वीर कुँवर सिंह विश्वविद्यालय, आरा (बिहार)

स्नातक खण्ड–2 (विज्ञान)

PHYSICS (Hons.)

The Course shall consist of two Theory papers III and IV each of 75 marks. The pass marks in the two theory papers taken together will be 67 and the examination in each will be of 3 hours duration. There will be Two practical paper of 50 marks. The pass marks will be 23 and the examination will be of 6 hours duration in this paper.

The following will be the detailed Courses–

Time: 3 Hours

Paper-III
THEORY

Full Marks :75

10 questions to be set, 5 to be answered. Question number one will be objective (15 Questions) and it will be Compulsory. 6 questions will be set from group A, and 3 from group B. Atleast one question from each group is to be answered. All questions will be of equal marks.

Group-A

OPTICS:

6 Questions

Fermat's principle and mirror and lens formula. Cardinal points of thick lens and thick lens formula. Interference phenomena by division of wave front and division of irnplitude. Michelson Interferometer. Fabreyperot Interferometer, L.G. Plate, Echelon Grating.
Diffraction– FresnePs and Fraunhoffer's diffraction, Half Period Zones. Zone Plate, FresnePs diffraction at straight edge and single narrow wire. Fraunhoffer 's diffraction at n slits circular aperture. Plane diffraction grating, Concave grating and Eagle's mounting. Resolving power of Prism, Telescope and microscope. Production of plane, Circularly and elliptically polarized light. NicoPs prism. Quarter wave plate. Babinate's Compensator and analysis of elliptically polarised light. Rotatory polarisation and Polarimeter, Principle of Laser action, Ruby Laser, He-Ne Laser.

Group-B

ELECTROMAGNETIC THEORY:

3 Questions

Maxwells field equations, Poynting vector, Electromagnetic momentum, Maxwell's stress Tensor, Pressure of radiation. Plane electromagnetic waves. Reflection, Refraction and total internal reflection of polarised light. Double refraction in crystals. Theory of dispersion, Optical properties of metals and dispersion in metals Scattering by free and bound charges.

Paper-IV
THEORY

Time: 3 Hours

Full Marks :75

10. questions to be set, 5 to be answered. Question number one will be objective.(15. Questions) and it will be Compulsory. 2 questions will be set from group-A, 4 from group-B and 3 from group-C. Atleast one question from each group is to be answered. All questions will be of equal marks.

Group-A

ELECTROSTATICS, MAGNETISM:

2 Questions

Boundary Condition at the surface of separation of two dielectrics and refraction of lines of force. Scalar potential in electrostatics. The potential of system of charges. Dipole and Quadruple moment Energy stored in an electrostatic field. Poisson's and Laplace's equation in Cartesian. Polar and cylindrical Co-ordinates and their solutions for simple geometries. Dielectric polarisation Relation between D. E and P.

Properties of ferromagnetic material. Hysteresis Curve, Method for obtaining B-H Curve, Energy loss per cycle of magnetisation. Magnetic flux density (B) by (a) B.G and search coil (b) Grass root fluxmeter. Energy stored in a magnetic field. Measurement of Susceptibility of liquid by quinke's method. Langevin's and Weiss theories of dia, Para and ferromagnetism.

Group-B

CURRENT ELECTRICITY

4 Questions

Thermodynamic treatment of see back. Peltier and Thomson effects and their applications. Self inductance and Mutual Inductance. Growth and decay of current in circuits Containing L. C. and R. Simple applications of these circuits Moving coil galvanometer. A periodic and ballistic galvanometers, A.C. and

A.C. Circuits Use of Vectors and Complex numbers in A.C. Circuits. Theory, series and parallel resonant Circuits. Power in A.C Circuits. Wattmeter, A.C. Bridges (i) De Sauty's bridge (ii) Anderson bridge (iii) Carey Foster bridge (iv) Schering bridge. Three phase A.C. Systems, Mutually Coupled Circuits. Rotating magnetic field. Polyphase and single phase induction motors. The transformer-Equivalent Circuit and vector diagram. Iron and copper losses in transformer.

Group–C

3 Questions

MODERN PHYSICS :
Measurement of charge by Milkan's method and specific charge of an electron by Thomson's method. Natural radio-activity, Rutherford- soddy's Theory of radio-active decay, Geiger Muiller Counter. Discovery of Neutron. Isotopes, Artificial radio activity., Elementary ideas about nucleus and its structure, Nuclear fission Reactors. Astons mass spectrograph. Cyclotron and Betatron.

Photoelectric emission, Einstein's photoelectric equation. Photo conductive and photo-voltaic cells. Compton effect. Cathode ray Oscilloscope and its uses in amplitude, frequency and phase measurement Soild stale rectifier and one stage R-C amplifier.

Primary and secondary cosmic rays, Penetrating components of cosmic rays. Altitude and latitude variation of cosmic ray Intensity. E. W Asymetry, Cosmic ray showers, Rossi curves. Outline of cascade theory, Origin of cosmic rays.

PRACTICAL PAPER

Time: 6 hrs

Full Marks : 50

The Course shall be include the following experiments.
1. Magnifying power of Telescope.
2. Magnifying power of Microscope,
3. Dip by-
    (i) Dip Circle
    (ii) Earth's Inductor.
4. Wavelength by Newton's rings.
5. Refractive index by spectrometer.
6. Wavelength of monochromatic light using Biprism.
7. Charactristics of a semi-conductor Diode.
8. Specific rotation by polarimeter.
9. Figure of merit of a suspended Coil galvanometer.
10. Measure of monochromatic light by plane transmission grating using Spectrometer.
11. Measurement of monochromatic light using optical bench.
12. Resolving power of telescope.
13. Calliberation of ammeter and voltmeter by potentiometer.
14. Compare the capacities of capacitors by De Saute's Bridge .
15. B.C. Constant by decrement method.
16. Measurement of low and high resistance.
17. Figure of merit of ballistic galvanometer.
18. Design and study of single stage R.C. coupled amplifier.

B.Sc. Part–II
Paper– III(A)
CHEMISTRY (HONS.)

Full Marks : 50

There will be TEN questions each of ten (10) marks including question No. 1 (one) will be of objective type and compulsory covering the entire syllabus. Three questions will be set from each group out of which FOUR to be answered selecting at least ONE from each group.

GROUP-A
1. **SOLID STATE:**
Lattice energy its calculations and applications. crystal structure of NaCl,KCl. Zns and diamond. Radius ration rule and co-ordination numbers. Properties of solids: Magnetic properties. Electrical properties and Dielectic properties, Idea of liquid crystals.
2. **COLLOIDS:**
Definitions, classification, Lyophilic and Lyophobic colloids, Preparation of colloids: pepization, purification of colloids Dialysic, properties of colloids, Brownian Movement, Tyndall effect, electrophoresis,Origin of charge, electrokinetic potential, size determination, coagulation, Hardy schulze rule. Protection of Colloids Goldnumber, Gel. Emulsion and Mecelles.

3. CATALYSIS:

Definition and classification of catalyst, characteristics of catalyst, theory of catalysis, acid-base catalysis, auto-catalysis enzyme catalysis, zeolite catalysis, promoter, inhibitors, catalytic Poison,

GROUP-B

1. THERMODYNAMICS:

Second law of thermodynamic, Carnot theorem, Cornet Cycle. Entropy and its probability, entropy change for reversible and irreversible processes and ideal gases, entropy of mixing of ideal gases, free energy and work function. criteria of chemical reactions, Gibbs-Helmholtz equation, clausius-clapey cron equation and its applications.

2. PHASE EQUILIBRIUM:

Phase rule, terms and derivation, one component water and Sulphur systems, two component solid and liquid systems (Ag-Pb; Mg-Sn, KI-H_2O, $FeCl_3$-H_2O), Eutectic mixture, azeotropic mixture, congruent and incongruent compounds.

3. DISTRIBUTION LAW:

Nernst distribution law, Factors affecting partition co-efficient, thermodynamic derivation, limitations and applications, modification in case of association dissociation and chemical change.

GROUP-C

1. CHEMICAL KINETICS:

Effect of temperature on reaction rate (Arrhenius equation), effect of catalyst on reaction rate. Energy of activation and its determination, Experimental measurement of order in acid catalysed hydrolysis of methyl acetate, saponification of ester and inversion of cane sugar, first order gas phase reaction (LindemannTheory)

2. CONDUCTANCE:

Conductance of electrolytes, cell constant, specific conductance, equivalent conductance and' Molar conductance, effect of dilution on various types of conductance and their measurement. Kohlrausch's law independent migration of ions and its applications, conduct metric titration.

3. IONIC EQUILIBRIUM:

Ostwald's Dilution Law, Determination of dissociation constant of acetic with the help of conductance measurement, Relative strength of acids and bases, salt hydrolysis constant, degree of hydrolysis. Application of conductance measurement; solubility product, degree of ionisation and ionic product of water, theory of acid base indicators.

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Paper-III (B)
INORGANIC CHEMISTRY
GROUP-A

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1. ATOMIC STRUCTURE:

Determination of electronic charge and elm ratio. Bohr frequency condition, Dual nature of electrons. Uncertainty principle, idea of ground state term symbols. Excited state term symbol for d^2 system

2. CHEMICAL BONDING:

(a) Explanation of valence Bond Theory, Qualitative treatment, simple applications, Sidgwick-Powell theory, structures of BF_3, NH_3, H_2O, PCl_5, ClF_3, SF_4, SF_6, IF_7, CO_3, NO_3 SO_4, I_3

(b) Metallic bond-Idea of free electron theory and V.B.T. explanation, conductors, semiconductors.

3. COORDINATION CHEMISTRY:

Double salts and co-ordination compounds, I.U. P.A.C- nomenclature of co-ordination compounds including complexes with unsaturated molecules or groups and bridging group. Werner postulates, EAN rule, Valence bond theory of Co-ordination compounds, Isomcrism, Types with examples. Shapes of d-orbitals, C.FT. and its applications, chelates.

GROUP- B

1. General chemistry, structure and bonding of-
   (a) Noble gas compounds.
   (b) Pseudo halogens and polyhalides.

2. Transition metals and comparative chemistry of-
   (a) Sc, Y, La   (b) Ti, Zr, Hf
   (c) Fe, Co, Ni

3. Chemistry of Group-IV Elements:
   C, Si, Ge : Carbides, silicates and tetrahalides idea of fullerenes and zeolites.

GROUP-C

1. SPECTROS COPY:

Elementary idea of principles and simple applications of the following: I–R Spectroscopy, U-V and Visible spectroscopy.

2. **ANALYTICAL CHEMISTRY:**

(a) Use of complexation reactions in qualitative, inorganic mixture analysis. Organic reagents in inorganic analysis: EDTA, dimethyl glyoxime, Oxine. a-nitroso b-naphthol, cupeferron, thiosalicylic acid.

(b) Theory behind the group separation in inorganic qualitative cationic analysis.

3. (a) Outline of chemistry involved in the following and allied phenomena; cement, steel, water, fuel and industrial gases.

(b) Idea of major chemical pollutants in environment.

Paper-III (C)
ORGANIC CHEMISTRY

GROUP-A

1. **ISOMERISM:**

Tautomerism, Keto-enol tautomerism, Estimation of Keto and enolic content. Stereoisomerism, projection formulae elements of symmetry, geometrical and optical isomerism, E-Z and R-S modes of nomenclature, elementary idea of configuration, diastereoisomerism, Asymmetry and dismmctry, walden inversion.

2. Electrophilic substitution in benzene nucleus, mechanism of nucleophilic substitution at saturated carbon.

3. Name reaction with their mechanism; Friedel-craft reactions, Sandmeyer Reactions, Gattermann-koch reactions, Cannizzaro's reaction, Benzoin Condendation, Perkin reaction, Reimer- Tiemann reaction

GROUP-B

1. **CARBOHYDRATES:**

Nomenclature, classification, structure and configuration of glucose and fructose, Ring structure. Ruff degradation; killiani Fisclrer Synthesis. Osazone formation, mechanism, Epimerisation and interconversion (lower to higher carbohydrate & vice-versa, Aldose to ketose & vice-versa.

2. **AROMATIC COMPOUNDS:**

Aromaticity and Huckel's rule, Preparation and properties of benzene, toluene, benzene sulphonic acid, nitrobenzene, aniline, diazonium salt, phenol benzaldehyde, Bennoic acid.

3. **HYDROXY ACIDS:**

Lactic acid, citric acid, general methods of preparation and distinction between a and b hydroxy acids, stereochemistry of hydroxy acids.

GROUP-C

1. Synthetic applications of the following reagents in organic chemistry Raney Ni, $LiAlH_4$, Al CL, $Al(OCH<_{CH3}^{CH3})$ and HNO_2,

2. Brief introduction of TLC, Paper and gas chromatography.

3. (a) Organic polymers and resins
   (b) Brief idea of proteins.

DEGREE-II (HONOURS)
Paper-IV
CHEMISTRY PRACTICAL

Full Marks: 50
25

[A] **VOLUMETRIC ANALYSIS :**

(1) Estimate the amount of NaOH and Na_2CO_3, each in One Litre of the supplied mixture solution with the help of standard acid volution.

(2) Estimate the amount of Na_2CO_3 and $NaHCO_3$, each in One litre of the supplied mixture solution with the help of standard acid solution.

(B) **REDOX TITRATION:**

(1) Preparation of N/10 $KMnO_4$ solution and its standardisation with N/10 oxalic acid solution.

(2) Estimate the amount of Fe^{2+} in one litre of the supplied Mohr's salt solution USing standard $KMnO_4$ solution.

(3) Estimate the amount of H_2SO_4 and $H_2C_2O_4$ each in one litre of supplied mixture solution using standard $KMnO_4$ solution.

(4) Estimate the amount of Fe^{3+} in one litre of the supplied solution with the help of $K_aCr_2O_7$, solution or estimation of Ni^{2+} SO^4 and Ba^{2+} in one litre of the given solution gravimetricajly.

(5) Estimate the amount of copper in one litre of supplied solution with the help of standerd $Na_2s_2O_3$

2. Preparation Of anyone of the following-

(a) Acetylation of salicylic acid, aniline and P-toluidine.

(b) Benzoylation: Preparation of benzanilide and benzoyl derivative of P-. toluidine.

(c) Nitration: Preparation of p-nitroacetaniliide, Picric acid, and *m*- di nitrobenzene.

(d) Reduction: Preparation of m-nitroaniline from mela di nitrobenzene,
(f) Esterification: Preparation of (i) Benzolc. acid from benzaldehyde and (ii) anthranilic acid from anthracene.
3. Note Book and viva-voce. of ethyl benzoate

B.A./B.Sc. Part-II
MATHEMATICS (HONS)

There will be twelve questions to be set and Six to be answered in each paper selecting at least one from each group. One question will be objectivel short answer type and will be compulsory. This question will be of twenty marks and the rest questions are of each of sixteen marks in both the papers.

Paper-III

Time: 3 Hours

Full Marks: 100

1.	Group-A:	Real Analysis	: 4 Ques.
2.	Group-B:	Infinite Series	: 3 Ques.
3.	Group-C:	Abstract Algebra	: 4 Ques.

Group-A

REAL ANALYSIS:

Dedkind's Theory of real numbers, algebraic and order properties of real no. archmedian properties of real number, sequence and its convergence, Cauchy's sequence, Cauchy's general principle of convergence, monotonic sequence, cantor's construction of real nos.
Continuity and differentiability of a function of single variables. Properties of continuous and dis-continuous funnctions, Rollers theorem, Mean value theorems Taylor's and Macuvourins series of elementary functions.

INFINITE SERIES:

Group-B

Infinite series and their convergence, Comparison test Rabbe's test, Cauchy Condensation test, Integral test, leibniz test, Gauss, Best, Kummer's test, De Morgon's and Bertrand's test. Logarithmic ratio test. Absolute Convergence and rearrangemen of series, Pringmersin's theorems, Cauchy's multiplication of series and it convergence.

Group-C

ABSTRACT ALGEBRA:

Binary operation, notion of a group, abelian and non-abelian groups with example: Different ways of defining a group and their equivalence, Concept of a subgroup an cylic groups, inter section of subgroups. Cyclic subgroups Cosets, Order of an element, lagrange's Theorem, Group of residue classes,' permutation group, Cayley's theorem, Homomorphism and isomorphism of groups' Kernel ofa group, Homomorphism and isomorphism theorems for groups, factor group,' fundamental theorem.
Concept of a ring, Integral domain and field with examples, Divisor of Zero, a finite domain as a field. Ring of residue classes. ring of matrices, sub rings, ideals, ring homomorphism quotient rings, fundamental theorem of homomorphism of rings.

Paper-IV

Time: 3 Hours

Full Marks: 100

1.	Group-A	:	Diff. Equation	: 3 Ques.
2.	Group-B	:	Vector Calculus	: 2 Ques.
3.	Group-C	:	Statics (Via Vector)	: 3 Ques.
4.	Group-D	:	Dynamics	: 3 Ques.

Group-A

DIFF. EQUATIONS:

Formation and solution of differential equation, Diff equation of 1st order and 1st degree. Separation of variables, Homogeneous equations. Exact Differential Equations of 1st order but not of the first degree, orthogonal trajectory, singular solution. Linear differential Equations of 2nd order withconstant co-efficient, Complementary functions and particular integrals. Application of differential equations.

Group–B

VECTOR CALCULUS:

Product of three and four vectors. Differentiation of a vector point function, Differention of product of vectors, gradient, Divergence and cure of a vector functions and its. deductions, Moment of a localized vector, about a point, scalar moment of a vector about a directed line, integral ofa vector functions.
Scalar triple product and its geometrical interpretation. Vector triple product, scalar and vector products

of four vectors. Workdone by a force, moment of a force about a point and angular differentiation of vector point function. Differentiation of product of vectors, Gradient of a scalar field, Divergence and curve of vector functions.

Group-C

STATICS (VIA-VECTOR)

Reduction of a force system to a force and a couple, Equation of the resultant General conditions of equilibrium of a system of forces acting in one plane upon a rigs body. Asiatic centre. Principle of Virtual work for any system of forces in one plane and its converse, omission of the force. The Common Centenary and stability of equilibrium.

Group-D

DYNAMICS

Simple Harmonic Motion, Simple Pendulum, Elastic Springs and springs, Hooke's law, Component of Velocities and acceleration. Cartesian redial and transverse velocities and acceleration, tangential and normal velocities and acceleration.

Motion of a particle under Central force, differential equation of Central Orbit in polar and pedal forms, Newton Laws of gravitation and planetary orbit, Keplar's Laws of planetary motion.

Books Recommended :
1. Elementary Differnetial Equation– W.E. Boyee & R.C. Diprima, Wiley's publication.
2. Advance Calculus-Folland, Pearson Education
3. Advance Calculus-Kaplan, Person-Educaiton.
4. The Theory of Differential Equation-Kelly & Peterson.

B.Sc. Part-II :
Botany Honours

The paper will consist often questions, out of which Question No. 1 will be objective type and compulsory covering the entire syllabus. Out of remaining 9 questions five questions shall be from Group–A and four from Group-B. Four questions has to be answered besides Question No. 1 selecting atleast two questions from each groups.

Group-A: PLANT PHYSIOLOGY

1. Physiology of Plant Cell: Colloidal system, imbibitions. diffusion. osmosis and plasmolysis.
2. Plant-water relationships: water potential and chemical potential, transpiration and its significance, factors affecting transpiration, mechanism of stomata movement.
3. Mineral nutrition: Criteria of essentiality of elements macro and role of micro nutrients, essential elements, mineral deficiency and plant disorders, nutrient uptake and transport mechanisms,
4. Photosynthesis: Historical background and its significance, structure of photosynthetic apparatus, photosynthetic pigments, accessory pigments reaction centre complexes. photochemical reactions, photosynthetic electron transport, phtophosphoryl'ation, the calvin cycle- C_4 cycle
5. Respiration: Glycol sis. TCA cycle and its regulation, electron transport system, pentose phosphate pathway .cyanide-resistant respiration,
6. Transport of organic substances. Mechanism of translocation in the phloem.
7. Nitrogen metabolism: Biological nitrogen fixation, reduction of N_2 into ammonia, nit-genes, regulation of nitrate reductive and nitrogenise, nitrate and ammonium assimilation.
8. Growth and development: General aspect of definitions, Phases of growth, kinetics of growth, physiology of dormancy and seed germination, concept of photoperiodic.
9. Physiology of flowering: Origen concept of phytohormones and their role, verbalization, senescence and fruit ripening. physiological role and mechanism of action of phytohormones-Auxins, Cytokines, Gibberellins. Abscise acid and Ethylene, phytomorphogencsis, phytochrome, their role and mechanism of action. Signal transduction-basic concept, plant movement-tropic and mastic. Biological clock.

Group– B:ECOLOGY

1. **Introduction:** Ecological factors (Biotic and biotic). ecological amplitude. triggering factors-soil. water and atmosphere.
2. **Ecological adaptation:** Ecological groups of plants: Hydrophone, Xerophytes. Halophytes.
3. **Community:** Definition, composition, development of community and its structure. Method of study of communities. Succession such as hydro sere, Litho sere.
4. **Ecosystem :** Concept. component and organization, energy flow, ecological efficiencies, cycling of C. N and P. characterization and structure of ecosystem, biotic and biotic components, their inter-relationships, the tropic organization. auto trophy, heterotrophy, parasitism and detritus, food chain, food web and ecological pyramid.
5. **Flow of Energy and materials:** Flow of energy and materials within ecosystem', models of energy flow. ecosystem.productivity, biogeochemical cycles, major types of ecosystem.

6. **Phytogeography** : General principles, vegetation in India.
7. **Soil:** Types of soil in India, water holding capacity, soil conservation & reclamation

Paper-IV
DEVELOPMENT OF PLANTS AND THEIR UTILIZATIONS

Time: 3 Hours   Full Marks: 75

Ten questions has to be set out of which Question No. I will be of objective type and compulsory the entire syllabus. Out of remaining 9 questions, There will be five questions from Group-A and four from Group-B. Four questions has to be answered besides Question No.-1 selecting at least two questions from each group.

Group-A: DEVELOPMENTS OF PLANTS
1. **Organization of the higher plant body:**
   The shoot and the root system, variations in habit and longevity; environmental influences.
2. **Meristems and development:** Theories of shoot and root apical meristems, lateralmeristems and their functions,
3. Range of forms and structure of root, stem and leaf, their tissues and functions, mechanical tissues, organization of tissues In relation to environment.
4. **Secondary growth in Plants:** Vascular cambium, secondary xylem (basic structure of wood), secondary Pholem and Periderm, Anomalous secondary growth (Boerhaavia, Mirabilis Achyranthes, Nyclanthes. Dracaena).
5. **Embryology and Developmental Processes:**
   Microsporogensis and development of male gametophyte, megasporogenesis and development offemale gametophyre, endosperm (morphological nature) and embryogeny An outline of experimental embryology-anther and embryo culture.

Group-B: PLANT RESOURCE UTILIZATION
1. Plant biodiversity: Concept, status utilization in India.
2. Origin of crop Plants and historical perspective of economic Botany and Ethno botany.
3. **Domestical of Plants:** Primary and secondary centres of biodiversity, new introduction.
4. **General account of Seeds producing oils-** mustard, groundnut, soyabean and coconut, Pulses-Chickpea (Bengal Urad Gram), red gram (Arhar), gram, pea, masoor and mung, cereals-rice, wheat, maize, sorghum, bajara, sugar yielding-sugarcane, fibre yielding cotton, jute, coir, yegetables-potato, brinjal, Timber and firewood-any ten species of your locality, Medicinal plant species at least 10 species of your locality locality Rubber yielding plants, essential oil yielding plants. Ornamental Plants: Familiarity with seasonals and perennials species grown in your locality. Recycling of wastes and biogas resources.

PRACTICAL PAPER
Based on Paper-III & IV

Time 4 Hours   Full marks-50
1. Experiments based on (i) Osmosis, Diffusion, Transpiration, photosynthesis, Respiration (ii) Separation of chloroplast pigments by either paper chromatography or solvent method

   OR

   To extract enzymes and to study their activity-amylase, lipase, acid phosphatase, catalase and peroxidase.

   OR, Bioassay of plant hormones-auxin, ethylene, G.A., ABA and cytokinin.   12
2. Determination of the minimum size of the quadrate by species area curve method.

   OR, To study ecological adaptations in plants

   OR

   To study selected soil properties such (anyone) as texture, pH, carbonate, nitrate, base deficiency and reductivity.12
3. Internal anatomy of Primary and secondary structure of angios ermic plants-normal and abnormal characters.

   OR, Embryo dissection (e.g Tridax procumbens)   12
4. To comment upon spots (I -6) based on developments of plants plant resource utilizations.
5. Class records   05
6. Viva-voce   03

B.SC. Part-II
Zoology
SUBSIDIARY/GENERALCOURSE
Paper-IIA
(THEORY)

Time: 3 Hours

Full Marks: 75

In all ten questions are to be set out of which number I and 2 consists of objective (1×15 marks) and short answer (3×5) questions respectively and both shall span over the whole syllabus in the paper. Students would be required to answer five questions out of which question number I and 2 shall be compulsory.

1. **COMPARATIVE ANATOMY :**
   Study of following organ system in major Vertebrate groups :-
   (i) Integument: Its derivatives and function.
   (ii) Gastrointestinal tract.
   (iii) Respiratory System.
   (iv) Hear, Aortic Arches.
   (v) Brain.
   (vi) Evolution and fate of kidney, urinogenital ducts, gonads

2. **EMBRYOLOGY**
   (vi) Fertilization:
   (vii) Types of Vertebrate eggs early cleavage
   (viii) Development of Amphioxus (upto the formation of coelom)
   (ix) Development of chick (upto 3 germinal layers).
   (x) Development and function of extra-embryonic membrane in chick.
   (xi) Placenta in mammals-its development, types and function.
   (xii) Organogenesis of Heart, Brain and Eye in Chick embryo.