY  
PAPER-SECOND

Taxonomy :

Definition, Principles of nomenclature, classification and identification of plants. Salient features and economic importance of following families : Malvaceae, Brassicaceae Fabaceae, (Leguminosae), Apiaceae, Solanaaceae, Lamiaceae, Euphorbiaceae and Poaceae.

Plant physiology

plant Water relations, mineral nutrition, enzymes, photosynthesis, nitrogen metabolism, respiration, growth, Plant hormones, physiology of flowering and seed germination.

Biotechnology

Recombinant DNA technique, Tissue Culture, Application of Biotechnology in Agriculture, Horticulture, Medicine and Industry , Biofertilizers.

Plant pathology

A general account and control of important diseases of crop plants of India specially Wheat, Rice , Maize, Sorghum, Rye and cotton .

Plants, environment and Human welfare

Ecosystem, ecological adaptations, natural resources and pollution, Global warming, acid rains and ozone layer depletion. Role of plants in human welfare. Food Fibers, Wood and Medicine producing plants.

पाठ्यक्रम-वनस्पति विज्ञान  
द्वितीय प्रश्न पत्र

वर्गीकरण विज्ञान

परिभाषा पौधों के नामकरण के सिद्धांत, पौधों के वर्गीकरण पहचान । निम्नलिखित कुलों के प्रमुख लक्षण एवं आर्थिक महत्व – मालवेसी, ब्रेसीकेसी, फेबेसी (लेग्युमिनोसी), ऐपीएसी, सोलेनेसी, लेमीएसी, यूफोरबिएसी एवं पोएसी ।

पादप कार्यिकी

पादप-जल संबंध, खनिज पोषाहार, एन्जाइम्स, प्रकाश संश्लेषण, नाइट्रोजन चयापचय, श्वसन, वृद्धि, पादप हार्मोन, पुष्पन की कार्यिकी, बीजांकुरण ।

जैव प्रौद्योगिकी

पुनर्संयोजी डी.एन.ए. तकनीक, ऊत्तक संवर्धन, जैव प्रौद्योगिकी के कृषि, उद्यानिकी, औषधि एवं उद्योगों में अनुप्रयोग । जैव उर्वरक ।

पादप रोगविज्ञान

भारत के फसली पौधों विशेषकर गेहूँ, चावल, मक्का, ज्वार, बाजरा, राय एवं कपास के महत्वपूर्ण रोगों का सामान्य विवरण एवं नियंत्रण ।

पौधे, पर्यावरण एवं मानव कल्याण

पारिस्थितिक तंत्र, पारिस्थितिकी अनुकूलन, प्राकृतिक संसाधन एवं प्रदूषण, वैश्विक तपन, अम्लवर्षा एवं ओज़ोन परत क्षरण । मानव कल्याण में पौधों की भूमिका, खाद्य, रेशे, काष्ठ एवं औषधि प्रदान करने वाले पौधे ।

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SYLLABUS - ZOOLOGY  
FIRST PAPER

Unit-1:	Classification of Invertebrates (Lower and higher) upto classes according to parker and Heswell (7 <sup>th</sup> Edition) With characters and examples. Importance & classification of important animals of invertebrates.
Unit-2:	Type study of lower invertebrates- plasmodium, paramecium Sycon, Obelia, Taenia, Fasciola, Ascaris. Larval forms of lower invertebrates. canal system in Porifera. Polymorphism in Coelenterates.
Unit-3:	Type study of higher invertebrates- Pheretima, Periplaneta, Prawn, Pila, Asterias, Balanoglossus. Larval forms of higher Invertebrates. Metamerism. Torsion and detorsion in gastropods. Affinities of Balanoglossus.
Unit-4:	The cell- Cell Theory, Prokaryotic and Eukaryotic cell. Microscopy: Compound and Electron Microscope. Nuclear Organization of cell. Extra-nuclear organization

	of cell. Cell reproduction- Amitosis, mitosis, meiosis. Chromosome structure and Types. Structure of DNA, Operan model. Linkage & crossing over. Mendel's law and sex determination in animals.
Unit-5:	Origin of life (including modern concept). Lamarckism, Darwinism. Modern Synthetic theory. Variations, Mutations, Isolation & Speciation. Adaptations and Mimicry. Micro, macro and Mega evolution. Fossils, Methods of fossilization. Determination of age of Fossils. Study of Extinct forms: Dinosaurs and Archaeopteryx. Zoogeographical Distribution of animals. Evolution of man.

## SYLLABUS - ZOOLOGY

### FIRST PAPER

इकाई-1	पारकर एवं हेसवेल (सातवें संस्करण) के अनुसार अकशेरुकी (निम्न एवं उच्च) का वर्ग (क्लास) स्तर तक लक्षण एवं उदाहरण सहित वर्गीकरण। कुछ महत्वपूर्ण अकशेरुकी जंतुओं की पहचान, वर्गीकरण एवं महत्व।
इकाई-2	निम्नश्रेणी के अकशेरुकी प्राणी विशेष का अध्ययन- प्लाजमोडियम, पैरामिशियम, सायकॉन, ओबेलिया, टिनिया, फेसिओला, एसकेरिस। निम्न अकशेरुकियों के लार्वा के प्रकार। पोरीफेरा में नाल तंत्र। सिलेनट्रेट्स में बहुरूपता।
इकाई-3	उच्च श्रेणी के अकशेरुकी प्राणी विशेष का अध्ययन- फेरिटिमा, पेरीप्लेनेटा, प्रॉन, पाइला, एस्टेरियस, बेलेनोग्लॉसस। उच्च अकशेरुकी के लार्वा के प्रकार। मेटामेरिज्म। गेस्ट्रोपोड में टॉर्शन और डीटार्शन। बेलेनोग्लॉसस की बंधुता।
इकाई-4	कोशिका-कोशिका सिद्धांत, प्रोकेरियोटिक एवं यूकैरियोटिक कोशिका। सूक्ष्मदर्शिकी: संयुक्त तथा इलेक्ट्रॉन सूक्ष्मदर्शी। कोशिका का केन्द्रकीय संगठन। कोशिका की बाह्य-केन्द्रीकीय संगठन। कोशिका प्रजनन-असूत्री, समसूत्री तथा अर्ध-सूत्री विभाजन। गुणसूत्र की संरचना एवं प्रकार। DNA की संरचना, ऑपेरॉन मॉडल। सहलग्नता एवं क्रासिंग ओवर। मेण्डल के नियम एवं जन्तुओं में लिंग निर्धारण।
इकाई-5	जीवन की उत्पत्ती (आधुनिक सिद्धांत सहित)। लैमार्कवाद, डार्विनवाद। आधुनिक संश्लेषणवाद। विभिन्नताएं, उत्परिवर्तन, पृथक्करण तथा स्पीशीज का निर्माण। अनुकूलन तथा अनुहरण। मेक्रो एवं, मैगा उद्विकास। जीवाश्म, जीवाश्म के निर्माण की प्रक्रिया। जीवाश्मों की आयु का निर्धारण। विलुप्त जीवों का अध्ययन- डायनोसॉर व आर्कियोप्टेरिक्स। प्राणियों का भौगोलिक वितरण। मानव का विकास।

## SYLLABUS - ZOOLOGY

### SECOND PAPER

Unit-1:	Classification of chordata up to order according to Parker and Heswell (7 <sup>th</sup> editio)- Pisces, Ambhibia, Reptilia, Aves, Mammals with Characters & example. Type study-Herdmania, Amphioxus and their affinities. pertomyzon and their affinities.
Unit-2:	Anatomy and physiology of organs and systems of chordate: Integumentary,

	Respiratory, Digestive, Excretory, Circulatory, Nervous, Reproductive, Sensory organs and Endocrine glands.
Unit-3:	Parthenogenesis. Gametogenesis. Fertilization. Patterns of cleavage. Frog and chick embryology upto the formation of three germinal layers. Fate map construction in frog & chick. Gastrulation in frog and chick. Concept of competence, determination and differentiation. Extra embryonic membranes in chick. Concept of regeneration.
Unit-4:	Abiotic and Biotic Factors. Energy flow in ecosystem. Food chain and Food web. Biogeochemical cycle: CO <sub>2</sub> , O <sub>2</sub> , N and P. Population Concept- Characteristics of population. Factors affecting population growth. Community Concept, Succession, Periodicity, Indicators, Fresh water habitat - Factors and classification. Marine habitat: Factors and classification. Terrestrial habitat: Factors and classification. Ecological divisions of India. Natural resources and their Conservation with special reference to forests.
Unit-5:	General study of Edible fresh water fishes. Carp fish culture: Types of Ponds, Management of ponds, Preservation and Processing of fishes. Maintenance of Aquarium. Plankton and their role in Fisheries. Elementary knowledge of polyculture: Species of Silkworm, life history of bombyx mori, Sericulture Industry in India. Apiculture- life cycle and species, Methods of bee keeping, products of bees, enemies of bees. Lac culture: Lifecycle, Host Plant cultivation. Common Pest: Stored Grains pests- Sitophilus oryzae and Tribolium castaneum, Vegetable pest- Pests brassicae and Dacus cucurbitae. Biological Control of insect pests.

## SYLLABUS - ZOOLOGY

### SECOND PAPER

इकाई-1	कॉडेटा (रज्जुकी संघ) का पारकर एवं हेसवेल (सातवें संस्करण) के अनुसार गण स्तर तक वर्गीकरण, वर्ग पायसिस (मछलियां), एम्फीबिया (उभयचर), रेप्टिलिया (सरीसर्प), एविस(पक्षी) एवं मेमेलिया (स्तनी) का वर्गीकरण लक्षण एवं उदाहरण सहित। प्राणी विशेष का अध्ययन- हर्डमानिया, एम्फीऑक्सस तथा उनकी बंधुता। पेट्रों माइजोन एवं उसकी बंधुता।
इकाई-2	कशेरुक अंगों एवं संस्थान की अन्तः रचना (एनॉटामी) तथा कार्यात्मिकी अध्यावरण, श्वसन, पाचन, उत्सर्जी, परिसंचरण, तंत्रिका, प्रजनन, संवेदी अंग एवं अतः-स्त्रावी ग्रंथियां।
इकाई-3	अनिषेचक जनन। युग्मकजनन। निषेचन। विदलन के प्रकार। मेंढक व चूजे में तीन जनन स्तरों बनने तक का निर्माण एवं आरंभिक विकास। मेंढक एवं चूहे में भविष्य मानचित्र निर्धारण। मेंढक तथा चूजे में कन्दुकरण (गेस्ट्रूलेशन)। सामर्थ्य (क्षमता), निर्धारण एवं विभेदीकरण की अवधारणा। चूजे की अतिरिक्त गर्भ झिल्लियाँ। पुनरुद्भवन की अवधारणा।
इकाई-4	जैविक एवं अजैविक घटक। पारिस्थितिक तंत्र में उर्जा प्रवाह, खाद्य-शृंखला तथा खाद्य-जाल। जैव-भू-रासायनिक चक्र: CO <sub>2</sub> , O <sub>2</sub> , N तथा P। जनसंख्या की अवधारणा-जनसंख्या के लक्षण, जनसंख्या वृद्धि को प्रभावित करने वाले कारक। समुदाय की अवधारणा, अनुक्रमण, आवृत्ति, सूचक। स्वच्छ जलीय आवास : घटक तथा वर्गीकरण। समुद्र जलीय आवास घटक तथा वर्गीकरण। स्थलीय आवास : घटक एवं वर्गीकरण। भारत का पारिस्थितिकीय विभाजन। प्राकृतिक संसाधन एवं उनका संरक्षण (वनो के विशेष संदर्भ में)।
इकाई-5	खाद्य योग्य स्वच्छ जलीय मछलियों का सामान्य अध्ययन। कार्प मछली संवर्धन : तालाब के प्रकार, तालाब का प्रबंधन, मछलियों का परिरक्षण एवं संसाधिकरण। मछलीघर का प्रबंधन। प्लवक एवं उनकी मत्स्यीकी उद्योग में भूमिका। पॉली कल्चर (बहुसंवर्धन) का प्रारंभिक ज्ञान।

<p>रेशमकीट: संवर्धन, रेशमकीट की प्रजातियां, बाम्बेक्स मोरी का जीवन चक्र, भारत में रेशम उद्योग। मधुमक्खी पालन: जीवन चक्र एवं जातियां, मधुमक्खी पालन की विधियां, मधुमक्खी पालन के उत्पाद, मधुमक्खी के शत्रु। लाख कीट: संवर्धन, जीवन चक्र, पौषीय पौधों की खेती। सामान्य पीड़क : संग्रहित अनाज के पीड़क – सिटोफिलस ऑरायजी एवं ट्राइबोलियन कास्टेनेयम। सब्जियों के पीड़क-पियरिस ब्रेसिसी एवं डेकस कुकरबिटी। कीट पीड़कों का जैविक</p>
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## SYLLABUS -PHYSICS

### FIRST PAPER

#### 1). Mathematical Physics

Scalar and vector fields; Differentiation & integration of a vector; Repeated integral of a function of more than one variable; Unit tangent vector and unit normal vector; Gradient, Divergence and Curl; Laplacian operator; Idea of line, surface and volume integrals; Gauss, Stokes and Green's Theorems.

#### 2). Mechanics

Velocity and Position by Integration, Position and Velocity Vectors, Acceleration Vector, Components of velocity and acceleration in different coordinate systems.

Newton's Laws of motion and its explanation with problems, various types of forces in nature (explanation), Pseudo Forces (e.g. Centrifugal force), Coriolis force and its applications. Motion under a central force, Derivation of Kepler's laws. Gravitational law and field, Potential due to a spherical body. Gauss & Poisson's equation of Gravitational self-energy. System of particles, Centre of mass and reduced Mass. Elastic and inelastic collisions.

#### 3). General Properties of Matter

Elasticity: Hook's law and coefficient of elasticity; Young's modulus, Bulk modulus and Modulus of rigidity; Work done during longitudinal strain, volume strain, and shearing strain, Poisson's ratio; Relation between three elastic moduli ( $Y, \eta, K$ ); Determination of  $Y$  of rectangular thin bar loaded at the centre; Torsional oscillations, Torsional rigidity of a wire.

*Surface tension:* Surface Tension, Angle of Contact, Capillary Rise Method; Energy required to raise a liquid in capillary tube; Factors affecting surface tension; Jeager's method for Determination of surface tension; Applications of Surface Tension.

*Viscosity and Fluid Mechanics:* Concept of Viscous Forces and Viscosity; Steady and Turbulent Flow, Reynolds's number Equation of Continuity; Bernoulli's Principle; Application of Bernoulli's equation - Speed of Efflux, Venturimeter.

#### 4). Oscillations

Concept of Simple, Periodic & Harmonic Oscillation with Illustrations; Differential equation of harmonic oscillator; Kinetic and potential energy of Harmonic Oscillator; Oscillations of two masses connected by a spring; Translational and Rotational Motion, Moment of Inertia and their Product, Principal moments and axes, Motion of Rigid Body, Euler's equation.

#### 5). Thermodynamic

Reversible and irreversible process, Heat engines, Definition of efficiency, Carnot's ideal heat engine, Carnot's cycle, Effective way to increase efficiency, Carnot's engines and refrigerator, Coefficient of performance, First and Second law of Thermodynamics, Carnot's Theorem, Clapeyron's latent heat equation, Carnot's cycle and its applications.

Concept of entropy, Change in entropy in adiabatic process, Change in entropy in reversible cycle. Principle of increase of entropy, Change in entropy in irreversible process. T-S diagram, Physical significance of Entropy, Entropy of a perfect gas, Kelvin's thermodynamic scale of temperature, The size of a degree, Zero of absolute scale, Identity of a perfect gas scale and absolute scale. Third law of thermodynamics, Zero point energy, Negative temperatures (not possible). Relation between thermodynamic variables (Maxwell's relations)

#### 6). Optics



The Principle of superposition, two slit interference, coherence requirement for the sources, optical path retardations, lateral shift of fringes, Rayleigh refractometer and other applications. Localised fringes, thin films, interference by a film with two nonparallel reflecting surfaces, Newton's rings. Haidinger fringes (Fringes of equal inclination), Michelson interferometer, its application for precision determination of wavelength, wavelength difference and the width of spectral lines.

*Fresnel diffraction* : Fresnel's theory of half period zone, diffraction at straight edge, rectilinear propagation.

*Fraunhofer diffraction* : Diffraction at a slit, phasor diagram and integral calculus methods. Diffraction at a circular aperture and a circular disc, Rayleigh criterion of resolution of images. Resolving power of telescope and microscope. Outline of phase contrast microscopy. Diffraction Grating: Diffraction at N-parallel slits, Intensity distribution, Plane diffraction grating, Concave grating and its mountings.

Transverse nature of light waves, Polarization of electromagnetic (em) waves, Plane polarised light-Production and analysis, Description of Linear, circular and elliptical polarisation. Propagation of em waves in anisotropic media, uniaxial and biaxial crystals, symmetric nature of dielectric tensor, Double refraction, Hygen's Principle, Ordinary and extraordinary refractive indices, Fresnel's formula, light propagation in uniaxial crystal, Nicol prism, Production of circularly and elliptically polarized light.

#### 7). Electrostatics

Coulombs law in vacuum expressed in vector forms, calculations of electric field E for simple distributions of charge at rest, dipole and quadruple fields. Work done on a charge in an electrostatic field expressed as a line integral, conservative nature of the electrostatic field. Relation between electric field & electric potential ( $\mathbf{E} = -\nabla V$ ), torque on a dipole in a uniform electric field and its energy, Flux of the electric field, Gauss's law and its application for finding E for symmetric charge distributions, Gaussian pillbox, fields at a surface of conductor, screening of E field by a conductor.

Capacitors, electrostatic field energy, force per unit area of the surface of a conductor in an electric field, conducting sphere in a uniform electric field, point charge in front of a grounded infinite conductor.

#### 8). Magnetostatics

Force on a moving charge, Lorentz force equation and definition of B, force on a straight conductor carrying current in a uniform magnetic field, torque on a current loop, magnetic dipole moment, angular momentum and gyromagnetic ratio, Biot and Savart's law, calculation of H for simple geometrical situations such as Solenoid, Anchor ring. Ampere's Law.  $\nabla \times \mathbf{B} = \mu_0 \mathbf{J}$ ,  $\nabla \cdot \mathbf{B} = 0$ . Field due to a magnetic dipole, free and bound currents, magnetization vector (M), relationship between B, H and M. Derivation of the relation  $\nabla \times \mathbf{M} = \mathbf{J}$  for nonuniform magnetization.

#### 9). Current Electricity:

Steady current, current density J, non-steady currents and continuity equation, Kirchoff's laws and analysis of multiloop circuits, growth and decay of current in LR and CR circuits, decay constants, LCR circuits. AC circuits, complex numbers and their applications in solving AC circuits problems, complex impedance and reactance, series and parallel resonance. Q-factor, power consumed by an A.C. circuit, power factor.

#### 10). Electrodynamics

Electromagnetic induction, Faraday's Laws, Electromotive force, Integral and differential forms of Faraday's laws, Self and mutual inductance, Transformers, Energy in a static magnetic field, Maxwell's displacement current, Derivations of Maxwell's equations, Electromagnetic field energy density.

Poynting vector, Electromagnetic wave equation, Plane electromagnetic waves in vacuum and dielectric media, Reflection at a plane boundary of dielectrics, Fresnel's Laws, polarization by reflection and total internal reflection, waves in a conducting medium, Reflection and refraction by the ionosphere.

## पाठ्यक्रम –भौतिकी

### प्रथम प्रश्न-पत्र

#### 1). गणितीय भौतिकी

अदिश व सदिश क्षेत्र, सदिश का समाकलन एवं अवकलन, एक से अधिक चरों के फलन का बारम्बार समाकलन, इकाई स्पर्श सदिश व इकाई नार्मल सदिश, सदिश का ग्रेडियन्ट, डायवर्जेंस एवं कर्ल, लाप्लासीयन आपरेटर, रेखीय, पृष्ठीय, आयतन समाकलन, गॉस, स्टोक व ग्रीन प्रमेय।

#### 2). यांत्रिकी

समाकलन द्वारा वेग व स्थिति, स्थिति व वेग सदिश, त्वरण सदिश, गति व त्वरण के विभिन्न निर्देशांक पद्धतियों में घटक। न्यूटन के गति के नियम व इसकी व्याख्या, प्रकृति में विभिन्न बल व व्याख्या, छद्म बल, उदाहरण: अभिकेंद्रीय बल कोरियालिस बल व इसके उदाहरण, केंद्रीय बल के अंतर्गत गति, केप्लर के नियमों की निष्पत्ति, गुरुत्वाकर्षण का नियम व क्षेत्र, गोलाकार पिण्ड का गुरुत्वीय विभव, गॉस व पायसन की गुरुत्वीय स्व-उर्जा की समीकरण, कणों का निकाय, द्रव्यमान केंद्र व समानीत द्रव्यमान, प्रत्यास्थ व अप्रत्यास्थ टक्कर।

#### 3). द्रव्य के सामान्य गुण

प्रत्यास्थता: हुक का नियम एवं प्रत्यास्थता गुणांक, यंग प्रत्यास्थता गुणांक, आयतन प्रत्यास्थता गुणांक एवं दृढ़ता गुणांक, अनुदैर्घ्य विकृति, आयतन विकृति एवं ऐठन विकृति में किया गया कार्य, पायसन निष्पत्ति, समदैशिक ठोस के तीन प्रत्यास्थता गुणांकों में संबंध  $(Y, \eta, K)$ । मध्य में भारित पतली आयताकार छड़ (केन्टीलीवर) के  $Y$  का निर्धारण, ऐठन दोलन, किसी तार की ऐठन दृढ़ता।

पृष्ठ तनाव: पृष्ठ तनाव, स्पर्श कोण, केशिका उन्नयन विधि, केशिका में द्रव चढ़ाने में आवश्यक उर्जा, पृष्ठ तनाव को प्रभावित करने वाले कारक, जेगर की विधि से पृष्ठ तनाव का निर्धारण पृष्ठ तनाव के अनुप्रयोग।

श्यानता एवं तरल यांत्रिकी: श्यान बल की संकल्पना व श्यानता गुणांक, धारा रेखीय व विक्षुब्ध प्रवाह, रेनॉल्ड संख्या, सांतत्य समीकरण, बरनॉली का सिद्धांत, बरनॉली प्रमेय के अनुप्रयोग: एपलक्स की चाल व वेन्चुरीमीटर।

4). दोलन सरल, आवर्ती व हार्मोनिक गति की सचित्र संकल्पना, आवर्ती दोलित्र का समीकरण, आवर्ती दोलित्र की गतिज व स्थितिज उर्जा, स्प्रिंग से जुड़े दो पिंडों का दोलन, स्थानान्तरणीय व घूर्णीय गति, जड़त्व आघूर्ण व उनका गुणन, मुख्य आघूर्ण एवं अक्ष, दृढ़ पिण्ड की गति, यूलर समीकरण।

#### 5). उष्मागतिकी :

उत्क्रमणीय एवं अनुत्क्रमणीय प्रक्रम, कार्नों का आदर्श चक्र, इसकी दक्षता बढ़ाने के प्रभावी तरीके, कार्नों का उष्मीय इंजन व प्रशीतक, दक्षता गुणांक, उष्मागतिकी का प्रथम एवं द्वितीय नियम, कार्नों का प्रमेय, क्लेपरियॉन की गुप्त उष्मा समीकरण, कार्नों चक्र एवं उसके अनुप्रयोग।

एन्ट्रॉपी की संकल्पना, रूद्धोष्म प्रक्रम में एन्ट्रॉपी का परिवर्तन, एन्ट्रॉपी के वृद्धि का सिद्धांत, उत्क्रमणीय व अनुत्क्रमणीय प्रक्रम में एन्ट्रॉपी का परिवर्तन। T-S आरेख, एन्ट्रॉपी का भौतिक महत्व, आदर्श गैस की एन्ट्रॉपी, केल्विन का उष्मागतिक ताप पैमाना, परम पैमाने का शून्य ताप, आदर्श गैस व परम ताप पैमाने में साम्यता। उष्मागतिकी का तृतीय नियम, शून्य बिन्दु उर्जा, ऋणात्मक तापक्रम (सम्भव नहीं)। उष्मागतिकी चरों में संबंध (मैक्सवेल के समीकरण)।

#### 6). प्रकाशिकी :

अध्यारोपण का सिद्धांत, द्विस्लिट व्यतिकरण, स्रोतों की कला संबद्धता की आवश्यकता, प्रकाशीय पथ का मंदन, फ्रिंजों का पार्श्विक विस्थापन, रैले का रिफ्रेक्ट्रोमीटर व अन्य अनुप्रयोग, स्थानीकृत फ्रिंजें, पतली फिल्म, दो समानान्तर परावर्तक सतह से बनी फिल्म से व्यतिकरण, न्यूटन वलय। हैडिन्जर फ्रिंजें (संमान झुकाव की फ्रिंजें), माइकल्सन व्यतिकरणमापी, इसके द्वारा प्रकाश की तरंग दैर्घ्य  $(\lambda)$  दो अत्यंत समीपस्थ तरंग दैर्घ्य का अंतर तथा वर्णक्रम रेखा की चौड़ाई का परिशुद्ध निर्धारण।

फ्रेनल विवर्तन : फ्रेनल के अर्द्धकालिक कटिबंध का सिद्धांत, सीधी कोर पर विवर्तन, सरलरेखीय गमन।

फ्रानहॉफर विवर्तन: एकल झिरी पर विवर्तन का आरेख एवं समाकलन विधियाँ, वृत्तीय द्वारक, वृत्तीय चकती पर विवर्तन, प्रतिबिम्बों के विभेदन की रैले की कसौटी। दूरदर्शी व सूक्ष्मदर्शी की विवेदन क्षमता, फेज कन्ट्रास्ट, सूक्ष्मदर्शी की सामान्य रूपरेखा।

विवर्तन ग्रेटिंग : N समानान्तर झिरियों पर विवर्तन, तीव्रता वितरण, समतल विवर्तन ग्रेटिंग, परावर्तन ग्रेटिंग, अवतल ग्रेटिंग व विभिन्न आरोपण विधियाँ।

प्रकाश तरंग की अनुप्रस्थ प्रकृति, विद्युत चुम्बकीय तरंग का ध्रुवण, समतल ध्रुवित प्रकाश-उत्पादन व विश्लेषण। रैखिक, वृत्तीय व दीर्घवृत्तीय ध्रुवण का वर्णन।

विद्युत चुम्बकीय तरंग का असमांगी माध्यम में संचरण, एक-अक्षीय व द्वि-अक्षीय क्रिस्टल, परावद्युत टेन्सर की सममिति प्रकृति, द्वि-अपवर्तन, हाइगन का सिद्धांत, साधारण व असाधारण अपवर्तनांक, फ्रेनल का सूत्र, एक अक्षीय क्रिस्टल में प्रकाश संचरण। निकॉल प्रिज्म, वृत्तीय व दीर्घवृत्तीय प्रकाश का उत्पादन।

7). स्थिर विद्युतिकी :

निर्वात में कूलम्ब का नियम— सदिश रूप में विद्युत क्षेत्र  $E$  की स्थिर आवेश के सरल द्विध्रुव व चतुर्ध्रुव आघूर्ण वितरण हेतु गणना। स्थिर विद्युत क्षेत्र में किसी आवेश पर किया गया कार्य एवं

उसे रैखिक समाकन रूप में लिखना, स्थिर विद्युत क्षेत्र की संरक्षी प्रकृति। विद्युत क्षेत्र और विभव में संबंध ( $E = -\nabla V$ ), एक समान विद्युतीय क्षेत्र में द्विध्रुव का आघूर्ण व इसकी उर्जा विद्युत क्षेत्र का फ्लक्स, गॉस का नियम व इसका सममित आवेश वितरण हेतु  $E$  के परिकलन में उपयोग। गॉसियन पिलबॉक्स, चालक की सतह पर क्षेत्र, चालक द्वारा  $E$  क्षेत्र की स्क्रीनिंग।

संधारित्र, स्थिर विद्युत क्षेत्र उर्जा, किसी विद्युत क्षेत्र में रखे चालक की सतह के इकाई क्षेत्रफल पर उर्जा, समरूप विद्युत क्षेत्र में गोलकार चालक, किसी पृथ्वीकृत अनन्त चालक के सम्मुख बिन्दु पर आवेश।

8). स्थिर चुम्बकत्व :

किसी गतिमान आवेश पर बल, लारेंज बल समीकरण एवं  $B$  की परिभाषा, सीधे धारावाही चालक को चुम्बकीय क्षेत्र में रखने पर बल, धारा लूप पर बल आघूर्ण, चुम्बकीय बल आघूर्ण, कोणीय संवेग व जाइरोमैग्नेटिक अनुपात, बायो-सेवार्ट का नियम, सरल ज्यामितीय परिस्थितियों में  $H$  की गणना (परनलिका एवं एंकर वलय), एम्पियर का परिपथीय नियम,

$\nabla \times B = \mu_0 J$ ,  $\nabla \cdot B = 0$ , चुम्बकीय द्विध्रुव द्वारा बद्ध व मुक्त धाराएँ, चुम्बकन सदिश ( $M$ );  $B$ ,  $H$  एवं  $M$  में संबंध, असमरूप से चुम्बकित पदार्थ हेतु  $\nabla \times M = J$  का निगमन।

9). विद्युत धारा :

स्थाई धारा, धारा घनत्व  $J$ , अस्थाई धारा समीकरण, किरचॉफ के नियम व मल्टीलूप परिपथ विश्लेषण,  $LR$  व  $CR$  परिपथ में धारा की वृद्धि व क्षय, क्षय-नियतांक,  $LCR$  परिपथ।  $AC$  परिपथ, सम्मिश्र संख्याएं और उनके अनुप्रयोग द्वारा  $AC$  परिपथ में सम्मिश्र प्रतिबाधा, रीएक्टेंस, श्रेणी एवं समानांतर अनुनाद को हल करना।  $Q$  गुणांक,  $AC$  परिपथ द्वारा शक्ति का उपयोग, शक्ति गुणांक।

10). विद्युत गतिकी :

विद्युत चुम्बकीय प्रेरण, फेराडे के नियम, विद्युत बाहक बल, फेराडे नियम के अवकलन व समाकलन रूप, स्व: व अन्योन्य प्रेरण, ट्रान्सफार्मर, स्थिर विद्युत क्षेत्र में उर्जा, मैक्सवेल की विस्थापन धारा घनत्व की संकल्पना, मैक्सवेल की समीकरणों की स्थापना, विद्युत चुम्बकीय क्षेत्र का उर्जा घनत्व।

पॉयंटिंग सदिश, विद्युत चुम्बकीय तरंग समीकरण, निर्वात एवं परावैद्युत माध्यम में समतल विद्युत चुम्बकीय तरंग, परावैद्युत की समतल सतह से परावर्तन, फ्रेनल के नियम, परावर्तन से ध्रुवण व पूर्ण आंतरिक परावर्तन, चालक, माध्यम में तरंग, आयनमण्डल के द्वारा परावर्तन व अपवर्तन।

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## SYLLABUS -PHYSICS PAPER-SECOND

1). Theory of Relativity:

Michelson-Morley experiment and its outcome, Postulates of Special Theory of Relativity, Lorentz Transformations. Simultaneity and order of events; Lorentz contraction; Time dilation; Relativistic Transformation of velocity, Relativistic addition of velocities; Variation of mass with velocity. Reference systems, inertial frames, Galilian Invariance and conservation laws, propagation of light, mass- energy equivalence, particle with zero rest mass.

2). Statistical Physics :

Description of a System: Significance of statistical approach Microstates and Macro- states of a system, Equilibrium states, Fluctuations, Classical & Statistical Probability, The equi-probability postulate, Statistical ensemble, Number of states accessible to a system, Phase space. Micro Canonical Ensemble, Canonical Ensemble, Helmholtz free energy, Enthalpy, Gibbs free energy, Grand Canonical Ensemble.

Phase space the probability of a distribution, the most probable distribution and its narrowing with increase in number of particles, Maxwell-Boltzmann statistics, Molecular speeds, Distribution and mean, r.m.s. and most probable velocity, Constraints of accessible and inaccessible states.

Partition Function, Relation Between Partition Function and Entropy, Bose-Einstein statistics, Black-Body Radiation, The Rayleigh-Jeans formula, The Planck radiation formula, fermi-Dirac Statistics Comparison of results.

### 3). Quantum Physics :

Failure of classical physics to explain the phenomena such as a black-body spectrum, photoelectric effect, Planck's radiation law. Einstein's explanation of photoelectric effect. Bohr's quantization of angular momentum and its application to hydrogen atom, limitations of Bohr's theory. Wave-particle duality and uncertainty principle; de Broglie's hypothesis for matter waves; the concept of wave and group velocities, evidence for diffraction and interference of particles, experimental demonstrations of matter waves. Consequence of de Broglie's concepts;

quantization in hydrogen atom; energies of a particle in a box, wave packets Heisenberg's uncertainty relation for  $p$  and  $X$ , its extension to energy and time Consequence of the uncertainty relation; gamma ray microscope, diffraction at a slit, particle in a box, position of an electron in a Bohr's orbit, Schrodinger's equation. Postulates of quantum mechanics; operators, expectation values.

### 4). Atomic and Molecular Physics :

Solution of Schrodinger equation for Hydrogen atom, natural occurrence of quantum numbers- $n$ ,  $l$  and  $m$ , the related physical quantities. Spectra of hydrogen, deuteron and alkali atoms spectral terms, doublet fine structure. screening constants for alkali spectra for  $s, p, d$  and  $f$  states, selection rules, Singlet and triplet fine structure in alkaline earth spectra. L-S and J-J couplings.

Discrete set of electronic energies of molecules, quantization of vibration and rotational energies, determination of inter-nuclear distance, pure rotational and rotation-vibration spectra Dissociation limit for the ground and other electronic states, transition rules for pure vibration and electronic vibration spectra.

Raman Effect, Stokes and anti-stokes lines, complimentary character of Raman and infrared spectra.

### 5). Nuclear Physics :

Interaction of charged particles and neutrons with matter, working of nuclear detectors, G-M counter, proportional counter, scintillation counter, cloud chamber, spark chamber and emulsions technique. Structure of nuclei, basic properties ( $Z, \mu, Q$  and **Binding energy**), deuterium binding energy,  $p$ - $p$  and  $n$ - $p$  scattering and general concepts of nuclear forces. Beta decay, range of alpha particle, Geiger-Nuttal law. Gamow's explanation of alpha decay, beta decay, continuous and discrete spectra. Nuclear reactions, channels, compound nucleus, direct reaction (concepts). Shell model, Liquid drop model, Nuclear fission and fusion (concepts), energy production in stars by  $p$ - $p$  and carbon- nitrogen cycles (concepts).

### 6). Solid State Physics :

Crystal Structure: Periodicity, lattices and bases, Fundamental translation vectors, unit cell, Wigner-Seitz cell, allowed rotations, lattice types, and lattice planes. Common crystal structures. Laue's theory of X-ray diffraction, Bragg's law, Laue patterns.

Bonding: Potential Between a pair of atoms, Lennard -Jones potential, concept of cohesive energy, covalent, Vander Waal, ionic and metallic crystals.

Magnetism: Atomic magnetic moment, magnetic susceptibility, Dia, Para and Ferromagnetism, Ferro magnetic domains. Hysteresis.

Thermal Properties: Lattice vibrations, simple harmonic oscillator, second order expansion of Lennard- Jones potential about the minimum, vibrations one dimensional mono-atomic chain under harmonic and nearest neighbor interaction approximation. Concept of phonons, density of modes (1-D). Debye model; Lattice specific heat low temperature limit, extension (conceptual) to 3-D.

Band Structure: Electrons in periodic potential; nearly free electron model (qualitative), energy band, energy gap, metals, insulators, semiconductors.

### 7). Semiconductors and electronics :

Semiconductors: Intrinsic-semiconductors, electrons and holes, Fermi Level, Temperature dependence of electron and hole concentrations. Doping: impurity states,  $n$  and  $p$  type semiconductors, conductivity, mobility, Hall Effect, Hall Coefficient.

Semiconductor Devices: Metal-semiconductor Junction, P-n Junction, majority and minority carriers, diode, Zener and tunnel diodes, light emitting diode, transistor, and solar cell.

Transistors : Characteristics of a transistor in CB, CE and CC mode, graphical analysis of the CE configuration, low frequency equivalent circuits, h-parameters, bias stability, thermal runaway.

FETS: Field effect transistors, JFET volt-ampere curves, biasing JFET, ac operation of JFET, source follower. MOSFET, biasing MOSFET, FET as variable voltage resistor.

Amplifiers: Small signal amplifiers: General Principle of operation, classification, distortion, RC coupled amplifier, gain frequency response, input and output impedance, multistage amplifiers.

8). Laser :

Laser system, Purity of a spectral line, coherence length and coherence time, spatial coherence of a source, Einstein's A and B coefficients. spontaneous and induced emissions, conditions for laser action, population inversion. Types of Lasers (gas and solid state), Pulsed lasers and tunable lasers, spatial coherence and directionality, estimates of beam intensity, temporal coherence and spectral energy density.

## पाठ्यक्रम- भौतिकी द्वितीय प्रश्न-पत्र

### 1. सापेक्षता का सिद्धान्त

माइकल्सन व मोरले का प्रयोग एवं इसके निष्कर्ष, विशिष्ट सापेक्षता के सिद्धांत की अवधारणाएँ, लॉरेंज रूपान्तरण, समकालिक घटना एवं घटनाओं के क्रम, लॉरेंज संकुचन समय विस्तारण, वेग, का सापेक्षकीय रूपान्तरण, वेगों का सापेक्षकीय योग, वेग के साथ द्रव्यमान परिवर्तन। निर्देश तंत्र, जडत्वीय तंत्र, गैलिलीयो का निश्चरता और संरक्षण के नियम, प्रकाश का संचरण, द्रव्यमान ऊर्जा समतुल्यता, शून्य विराम द्रव्यमान का कण।

### 2. सांख्यिकीय भौतिकी

निकाय का वर्णन : सांख्यिकीय अवधारणा का महत्व, निकाय की सूक्ष्म एवं स्थूल अवस्थाएँ, साम्य अवस्थाएँ, विचलन, चिरसम्मत व सांख्यिकी प्रायिकता, पूर्व प्रायिकता सिद्धान्त, सांख्यिकी एन्सेम्बल, किसी निकाय के लिये अभिगम्य अवस्थाएँ, कला आकाश। माइक्रो केनोनीकल एन्सेम्बल, केनोनीकल एन्सेम्बल, हेल्महोल्टज मुक्त उर्जा, एन्थैल्पी, गिब्स मुक्त उर्जा, ग्रैंड केनोनीकल एन्सेम्बल।

कला आकाश, वितरण की प्रायिकता, अधिकतम संभाव्य वितरण व इसका कणों की संख्या बढ़ने पर संकुचन, मेक्सवेल बोल्टजमैन सांख्यिकी, आणविक चाल का वितरण, औसत चाल, वर्ग-माध्य-मूल चाल और अधिकतम प्रसम्भाव्य वेग, प्रतिबंध, अभिगम्य एवं अनभिगम्य अवस्थाओं के प्रतिबंध।

विभाजक फलन, एंटापी व विभाजक फलन में संबंध, बोस आइन्सटीन सांख्यिकी, कृष्ण पिण्ड विकिरण, रेले-जीन्स सूत्र, प्लांक विकिरण सूत्र, फर्मी-डिराक सांख्यिकी, परिणामों की तुलना।

### 3. क्वाण्टम भौतिकी

निम्न घटनाओं की चिरसम्मत भौतिकी द्वारा व्याख्या करने में असफलता जैसे- कृष्ण-पिण्ड स्पेक्ट्रम, प्लांक का विकिरण का नियम, प्रकाश-विद्युत प्रभाव की आइन्सटीन द्वारा व्याख्या, कोणीय संवेग का बोहर क्वांटीकरण तथा हाईड्रोजन परमाणु हेतु इसका अनुप्रयोग। बोहर सिद्धान्त की सीमायें। तरंग कण द्वैतता तथा अनिश्चतता का सिद्धांत, द्रव्य-तरंगों की डी-ब्रोगली परिकल्पना, तरंग तथा समूह वेगों की अभिधारणा, कणों के विवर्तन एवं व्यतिकरण हेतु साक्ष्य, द्रव्य तरंगों का प्रायोगिक प्रदर्शन। डी-ब्रोगली अवधारणा के प्रतिफल, हाईड्रोजन परमाणु में क्वांटीकरण, बॉक्स के अंदर स्थित कण की उर्जा, तरंग पैकेट्स संवेग और स्थिति में अनिश्चतता का हाईजनबर्ग संबंध तथा इसका ऊर्जा व समय के साथ विस्तार। अनिश्चतता सिद्धांत के प्रतिफल : गामा किरण सूक्ष्मदर्शी, एकल स्लिट द्वारा विवर्तन, बॉक्स के अंदर कण, बोहर कक्ष में इलेक्ट्रान की स्थिति। क्वांटम यांत्रिकी : श्रोडिन्जर समीकरण, क्वांटम यांत्रिकी की परिकल्पनाएँ, संकारक, प्रत्याशा-मान।

### 4. परमाणु एवं आणविक भौतिकी

हाइड्रोजन परमाणु के लिए श्रोडिन्जर समीकरण का हल,  $n, l$  तथा  $m$  क्वांटम संख्याओं की प्राकृतिक व्याख्या तथा संबंधित भौतिक राशियां, हाइड्रोजन वर्णक्रम, ड्यूट्रान तथा क्षारीय स्पेक्ट्रमी तत्व, द्वि-सूक्ष्म संरचना (डबलेट फाइन स्ट्रक्चर),  $s, p, d$  तथा  $f$  अवस्थाओं वाले क्षारीय स्पेक्ट्रम हेतु आवरणों (स्क्रीनिंग नियतांक), वरण नियम, क्षारीय मृदा (अल्कलाईन अर्थ) वर्णक्रम की एकल तथा त्रिक संरचनायें। L-S और J-J युग्मन।

अणुओं के इलेक्ट्रानिक उर्जाओं के विभिन्न स्तर, काम्पनिक एवं घूर्णिक उर्जाओं के क्वांटीकरण, आन्तर नाभिकीय दूरी का मापन, शुद्ध घूर्णीय तथा घूर्णीय काम्पनिक वर्णक्रम, मूल (ग्राउंड) तथा अन्य इलेक्ट्रानिक स्तरों की अपघटन सीमाएँ, शुद्धकाम्पनिक तथा इलेक्ट्रानिक काम्पनिक वर्णक्रम के संक्रमण नियम।

रमन प्रभाव, स्टोक तथा प्रति स्टोक रेखाएँ, रमन एवं अवरक्त वर्णक्रम की पूरक प्रकृति।

### 5. नाभकीय भौतिकी

न्यूट्रान तथा आवेशित कणों की द्रव्य के साथ अनुक्रिया। नाभिकीय संस्रूकों की कार्यविधि, गायगर-मुलर गणक, आनुपातिक तथा प्रस्फुरण गणक, मेघ कोष्ठ, स्पार्क प्रकोष्ठ, इमल्शन तकनीक। नाभिकों की संरचना, मूलगुण ( $I, \mu, Q$  और बंधन उर्जा) ड्यूटेरियम की बन्धन उर्जा, प्रोटान-प्रोटान तथा न्यूट्रान प्रोटान प्रकीर्णन एवं नाभिकीय बलों की सामान्य अवधारणा। बीटा क्षय, अल्फा कणों का परास, गाइगर-नटल नियम। एल्फा क्षय के लिए गैमों की व्याख्या, बीटा क्षय, सतत एवं विविक्त वर्णक्रम। नाभिकीय अभिक्रिया, जैनल, यौगिक नाभिक, सीधी अभिक्रिया (अवधारणाएँ), कोश मॉडल, द्रव-बूंद मॉडल, नाभिकीय विखण्डन एवं संलयन अवधारणाएँ (फिजन एवं फ्यूजन अवधारणाएँ), तारों में ऊर्जास्रोत, p-p एवं C-N चक्र (अवधारणाएँ)।

6. ठोस अवस्था भौतिकी

क्रिस्टल संरचना : आवृत्तता, जालक एवं आधार, मूल स्थानांतरण सदिश, इकाई सेल, विग्नर-सिट्ज सेल, अनुभूत घूर्णन, जालक प्रकार, जालक तल, सामान्य क्रिस्टल संरचनाएँ। X-किरण विवर्तन का लॉउ सिद्धान्त, ब्रेग का नियम, लॉउ पैटर्न।

परमाणु अबधन : परमाणु के जोड़ों के मध्य विभव, लेनार्ड - जोन विभव, ससंजक ऊर्जा की अभिधारणा, सह संयोजन, वाण्डर-वॉल, आयनिक तथा धात्विक क्रिस्टल।

चुम्बकत्व : परमाणविक चुम्बकीय आघूर्ण, चुम्बकीय प्रवृत्ति, प्रति, अनु एवं लौह चुम्बकत्व, लौह चुम्बकीय डोमेन शैशिल्य हानि।

उष्मीय गुण : जालक कम्पन, सरल आवर्त दोलित्र, लेनार्ड - जोन विभव के निम्नतम मान के परितः द्वितीय श्रेणी प्रसार, निकटतम सानिध्य तथा आवर्त अन्योन्य क्रिया के सन्निकटता में एक परमाणविक कड़ी के एक विमीय दोलन, फोनोन की अभिधारणा, विधाओं (एक विमीय) का घनत्व, डिबाई प्रतिरूप, जालक विशिष्ट उष्मा, निम्न तापक्रम सीमा, त्रिविमीय विस्तार (केवल अभिधारणा)

बैण्ड संरचना : आवर्ती विभव में इलेक्ट्रॉन, लगभग मुक्त इलेक्ट्रॉन प्रतिरूप (गुणात्मक), ऊर्जा बैण्ड, ऊर्जाअंतराल, धातु, कुचालक, अर्धचालक।

7. अर्द्ध चालक एवं इलेक्ट्रॉनिकी

आन्तरिक अर्द्ध चालक, इलेक्ट्रान एवं विवर, फर्मी स्तर, इलेक्ट्रान तथा विवर सान्द्रता की ताप पर निर्भरता, अपमिश्रण, अशुद्ध अर्द्धचालक, P तथा N प्रकार के अर्धचालक, चालकता, गतिशीलता, हाल प्रभाव, हाल गुणांक।

अर्धचालक युक्तियाँ: धातु अर्धचालक संधि, p-n संधि, बहु एवं अल्पसंख्यक वाहक, डायोड, जेनर एवं टनल डायोड, प्रकाश उत्सर्जन डायोड, ट्रांजिस्टर, सोलर सेल।

ट्रांजिस्टर : ट्रांजिस्टर के अभिलाक्षणिक वक्र: उभयनिष्ठ आधार, उत्सर्जन एवं संग्राहक विधा में, उभयनिष्ठ उत्सर्जन विधा में ग्राफीय विश्लेषण, निम्न आवृत्ति समतुल्य परिपथ, h प्राचल, अभिनति स्थायित्वता, तापीय अस्थिरता।

क्षेत्र प्रभाव ट्रांजिस्टर : वोल्ट- एम्पियर वक्र, JFET अभिनति, JFET के प्रत्यावर्ती प्रचालन, स्रोत अनुगामी, MOSFET, MOSFET अभिनति, परिवर्ती वोल्टेज प्रतिरोध के रूप में FET.

प्रवर्धक : लघु सिग्नल प्रवर्धक : प्रक्रिया के सामान्य सिद्धान्त, वर्गीकरण, विरूपण, RC युग्मित प्रवर्धक, आवृत्ति प्रवर्धक अनुक्रिया, निवेशी एवं निर्गत प्रतिबाधा, बहुस्तरीय प्रवर्धक।

8. लेजर :

लेजर निकाय, वर्णक्रम रेखा की शुद्धता। कला संबद्ध लम्बाई एवं कला संबद्ध समय। स्रोत की दैशिक कला संबद्धता, आइन्सटीन के A तथा B गुणांक। स्वतः एवं प्रेरित उत्सर्जन, लेजर क्रिया के लिए प्रतिबंध। जनसंख्या व्युत्क्रमण। लेजर के प्रकार : गैस एवं ठोस अवस्था, स्पंद लेजर एवं ट्यूनेबल लेजर, दैशिक कला संबद्धता, पुंज तीव्रता का आकलन, कालिक कला संबद्धता तथा वर्णक्रम ऊर्जाघनत्व।

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## Syllabus-- Chemistry

### Paper - I

1. Atomic structure-

Quantum theory, Heisenburg's uncertainty principle, Schrodinger wave equation, significance of  $\psi$  and  $\psi^2$ , quantum numbers, Shapes of orbital's, Radial and angular wave functions, Aufbau principle, Hund's multiplicity rule, Pauli exclusion principle, Effective nuclear charge.

2. Chemical bonding-

Chemical bonds, Valence bond theory, concept of resonance and resonance energy; Molecular orbital theory, Comparison of valence bond and molecular orbital theories, bond order, bond strength and bond length; Lattice energy, Born-Haber cycle; polarities of bonds in molecules and their dipole moments, The concept of hybridization, Weak interactions- hydrogen bonding and Vander Waals forces.

### 3. The gaseous state-

Deviation of real gases from the equation of state for an ideal gas; Vander Waals equation of state, critical phenomena, law of corresponding states, equation for reduced state; Liquefaction of gases, distribution of molecular velocity, collisions between molecules in a gas; mean free path.

### 4. Thermodynamics-

Thermodynamics systems, states and processes, work, heat and internal energy; first law of thermodynamics, work done on the system and heat absorbed in reversible and irreversible processes, calorimetry; Second law of thermodynamics; entropy and entropy changes in various process; Free energy functions; criteria for equilibrium, relation between equilibrium constant and thermodynamic quantities; Thermochemistry: Hess's law, heat of reaction at constant pressure and constant volume.

### 5. Phase rule and its applications-

Phase equilibria in pure substances; Clausis-Clapeyron equation, Number of components, phases and degrees of freedom; phase rule and its applications; simple systems with one (water and sulphur) and two components (lead-silver, salt hydrates); Distribution law, its modifications, limitations and applications.

### 6. Electrochemistry-

Electrochemical series, pH and buffers, Theory of indicators and acid-base titrations; Conductivity of ionic solutions, its variation with concentration; Ostwald's dilution law, Kohlrausch law and its application; Galvanic cells and measurements of their e.m.f., cell reactions, standard cell, standard reduction potential, Nernst equation, relation between thermodynamic quantities and cell e.m.f.

### 7. Chemical Kinetics -

Rate of chemical reaction and its dependence on concentration of the reactants; differential and integral rate equations for first and second order reaction, half-life period; temperature dependence of rate constant and Arrhenius equation.

### 8. Photochemistry-

Absorption of light; laws of photochemistry, quantum yield, the excited state and its decay by radiative, nonradiative and chemical pathways; simple photochemical reactions.

### 9. Catalysis-

Homogeneous and heterogeneous catalysis and their characteristics, mechanism of homogenous catalysis; enzyme catalysed reactions (Michaelis-Menten mechanism).

### 10. Bio-inorganic chemistry-

Essential and trace elements in biological processes, Biological role of alkali and alkaline earth metal ions, Nitrogen fixation.

### 11. Coordination chemistry-

Nomenclature, isomerism in coordination compounds, theories of coordination compounds (Valence bond theory and Crystal field theory) Magnetic properties of transition metal complexes; Compounds with metal-metal bonds, stereochemistry of complexes with 4 and 6 coordination numbers.

### 12. General chemistry of f-block elements-

Lanthanides and actinides: General characteristics, oxidation states, magnetic and spectral properties, lanthanide contraction, separation.

पाठ्यक्रम –रसायन शास्त्र

प्रथम प्रश्न पत्र

1. परमाणु संरचना—

क्वाण्टम सिद्धांत, हाइजनबर्ग का अनिश्चितता सिद्धांत, श्रौडिंजर तरंग समीकरण, तथा  $2$  की सार्थकता, क्वाण्टम संख्याएँ, आर्बिटलों के आकार, त्रिज्यीय तथा कोणीय तरंग फलन, ऑफबाऊ सिद्धांत, हुण्ड्स का बहुलता नियम, पाउली का अपवर्जन सिद्धांत, प्रभावी नाभिकीय आवेश।

2. रासायनिक बन्धन—

रासायनिक बन्ध, संयोजकता बन्ध सिद्धांत, अनुनाद की अवधारणा एवं अनुनाद ऊर्जा, आण्विक कक्षक सिद्धांत, संयोजकता बन्ध सिद्धांत तथा आण्विक कक्षक सिद्धांत का तुलनात्मक विवरण, आबन्ध कोटि, आबन्ध शक्ति, बन्ध लम्बाई; जालक ऊर्जा, बार्नर हैबर चक्र, अणुओं में बन्धों की ध्रुवणता एवं उनका द्विध्रुव आघूर्ण, संकरण की धारणा, दुर्बल अन्वय—हाइड्रोजन आबन्धन तथा वाण्डरवाल बल।

3. गैसीय अवस्था—

आदर्श गैस अवस्था समीकरण से वास्तविक गैसों का विचलन; वाण्डरवाल का अवस्था समीकरण, क्रान्तिक घटना, संगत अवस्थाओं का नियम, अवस्था का समानीत समीकरण; गैसों का द्रवण, आण्विक वेग का वितरण, गैस अणुओं के मध्य संघट्टन, माध्य मुक्त पथ।

4. ऊष्मागतिकी—

ऊष्मागतिकी तन्त्र, अवस्था एवं प्रक्रम, कार्य, ऊष्मा तथा आन्तरिक ऊर्जा, ऊष्मागतिकी का प्रथम नियम, उत्क्रमणीय तथा अनुत्क्रमणीय प्रक्रम में तन्त्र पर किया गया कार्य एवं अवशोषित ऊष्मा, कैलोरीयमिती; ऊष्मागतिकी का द्वितीय नियम, एण्ट्रॉपी तथा विभिन्न प्रक्रमों में एण्ट्रॉपी में परिवर्तन; मुक्त ऊर्जाफलन, साम्य कसौटी, साम्य स्थिरांक तथा ऊष्मागतिकी परिमाणों के मध्य सम्बन्ध; ऊष्मा रसायन—हेस का नियम, स्थिर दाब तथा स्थिर आयतन पर अभिक्रिया की ऊष्मा।

5. प्रावस्था नियम तथा उनके अनुप्रयोग—

शुद्ध पदार्थों में प्रावस्था साम्य, क्लॉसियस क्लेपेरोन समीकरण, घटकों की संख्या, प्रावस्था तथा स्वतंत्रता की कोटि, प्रावस्था नियम तथा उनके अनुप्रयोग; एक घटक (जल तथा सल्फर) तथा दो घटकों (लेड—सिल्वर, लवण हाइड्रेट) के सरल तन्त्र; वितरण नियम, इसका संशोधन, सीमाबन्धक तथा अनुप्रयोग।

6. विद्युत रसायन—

विद्युत रासायनिक श्रेणी, pH तथा बफर, सूचकों का सिद्धांत तथा अम्ल—क्षार अनुमापन; आयनिक विलयन की चालकता, सान्द्रता के साथ इसमें परिवर्तन; ओस्टवाल्ड का तनुता नियम, कोलरॉस नियम तथा इसका अनुप्रयोग; गैल्वनी सेल तथा उनके विद्युत वाहक बल (E.M.F.), का निर्धारण, सेल अभिक्रियायें, मानक सेल, मानक अपचयन विभव, नर्न्स्ट समीकरण, सेल के E.M.F. तथा ऊष्मागतिकी परिमाणों के मध्य सम्बन्ध।

7. रासायनिक बलगतिकी—

रासायनिक अभिक्रिया की गति तथा अभिकारकों की सान्द्रता पर निर्भरता; प्रथम एवं द्वितीय कोटि की अभिक्रिया के लिये अवकल तथा समाकलनीय वेग समीकरण, अर्द्ध—आयुकाल, वेग स्थिरांक की तापक्रम पर निर्भरता तथा अरहीनियस समीकरण।

8. प्रकाश रसायन—

प्रकाश का अवशोषण, प्रकाश रसायन के नियम, क्वाण्टम लब्धि, उत्तेजित अवस्था एवं इसका विकिरण, विकिरण रहित तथा रासायनिक मार्गक्रम द्वारा क्षरण, सरल (सामान्य) प्रकाश रासायनिक अभिक्रियाएं।

9. उत्प्रेरण—

समांगी तथा विषमांगी उत्प्रेरण तथा उनके अभिलक्षण, समांगी उत्प्रेरण की क्रियाविधि; एन्जाइम उत्प्रेरित अभिक्रियाएँ (माइकेलिस—मेन्टन क्रियाविधि)।

10. जैव—अकार्बनिक रसायन—

जैविक प्रक्रियाओं में आवश्यक तथा सूक्ष्म तत्व, क्षारीय तथा क्षारीय मृदा धातु आयनों का जैविक महत्व, नाइट्रोजन स्थिरीकरण।

11. उपसहसंयोजक रसायन—

नामकरण, उपसहसंयोजक यौगिकों में समावयवता, उपसहसंयोजक यौगिकों के सिद्धांत (संयोजकता बन्ध सिद्धांत एवं क्रिस्टल क्षेत्र सिद्धांत), संक्रमण धातु संकुलों के चुम्बकीय गुण, धातु—धातु बन्ध वाले यौगिक, संकुलों (4 एवं 6 उपसहसंयोजन संख्या वाले) के रसायन।

12. एफ—ब्लॉक तत्वों का सामान्य रसायन—

लेन्थीनाइड्स एवं एक्टिनाइड्स: सामान्य विशेषताएँ, ऑक्सीकरण अवस्थाएँ, चुम्बकीय एवं स्पेक्ट्रमीय गुण; लेन्थीनाइड संकुचन, पृथक्करण।



## Syllabus--Chemistry

### SECOND PAPER

#### 1. Structure and Bonding-

Electronegativity, electron displacements-inductive, mesomeric and hyperconjugative effects; bond polarity and bond polarizability, dipole moments of organic molecules; fission of covalent bonds-homolysis and heterolysis; reaction intermediates-carbocations, carbanions, free radicals carbenes, benzynes and nitrenes, their generation, geometry, stability and reactions; nucleophilic and electrophilic reagents, Hybridization, hydrogen bond.

#### 2. Aliphatic compounds-

Nomenclature, alkanes-synthesis, reactions (free radical halogenation), pyrolysis; preparation and reactions of cycloalkanes, Baeyer's strain theory; alkenes and alkynes-Synthesis, electrophilic addition reactions, Markownikov's rule, peroxide effects, polymerization; relative acidity; synthesis and reactions of alkyl halides and alcohols.

#### 3. Stereochemistry of carbon compounds-

Elements of symmetry, chiral and achiral compounds; Fischer projection formulae, optical isomerism of lactic and tartaric acids, enantimerism and diastereoisomerism, configuration (relative and absolute), conformation of ethane, n-butane and cyclohexane; D,L and R,S notations of compounds containing chiral centres; Fischer, Newman and Sawhorse projection of compounds containing two adjacent chiral centres; meso and dl-isomers, erythro and threo isomers; racemization and resolution; geometrical isomers; E and Z notations.

#### 4. Organometallic compounds-

Preparation and synthetic uses of Grignard reagents and alkyl lithium compounds, organo Zinc compounds.

#### 5. Aromatic Compounds-

Aromaticity; Huckel's rule; electrophilic aromatic substitution-nitration, sulphonation, halogenations (nuclear and side chain), Friedal-Crafts alkylation and acylation, substituents effect; chemistry and reactivity of aromatic halides, phenols, nitro and diazonium compounds.

#### 6. Chemistry and mechanism of reactions-

(a) General methods of study of mechanism of organic reactions, energy of activation; thermodynamic control and kinetic control of reactions.

(b) Aldol condensation, Claisen condensation, Dieckmann, Perkin, Knoevenagel, Wittig, Cannizzaro benzoin reactions, Sandmeyer and Reimer-Tiemann reactions, Fischer indole synthesis, Skraup synthesis.

#### 7. Spectroscopy-

Basic principles and applications of UV –visible, IR and NMR spectroscopy of simple organic molecules.

#### 8. Carbohydrates-

Classification, DL-configuration, step-up, step-down of aldoses and ketoses; mechanism of osazone formation, interconversion of glucose and fructose, Configuration of monosaccharide, cyclic structure of D(+) glucose, mechanism of mutarotation.

#### 9. Photochemistry-

Interaction of radiation with matter, difference between thermal and photochemical process; Law of photochemistry: Grotthus-Draper law, Stark-Einstein law, Beer-Lambert's law; Determination of rate constant of unimolecular reactions; Electronic transitions, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence and phosphorescence, photosensitized reactions-energy transfer processes.

पाठ्यक्रम—रसायन शास्त्र  
द्वितीय प्रश्न पत्र

1-संरचना एवं आबंधन—

विद्युत ऋणात्मकता, इलेक्ट्रॉन विस्थापन—प्रेरणिक प्रभाव, मेसोमेरिक प्रभाव एवं अतिसंयुग्मन प्रभाव; आबंध ध्रुवता एवं आबंध ध्रुवणीयता, कार्बनिक यौगिकों में द्विध्रुव आघूर्ण; सहसंयोजक बंध का विखंडन—समांश एवं विषमांश; सक्रिय मध्यवर्ती : कार्बोकेटायन, कार्बोएनायन, मुक्त मूलक, कार्बिन, बेन्जाइन तथा नाइट्रिन का बनना, ज्यामिती, स्थायित्व एवं अभिक्रियाएँ; नाभिकरस्नेही एवं इलेक्ट्रॉनरस्नेही अभिकर्मक, संकरण, हाइड्रोजन बंध।

2-एलीफैटिक यौगिक—

नामकरण, एल्केन—संश्लेषण, अभिक्रियाएँ (मुक्त मूलक हेलाजनेशन) ताप विघटन; साइक्लोएल्केनों के बनाने की विधियाँ एवं अभिक्रियाएँ, बॉयर का तनाव सिद्धांत, ऐल्कीनों एवं ऐल्काइनों का संश्लेषण, इलेक्ट्रॉनरस्नेही योगात्मक अभिक्रियाएँ, मारकॉनीकॉफ सिद्धांत, परॉक्साइड प्रभाव, बहुलकीकरण, सापेक्ष अम्लीयता; ऐल्किल हैलाइडों एवं एल्कोहलों का संश्लेषण एवं अभिक्रियाएँ।

3-कार्बनिक यौगिकों का त्रिविम रसायन—

सममिति तत्व, किरेल एवं अकिरेल यौगिक, फिशर प्रक्षेपण सूत्र, लैक्टिक एवं टारटरिक अम्ल की प्रकाशिक समावयवता, प्रतिबिम्बीय एवं अप्रतिबिम्बीय रूप समावयवी, विन्यास (सापेक्ष एवं निरपेक्ष); एथेन, n-ब्यूटेन एवं साइक्लोहेक्जेन के संरूपण; किरेल केन्द्र युक्त यौगिकों के D,L तथा R,S संकेतन, दो निकटवर्ती किरेल केन्द्रक यौगिकों के फिशर, न्यूमैन एवं सॉहर्स प्रक्षेपण सूत्र, मीजो एवं dl समावयवी, एरिथ्रो एवं थीओ समावयवी, रेसिमीकरण एवं विद्योजन, ज्यामितीय समावयवी, E एवं Z संकेतन।

4- कार्बधात्विक यौगिक—

ग्रिगनार्ड अभिकर्मक, ऐल्किल लिथियम यौगिकों एवं कार्बनिक जिंक यौगिकों का बनना एवं सांश्लेषिक उपयोग।

5- ऐरोमैटिक यौगिक—

ऐरोमैटिसिटी, हुकल का नियम, इलेक्ट्रॉन रस्नेही ऐरोमैटिक प्रतिस्थापन—नाइट्रीकरण, सल्फोनीकरण, हैलोजनीकरण (नाभिक एवं पार्श्व श्रृंखला), फ्रीडल क्रॉफ्ट्स ऐल्कलीकरण एवं ऐसिलीकरण; प्रतिस्थापक प्रभाव, ऐरोमैटिक हैलाइड्स, फीनॉल्स, नाइट्रो एवं डाइएजोनियम यौगिकों की रासायनिकी एवं क्रियाशीलता।

6- अभिक्रियाओं की क्रियाविधि एवं रसायन—

(अ) कार्बनिक अभिक्रियाओं की क्रियाविधि के अध्ययन की सामान्य विधियाँ, सक्रियण ऊर्जा, अभिक्रियाओं के ऊष्मागतिकी एवं बलगतिकीय नियंत्रण।

(ब) एल्डोल संघनन, क्लेजन संघनन, डीकमैन अभिक्रिया, पर्किन अभिक्रिया, नोवेनजेल, विटिंग, कैनिजारो एवं बेन्जोइन अभिक्रियाएँ सैन्डमेयर एवं राइमर—टीमेन अभिक्रिया; फिशर इंडोल संश्लेषण एवं स्कॉप संश्लेषण।

7-स्पेक्ट्रमिति—

स्ल कार्बनिक अणुओं की पराबैंगनी, दृश्य, अवरक्त एवं नाभिकीय चुम्बकीय अनुनाद स्पेक्ट्रमिति के मूल सिद्धांत एवं उपयोगिता।

8- कार्बोहाइड्रेट्स—

वर्गीकरण, D,L- विन्यास, ऐल्डोस एवं कीटोस की पदवृद्धि एवं पदह्रास; ओसाजोन बनने की क्रियाविधि, ग्लूकोज व फ्रक्टोज का रूपांतरण, मोनोसेकेराइड का विन्यास, D (+) ग्लूकोज की चक्रीय संरचना, म्यूटारोटेशन की क्रियाविधि।

9- प्रकाश रसायन—

विकिरण तथा पदार्थ की अन्योन्यक्रिया, ऊष्मीय अभिक्रिया तथा प्रकाश रसायन अभिक्रिया में अंतर, प्रकाश रसायन के नियम: ग्रोथस—ड्रेपर नियम, स्टार्क—आइन्स्टाइन नियम, लेम्बर्ट—बीयर नियम; एकाण्विक अभिक्रियाओं के वेग स्थिरांक का निर्धारण; इलेक्ट्रॉनिक संक्रमण, उत्तेजित अवस्था में घटित होने वाले विभिन्न प्रक्रमों को दर्शाने वाला जेबलोन्सकी आरेख, प्रतिदीप्ति एवं स्फुरदीप्ति का गुणात्मक विवरण, प्रकाश संवेदी अभिक्रियाएँ—ऊर्जा स्थानान्तरण प्रक्रम।

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## SYLLABUS -- MATHEMATICS

### PAPER-I

Matrix Theory: Rank and Nullity of Matrix, Elementary transformations - Echelon and Normal form of matrices, Eigen values and Eigen vectors, Cayley Hamilton theorem and its applications, solution of systems of homogeneous and non-homogeneous of linear equations.

Theory of Equations: Roots of an equation and their properties, Multiplicity of roots, Relation between roots and coefficients, Symmetric functions of roots, Transformations of equations, Descarte' s rule of sing.

Trigonometry: De Moivre's theorem and its application, Direct and inverse circular and hyperbolic functions, Expansion of trigonometric functions. Logarithm of compled quantities.

Abstract algebra : Group and their general properties, Order of an element of group, Sub group, Cyclic group, Coset and Coset decomposition, Normal subgroup, Quotient group. Homomorphism, Isomorphism, of groups, Permutation and permutation group, Cayley's them, Regular group. Conjugacy relation, Centralizer and Normalizer of groups, Ring, Subring and Ideals, Integral domain and Field structures with their general properties.

Calculus : functions of one variable- Limit, Continuity and Differentiability, Mean value theorems, Taylor's theorem. Successive differentiation, Liebnitz's theorem, Expansion of functions - Maclaurin and Taylor's theorems, Asymptotes, Curvature, curve tracing.

Funcitons of two variables- Limit Continuity and Differentiability, Partial diferentiation, Homogeneous functions, Euler's theorem, Mean value theorem, Taylor's theorem, Jacobians, Maxima and Minima.

Intrgration of irrational algebraic and trnscedental functions. Definite Integral, Rectification, Surface and Volime of solids, beta and Gamma functions. Multiple Integrals. Chang of order of Integrations.

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## SYLLABUS -- MATHEMATICS PAPER-II

Vector Analysis and Vector calculus : Scalar and vector products of two, three & four vectors with their properties and applications, Vector differentiation, Gradient, Divergence and Curl, Directional derivatives.

Vector Integration, Line, Surface and Volume Integration, Greens, Gauss divergence and Stokes, theorems.

Differential Equations: Differential equations of first order and first degree, Exact differential equations, First order and higher degree differential equations, Linear differential equations of higher order with constant coefficients, Homogeneous linear differential equations, Method of variation of parameters.

Partial differential equations of first order, Charpit's method, Homogeneous and non-Homogeneous partial differential equations with constant coefficients, Partial differential equations reducible to equations with constant coefficients.

Linear Algebra: Definition, examples and basic properties of vector space, Subspace and their properties, Linear dependence and Linear span, Basis and Dimensions of vector space, Finite dimensional vector spaces.

Linear transformations and their properties, Matrix representation of Linear transformations, Rank and Nullity of linear transformations, Eigen values and Eigen vectors, Diagonalization.

Analysis: Sequence of real numbers, Boundedness, Limit and Convergence of sequences, Monotonicity of sequences, Cauchy sequence.

Series of non-negative terms and their convergence, Comparison test, Cauchy's root and D' Alembert ratio test etc., Absolute and conditional convergence.

Analytical Geometry: Cartesian and polar co-ordinates, Spherical polar and cylindrical co-ordinates, Straight line, Circle, Ellipse, Parabola and Hyperbola, Plane, Sphere, Cone and Cylinder.

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### पाठ्यक्रम ( गणित )

#### प्रथम – प्रश्न पत्र

आव्यूह सिद्धान्त:

आव्यूह की जाति एवं शून्यता, प्रारंभिक रूपांतरण—एशेलॉन एवं प्रसामान्य रूप, आइगन मान एवं आइगन सदिश, कैली हेमिल्टन प्रमेय एवं इसके अनुप्रयोग, समघात तथा असमघात रेखिक समीकरणों के निकाय के हल ।

समीकरण सिद्धान्तरूप एक चर के सामान्य बहुपदों के समीकरणों के मूल एवं उनके गुणधर्म, बहुकता के मूल, मूलों एवं गुणांकों के मध्य सम्बन्ध, मूलों के सममित फलन, समीकरणों के रूपांतरण, दकार्त का चिन्ह नियम ।

त्रिकोणमिति द – मादवर प्रमेय एवं इसके अनुप्रयोग एसीधे एवं प्रतिलोम वृत्तीय एवं अतिपरवलयिक फलन, त्रिकोणमितीय फलनों के प्रसार, सम्मिश्र राशियों के लघुगणक ।

आमूर्त बीजगणित – समूल एवं उनके सामान्य गुणधर्म, समूह के अवयव की कोटिएउपसमूह, चक्रीय समूह, सह—समुच्चय एवं सह—समुच्चय वियोजन, प्रसामान्य उपसमूह, विभाग समूह, समूहों की समाकारिता एवं तुल्याकारिता, क्रमचय एवं क्रमचय समूह, कैली का प्रमेय, नियमित समूह, संयुग्मिता संबंधी, केन्द्रीयकारका एवं प्रसामान्यकएवलयएउपवलय एवं गुणजावली, पूर्णाकीय प्रांत एवं क्षेत्र संरचनाएँ एवं उनके सामान्य गुणधर्म ।

कलन— एक चर के फलन— सीमा, सातत्य एवं अवकलनीयता, माध्यमान प्रमेय, टेलर प्रमेय, उतरोत्तर अवकलन, लैबनीज प्रमेय, फलनों के प्रसार— मैकलॉरिन एवं टेलर/प्रमेय, अनंतस्पर्शियाँ, वक्रता, वक्रों का अनुरेखण ।

दो चरों के फलन— सीमा, सातत्य एवं अवकलनीयता, आंशिक अवकलन, समघाती फलन, ऑयलर प्रमेय, माध्यमान प्रमेय, टेलर प्रमेय, जैकोबियाँ, उच्चिष्ठ एवं निम्निष्ठ ।

अपरिमेय बीजीय एवं अबीजीय फलनों के समाकलन, निश्चित समाकलन, चापकलन, ठोसों के पृष्ठ एवं आयतन, बीटा एवं गामा फलन, बहु समाकलन, समाकलनों के क्रम परिवर्तन ।

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## पाठ्यक्रम ( गणित ) द्वितीय –प्रश्न पत्र

सदिश विश्लेषण एवं सदिश कलन: दो तीन एवं चार सदिशों के अदिश एवं सदिश गुणनफल एवं उनके प्रगुण तथा अनुप्रयोग,सदिश कलन,ग्रेडिएण्ट,डायवर्जेंन्स एवं कर्ल ।  
सदिश समाकलन,रेखीय,पृष्ठीय एवं आयतन समाकलन,ग्रीन,गॉस डायवर्जेंन्स एवं स्टोक के प्रमेय ।  
अवकल समीकरण: प्रथम कोटि एवं प्रथम घात के अवकल समीकरणएयथातथ अवकल समीकरण, प्रथम कोटि एवं उच्च घातों के अवकल समीकरण, अचर गुणांको वाले उच्च कोटि के रैखिक अवकल समीकरण, समघाती अवकल समीकरण, प्राचल विचरण विधि ।  
प्रथम कोटि के आंशिक अवकल समीकरण, चार्पिट की विधि, अचर गुणांको वाले समघाती एवं असमघाती आंशिक अवकल समीकरण,अचर गुणांको वाले समीकरणों में परिवर्तनीय आंशिक अवकल समीकरण ।  
रैखिक बीजगणित: सदिश समिष्ट की परिभाषा, उदाहरण एवं सामान्य गुणधर्म,रैखिक रूपांतरणों की जाति एवं शून्यता,आइगन मान एवं आदगन सदिश,विकर्णीकरण ।  
विश्लेषण: वास्तविक संख्याओं के अनुक्रम,अनुक्रमों की परिवद्धता,सीमाएँ एवं अभिसरण, अनुक्रमो की एकदिष्टता,कौशी अनुक्रम ।  
ऋणोत्तर पदों की श्रेणियों एवं उनका अभिसरण,तुलना परीक्षण, कौशी मूल परीक्षण, द-अलम्बर्ट अनुपात परीक्षण आदि,निरपेक्ष एवं सापेक्ष अभिसरण ।  
वैश्लेषिक ज्यॉमिति: कार्तीय एवं ध्रुवीय निर्देशांक,गोलीय ध्रुवीय एवं बेलनीय निर्देशांक,सरल रेखा,वृत्त,दीर्घवृत्त,परवलय एवं अतिपरवलय,समतल,गोला,शंकु एवं बेलन ।

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## पाठ्यक्रम – भू-गर्भ शास्त्र प्रथम प्रश्न पत्र

1. सामान्य भू विज्ञान एवं भूगतिकी :  
सौर-मंडल । पृथ्वी की उत्पत्ति, आयु एवं आंतरिक संरचना। ज्वालामुखी : प्रकार, उत्पाद, कारण, प्रभाव एवं वैश्विक वितरण। भूकंप : तीव्रता, परिमाण, कारण, प्रभाव एवं वैश्विक वितरण। समस्थिति की प्रारंभिक धारणा। भू-अभिनति, पर्वतन, महाद्विपीय विस्थापन, समुद्र तल विस्तारण, पुराचुम्बकत्व, प्लेटविवर्तनी, मध्य-महासागरीय कटक, गर्त एवं द्वीपीय चाप।
2. भू-आकृति विज्ञान  
मूल अवधारणाएं, बाह्य एवं अंतः प्रक्रम। शैल अपक्षय, अपरदन चक्र। जलीय भू आकृतियां एवं प्रवाह तंत्र। भू-आकृतियां। पवन, समुद्र, हिमनद एवं कार्स्ट-स्थताकृति के द्वारा निर्मित भू आकृतियां। सुदूर-संवेदनकी प्रारंभिक धारणा।
3. संरचनात्मक एवं क्षेत्र भू विज्ञान  
प्राथमिक एवं द्वितीयक संरचनाएं। संस्तरों की नति एवं नतिलम्ब। प्रवणतामापी दिक्सूचक एवं इसके उपयोग। वलनों, भ्रंशों एवं विषमविन्यासों का वर्णन, वर्गीकरण एवं अभिज्ञान। संधियों,, शल्कन एवं रेखण का वर्णन एवं वर्गीकरण। वलनों एवं भ्रंशों का दृश्यांशों पर प्रभाव। दृश्यांशों का अध्ययन। संस्तरों के शीर्ष एवं तल की पहचान। पुरान्तःशायी एवं नवान्तःशायी। अतिव्यापन एवं अपव्यापन। शैल विरूपण की प्रारंभिक अवधारणा।
4. क्रिस्टल विज्ञान

क्रिस्टल के तत्व एवं क्रिस्टल सममिति। क्रिस्टल विज्ञान के नियम। अन्तःखण्डी अनुपात एवं सूचकांक पद्धतियां। क्रिस्टल नोटेशन। छः क्रिस्टल समुदायों के सामान्य वर्गों की सममिति तत्व एवं आकृतियाँ। क्रिस्टलों में यमलन।

#### 5. खनिज विज्ञान

प्रकाशिकी के सिद्धांत, अपवर्तनांक। द्विअपवर्तन। निकॉल प्रिज्म-रचना एवं कार्यप्रणाली। बहुवर्णता एवं विलोपन। साधारण ध्रुवण सूक्ष्मदर्शी के भाग एवं कार्यप्रणाली। निम्न लिखित खनिजों समूहों के भौतिक, रासायनिक एवं प्रकाशीय गुण : सिलिका, फेल्सपार, माइका, पायराक्जीन, एम्फीबोल, ओलिवीन गार्नेट, कार्बोनेट एवं जियोलाईट। सिलिकेट संरचना एवं उसका वर्गीकरण। खनिजों में बंध। समाकृतिकता, बहुरूपता एवं कूटरूपता।

#### 6. आर्थिक भू-विज्ञान

अयस्क। अयस्क खनिज एवं अधात्री खनिज। खनिज निक्षेपों का वर्गीकरण। अयस्कों के निर्माण के प्रमुख प्रक्रम। निम्न अयस्कों की प्राप्ति की अवस्था, उत्पत्ति एवं भारत में वितरण – एल्यूमीनियम, क्रोमियम, तांबा, सोना, सीसा-जस्ता, लौह एवं मैगनीज। अपघर्षण, अग्निसह तथा सिरैमिक के रूप में काम आने वाले खनिज निक्षेप। कोयला एवं पेट्रोलियम निक्षेप-उत्पत्ति एवं भारत में वितरण। मध्य प्रदेश की खनिज सम्पदा।

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## पाठ्यक्रम – भू-गर्भ शास्त्र द्वितीय प्रश्न पत्र

शैलिकी का परिचय, शैलो का सामान्य वर्गीकरण एवं उनके विभेदक लक्षण

#### 1. आग्नेय शैलिकी :

मैग्मा की उत्पत्ति एवं संघटन। आग्नेय शैलो का बनना। बोवेन की प्रतिक्रिया श्रृंखला एवं प्रतिक्रिया सिद्धांत। एकघटकीय, द्विघटकीय एवं त्रिघटकीय मैग्मा का क्रिस्टलीकरण। आग्नेय शैलों का वर्गीकरण। आग्नेय शैलो की आकृतियाँ, गठन एवं संरचनाएँ। अम्लीय, क्षारीय, आधारिक एवं अतिआधारिक शैलो का संघटन, गठन, उत्पत्ति एवं प्राप्ति की अवस्था।

#### 2. अवसादी शैलिकी

अवसादी शैलो की उत्पत्ति, परिवहन एवं निक्षेपण। लिथिफिकेशन एवं डायजेनेसिस। अवसादी शैलों की संरचनाएँ एवं गठन। अवसादी शैलों का वर्गीकरण। संगुटिकाश्म, संकोणाश्म, बलुआपत्थर, शैल एवं चूनापत्थर की उत्पत्ति एवं संलक्षणों की प्रारंभिक अवधारणा।

#### 3. कायांतरित शैलिकी :

कायान्तरण के प्रकार एवं कारक। कायान्तरण के गम्भीरता मंडल, श्रेणी एवं संलक्षणियाँ। क्षेत्रीय एवं संस्पर्शी कायान्तरण। कायान्तरित शैलों का गठन एवं संरचनाएँ। मृण्मय, बालुकामय शैल एवं अशुद्ध चूनापत्थर का कायान्तरण। प्रतिस्थापन। शिस्ट, नीस, स्लेट, संगमरमर, एम्फीबोलाइट, चारनोकाइट, गोण्डाइट, खोण्डालाइट एवं क्वार्ट्जाइट का संगठन, संरचना एवं उत्पत्ति।

## 4. संस्तरिकी :

संस्तरिकी के सिद्धांत। अश्मस्तरिक, कालस्तरिक एवं जैवस्तरिक इकाई की मूल अवधारणा। संस्तरिकी सहसम्बन्ध की कसौटियाँ। भारत का भूआकृतिक विभाजन एवं भारत की रूपरेखा। भूवैज्ञानिक कालमापक। धारवार, विन्ध्यन, गोण्डवाना महासंघ का संक्षिप्त अध्ययन। बाघ एवं लमेटा समूह। डेकनट्रेप। सिवालिक समूह के मुख्य रूपविभाजन, अश्मविज्ञान, जीवाश्म, भौगोलिक वितरण एवं आर्थिक महत्व के संदर्भ में संक्षिप्त विवरण।

## 5. जीवाश्म विज्ञान :

जीवाश्म एवं जीवाश्मन। परिरक्षण की अवस्थायें एवं जीवाश्मों के उपयोग। सूचक जीवाश्म एवं उनकी सार्थकता। फोरामिनिफेरा, ब्रेकिओपोड्स, गैस्ट्रोपोड्स, लेमिलीब्रेक्स, अमोनाइट्स, कोरल्स, ट्राइलोबाइट्स, एकीनाइट्स तथा गोंडवाना वनस्पति जीवाश्मों की आकारिकी एवं भूवैज्ञानिक इतिहास।

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## SYLLABUS - GEOLOGY FIRST PAPER

## 1. General Geology and Geodynamics

Solar system, origin, age and interior of the earth. Volcanoes: types, products, causes, effects and global distribution. Earthquakes : intensity, magnitude, causes, effects and global distribution. Elementary ideas about Isostasy, Geosynclines, Mountain building, Continental drift, Sea- floor spreading, Palaeomagnetism and Plate tectonics. Mid- oceanic ridges, Trenches and Island arcs.

## 2. Geomorphology

Basic concepts, External and internal processes. Rock weathering, Cycle of erosion. Fluvial landforms and Drainage patterns volcanic landforms. Landforms of Aeolian, Marine, glacial and 'karst' landscapes. Element any idea about Remote sensing.

## 3. Structural and Field Geology

Primary and Secondary structures. Dip and Strike of beds. Clinometers compass and its use. Description, Classification and Recognition of Folds, Faults and Unconformities. Description and Classification of Joints, Foliation and Lineations. Effects of folding and faulting on outcrops. study or Outcrops. Recognition of Top and Bottom criteria of beds. Outliers and Inliers, Onlaps and offlaps. Elementary idea about rock deformation.

## 4. Crystallography

Elements of Crystal and Crystal symmetry. Laws of Crystallography. Parameter and indices system. Crystal notation Symmetry elements and forms of Normal classes of Six crystal systems. Twinning in crystals.

## 5. Mineralogy

Principles of optics, Refractive Index, Double refraction. Nicol prism-construction and working. pleochroism and Extinction. Parts and function of simple polarising microscope. Physical, Chemical and optical properties of following mineral groups : Silica, Feldspar, Mica, Pyroxene, Amphibole, Olivine, Garnet, Carbonates, and Zeolites. Silicate structures and its classification. Bonding in minerals. Isomorphism, Polymorphism and Pseudomorphism.

## 6. Economic Geology

Ore, Ore and Gangue mineral. Classification of ore deposits. Important processes of Ore formation. Mode of occurrence, Origin and Distribution of following ores in India : Aluminium, Chromium, Copper, Gold, Lead, Zinc, Iron, Manganese. Deposits of minerals used as Abrasives, Refractories and Ceramics. Deposits of coal and petroleum- origin and distribution in India. Mineral wealth of Madhya Pradesh.

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## SYLLABUS - GEOLOGY

### SECOND PAPER

#### Petrology :

Introduction to petrology. General classification of Rocks and their distinguishing characters.

## 1. Igneous Petrology :

Origin and Composition of magma. Formation of Igneous rocks. Bowen's Reaction series and reaction principles. Crystallization of Unicomponent, Bicomponent and Tricomponent magma. Classification of Igneous rocks. Forms, Textures and



Structures of igneous rocks. Composition, texture origin and mode of occurrence of Acidic, Alkaline, Basic and Ultrabasic rocks.

2. Sedimentary Petrology :

Origin, transportation and deposition of Sediments. Lithification and Diagenesis. Structures and Textures of sedimentary rocks. Classification of Sedimentary rocks. Elementary idea about origin and characteristics of Conglomerate, Breccia, Sandstone, Shale and Limestone.

3. Metamorphic Petrology :

Types and Agents of Metamorphism. Zones, grades and facies of Metamorphism. Regional and Contact Metamorphism. Textures and Structures of Metamorphic rocks. Metamorphism of argillaceous, arenaceous sediments and impure limestone. Metasomatism. Composition, structure and Origin of Schist, Gneiss, Slate, Marble, Amphibolite, Charnockite, Gondite and Khondalite and Quartzite.

4. Stratigraphy :

Principles of stratigraphy, Basic concept of Lithostratigraphic, Chronostratigraphic and Biostratigraphic units. Criterion of stratigraphic correlation, Physiographic divisions and outline of Stratigraphy of India Geological Timescale. Brief study of Dharwar, Vindhyan, Gondwana Supergroups Bagh and Lameta Formation. Deccan Trap. Siwaliks with reference to their major subdivisions, lithology, fossils, geographic distribution and economic importance.

5. Paleontology :

Fossils and Fossilization. Mode of Preservation and Uses of fossils. Index Fossils and their significance. Morphology and Geological history of Foraminifera Brachiopods, Gastropods, Lamellibranchs, Ammonites, Corals, Trilobites, Echinoids and Gondwana flora.

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SYLLABUS - (AGRICULTURE)

**First Paper**

1. Origin, history and development of agriculture in India. Agriculture and its importance in national economy. Agro-Climatic Zones of India and Madhya Pradesh. Weather and climate and its impact on crop production.
2. Meaning and scope of agronomy. Classification of crops, and its production technology. Factors affecting ecology, distribution and adaptation of cultivated plants. Classification of weeds and their management through mechanical, cultural, chemical and biological methods. Concepts of multiple cropping, multi-storey, setore and intercropping and their importance. Tillage, its classification and

- role in modern agriculture. Major sources of irrigation and methods. Micro irrigation systems. Criteria for scheduling irrigation. Drainage and its and their suitable methods for higher productivity.
3. Role of horticultural crops in human nutrition. Package and practices of important fruit, vegetable, spices, flowering and medicinal plants. Nursery management and propagation methods of horticultural crops. Major problems of horticultural crops and their management. Types of vegetable gardening; Physiological disorders in vegetables and fruits. Principles and methods of preservation of important fruits and vegetables and their processing techniques. Landscape, Floriculture including raising of ornamental plants. Design and layout of roof farming, terrace gardening, vertical gardens and traditional gardens.
  4. Elements of genetics and plant breeding. Basic genetics chromosome organization and functions. Mitosis and meiosis cell division. Reproduction and fertilization. Mendel's experiments and law of inheritance. Gene interaction, Linkage and crossing over, Chromosomal aberration. Cytoplasmic inheritance. Qualitative and quantities traits. Nilsson-Ehle's experiment. Structure and replication of genetic material. Gene expression. Central dogma. Gene transcription and translation. Genetic code. Operon model. Gene mutation.
  5. Crop improvement center of crop diversity, mode of reproduction, variability in plants, Germplasm. Male sterility and self incompatibility. Heterosis and inbreeding depression. Breeding methods for crop improvement and development of hybrid and composite varieties of different crops.
  6. Major insects, pest and diseases of important crops and their management Classification and symptoms of plant diseases, Principles of plant disease control including (exclusion, eradication, immunization and protection). Classification of pesticides and formulations. Agents and basic steps of biological control. Integrated diseases and insect pest management. Principle methods of control of stored grain pest and diseases. Methods of rodent control. Spray equipments, their selection and maintenance. Safety precautionary measures during pesticide usage. Legal control-plant quarantine and insecticidal act. Bee keeping (apiculture), sericulture, Fish farming (pisciculture) and mushroom cultivation.
  7. Agro-forestry, its scope and limitation in India. Silvi-culture and agro-forestry, Classification of agro-forestry system. Suitable models for waste land and watershed development in India and Madhya Pradesh.
  8. Elements of crop physiology, absorption and translocation of water and nutrients. Transpiration and water economy. Photosynthesis and respiration. Growth analysis and its importance. Photo-periodism and vernailisation. Growth hormones, senescence and post-harvest physiology (seed dormancy, storage physiology and fruit ripening)
  9. Organic farming. Definition and principles of organic Farming. Components of organic farming and its role in sustainable Agriculture. Different sources of bio-fertilizers and pesticides and their role in crop production. Production techniques of different organic manures and bio-fertilizers and their appropriate methods of application. Certification process of organic products.

Dry farming, dry land agriculture and rainfed farming. Dry land agriculture, its status and problems in India. Soil and Water management practices with special reference to dry land agriculture.

SYLLABUS - (AGRICULTURE)SECOND PAPER

1. Seed technology: Definition and importance. Seed germination and dormancy. Quality of different planting materials and its value. Seed and variety deterioration. DUS and VCU test. Physical and genetic purity. Seed health. Seed legislation and certification; Classes of seeds; basic principles of Seed production and processing.
2. Agricultural biotechnology: Role of biotechnology and genetic engineering in modern agriculture. Methods and application of plant tissue culture and development of transgenic varieties. D.N.A. Based marker gene cloning and tools for recombinant DNA technology.
3. Soil Science and Microbiology: Major soils of India and role in crop production. Processes and factors of soil formation. Soil taxonomic classification. Physico-chemical properties of soils. Soil fertility and productivity. Classification of different fertilizers and their application methods. Integrated nutrient management. Essential plant nutrients, their distribution, functions and cycling in soils. Problematic soils and their management. Microbial processes involved in recycling of plant nutrients. Symbiotic and non-symbiotic nitrogen fixation. Soil organic matter and nutrient cycling. Soil survey, conservation and land use planning. Processes and factors of erosion and runoff and their management.
4. Biodiversity and natural resource conservation: Natural resources (soil, water and forest), their management and conservation. Environmental pollution (air, water, and nuclear) and associated hazards to crops. Solid waste management. Utility of plant genetic resources in crop improvement. Germplasm collection and conservation.
5. Food science and technology: Food science and food bio-chemistry of carbohydrates and proteins. Types and properties of amino acids. Types of vitamins and their sources. Classification and nature of enzymes. Factors affecting activities of enzymes. Metabolism. Chemistry of natural products (natural antibiotics and plant hormones)
6. Agricultural economics and farm management. Agriculture marketing and its problems. Marketing costs. Profit margins and efficiencies. Cooperative marketing in India. EXIM policies and farm commodities for export. Barriers of export in context to WTO. Price policy of agricultural produce and its role in agricultural production.
7. Agricultural Extension Education: Agricultural extension and its importance. Rural society and institutions. Definitions, characteristics and importance of social stratification and culture. Extension organizations at the State district and block levels, their structure, functions and responsibilities. Importance and methods of extension training and evaluation. Importance of rural development programs in India. Communication and diffusion of agricultural innovations. Role of KVKs in dissemination of agricultural Technologies. Role and functions of ATMA and their Impact on agriculture productivity in India.
8. Farm management: Farm planning and budgeting Farm planning and resource management for optimal production. Role of farming systems in sustainable agriculture. Significance of farm mechanization in agricultural production.
9. Agricultural statistics: Measures of central tendency and dispersion. Correlation, regression and probability. Methods of data collection and analysis. Graphs and diagrams.
10. Computer science and Information technology: Scope and limitations of information technology in agriculture. Types and classification of computers. Applications of Computer based software in agriculture. Data operating systems and data management. Library function.

## पाठ्यक्रम— सांख्यिकी प्रथम प्रश्न पत्र

### 1. प्रायिकता (25 प्रतिशत भार)

यादृच्छिक प्रयोग, प्रतिदर्श समष्टि, घटनाएँ, घटनाओं का बीजगणित, चिर-सम्मत, सांख्यिकीय तथा अभिगृहीतीय परिभाषायें। प्रायिकता के मूल प्रमेय एवं उन पर आश्रित सरल उदाहरण, घटना की सप्रतिबंध प्रायिकता, अनाश्रित घटनाएँ, बैज का प्रमेय एवं इसके प्रयोग। असंतत एवं संतत यादृच्छिक चर एवं उनके बंटन। प्रत्याशा, आधूर्ण, आधूर्ण जनक फलन, दो यादृच्छिक चरों का संयुक्त बंटन, उपान्त एवं सप्रतिबंध बंटन, यादृच्छिक चरों की अनाश्रितता। असंतत एकसमान, द्विपद, ज्यामितीय, ऋणात्मक द्विपद, हायपर ज्यामेट्रिक, प्वासों, एकसमान, बीटा, चरघातांकी, गामा, कोशी प्रसामान्य एवं द्विचर प्रसामान्य बंटन। शेबिशेफ असमिका, दुर्बल वृहत संख्या नियम, स्वतंत्र एवं सर्वसम वितरित यादृच्छिक चरों जिनका प्रसरण मूल्य परिमित हो के लिए केन्द्रीय-सीमा प्रमेय एवं इसके सरल अनुप्रयोग।

### 2. सांख्यिकी विधियाँ (25 प्रतिशत भार)

सांख्यिकी समष्टि एवं प्रतिदर्श की अवधारणा, आंकड़ों के प्रकार, आंकड़ों का प्रदर्शन एवं संक्षेपीकरण, केन्द्रीय प्रवृत्ति, विक्षेपण, वैषम्य एवं ककुदता के माप, साहचर्य एवं आसंग के माप, सहसंबंध, कोटि-सहसंबंध, सहसंबंध अनुपात, सरल एवं बहुरेखीय समाश्रयण, बहु एवं आंशिक सहसंबंध (केवल तीन चरों के लिए) वक्र-आसंजन एवं न्यूनतम वर्ग सिद्धांत, यादृच्छिक प्रतिदर्श, प्राचल एवं प्रतिदर्शज की अवधारणाएँ।  $Z$  एवं  $\chi^2$  (काई वर्ग),  $t$  एवं  $F$  प्रतिदर्शज तथा उनके अनुप्रयोग।

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## पाठ्यक्रम—सांख्यिकी द्वितीय प्रश्न पत्र

### 3. सांख्यिकीय अनुमिति (25 प्रतिशत भार)

प्रतिदर्शज एवं उसके प्रतिदर्शी बंटन की अवधारणा, प्राचल का बिन्दु आकलन, आकलन की अभिनति एवं मानक त्रुटि की अवधारणा, प्रतिदर्श-माध्य एवं प्रतिदर्श-अनुपात की मानक-त्रुटियाँ, प्रसामान्य बंटन के माध्य का प्रतिदर्शी बंटन, एक प्रसामान्य बंटन के प्रतिदर्शी माध्य एवं प्रसरण का अनाश्रित रूप से बंटन (व्युपत्ति के बिना), सांख्यिकीय परीक्षण एवं अन्तराल आकलन : शून्य एवं वैकल्पिक परिकल्पनाएँ, त्रुटि के प्रकार,  $p$ , मूल्य, काई-वर्ग,  $t$  एवं  $F$  प्रतिदर्शजों का कथन, एकल प्रसामान्य बंटन के माध्य एवं प्रसरण का परीक्षण, दो प्रसामान्य बंटनों (अनाश्रित) के दो माध्यों के एक समान होने के तथा दो प्रसरणों के एक समान होने के परीक्षण, तत्सम्बन्धित विश्वास्यता अन्तराल, एक द्विचर प्रसामान्य बंटन के प्रतिदर्श-सहसम्बन्ध गुणांक की सार्थकता का परीक्षण एवं द्विचर प्रसामान्य बंटन के माध्यों की एक समानता का परीक्षण।

वृहत-प्रतिदर्श परीक्षण – विश्वास्यता-अन्तराल एकल माध्य, एकल अनुपात, दो माध्यों का अन्तर तथा दो अनुपातों का अन्तर, के परीक्षण एवं अंतराल आकलन में केन्द्रीय सीमा प्रमेय का उपयोग तथा अनुप्रयोग, फिशर का  $Z$  रूपांतरण एवं इसका उपयोग, आसंजन-सुष्ठुता के लिए पियर्सन का काई-वर्ग परीक्षण, आसंग:सारिणी एवं आसंग सारिणी में अनाश्रितता परीक्षण

अप्राचलिक परीक्षण – एकल एवं द्विचर बंटनों के लिए, चिन्ह-परीक्षण विलकाक्सन-मान-व्हिटने परीक्षण, परम्परा परीक्षण, माध्यिका-परीक्षण तथा स्पीयर मेन का कोटि-सह सम्बन्ध गुणांक परीक्षण।

4. प्रतिचयन सिद्धान्त, प्रयोग अभिकल्पना तथा गुणता-नियंत्रण (25 प्रतिशत भार)

प्रतिदर्श सर्वेक्षण, समष्टि एवं प्रतिदर्श की अवधारणाएँ, प्रतिचयन की आवश्यकता, गणना एवं प्रतिदर्श सर्वेक्षण, प्रतिदर्श सर्वेक्षण के संगठनात्मक दृष्टिकोण की मूल अवधारणाएँ, प्रतिदर्श चयन एवं प्रतिदर्श आकार, कुछ मूलभूत प्रतिचयन विधियाँ-सरल यादृच्छिक प्रतिचयन (एस.आर.एस.) प्रति-स्थापन एवं प्रतिस्थापन रहित, स्तरित यादृच्छिक प्रतिचयन, क्रमबद्ध-प्रतिचयन,(एस.आर.एस.) प्रतिचयन के अन्तर्गत अनुपात एवं समाश्रयण आकल विधियाँ। अप्रतिचयन त्रुटियाँ।

एकधा एवं द्विधा प्रसरण-विश्लेषण (एक प्रेक्षण प्रति कोटि)

अभिकल्पना के मूल तत्व, मूलभूत अभिकल्पनाएँ – (C.R.D., R.B.D., L.S.D.) एवं उनका विश्लेषण। बहु-उपादानी अभिकल्पनाएँ- अभिकल्पनाएँ –  $2^n$  ( $n \leq 4$ ) मुख्य प्रभाव, अन्योन्यक्रिया प्रभाव एवं संकरण प्रभाव  $2^3$  अभिकल्पना के लिए। (पूर्ण संकरण)

गुणता की अवधारणाएँ तथा नियंत्रण का आशय – नियंत्रण के विभिन्न प्रकार के संचित्र ( $\bar{X}, R, p, np$  तथा  $c$ ) प्रतिदर्शी निरीक्षण- गुणों के लिए एकल एवं द्विशः प्रतिचयन आयोजना। O.C, SN तथा TI वक्र। उत्पादक एवं उपभोक्ता की जोखिम की अवधारणाएँ।

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## SYLLABUS- STATISTICS

### PAPER-1

1. Probability ( 25 % weight )

Random Experiment, sample space, event, algebra of events, classical, Statistical and axiomatic definitions of probability . Basic theorems of probability and simple examples based there on, conditional probability of an event, independent events, Bayes' theorem and its applications. Discrete and continuous random variables and their distributions, expectation, moments, moment generating function. Joint distribution of two random variables, marginal and conditional distributions, independence of random variables. Discrete Uniform, Binomial, Geometric, Negative-binomial, Hypergeometric, Poission, Uniform, beta, exponential , gamma, Cauchy, normal, and bivariate normal distributions, Chebyshev's inequality. weak law of large numbers and central limit theorem for independent and identically distributed random variables with finite variance and its simple applications.

2. Statistical Methods ( 25 % weight )

Concept of a statistical population and a sample, types of data, presentation and summarization of data, measures of central tendency, dispersion, skewness and

kurtosis, measures of association and contingency, correlation, rank correlation, correlation ratio, simple and multiple linear regression, multiple and partial correlations ( for three variables only ) . Curve-fitting and principle of least squares, concepts of random sample, parameter and statistic. Z and  $\chi^2$  ( Chi-square) , t and F statistics and their applications .

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## SYLLABUS --STATISTICS

### PAPEER-II

#### 3. Statistical Inference ( 25 % weight )

Concept of statistic and its sampling distribution. Point estimate of a parameter. Concept of bias and standard error of an estimate . Standard errors of sample mean and sample proportion. Sampling distribution (withoutproof) of mean of normal distribution. Independence of sample mean and variance in random sampling from a normal distribution (withoutproof).

Statistical Tests and interval Estimation : Null and alternative hypotheses. Types of errors, p-values. Statement of Chi-square, t, and F. statistics. Testing for the mean and variance of univariate normal distribution, testing of equality of two means and testing of equality of two variances of two independent univariate normal distributions. Related confidence intervals. Testing for the significance of sample correlation coefficient in sampling from bivariate normal distribution and for the equality of means in sampling from bivariate normal distribution.

Large sample tests : Use of central limit theorem for testing and its applications to interval estimation of a single mean, a single proportion, difference of two means and two proportions. Fisher's Z-transformation and its uses. Pearson's Chi-square test for goodness of fit. Contingency table and test of independence in a contingency table

Non-parametric tests : Sign test for univariate and bivariate distributions, Wilcoxon-Mann-Whitney test, Run test, Median test, and Spearman's rank correlation coefficient test

#### 4. Sampling theory, Design of Experiments and Quality Control

(25 % weight )

Sample Survey, Concepts of population and sample, need for sampling, Census and sample survey, basic concepts in sampling organizational aspects of survey sampling, Sample selection and sample size . Some basic sampling methods- simple random sampling (SRS) with and without replacement. Stratified random sampling. Systematic Sampling. Ratio and regression methods of estimation under SRS. Non sampling errors,

Analysis of variance for one way and two-way classifications (with one observation per cell). Fundamental principles of design. Basic designs – CRD, RBD ,LSD and their analysis. Factorial designs -  $2^n$  ( $n \leq 4$ ) designs, Main effects and interaction effects and confounding in  $2^3$  design ( complete confounding )

Concepts of quality and meaning of control. Different types of control charts (  $\bar{X}$  , R, p , np and c ). Sampling inspection-single and double sampling plans for attributes. OC , ASN and ATI curves Concepts of producer's and consumer's risks

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### SYLLABUS- FORESTRY

#### PAPER-I

#### FORESTRY

##### (a) Sillyculture

Introduction, definition and extent of forests, history of forest and forestry in India.

Role of forests- productive, protective, recreational, ameliorative.

Environment of forests - locality inborn and their effect on vegetation, influence of forests on the environment. Forest types of India and their distribution theory and practices involved in natural and artificial forest stand regeneration. Nursery management, Biology of seed production by forest trees, Forest tree seed collection, extraction, storage, testing and grading of seeds, certification, germination and plant percentage.

Afforestation methods for saline & alkalino soils, ravinous and degraded areas, road sides, canal and river banks, railway and high-tension line and foreshore of irrigation tanks etc.

Protection and maintenance of plantations.

Tending operations - Thinning, Pruning etc.

Silviculture Systems - Definition, Objective and classification, Cutting systems and cultural operations including clear felling, shelter wood, selection and copples systems.

(b) Forest Management :-

Fundamental principles and analytical techniques used in planing, management and optimization of forest systems. Elementary forest harvest scheduling for even and uneven aged stand, Sustained yield-concept and meaning, tending series rotation, felling cycle. Normal forest definition and concept.

Actual growing stock and its increment. Yield regulation-general principles, various methods of yield regulation, application and control in forest management. Resource analysis-integration of biological, economic, mathematical and amenity characteristics of the forest system in making forest management decisions. Sustainable forest management principles, & indicators.

(c) Forest Utilisation

Definition, Scope and terminology.

Wood anatomy, structural properties of wood, density texture,

Wood seasoning and wood preservation

Use of adhesives, Plywood, particle-board, pulp & paper saw milling and wood tared industries.

Logging- definition, practices, tools and equipment organisation and management- Forest labour organisation Non-timber forest produce and importance of bamboo, oil beeds, gums, resins and olcoresins, fibres & florres, medicinal plants & sheltec silk and tasser, wax, honey, tuns & dyes, & bidi leaves.

(d) Forest Protection

Classification of injurious agencies-man, animals, insects, plants, atmospheric factors.

Forest fires causes and character of forest fires, fire prevention and control shifting cultivation.

Illicit fellings- Problem and remedies Encroachments-

Grazing- Cattle resources, fodder requirement, grazing management- controlled grazing rotational grazing and deferred grazing.

Forest Pathology :

Plant diseases- cause, symptoms, prevention and control wilt diseases, root diseases, heart-rots in trees, diseases due to rusts and micro-fungi, diseases duo to physiological causes, virus disease.

Forest entomology : insect pests of standing trees, biology, life history of insects of economic importance in forestry, principles and methods of insect post control.

(e) General Botany



Taxonomy- nomenclature and classification of plants, Systematic botany of Indian Forest plants following Bentham & Hooker's System, Distribution, distinguishing characteristics and economic importance of the following families :

Leguminosae, Compositae, Malvaceae, Rutaceae, Asteraceae, Urticaceae, Gramineae, Dipsacaceae and Verbenaceae, Rubiaceae, Myrsinaceae, Euphorbiaceae, Liliaceae.

Plant Anatomy - The tissue, tissue systems, cambium, primary and secondary growth in roots and stem, leaf anatomy.

Plant Physiology - Physiology of the cell- water relations, osmosis, imbibition, absorption, ascent of sap, Transpiration and related factors, mineral nutrition, Metabolism, synthesis of carbohydrates, protein and fats, seed germination and dormancy.

#### (f) Plant breeding and Tree Improvement

Plant breeding - history and development, Mode of reproduction in plants and their importance in plant breeding. Method of breeding of self pollinated, cross pollinated and vegetatively propagated crops, Hybridisation- objective & procedure.

Sterility and in-compatibility. Heterosis and its role in Plant breeding.

Mutation - types and significance in plant breeding. Tree Improvement in forest management programme.

Tree selection and propagation, plus tree selection, progeny testing, provenance trials, establishment and management of seed orchards, Tissue culture.

#### (g) Forest Policy & Legislation

Forest Policy - definition, scope and range contents of a national forest policy. India's national forest policy of 1988.

Forest Law - Legal definition, application of penal code to forests, object of special forest law -

Indian Forest Act, 1927, 2002, 2006

Forest Conservation Act, 1980

Biological Diversity Act 2002, Joint Forest Management Environment (Pollution) Act 1986.

#### (h) Soil and Water Conservation

Soil conservation - definition, scope and role in national economy, soil erosion- definition, extent : Erosion control measures and practices, Hydrological cycle,

Soil and Water conservation, measures in irrigated and rainfed areas.

Watersheds- Principles of watershed management, watershed management practices.

Role of forests in conserving soils.

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## SYLLABUS - FORESTRY

### PAPER-II

#### (i) Surveying and Mapping

Forest surveying - objects and scope, definitions, plane and geodetic surveys, cadastral, topographical, geographical, city route and engineering surveys, errors in surveying. Scales, Measurements of distances and angles, chain survey, chain & compass survey, plane table survey, levelling, Maps and map reading, copying, enlargement and reduction of maps, computation of areas.

#### (j) Forest Engineering

Building materials, building construction - Selection and preparation of site, foundations, walls, brick work, masonry, lintels, arches, carpentry and joinery, roofs, roof coverings, floorings, stairs, doors, windows, fire places and chimneys, lightning conductors, preparation of estimates.

Roads - general principles, types of roads and paths, principles of road design, road alignment, construction of roads, road curves, maintenance of roads, preparation of road estimates.

Bridges- Types of bridges, site selection, bridge construction and preparation of estimates.

Water Supply - Sources of water, sinking of wells, different types of well, yield of wells and streams, purification of water survey of ground water resources, cleaning and protection of wells and water sources.

#### (k) Forest Mensuration

Use of mathematical methods of resources systems to explore management strategies, problem analysis, system concepts and optimisation of resource allocation. Static and dynamic forest models. Evaluation of regression techniques forest models. Evaluation of regression techniques.

Measurements of individual trees and populations measurement of felled trees, estimation of volume of standing trees, determination of age of trees methods of determination of growth of trees, growth curves, Measurement construction and compilation of volume, site index and yield tables and equations. Forest inventories and crop measurements. Enumerations and sampling. Application of remote sensing techniques in forestry.

#### (l) Forest Economics and Valuation

Definition, role and relevance to forestry, tools of economic analysis, demand and supply, market structure, factors of production, law of diminishing returns, cost of production.

Forest valuation - concept of interest on capital, present worth, internal rate of return, load expectation value and concept of profit, planning in forestry, project formulation and evaluation, concepts of budgeting with application to forestry, rule of forestry in Indian economy.

#### (m) Social Forestry

Social Forestry - definition, scope, necessity, objectives, special significance in the context of energy and small timber requirements.

Extent and importance of trees outside forests (ToF)

Farm forestry - need, scope and role in rural economy establishment of farm forests - choice of species, planting techniques, maintenance, organisation of the programme, role of forest department.

Current trends in agro-forestry - Agro forestry systems- advantages and constraints.

Fodder farming - trees, grasses and legumes.

Nutrient content of different fodder and pasture species.

Extension - meaning, objectives, philosophy and principles, Extension, Role of panchayats in Social Forestry, Social Psychology - nature, scope and relation with other science, Methods in social psychology - observation, interview, questionnaire, sociometry and experiment, Motivation, Mass behaviour.

(n) Basic Ecological principles and concepts, Scope and importance of ecology in conservation of natural resources, land use, forestry, grassland management and wildlife. Ecology and its relation to other sciences, Concepts of ecosystem, habitat and ecological niche ecosystem components, Fundamental concepts related to energy in ecological systems. The food chain, trophic structure and ecological pyramids.

Forest environment - Forest biotic and abiotic components, their inter-relationships and importance in forest ecology. Effect of interaction of different environmental factors on the development of forest vegetation. Measurement of environmental factors like solar radiation, light intensity and temperature. Paragraph limiting factors - Principles of limiting factors and ecological indicators Biotic community concepts. Methods of studying vegetation life forms, structure and physiognomy, concept of ecological dominance, competition, tolerance aggression, seral and climax communities, ecotones and edge effect.

Vegetation dynamics - Ecological succession , primary and secondary succession, retrogression, arrested succession and climax.

Autecology - Growth requirement of tree species, competition, Moisture requirements and root development.

Productivity of forest - Production of organic matter, accumulation of organic matter, nutrient cycling, energy budgets, Vegetation as an indicator of site productivity.

## (o) Wildlife management

Biological and ecological base of management, Distribution and behaviour of animals as affected by various, environmental factors and adaptations, concepts of niche, habitat and ecosystem, environmental gradients, zoogeographic regions of world with special reference to wildlife food concept of food chains, food webs, pyramid of numbers, water, pinch period, shelter-territory, home range, edge effect, factors affecting animal populations concept of age and sex structure, mortality and natality, density and saturation point, gregariousness and flocking, breeding potential, extinction threshold, social organization and behaviour - animal communities, general inter and intra-specific relationships, dominance, predator and prey relationship, ingestive, eliminative and behaviour, parasitism, symbiosis.

Techniques of field studies of wildlife pollution-field observation and records, tracks, trails and other animal signs, trapping, capturing and marking ruses and matter analysis.

Population estimation - census and estimates direct and indirect, visual counts, use of animal tracks and signs, simple estimates, pellet group counts. Wildlife-minerals & human conflicts prevention & control.

## (p) Soil Science

Earth as a planet, rocks and minerals of the crust, igneous rocks, sedimentary rocks and metamorphic rocks, Geological formations and their correlation with forests. Weathering and soil formation.

Soil composition, soil profile, physical and chemical properties of soil. Soil reaction, Soil fertility evaluation, Improvement of problem soils.

Soil survey and classification, land evaluation and land use planning, land use and capability classification, impact of mining in trust lands.

## (q) Forest Tribology

Introduction, definitions, types, distribution and demography tribes, racial classification, Concept of tribe, family clan and kinship, principles of social grouping, cultural traditions, customs, ethos, beliefs and practices of tribes, political organisations and social controls.

Tribal economy, tribals and forests, their symbiotic relationship.

Details of few important tribal- Bhils, Gonds and Santhals, Administration of tribal affairs, Constitutional provision for their welfare.

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SYLLABUS- CIVIL ENGINEERING  
PAPER - I

1. Structural Analysis

Simple Stresses & Strains, Elastic Constants, Compound Stresses & Strains, Mohr's Circle, Bending Moment & Shear Force, Bending & Shear Stresses, Deflection in Beams, Columns & Struts, Torsion of Shafts.

Determinate and Indeterminate Structures, Degrees of Freedom, Static and Kinematic indeterminacy, Principle of Superposition, Virtual Work, Energy theorem, Deflection of Trusses, Redundant Frames.

Analysis of Determinate and Indeterminate Arches, their Influence Lines.

Rolling loads, Influence Lines for Determinate Beams and Pin-jointed Frames, Muller Breslau's Principle and Influence Lines for Indeterminate Beams and Frames.

Slope Deflection, Moment Distribution and Kani's methods, Column Analogy, Energy Methods for analysis of indeterminate beams and frames.

Matrix Methods of analysis, Stiffness and Flexibility Matrices of Beams, Frames & Trusses.

2. Structural Design

Steel Design

Factors of Safety and Load Factors.

Riveted and Welded connections of Members, Design of Tension, Compression and Flexural members, Built-up Beams and Plate Girder Slab and Gusseted Bases for Columns, Design of Roof Trusses, Purlins and Coverings, Water tank and supporting Tower's Design, Plastic Design of Continuous Beams & Frames.

R.C.C. Design

Working Stress and Limit State methods for design of Rectangular, T and L Beams, Slabs and Columns.

Isolated and Combined footings, Raft Foundations.

Overhead, Resting on ground and Underground Water Tanks.

Design of Bunkers and Silos.

3. Construction Planning and Management

Stone, Bricks, Lime, Cement, Sand, Concrete, Timber, Laboratory Tests on these materials as per I. S. Specifications.

Detailed Estimates, Specifications and Analysis of Rates of various works in Civil Engineering.

Construction activity, Work Break Down Structures, Scheduling through CPM and PERT Analysis, Cost Optimization through network construction, Float times, Bar charts, Project Control and Super-vision , Cost Reduction measures,

Cost Analysis and Resource Allocation,

4. Environmental Engineering

Water Demand – Per capita Demand, Population Forecasting methods

Water Quality Criteria for various uses viz. Domestic, Non-Domestic & Irrigation, Effects & Significance of important parameters and permissible concentration as per relevant standards.

Transmission of Water- relative merits & demerits of various pipes viz, C.I. G.I. Mild Steel.

A.C. Pressure Pipes. Corrosion of Pipes, Types & Methods of control system of Distribution & Layouts of Distribution.

Unit Processes & Operations for Water Treatment viz, Objectives and Design criteria of Sedimentation, Coagulation, Flocculation, Chemical Sedimentation. Filtration (Slow Sand & Rapid Sand), Disinfection, Softening.

Quantity & Characterization of Domestic Sewage, Significance of B.O.D., C.O.D., D.O., Solids, T.O.C., N.O.D.

Effluent Standards, River Standards.

Sewage System: Design of Sewer & Storm Sewer, Sewage Pumps.

Design of Screens, Grit Chamber, Primary Sedimentation tank, Biological Treatment Units viz Trickling filters, Activated Sludge Treatment and Secondary Sedimentation tank.

Waste Stabilization Ponds- Aerobic, Anaerobic & Facultative Ponds, design criteria and principles.

Sludge Treatment: Digestion & Sludge Disposal, Septic Tanks-design criteria & working, Self-Purification of Streams, Oxygen Sag curve.

Types of Pollution: Sources & effects of various pollution viz., Water, Air, Land & Noise, Relevant standards.

Rural Sanitation, Solid Waste-collection & disposal.

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## SYLLABUS- CIVIL ENGINEERING PAPER - II

### 1. Water Resources Engineering

Fluid Mechanics: Properties of Fluids, Statics, Kinematics & Dynamics of Fluids, Dimensional Analysis, Similitude. Pipe Flow Systems, Open Channel Flow Systems.

Irrigation: Necessity, Scope, Benefits & Effects.

Methods & Systems of Irrigation, their efficiencies, Water Distribution & Scheduling techniques.

Crop Water Requirements, Evapotranspiration, Consumptive Use, Duty, Delta, Base Period their relation, Crop Rotation, Quality of Irrigation Water.

Hydrology: Hydrological Cycle, Precipitation – Types, Measurement, Rain gauge Network, Analysis of Precipitation Data, Dependability Analysis, Unit Hydrograph, Summation &

Synthetic Hydrographs, Design Flood by UH & Frequency Studies, Flood Routing : Reservoir & Channel Routing.

Ground Water: Classes & Availability of Soil Moisture. Aquifers- Confined & Unconfined, Open & Tube Wells, Radial Flow in Wells, Dupuit's Theory, Darcy's Law, Seepage Analysis using Flow Nets. Yield of Wells, determination.

Storage Scheme: Reservoir Planning, Capacity, Yield, Life. Gravity & Earthen Dams. Forces Acting, Modes of Failure, Stability Criteria, Design, Galleries, Shafts, Joints in Gravity Dams, Foundation Treatment.

Spillways, Types, Design of Ogee & Siphon Spillways, Energy Dissipating Devices, Design of Stilling Basins.

Diversion Schemes: Structures on Pervious Formations, Bligh's & Khosla's Theory, Hydraulic Jump, Design of Vertical Drop Weir & Barrage.

Distribution System: Canals – Classification, Layout, Alignment, Capacity, Design of Canals. Silt Theories, Canal Regulation Structures. Design of: Head & Cross Regulators, Canal Falls, Cross Drainage Works, Outlets and Escapes.

Water Logging: Causes, Effects, Remedial Measures, Losses in Canals, Canal Lining, Types, Advantages, Conjunctive Use of Surface & Ground Water.

## 2. Transportation Engineering

Survey: General principles, Chain, Compass & Plane Table Survey, Levelling, Theodolite Traversing, Tacheometry, Contouring, Curves, Planimeter, GPS & Total Station.

Railways: Permanent Way, Sleepers, Rail Fastenings, Ballast, Points and Crossings, Different Types of Turn Outs.

Stations and Yards, Turn Tables, Signals and Interlocking, Level Crossing.

Maintenance of Track, Super-elevation, Creep of Rails, Ruling Gradients, Track Resistance, Tractive Efforts, Curve Resistance.

Highways & Airports: Principles of Highway Planning, Highway Alignments.

Geometric design, Cross-section, Camber, Super-elevation, Horizontal and Vertical curves. Classification of Roads.

Design and Construction of Flexible and Rigid Pavements for Highways and Airfields.

Traffic Engineering: Traffic Surveys, Highway Capacity, Intersections, Rotary Design Elements, Signs, Signals and Markings.

Selection of Airport Sites, Wind Rose Diagram & Runway Orientation, Runway and Taxiway Geometrics and Lighting.

Bridge Engineering: Selection of Site, Design Data collection, Hydraulic Design, Scour Depth for Bridge Foundation, Economic Span.

Types of Road and Railway Bridges, Design Loads and Forces, Impact Factor, Indian Loading Standards.

Super Structure & Sub Structure, Abutments, Piers, Wing Walls, Return Approaches.

### 3. Geotechnical Engineering

Index Properties of Soil, Classification of Soils. Clay Minerals.

Capillary Water, Permeability, Factors Affecting Permeability, Lab and field methods, Permeability of stratified soil deposits.

Seepage Pressure, Quick Sand Condition, Flow Net, its properties & uses.

Stress distribution in soils, Boussinesq's theory, Newmark's Chart.

Consolidation and Settlement: Terzaghi's theory, Consolidation test, Settlement computation, Time Settlement curve.

Compaction tests & their significance, Factors Affecting Compaction.

Shear Strength Parameters, Shear Tests, Mohr Coulomb's failure theory, Skempton's Pore Pressure coefficients.

Earth Pressure at Rest, Active and Passive Pressures, Rankine's and Coulomb's theory.

Bearing capacity, Terzaghi's analysis, factors affecting Bearing Capacity, Plate Load Test.

Stability of Slopes, Swedish Slip Circle method and Bishop's simplified method, Stability Number.

Sub-surface Exploration: Methods, Sampling, SPT, DCPT and Static Cone Penetration Test, Electrical Resistivity and Seismic method.

Essential features of Foundation, Types, Design Criteria, Rafts.

Pile Foundation, Types of Piles, Pile Capacity, Pile Load Test, Group Action, Static/Dynamic formulae.

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## SYLLABUS -- MECHANICAL ENGINEERING

### PAPER - I

Note : Use of Design Data Book is permitted.

#### 1. Engineering Mechanics and Mechanics of Solids

Free body Diagram and Equilibrium; Trusses and Frames; Stress and Strains in Two Dimension; Mohr's Construction; Beams – Bending Moment and Shear Force Diagram; Bending and Shear Stress Distribution; Torsion of Shafts; Thin and Thick Walled Pressure Vessels; Euler's Theory of Column. Leaf and Helical springs.

#### 2. Theory of Machines

Displacement, Velocity and Acceleration of Plane Mechanisms (Maximum 6 Links), Kliens' Construction; Law of Gearing, Gear Tooth Profile, Epicyclic Gear Trains; Motion Analysis of Cam and Followers; Balancing of Rotating Masses, Reciprocating Masses – Hammer Blow, Tractive Effort and Swaying Couple; Power Transmission by Belt Drive; Analysis of Simple Band, Block,



Band and Block Brakes; Dynamometers; Free Vibrating of Single Degree of Freedom Systems; Whirling of Shafts; Gyroscopic Stability of Shaft, Ship and Aeroplane.

### 3. Design of Machine Elements

Design Concepts; Theories of Failure; Design for Static and Dynamic Loading, Design of Bolted, Rivetted and Welded Joints; Design of Shaft and Coupling.

### 4. Production Engineering

Merchant's Force Analysis, Tool Life and Tool Wear; Cutting fluids, Machinability and Machining Economics; Principles of Non-Traditional Machining Processes – EDM, ECM, USM & Laser; Principles of Design of Jigs and Fixtures; Limits, Fits and Tolerances; Comparators, Gauge Design; Measurement of Surface Roughness; Interferometry; Acceptance Test of Machine Tools.

### 5. Production Management

Production Planning and Control; Forecasting Models; Aggregate Production Planning; Material Requirement Planning; Inventory Control – ABC Analysis, EOQ Model; Linear Programming – Simplex Method, Transportation & Assignment Model; Simple Queuing Models; PERT & CPM; Quality Control in Manufacturing, Control Charts for Variables & Attributes.

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## SYLLABUS -- MECHANICAL ENGINEERING

### *PAPER - II*

Note : Use of Steam Table and Psychometric Chart are permitted.

#### 1. Thermodynamics

Steady Flow Energy Equation; Entropy and Irreversibility; Availability and Available Energy; Detailed Analysis of Thermodynamic Cycles and their Limitations.

#### 2. Fluid Mechanics and Machines

Continuity, Momentum and Energy Equations; Flow net; Turbulent Flow through Pipes; Velocity Distribution in Laminar and Turbulent Flow; Dimensional Analysis; Boundary Layer on a Flat Plate; Adiabatic and Isentropic Flow of Compressible Fluids; Classification of Hydraulic Turbines and Pumps; Specific Speed; Impulse and Reaction Turbines; Velocity Diagrams.

#### 3. Heat Transfer, Refrigeration and Air Conditioning

Critical Thickness of Insulation; Conduction through Walls and Pipes; Heat Transfer from Fins; Dimensionless Numbers; Free Forced Convection; Heat Exchange by Radiation between black and Gray Surfaces; Electrical Analogy; Heat Exchanger Classification; Effectiveness; LMTD and NTU Methods; Fouling Factor.

Vapour Compression and Vapour Absorption Systems and their Cycle Analysis; Nomenclature, Properties and Characteristics of Important Refrigerants; Ozone Friendly Refrigerants; Human Comfort and ASHRAE Comfort Charts; Estimation of Air-Conditioning Loads.

#### 4. Energy Conversion Systems

Theories of Combustion in Compression Ignition and Spark Ignition Engines; Abnormal Combustion; Carburetion and Fuel Injection; Emissions from Engine and their Control; Modern Trends in IC Engines; Classification of Steam Turbines, Specific Speed, Velocity Triangles; Open and Closed Cycle Gas Turbine Plants; Nuclear Power Plants; Renewable Energy Sources.

#### 5. Computer Aided Engineering

Introduction to CAD, 2D and 3D Drawing Concepts; Computer Aided Manufacturing – NC and CNC Machines, Methods of Part Programming; Elements of Robotics and Automated Material Handling System; FMS and Expert System.

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### SYLLABUS--CHEMICAL ENGINEERING

#### PAPER-I

(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. Laws of thermo-chemistry, heat of combustion heat of reaction.

(b) 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 (Atmospheric 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.

(c) Fluid and Particle Mechanics: Viscosity of fluids. Laminar and turbulent flows. Equation of continuity and Navier-Stokes equation, Reynold's Number and friction factor – effect of pipe roughness. Economic pipe diameter. Pumps, 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. Free and hindered settling. Fluidization and minimum fluidization velocity,

concepts of compressible and incompressible flow. Transport of Solids.

(d) 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 equilibrium conversions. Thermodynamic cycles refrigeration and power.

(e) Mass Transfer: Analogies in transfer processes, Molecular diffusion coefficients, First and second law and diffusion, mass transfer coefficients, film and penetration theories of mass transfer. Distillation, simple distillation, relative volatility, flash distillation, 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. Crystallization. Adsorption theories, BDST models for adsorption calculation. Design of mass transfer equipments.

(f) Heat Transfer: Conduction, thermal conductivity, individual and overall heat transfer coefficient, General design of shell and tube exchangers, condensers, extended surface equipments. 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 Black body radiation, concept of shape factor, Stefan-Boltzmon Law, emissivity and absorptivity. Calculation of heat load of a furnace. Solar heaters.

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## SYLLABUS-- CHEMICAL ENGINEERING

## PAPER-II

## CHEMICAL ENGINEERING -II

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

(h) 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. Characteristics of final control elements and PID controllers.

Block diagram representation transient and frequency response, stability of closed loop system. Advanced control strategies.

(i) Chemical Reaction Engineering: kinetics of homogeneous reactions and interpretation of kinetic data. Classification of Reactors: Concept of , ideality, Development of design equations for batch, semi batch, tubular and stirred tank reactor, Design of Isothermal and non-isothermal batch, CSTR, PFR, reactors. Combination of Reactors, Reactors with recycle, yield and selectivity in multiple reactions.

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 inter-phase and intra-particle mass transfer on performance.

(j) 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. Fire and explosion hazards rating - HAZOP and HAZAN. Emergency, planning, disaster management. Environmental legislations.

(k) Process Engineering Economics: Fixed and working capital requirement for a process industry and estimation methods. Cost estimation and comparison of alternatives. Time value of money, net present value and venture worth. Pay back analysis. IRR, Depreciation, taxes and insurance. Break-even analysis. Project scheduling - PERT and CPM. Profit and loss account, balance sheet and financial statement. Plant location and plant layout including piping. Mathematical representation of steady state flow sheet.

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## SYLLABUS -COMPUTER SCIENCE ENGINEERING

### FIRST PAPER

#### COMPUTER ORGANIZATION & MICROPROCESSORS

##### 1. Basic Component of Computer Organization-

Evolution of Computers and Computer Generations, Computer Classification, Processing speed of a computer, Block Diagram of Computer, Input devices, output devices, memory, CPU, compiler, assembler & interpreter.

##### 2. Number systems, Logic Gates and Memory-

Decimal Number system, Binary number system and Hexa decimal number system, 1's & 2's complement, Representation of Positive and Negative Numbers, Binary Fixed-Point Representation, Arithmetic operation on Binary numbers, Floating Point Representation. Codes, ASCII. Logic Gates- AND, OR, NOT, NOR, NAND & XOR GATES and their Truth tables.

Storing data and Program in Memory, Memory Hierarchy in a Computer, Internal Organization of Semiconductor, Main Memory Chips, Types of memory: RAM and ROM, Auxiliary Memory, Peripheral Devices, Secondary Storage Memory, Magnetic Memories and Hard Disk, Optical Disks and CD/DVD, Pen drives.

##### 3. Microprocessor -

Counters, Registers, Shift Registers, The 8085 Programming Model, 8085 Hardware Model, Block Diagram and uses of Registers, Accumulator, Flag, Program counter and stack pointer, How to write, assemble and execute a simple assembly program.

#### COMPUTER PROGRAMMING FUNDAMENTALS ANS "C"-

##### 1. Algorithms and C- Programming

Algorithm, Flowchart, Logic Development & Problem Solving. Structure of C program, C declarations, keywords, identifiers, constants, Variables, Data types, type conversion, Types of operators and expressions, Input & output functions in C.

Decision Statement – IF-ELSE statement, break, continue, goto, switch() case and nested IF statement. Loop Control Statements – For loop, While loop, Do-while loop and nested loops.

##### 2. Arrays, Pointer, Functions, Files, Union and Structure using C-Programming -

Arrays – Definition, Initialization, characteristics, One, Two, Three and Multi-dimensional Arrays, Working with scanf, printf, Strings & Standard Functions.

Pointers – Introduction, Features, Declaration & Arithmetic operations on pointers. Pointers and Arrays, Array of pointers. Pointers to pointers, pointers and strings, Void pointers

Functions – Declaration, Prototype, Types of functions, Call by value and reference, Function with operators. Function with decision statements, function with Loop statements. Function with Arrays and Pointers. Types of Storage Classes. Files- Introduction to Files, Streams and File Types, Steps for file operations, File IO, Files – Streams and file types, file operations Write and Other file functions. Command line arguments, Application of Command Line Arguments.

Union and Structure – Declaration, Initialization, structure within structure, Array of structure, Enumerated data types, Union of structure.

#### DATA STRUCTURES-

Stack, Queue, Link list, Searching & Sorting, Tree and Graph:

Stack: Definition, Array implementation of stack (static stack) : Operations PUSH, POP, TRAVERSE. Applications of stack: Infix, Prefix, Postfix representation and evaluation using stack, Use of stack in recursive implementation.

Queue: Definition, Array implementation of queue (static queue), Operations INSERT, DELETE, TRAVERSE.

Circular queue: Definition & implementation, Priority queue, Double ended queue, Applications of queue.

Linked List: Definition, advantages, Types of linked list- single, doubly, circular linked list.

Operations: Creation, insertion, deletion & traversal of linked list.

Searching Algorithm: Linear or sequential search, Binary search, Complexity of Linear search, Binary search,

Sorting Algorithm: Bubble sort, Selection sort, Insertion sort, Merge sort Complexity of sorting algorithm.

Tree: Definition, Binary tree, representation, Operations: Traversal, insertion, deletion, Binary search Tree (BST): Definition and creation, Search using BST, Introduction to B-Tree & B+ tree.

Graph: Definition & representation, Graph Traversal: Depth First Search (DFS), Breadth First Search (BFS) algorithm.

## OBJECT ORIENTED PROGRAMMING-

### 1. Introduction Object Oriented Programming and C++

Introduction, OOPS languages, characteristics of OOP's languages, application of OOP's, OOP's paradigm, concepts: object, class, data abstraction, data encapsulation, inheritance, and polymorphism. Static and dynamic binding, message passing, benefits of OOP's, disadvantage of OOP's. Application of OOP's.

### 2. Basic Programming, Function and arrays using C++

Basic Programming - C++ programming basics, basic program structure, preprocessor directives, data types, operators, manipulator, type conversions, C++ stream class. Control statements- for, do, while, do-while, Decision statements- if, if-else, switch-Case. Jump statement: break, continue, go to and exit.

Function and arrays. Classes and instances, defining classes in object oriented language, building and destroying instances (constructors and destructors), modifiers, friend and inline functions, string handling function.

### 3. Polymorphism and Inheritance-

Polymorphism- operator overloading, function overloading, virtual functions, Data encapsulation.

Inheritance- reusability of code through inheritance, type of inheritance, data abstraction, abstract classes, Templates and exception handling.

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## SYLLABUS -COMPUTER SCIENCE ENGINEERING

### SECOND PAPER

#### DBMS

##### 1. Fundamentals of DBM-

DBMS- Data, Information, Database & Computers, DBMS Definition, DBMS versus file processing system, Components of DBMS Environment, Instances & Schemas, Three Levels Architecture, Data Independence, Data Dictionary, Database Users, Data Administrators. Modeling the Real World, Various Data Models & their Comparison, Entity-Relationship Model.

RDBMS –Concept, Components, Data Integrity, Keys, Relational data Manipulations and Relational Algebra, Tuple Calculus.

##### 2. Normalization and Transaction-

Normalization: Definition, Decomposition, Basic Concepts like Functional Dependence (FD), Objectives of Normalization. Normal Forms- First, Second, Third Normal Form, Boyce–Codd normal form (BCNF), Concept of Multi Valued Dependencies.

Transaction: Concept of Transaction, Concurrency Control-Problem & its Basis, Concurrency Control - Locks & Deadlocks. Recovery-Kind of Failures, Recovery Techniques, Security-Authentication, Authorization, Access Control.

##### 3. SQL Commands -

Introduction to SQL, DDL, DML, and DCL statements, Creating Tables, Adding Constraints, Altering Tables, Update, Insert, Delete & various Form of SELECT- Simple, Using Special Operators for Data Access. Nested Queries & Exposure to Joins, Aggregate Functions.

## COMPUTER NETWORKS AND DATA COMMUNICATION-

1. Fundamental of Computer Network and Data communication system-  
 Fundamental of Computer Network- Computer Network, Goals and Applications, Reference models – OSI and TCP/IP. Network – LAN, MAN and WAN and topologies, LAN components – File server, Workstations, Network Adapter Cards. Connection Oriented and Connection less services.  
 Data communication system- data communication links, character codes, digital data rates, serial data formats, encoded data formats, error detection & correction. Transmission media- guided and unguided media, Switching Techniques – Circuit Switching, Packet Switching, Message Switching.

### 2. Internet Protocols

Data link protocol, character oriented protocol & bit oriented protocol, network architecture protocols, Ethernet, fast ethernet, Gigabit Ethernet.

## INTERNET AND WEB TECHNOLOGY

1. Internet basics: - Elements of the web, viewing web pages with a browser, using a browser for a mail, News and chat, security and privacy issues. Internet: advantage and disadvantage. Internet Services, Web server and proxy server, Web caches, Web browsers, and Communication Suit, Internet Security issues, Embedded and Software based firewall, Data encryption and Digital Signature and Certificates

### 2. Application of HTML

The art of creating the website and home page, The HTML programming basics, Syntax and rules, Tables, Frames, Forms, Example of HTML page, Choice of color, banners, Linking with HTML page, Div, Span, met tags, span, Introduction to DHTML, JavaScript, Use of JavaScript, JavaScript Syntax, Data type, Variable, Array, Operator and Expression

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## SYLLABUS –ELECTRONICS ENGINEERING

### FIRST PAPER

#### 1. Basic Components and Capacitors

Circuit symbols, working principle, classification according to construction, specifications, and applications of passive components – Resistors & Color Coding, Inductors, Transformers, Switches, Relays(Electromagnetic), Thermistors, LDR, Micro- Phone and Loud-Speakers.

Capacitors: - Capacitance, Capacitor Specifications, Classification of Capacitor- Fixed (Mica, Paper, Ceramic, Plastic, Electrolytic etc.), Variable capacitor (Trimmer, Padder, Gang). Stray Capacitance, Leakage Resistance, Testing of Condenser, Area of Application and Problem related to Electrical Energy Storage.

#### 2. Basic Circuits and Network Theorems

Basic Circuits- Concept of Ideal and Practical Voltage and Current Sources, Internal Resistance, AC and DC Sources, Ohms Law, AC Currents & Voltages, Expression for RMS value & Mean Value, 'j' Operator, study of LR, CR, Series & Parallel resonance circuit, Expression for Q factor & Band width in resonance circuit, Phase relationship between Current & Voltage in different circuits. Numerical on Quality Factor, Power Factor, Bandwidth Calculations.

Network theorems- Kirchoff's Current and Voltage Law, Application of KVL& KCL to simple DC Resistive Networks. Thevenin's and Norton's Theorems and corresponding equivalent of simple Resistive Networks. Superposition Theorem, Maximum Power Transfer Theorem, Loop Current and Node Voltage Analysis Methods.

#### 3. Semiconductors and P-N junction

Semiconductors- Conductors, Semiconductors and Insulators. Their classification on the basis of Band Theory, Intrinsic and Extrinsic semiconductor, Diode current equation, Drift & Diffusion.

P-N junction- Forward and Reverse bias of Diode. Concept of recombination of carriers, temperature variation of Forward and Reverse Current through the P-N Junction. Characteristics of Forward & Reverse Bias Diode, Dynamic and Static Resistances, Voltage dependent Junction Capacitance of a P-N junction.

#### 4. Special Diodes, BJT and Power Devices

Special Diodes- Zener Diode, its construction and characteristics. Temperature coefficient of Zener Diode. Zener Diode as Voltage Regulator, Schottky Diode, Tunnel Diode, LED, Solar Cell, Photodiodes.

BJT- Construction and characteristics in different configuration, merits and demerits, biasing of transistor: different methods, load line, Q point and thermal stability. Transistor as an ON/OFF switch. Transistor as a black box, h-parameter concept only. Qualitative analysis of h-parameter model in CE, CB and CC mode.

Power Devices- Construction, characteristics and uses of SCR, DIAC, TRIAC, UJT and Optocoupler devices.

#### 5. Power Supplies, FETs & Amplifiers

Rectifiers: Half wave, Full wave and Bridge Rectifiers, Efficiency, Ripple factor and voltage regulation. Block Diagram of Regulated Power Supply, Series and Shunt Regulation. Three terminal Regulators (78XX and 79XX).

JFET and MOSFET: Construction and Characteristics, Depletion and Enhancement type MOSFET, problems related to pinch off voltage,  $I_D$ ,  $V_{GS}$ , transfer characteristics,  $\mu$ ,  $r_d$ ,  $g_m$ ,  $I_D$ ,  $I_{DSS}$  relation for FET and threshold voltage.

Transistor as an amplifier: Class A, Class B, Class AB and Class C operation and their Applications, Class B push pull amplifier, Noise and Distortion in Amplifier.

#### 6. Feedback, Oscillators and Operational Amplifier

General theory of feedback, classification of feedback, closed loop gain, open loop gain and return difference, stabilization of gain, Negative feedback in amplifier, Effect of negative feedback on gain, non linear distortion, Band width, Noise, Input and output impedance, Topologies of feedback.

Positive feedback and Barkhausen criterion for oscillator, RC phase shift oscillator, Wien Bridge oscillator, RF oscillator, effect of L and C on RF oscillator frequency, Hartley oscillator, Colpitts oscillator, crystal oscillator.

Basic Building Block of Op-Amp, Differential amplifier and its types. DC and AC analysis of Differential amplifier, Concept of Virtual ground.

Op-amp Parameters: Concept of ideal op-amp, Input and output offset voltage, Input offset current, Input bias current, CMRR, PSRR and slew rate, open loop gain, Input and output resistance, frequency response. Calculation of CMRR and Slew rate.

#### 7. Linear and Non-linear applications of op-amp

Voltage Amplifier: Inverting and non-inverting amplifier, summing amplifier, Differential and Instrumentation Amplifiers.

Comparator, Zero crossing and limit detector. Schmitt trigger, Differentiator, Integrator and logarithmic amplifier and problems related to above topics.

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## SYLLABUS –ELECTRONICS ENGINEERING

### SECOND PAPER

#### 1- Number Systems, Codes and Logic Gates

Decimal, Binary, Octal, Hexadecimal number systems and their interconversions, Signed and fractional binary number representation. BCD, Excess-3, Gray, ASCII & EBCDIC Codes. Basic logic gates & Derived gates (AND, OR, NOT, NAND, NOR, XOR, XNOR): Symbols, Truth Tables and Circuit diagrams using switches, diodes and transistors.

#### 2- Boolean algebra and K-map, Arithmetic & Combinational Circuits

Boolean Algebra, minterms, maxterms, Boolean expression in SOP form and POS form, conversion of SOP/POS expression to its standard SOP/POS form, Demorgan's Theorem. Universal Gates, Simplification of Logic equations using laws of Boolean algebra and Karnaugh map (upto 4 variables)

Arithmetic & Combinational Circuits- Binary addition, subtraction, multiplication & division, 1's and 2's complement, Half adder and Full Adder, Half Subtractor and Full Subtractor, Binary Adder, 2's complement Adder/Subtractor circuit, Digital Comparator, Multiplexer, Demultiplexer, Encoder, Decoder and code converters.

#### 3- Sequential Circuits, A/D and D/A Converter-

Sequential Circuits- R-S & D Latches, R-S, D, J-K & T Flip Flops, Concept of racing and J-K Master-Slave Flip Flops, Registers & Counters and their different types.

A/D and D/A Converter- Basic D/A Converters: R-2R, Binary Weighted Resistor type, A/D Converters: Counter Ramp, Flash and Successive Approximation. Sample and Hold Circuits: Basic Concept and Working.

#### 4- Microprocessor, Assembly Language Programming

Microprocessor- Microprocessor architecture and Block diagram, pin out diagram, ALU and Control unit, concept of Fetch Cycle, Execution cycle, machine cycle and instruction cycle.

Assembly Language Programming- 8085 based instructions, Data Transfer, Arithmetic and Logical Branch I/O and machine control instruction and timing diagram, Stack, Stack pointer, Stack related instruction, code conversion, subroutines, conditional/unconditional call and return instructions.

Interrupts- Hardware and Software interrupt, Maskable and Non Maskable, vectored and Non vectored interrupt, priority interrupt and interrupt service routine DMA, Memory mapped I/O and I/O mapped I/O techniques, In and Out instruction & Timing diagrams.

5- Memory Interfacing & Peripheral Interfacing

RAM, ROM, EPROM, Memory interface, Interfacing ROM, 2Kx8, 4Kx8, Interfacing. RAM 2Kx8 and 4Kx8. Timing diagram for memory read and memory write Instruction and T Cycle.

Interfacing peripheral- Interfacing peripheral devices, programmable, peripheral, interface, 8255 – Internal architecture, control register and control word 8255. Functional description-Operational programming in mode 0, mode 1 and mode 2.

6- Measuring Instruments, Bridges & Transducers

Measuring Instruments- Measurement and Error Definition, accuracy and precision, Types of errors, probability of errors, limiting errors. PMMC mechanism, DC Voltmeter, Ammeter sensitivity, series and shunt type ohm meter, multimeter or VOM. True RMS voltmeter Digital voltmeter: Rectifier – amplifier and amplifier – Rectifier type.

Bridges & Transducers- DC and AC Bridges, Wheat stone Bridge, Kelvin Bridge, Maxwell Hay, Schering, Wien Bridges, Cathode ray oscilloscope, Block diagram, Basic operation, Transducers and their classification, strain gauge and displacement transducer.

7- Amplitude Modulation and Demodulation

Definition of AM and Detection of AM, Modulation index, power in AM wave, linear and square law modulation technique, Numerical problems.

Definition of Amplitude Demodulation Generation and detection of amplitude demodulation, linear diode detection, choice of RC, Numerical problems.

8. Frequency Modulation and Demodulation, Digital Modulation

Frequency Modulation and Demodulation- Definition of frequency modulation, modulation index, frequency spectrum of frequency, frequency modulation wave, direct and indirect method of FM, Pre-emphasis and de-emphasis.

Frequency demodulation: Foster seeley and phase locked loop. Numerical problem related to FM demodulation.

Digital Modulation- Pulse code modulation (PCM), Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK)

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## SYLLABUS -- ELECTRICAL ENGINEERING

### PAPER - I

#### 1. Circuit theory

Circuit Components, Network graphs, KCL, KVL, Circuit analysis methods: Nodal analysis, mesh analysis, basic network theorems; transient analysis : RL, RC and RLC Circuits; sinusoidal steady state analysis, resonance, Quality factor, balanced three phase circuit analysis. Frequency domain analysis Laplace's transform, Fourier series (trigonometric & exponential). two port networks and their various parameters; Poles and Zeros driving point & transfer function. Passive filter design theory.

#### 2. Electro Magnetic field Theory and Materials

Electrostatic and Magneto static field Laplace's and Poisson's equations, Boundary value problems and solutions; Maxwell's equation, Electromagnetic wave propagation : Reflection and refraction of plane waves. Poynting vector, wave propagation through dielectrics and conductors. Electrical/electronic behaviour of materials : conductivity; free-electrons and band-theory; intrinsic and extrinsic semi-conductor, p-n junction; solar cells, super-conductivity. Dielectric behaviour of materials : polarization phenomena; piezo-electric phenomena. Magnetic material:, superconductivity.

#### 3. Measurement and Instrumentation

Error analysis, Measurement of current, voltage, power, energy, power factor, resistance, inductance, capacitance and frequency Analysis of Bridges. Electronic measuring instruments: Multimeter, CRO, digital volt meter, frequency counter, Q-meter.



transducers, measurements of non-electrical quantities by electrical methods, measurement of displacement, temperature, velocity, pressure, Signal conditioning, Data acquisition system.

#### 4. Analog and Digital Electronics

Characteristics and equivalent Circuits (for small & large signals) of Diode, BJT, JFET and MOSFET Clipping, clamping and rectifier circuits, Biasing and bias stability. 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. Power supplies.

Boolean Algebra, Boolean function minimization. Logic gates, Combinatorial Circuits : arithmetic circuits, code converters, multiplexers and decoders, sequential circuit : latches and flip flops, Counters, Shift registers, Comparators, timers, multivibrators, Sample and hold circuits, ADCs and DACs. Semiconductor memories, logic implementation using programmable devices (ROM, PLA etc.)

#### 5. Power Electronics

Semiconductor power devices: diode, transistor, SCR, triac, GTO, MOSFET & IGBT, triggering circuits. Phase Control rectifiers. bridge converters : fully Controlled and half Controlled, principles of choppers and inverters.

#### 6. Signals and Systems

Representation and continuous time and discrete time signals and systems; Linear time Invariant systems; Convolution, impulse response; time domain analysis of LTI systems based on convolution and differential equations, Fourier transform, Laplace transform, Z transform, transfer function, sampling of signals, DFT, FFT, processing of analog signals through discrete time systems.

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### SYLLABUS ELECTRICAL ENGINEERING

#### PAPER - II

##### PART -I

#### 1. Control System

Fundamental of control systems, block diagram algebra, Signal flow graph and Mason's gain formulae, Linear Time Invariant Systems; Time domain and frequency response. Proportional, PI and PID Control strategies. Stability analysis; Routh Hurwitz Criterion, Nyquist criterion, Design of lead-lag compensators. State Space models, Controllability and observability. Principles of discrete Control systems.

#### 2. Microprocessors and Microcomputers

8 bit microprocessor 8085 : Architecture, CPU, module design, memory interfacing and I/O, interrupts, PPI 8255.

## PART -II

## Heavy Currents

## 1. Electromechanical energy Conversion

Principles of electromechanical energy conversion, Torque and emf in rotating machines, characteristics and performance analysis of DC machines and their starting and speed control. Transformers: Principles of operation and analysis, regulation, Three phase transformer, Three phase induction machines, and synchronous machines: Their characteristics and performance analysis, speed control. Special machines : Stepper motors, Brushless DC motors, switched reluctance motors, permanent magnet motors, Single phased induction motor (FHP motors) : Performance and analysis;

## 2. Industrial Drives &amp; Utilisation

Basic Concepts of speed control of dc and ac motor drives. Applications of Variable speed drives V/f control, Quadrant operation of drives, Concept of Cycloconverts & Dual Converts fed AC & DC drive.

Rating & characteristic of traction motors, dielectric & induction heating.

## 3. Power Systems Analysis and control

Performance evaluation of overhead transmission lines and cables, fundamentals of active and reactive power transfer, voltage control and power factor correction, per unit representation, Bus admittance and impedance matrices, Load flow study, Economic operation of power system, Symmetrical components, Analysis of symmetrical and unsymmetrical faults, concept of stability, swing curve and equal area criterion, static VAR systems, basic concepts of HVDC transmission, series and shunt compensation, FACTS. speed control of generators, tie line control and frequency control.

## 4. Switch gear and protection

Principle of over current, differential and distance protection, concept of solid state relays and circuit breakers various protection scheme for transmission lines, generator and transformer. Protection against surges.

## PART - III

## Light Current

## 1. Analog communication

Random variables - continuous, discrete, probability density functions, statistical averages, random signals, and noise, noise equivalent bandwidth, signal transmission with noise, signal to noise ratio, amplitude modulation, DSB, DSB-SC and SSB, modulators and demodulators, phase and frequency modulation, PM and FM signals, narrowband FM, generation and detection of FM and PM.

## 2. 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.

## 3. Satellite Communication, Radar and T

Satellite communication, general overview and technical characteristics earth station equipments, satellite link design, CNR of satellite systems, Radar : basic principles, pulsed

systems : CW Doppler radar, FMCW radar, Phase array radar, television systems and standards, colour TV transmission and receiver systems.

#### 4. Microwaves & Antenna

Electromagnetic radiation, Propagation of waves - ground waves, sky wave, space wave, tropospheric scatter propagation. Extraterrestrial communications. Antenna : Various types, gain, resistance, band-width, beam width and polarization, effect of ground. Antenna coupling; high frequency antennas; microwave antennas; special purpose antennas. Microwave Services : Klystron, magnetron, TWT, gun diodes, Impatt, Bipolar and FETs, Microwave integrated circuits. Microwave measurements.

#### 5. Fiber Optic Systems

Multiplexing - Time division multiplexing, frequency division multiplexing, optical properties of materials, refractive index absorption and emission of light, optical fibers lasers and optoelectronic materials, fiber optic links.

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### SYLLABUS-- AGRICULTURE ENGINEERING

#### PAPER-I

#### 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 stonewalls, 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- food-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 for shelter belts and wind brakes and their management. Forest (Conservation) Act.

2. Aerial Photography and Remote Sensing: Basic characteristics of photographic image, 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.

#### Section-B

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 well. Drainage causes of water logging and salt problem. Methods of 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.

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## SYLLABUS AGRICULTURE ENGINEERING

### PAPER-II

#### Section-A

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 (PTO) 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 photovoltaic) 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.

#### Section-B

3. Agricultural Process Engineering : Post harvest technology of crops and its scope. Engineering properties of agricultural produces and by- products. Unit operations- cleaning 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. Wastes and by-product utilization- rice husk, rice bran, sugarcane bagasse, plant residues and coir pith.

4. Instrumentation and computer application in agricultural Engineering :

Electronic devices and their characteristics- rectifiers, amplifiers, oscillator, multivibrators. Digital circuits â€™ sequential and combinational system. Application of microprocessors in data acquisition and control of agriculture engineering processes- measurement system for level, flow, strain, force, torque, power, pressure, vacuum and temperature. Computers â€™ introduction input/output devices, central processing unit, memory devices, operating systems, processors, keyboards and printers. Algorithms, flowchart specification programme translation and problem analysis in Agriculture Engineering. Multimedia and Audio- Visual aids.

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## Syllabus- Horticulture

### Paper- I

#### Production Technology of fruit crops:

- Definition, importance and scope of Horticulture, division of horticulture. Climatic zones of horticultural crops, selection of site, planting systems, high density planting, planning and establishment of orchards.
- Importance of plant propagation sexual and asexual methods, vegetative propagation- cutting, layering, budding, grafting and tissue culture.
- Root stock production, use of rootstock for imparting high yield, quality and for tackling specific problems like tree size control.
- Use of growth regulators in plant propagation, control of Flower and Fruit drop, enhancing the berry size, use for seedlessness.
- Importance of elite planting materials in fruit production. Fundamental principles and practices to be followed in nursery management. Factors to be considered in the establishment of commercial nurseries in fruit crops. Importance of polythene in nursery. Packing, storage and transport of nursery plants.
- Hardening of nursery plants. Productions of disease free nursery stock and protection of nursery plants from pests and disease.
- Package of practice for the cultivation of major fruit crops: Mango, Banana Lime, Sweet Lime, Mandarin, Guava, Grape, Sapota Apple, Litchi and Papaya, Minor fruits :- Pineapple, custard apple, Pomegranate, Ber, Fig Jackfruit, Pear Plum Peach and cherry.

#### Production Technology of Vegetable crops:

- Importance of Vegetables, scope. area, production, productivity in India and M.P., Vegetable classification, Kitchen garden.
- Package of practices for fruits vegetables (Tomato, Brinjal, Hot and Sweet capsicum.)
- Package of practices for cucurbitaceous vegetable - Bottle gourd, Pumpkin, Sponge gourd, Ridge gourd, Ash gourds, Snake gourd, Bitter gourd Water melon, Musk melon and cucumber. Cole Corps- Cabbage, cauliflower and knol-khol. Bulb crops- Onion garlic, Sugar beet Beans :- French beans, Cluster beans, dolichos, peas and cowpea. Tuber crops- Potato, Sweet Potato, Tapioca, Colocasia Yams. Root crops- carrot, radish, turnip and beet root. Leafy Vegetables: Amaranthas, Palak Perennial vegetables- drumstick, coccinia and curry leaf.

### Post harvest management and value addition of fruits and vegetable

- Importance of post harvest technology in horticultural crops. Maturity indices, harvesting and post harvest handling of fruits and vegetables. Maturity and ripening process. Factors affecting ripening of Fruits and vegetables. Causes of spoilage of fruits and vegetables.
- Methods of storage- Pre cooling, pre storage treatments, low temperature storage controlled atmospheric storage. Specific packing for export of mango, Banana, Grapes, Kin-now, Sweet orange and Mandarin.
- Preparation of Jams, Jellies, Pickles, Ketchup, Sauce. Squashes, Potato chips.

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## Syllabus- Horticulture Paper- II

Production technology of Spices, Aromatic. Medicinal and plantation crops :

- Importance, scope, area. production and productivity. importance package of practices of Spices Crops :- Ginger, Turmeric, Pepper. Cardamom, Cumin. Fenugreek
- Aromatic Crops :- Lemongrass, Citronella, Palmrosa, Vetivar, Geranium, Dawana.
- Plantation crops: Coconut, Arcanut, Betelvine, Cashewnut, Cocoa, Coffee, Oilplant.
- Medicinal plants: Dioscoria. Rauwolfia, Opium, Perwinkle. Aloe. Guggul, Beladonna, Nuxvomica, Solanum khasiamum. Aonla, Senna, Plantago, Stevia, Coleus and Acorus,
- Distillation procedure for aromatic crops. propagation methods in plantation crops. processing and curing of spices ginger, Turmeaic and Black pepper.

Commercial Floriculture :

- Status and prospects of commercial cultivation of Flowers, varieties, planting system, spacing, manure, irrigation pruning , mulching, plant protection, harvesting, post harvest handling and marketing of major traditional and cut flowers- Aster, Gaillardia, Marigold, Gomphrena, Tuberose and Gladiolus. Protected cultivation of Rose. Gerbera and Chrysanthemum.
- Commercial cultivation of winter season flowers, status and prospects in India and M.P. Planting material production, methods of planting, media components and management, shade regulation, irrigation, nutrition , plant protection, stage and method of harvest , post harvest handling and marketing. Winter season flowers- Aster, Cosmos, Calendula, Larkspur, Phlox, Begonia, Verbena, Salvia, Nasturtium and pansy viola.

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SYLLABUS-- ENVIRONMENTAL SCIENCEPaper- I

Multidisciplinary nature of environmental Science : Definition, scope and importance, need for public awareness. Origin and structure of earth. Atmosphere: structure and composition. Hydrosphere: Global water resources and hydrological cycle. Lithosphere: a brief account. Biosphere: its components.

Climatic Zones : Major climatic Zones of the world, climate of India , climatic extremes, Global climatic change and its impact on Environment.

Natural Resources: Renewable and non-renewable resources: Natural resources and associated problems a ) Forest resources" Use and over-exploitation, deforestation. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams- benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources. d) Food resources: world food problems, changes cause by agriculture and overgrazing, effects of modern agriculture, fertilizer- pesticide problems, water logging, salinity. e) Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. • Role of an individual in conservation of natural resources • Equitable use of resources of sustainable lifestyles.

Ecosystems • Concepts of an ecosystem. • Structure and function of an ecosystem. • Producers, consumers and decomposers. • Energy flow in the ecosystem. Ecological succession. • Food chains, food webs and ecological pyramids. • Introduction, types, characteristic features, structure and function of the following ecosystem: - a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystems ( ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and its conservation • Introduction - Definition: genetic, species and ecosystem diversity • Bio- geographical classification of India • Value of biodiversity: consumptive use productive use, social ethical, aesthetic and option values • Biodiversity at global, National and local levels. • India as a mega-diversity nation • Hot-spots of biodiversity. • Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Wild life protection act. • Endangered an endemic species of India • Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

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SYLLABUS-- ENVIRONMENTAL SCIENCEPaper- II

Environmental Pollution: • Definition • Cause, effects and control measures of :- a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear hazards. • Solid waste Management : Causes, effects and control measures of urban and industrial wastes. Biomagnifications of pesticides, heavy metals and radioactive substances.

• Role of an individual in prevention of pollution • Disaster management : floods, earthquake. cyclone an landslide.

Social Issues and the Environment • From Unsustainable to Sustainable development • Urban problems related to energy • Water conservation, rain water harvesting, watershed management • Resettlement and rehabilitation of people; its problems and concerns. • Environmental ethics: Issues and possible solution. • Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents an holocaust. • Wasteland reclamation. • Consumerism and waste products. • Environment Protection Act. • (Prevention and Control of Pollution ) Act. • Water (Prevention and Control of Pollution ) Act. • Forest Conservation Act. • Issues involved in enforcement of environmental legislation. • Public awareness.

Human Population and the Environment • Population growth, variation among nations. • Population explosion- Family Welfare Programme. • Environment an human health. • Human Rights. • Value Education. • HIV/AIDS. • Women and Child Welfare. • Role of Information Technology in Environment and human health.

Environmental remote sensing & GIS: Principles of remote sensing, space imaging, digital image processing, Geographical Information system (GIS) and Global Positioning System (GPS)

Watershed Management : Concept, planning, measures and Land use planning of watershed Management, Water harvesting and recycling, flood control and watershed management, Socioeconomic aspects of Watershed Management.

Sustainable Development : Concept of sustainable development, indicator of sustainability, Models of sustainable development, Global and National sustainable development scenario.

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## SYLLABUS -- ANIMAL HUSBANDRY AND VETERINARY SCIENCE PAPER-I

### 1. Animal Nutrition

Metabolism of carbohydrates, proteins and fats, its requirements for maintenance, growth and production of milk, meat, work, eggs and wool.

Mineral and trace elements, its metabolism, source and role of minerals and trace elements, their requirements of, growth and production and deficiency syndromes.

Vitamins, their sources, requirements, role in metabolism and deficiency syndromes.

Feeding standards and measures of feed energy. Limitations of different feeding systems. Feeding practices in livestock in normal and drought conditions.

Feed additives in the ration of livestock and poultry: antibiotics and hormonal compounds and other growth stimulators their uses and abuse.

Preservation of feed.

Feeding infants and growing animals. Importance of colostrums Feeding and care of expectant and nursing mothers.

### 2. Genetics and Animal breeding

Breeds of livestock and poultry, specially Indigenous and Exotic breeds.

Mendelian principles gene and genotype frequency. Inheritance of quantitative traits. Causal components of variation. Heritability, repeatability Estimation of additive, non additive and environmental variance. Genetic and environmental correlations.

Mating systems, inbreeding, out breeding . Measurement of inbreeding, Aids to selection, Methods of selection genetic gain, correlated response to selection, Reciprocal Recurrent selection, Hybridization . Choice of effective breeding plan. Field progeny testing. Application of biotechnology in genetic improvement of livestock. Conservation of animal genetic resources. Importance of breeding record in livestock and poultry.

Application of computer for statistical analysis of data obtained from livestock farms, Veterinary hospitals and epidemiological studies.

### 3. Livestock production and Management

Comparison of dairy farming in India with advanced countries. Dairying under mixed farming and as a specialized farming, economic dairy farming, starting of a dairy farm. Capital and land requirement of organized dairy farm. Procurement of goods, opportunities in dairy farming, factors determining the efficiency of dairy animal. Herd recording, budgeting, cost of milk production.

Pricing policy: Personnel management.

Wild and zoo animal management .

Management of pack animals.

Management of laboratory animal & fish production.

### 4. Poultry:

Brooding and rearing practices used for poultry Care and management of growing layer/broiler birds of both breeders and commercial categories of poultry.

Battery cage management .

Poultry Feeding, Litter management, water Management in poultry.



Economics of layer and broiler production, hatchery Management including principles of incubation, sanitation hatchery hygiene.

Factors affecting fertility and hatchability.

Biosecurity in poultry farm and hatchery.

#### 5. Milk Technology

Organization of rural milk procurement, collection and transport of raw milk. Quality testing and grading raw milk. Grades of whole milk, skimmed milk and cream.

Defects in processing, packing, storing, distribution and marketing of milk and milk products and their remedial measures.

Nutritive properties of pasteurized, standardized, toned, double toned, sterilized, homogenized, reconstituted, recombined and flavored milk.

Preparation of cultured milks, Cultures and their management. vitamin D, acidified and other special milks,

Legal standards and sanitation requirements for clean and safe milk and for the milk plant equipments.

Methods of preparation of butter, ghee, khoa, lassi, curd, ice cream and cheese.

#### 6. Hygiene

Veterinary Hygiene with respect to water, air and habitation.

Duties and role of Veterinarians in a slaughter house to provide meat that is produced under ideal hygienic conditions.

By- products from slaughter house and their economic utilization.

Methods of collection, preservation and processing of hormonal glands for medicinal use.

Sanitation of animal houses. Source of air pollution in animal houses and its effect on animal health and production.

#### 7. Extension

Extension Education : evolution of extension Education in India: classification of extension, teaching methods, audio- visual aids, their classification.

Role of animal in the economy, health, socio-psychology of rural, semi urban and urban society (role of farm stock, companion animal, sports animals etc.)

Different methods adopted to educate farmers under rural conditions.

Utilization of fallen animals for profit extension Education, etc.

Define TRYSEM : Different possibilities and method to provide self employment to educated youth under rural condition.

Cross breeding as a method of upgrading the local cattle.

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## SYLLABUS -- ANIMAL HUSBANDRY AND VETERINARY SCIENCE PAPER-II

### 1. Anatomy

Anatomy of ox and fowl.

Histological technique freezing, paraffin embedding etc.

Common histological stain. Preparation and straining of blood films.

Mammalian Histology .

Structure and function of cell and cytoplasmic constituents: Structure of nucleus, plasma membrane, mitochondria, golgibodies, endoplasmic reticulum and ribosomes.

Cell division: Mitosis and Miosis.

Systemic embryology- stage wise study of embryo/foetus of chicks, cattle, buffalo, sheep, goat and cat.

### 2. Physiology

Prenatal and post natal growth.

Hormonal control of development of udder and milk.

Environmental factors affecting reproduction in males and females.

Methods of ameliorating environmental stress.

Physiological relations and their regulations: mechanism of adaptation, environmental factors and regulatory mechanisms involved in animal behavior. Methods of controlling climatic stress. Physiology of circulation, respiration excretions, digestions and reproduction.

Shock, its mechanism, classification of shock. Fluid and electrolytes balance. Hypoxia role of respiration in acid base mechanism.

Respiration in poultry.

### 3. Animal Biotechnology

Recombinant DNA technology. Embryo biotechniques. Marker assisted selection Nutritional biotechnology including bio conversion of lignocellulose, genetic manipulation of microbes for improved feed utilization and health.

Molecular diagnosis including PCR and DNA probes.

New generation vaccines.

### 4. Pharmacology

Pharmacology of drugs acting on gastrointestinal, cardio-vascular, urinary, respiratory, nervous, genital systems and endocrines, Therapeutic agents against bacteria, protozoa fungi, parasites and insects, including their mechanism of action.

Common toxic compounds and plants their effects and treatment.

Use of anticancer agent in animals, pharmacological and therapeutic efficacy of indigenous drugs.

### 5. Diseases

Common livestock and poultry diseases caused by bacteria, fungi protozoa, viruses and parasites pertaining to their causal agents, epidemiology, symptoms diagnostic methods, treatment and prevention. Important zoonotic diseases. Toxicity caused by agrochemicals and environmental toxicity. Methods of collection and dispatch of material for laboratory diagnosis.

Principles of immunity and immunization.

Principles of epidemiology, public health aspects of food products of animal origin ( meat, egg, milk and fish) their inspection and marketing.

### 6. Veterinary gynecology and obstetrics:

Abnormalities of reproductive tracts in domestic animals.

Delayed puberty and sexual maturity, Estrous detection and pregnancy diagnostics.

Infertility, sterility and repeat breeding: causes and therapeutic management.

Dystocia: Types of dystocia, maternal and fetal approach diagnosis and treatment. Postpartum diseases and complications.

### 7. Veterinary andrology and reproductive techniques:

Factors causing infertility in male its diagnosis and treatment.

Diseases of male genitalia and coital injuries their diagnosis and treatment.

Artificial Insemination- methods of semen collection. Factors affecting quality and quantity of semen, macroscopic, microscopic, biochemical and biological tests for evaluation of semen.

Extenders used for semen preservation. Preservation of semen at different temperature techniques of it.

### 8. Surgery

Anesthesia in animals.

Common surgical affections of different systems of the body.

Diseases of locomotion system with special reference to soundness, health identification.

Principles of radiology.

Electrotherapy in veterinary practice.

Familiarization with fluoroscopic examination and ultra- sonography

### 9. Jurisprudence

Jurisprudence in veterinary practice.

Common offences towards animals. Common adulteration practices regarding milk and milk products and meat and their detection.

Laws relating to offences affecting public health.

Laws relating to adulteration of drugs.

Evidence procedure in court.

Legal duties of veterinarian.

Code of conduct and ethics for veterinarian.

Post mortem and Medico-legal examinations.

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